Confidential

Independent Market Research on Global Precision Manufacturing Industry

For

LENS 蓝思科技®

Signature: _____

Date: _____

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Agenda

Overview of Global Precision Manufacturing Industry

Definition of Precision Manufacturing

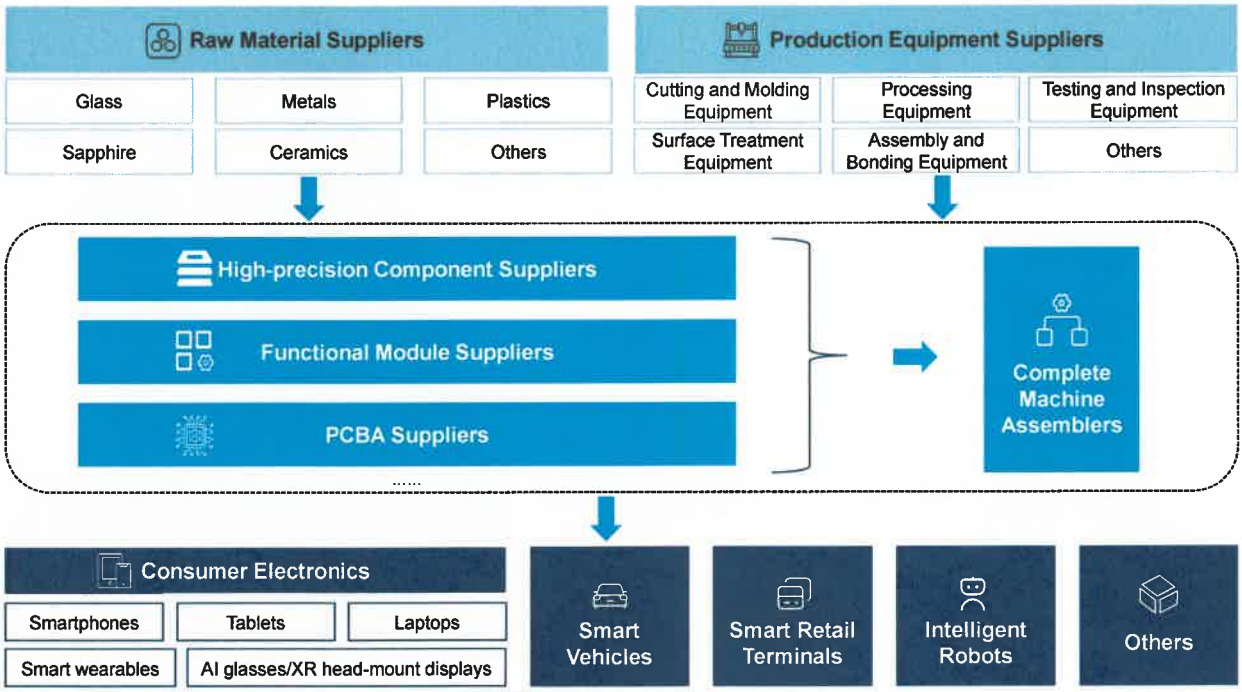
Definition of Precision Manufacturing

- The precision manufacturing industry refers to the use of advanced processing technologies, rapid prototyping, automation control, and other related technologies to design, produce, process, assemble, and sell complex and high-precision structural components, functional modules, and complete products. Its products are widely applied in fields such as consumer electronics, new energy vehicles, smart retail terminals, and intelligent robots.
- Precision manufacturing plays a crucial role in driving product innovation and realization. As the platform for bringing product ideas to life, precision manufacturing is responsible for transforming complex designs into high-quality, mass-producible products in the industrial chain. With continuous technological advancements, the capability of precision manufacturing directly determines a product's market competitiveness and whether innovation can successfully be turned into practical applications. For example, cutting-edge consumer electronics products, such as foldable smartphones, would not reach the market without the technical support of high-end precision manufacturers. Similarly, as corporate needs become more diverse, the role of precision manufacturing has evolved from traditional product production to becoming a comprehensive solution provider, supporting the entire development process from concept design to the final product. Therefore, precision manufacturing is not only a critical link in the industrial chain but also a key force behind innovation, helping enterprises maintain competitive advantages and achieve rapid product iteration and optimization in the context of fast-paced technological advancements.
- Leading precision manufacturing companies not only provide manufacturing services but also engage deeply with clients in product design, R&D, production, assembly, and other stages. They offer customized solutions based on customer needs and continuously strengthen long-term strategic partnerships. In addition, in product design, leading precision manufacturers proactively propose concept designs and present them to clients for selection. At the same time, these companies continuously promote vertical integration of their supply chains, actively investing in key raw materials and intelligent production equipment, which helps reduce supply chain costs, enhance production efficiency, and build a complete industrial ecosystem, fostering collaborative innovation across all stages of the value chain.

Source: Frost & Sullivan

Overview of Global Precision Manufacturing Industry

Value Chain of Global Precision Manufacturing Industry (1/2)



Source: Frost & Sullivan

Overview of Global Precision Manufacturing Industry

Value Chain of Global Precision Manufacturing Industry (2/2)

- The upstream of the precision manufacturing industry chain mainly includes raw material suppliers, production equipment suppliers, and labor providers. Upstream enterprises provide materials such as glass, metals, plastics, sapphire, ceramics, and other raw materials, as well as production equipment like cutting and molding equipment, processing equipment, surface treatment equipment, assembly and bonding equipment, and testing and inspection equipment, which provide basic support for midstream precision manufacturers. Leading precision manufacturers improve production efficiency, reduce costs, and shorten delivery times by investing in the research and development of raw materials and key production equipment. For example, they may develop or invest in the construction of high-precision industrial robots and smart production equipment.
- Midstream participants in the precision manufacturing industry are mainly responsible for processing raw materials provided by the upstream into high-precision components, functional modules, and offering PCBA and complete machine assembly services. Leading precision manufacturers closely collaborate with customers, co-develop designs, and provide customized production, thereby establishing long-term strategic partnerships and gradually achieving full vertical integration across the industry, creating a strong industrial ecosystem. This further improves production efficiency and accelerates the rapid iteration of technology and the efficient realization of products. Lens Technology is one of the few precision manufacturers in the industry that covers the entire supply chain from raw materials and production equipment, to precision components, functional modules, and complete machine assembly. This vertical integration capability not only enables rapid responses to the diverse needs of high-end customers, achieving fast mass production and economies of scale, but also helps reduce supply chain risks and enhance market competitiveness by integrating the industrial ecosystem.
- The downstream application fields of the precision manufacturing industry include consumer electronics, smart vehicles, smart retail terminals, and intelligent robots. Precision manufacturers provide high-quality structural components and functional modules to downstream industries. Consumer electronics brands typically do not participate in manufacturing, so precision manufacturers play a vital role in the production of consumer electronic products. Additionally, with the rapid development of smart vehicles, smart retail terminals, and other smart devices, the demand for precision manufacturing will continue to grow in the future.

Source: Frost & Sullivan

Overview of Global Precision Manufacturing Industry

Development Trends of Global Precision Manufacturing Industry (1/2)

High Precision Development and Multi-material Application

The precision manufacturing industry is characterized by high precision, high efficiency, automation, and non-standard customization. The manufacturing process is complex, involving various types of materials such as brittle materials like glass, metal, and polymer. With the rapid development of high-tech fields such as consumer electronics, smart vehicles, and intelligent robots, the market's demand for high-precision, high-performance structural components and functional modules is becoming increasingly stringent. These industries have higher requirements for product stability, reliability, and innovation. Leading precision manufacturers are adopting advanced processing technologies, highly reliable processes, and innovative material applications, not only ensuring product accuracy and functionality but also significantly enhancing product competitiveness. In this context, the global precision manufacturing industry is gradually moving towards ultra-high precision, high performance, and high added value.

Industrial Intelligence Empowering Production Efficiency

Through the widespread application of industrial robots, automated equipment, and customized data collection and reverse control via the industrial internet, the precision manufacturing industry is improving efficiency and reducing costs from the production intelligence end. Industrial robots and intelligent devices make production processes more precise and stable by automating handling and precise control, thus reducing human errors and energy consumption. At the same time, by integrating new technologies such as the industrial internet, big data, cloud computing, and artificial intelligence, the precision manufacturing industry has greatly enhanced its ability for automated data collection, analysis, and reverse control. This boosts production efficiency and yield, fundamentally transforming the production chain and lowering management costs. Leading enterprises are combining precision manufacturing with intelligent manufacturing, creating highly standardized, automated production processes to achieve efficient production and assembly of components to finished products, further enhancing the industry's productivity and helping the global precision manufacturing industry move toward higher efficiency and intelligence.

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Source: Frost & Sullivan

Overview of Global Precision Manufacturing Industry

Development Trends of Global Precision Manufacturing Industry (2/2)

Global Layout Development

The precision manufacturing industry is developing towards a global layout. The core manufacturers in leading global sectors such as consumer electronics and smart vehicles are distributed across different regions, and customers have global attributes. As a result, precision manufacturing companies need to possess a flexible organizational structure, keen market perception, and global production and service capabilities to respond to real-time feedback on production, supply chains, and product optimization. Leading companies in the industry establish production service bases both domestically and internationally, forming an efficient and collaborative industrial chain ecosystem. By leveraging technological advantages and efficiency, they expand their global market business. These production bases are typically located near customers to quickly respond to demand, reduce logistics costs, and further enhance competitiveness by taking advantage of local policy incentives and low-cost resources. At the same time, leading companies set up R&D centers with strategic customers around the world to create a global R&D network, gaining timely access to cutting-edge technological information, driving innovation, and advancing technology to meet diverse market demands. Through global layout, precision manufacturing companies not only improve production efficiency but also strengthen market adaptability and technological R&D capabilities, laying a solid foundation for continued development in the international market.

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Source: Frost & Sullivan

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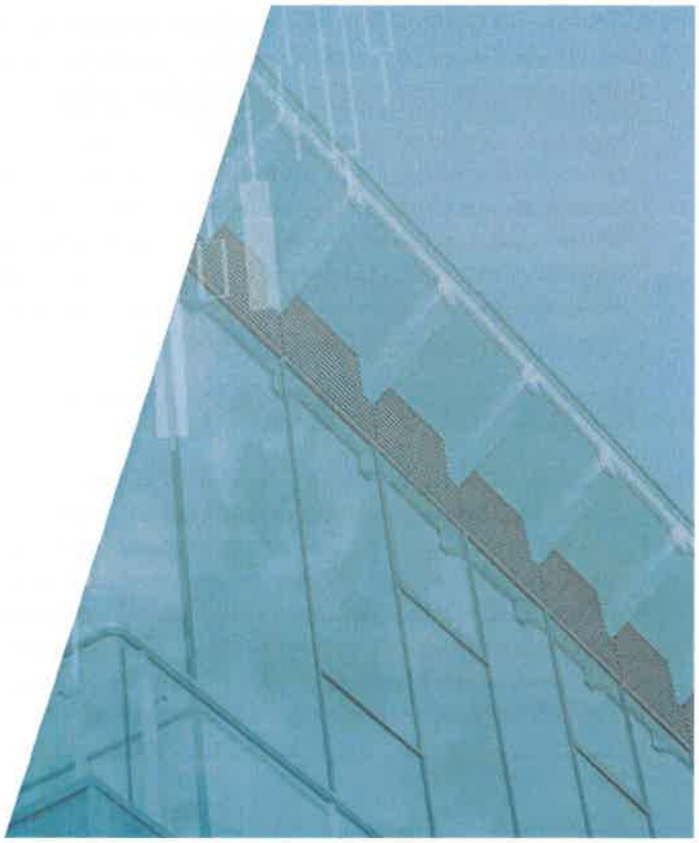


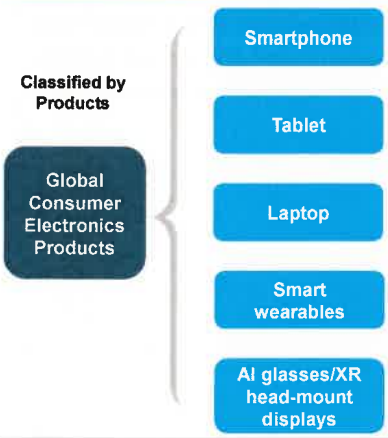
Overview of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Overview of Global Consumer Electronics Products Industry

Introduction to Global Consumer Electronics Products Industry

Consumer electronics refer to intelligent electronic products used in consumers' daily lives. These products are typically small in size, lightweight, easy to operate, and feature entertainment and portability. They include smartphone, tablet, laptop, smart wearable, AI glasses/XR head-mount displays. In 2024, global shipment volume of consumer electronics has reached 1,810.8 million units. As the largest segment within consumer electronics, smartphone continues to grow in popularity, with a global shipment volume of 1,238.8 million units in 2024. Driven by the strong demand for AI glasses, the global shipment of AI glasses in 2024 saw a significant year-on-year increase of over 200%, exceeding 2.0 million units. It is anticipated that the integration of innovative consumer electronics product designs and AI applications will drive further iterations of these products, with the global shipment volume of consumer electronics rising to 2,295.7 million units by 2029.

Classification and Shipment Volume of Global Consumer Electronics



Shipment Volume of Global Consumer Electronics, 2020, 2024 & 2029E

Product Types	2020 (Million Units)	2024 (Million Units)	2029E (Million Units)	CAGR 2020-2024	CAGR 2024-2029E
Smartphone	1,292.2	1,238.8	1,463.9	-1.0%	3.4%
Tablet	164.0	140.1	180.0	-3.9%	5.1%
Laptop	303.9	262.7	305.1	-3.6%	3.0%
Smart wearables	110.9	159.7	240.4	9.5%	8.5%
AI glasses/XR head-mount displays	6.8	9.6	106.3	8.9%	61.9%
Total	1,877.8	1,810.8	2,295.7	-0.9%	4.9%

Source: Frost & Sullivan

Overview of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Definition of Consumer Electronics Precision Structural Parts Integrated Solution

Definition of Consumer Electronics Precision Structural Parts Integrated Solution

Consumer electronics precision structural parts integrated solution refers to the one-stop solution for the design, manufacturing, and related services of structural parts (mainly including front, back protective covers and middle frames) and related functional modules for consumer electronics (including smartphones, tablets, laptops, smart wearables and AI/XR glasses).

Precision structural parts for consumer electronics are typically made from materials such as glass, metal, plastic, sapphire, and ceramics, with glass and metal being the most widely used materials. Glass, known for its excellent transparency, scratch resistance, and impact resistance, is widely used in smartphone front and back covers, offering good visual effects and durability. Metal materials like aluminum alloy, titanium alloy, and stainless steel, known for their high strength, corrosion resistance, and heat dissipation properties, are commonly used in smartphone middle frames, tablet back covers, and laptop casings, enhancing product stability and tactile feel.

The precision manufacturing of consumer electronics combines advanced material technology, precision processing techniques, and intelligent manufacturing, aiming to enhance product functionality, reliability, and aesthetics while meeting the increasingly complex market demands. Through customized structural designs and efficient production processes, these solutions ensure that products meet the requirements for thinness, high performance, durability, and comfort. To better support downstream customer requirements, leading providers of consumer electronics precision structural parts integrated solution typically engage in the product development process years before product releases. Industry participants and downstream customers often have strong ties, resulting in generally saturated orders.

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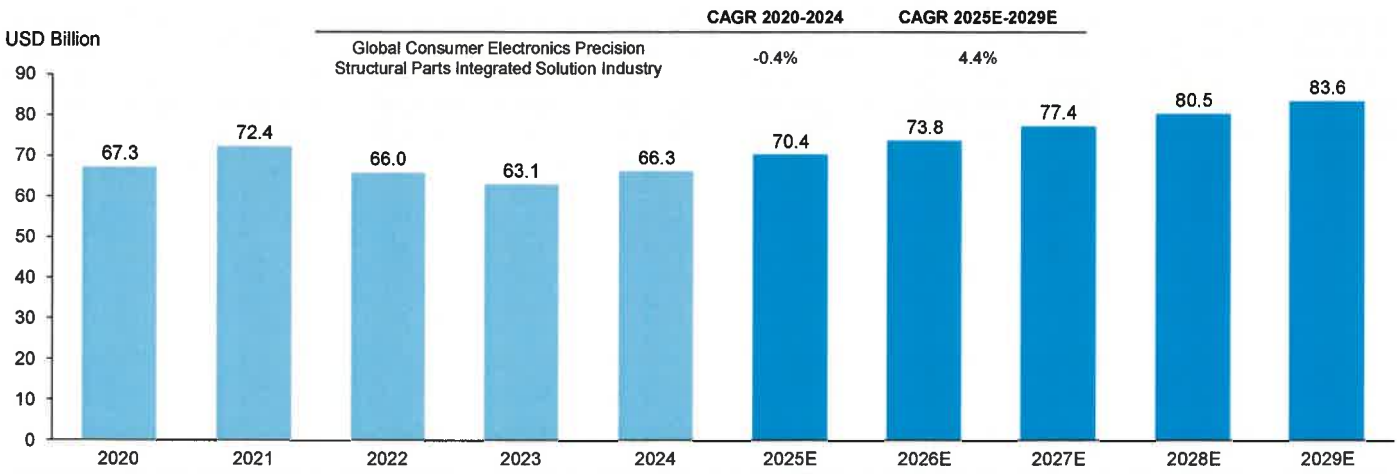
Source: Frost & Sullivan

Overview of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Market Size of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Market Size of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry, 2020-2029E



- Precision structural parts for consumer electronics support and protect these consumer electronics products, closely related to their functionality, intelligence, and application scenarios. With the widespread application of next-generation information technologies and continuous innovation in the appearance and performance of consumer electronics, the market size of global consumer electronics precision structural parts integrated solution industry has bounced back in 2024. Looking forward, the iteration of product appearances and breakthroughs in emerging material technologies will further expand the industry, as the market size is projected to grow from USD70.4 billion in 2025 to USD83.6 billion in 2029, with a CAGR of 4.4%.

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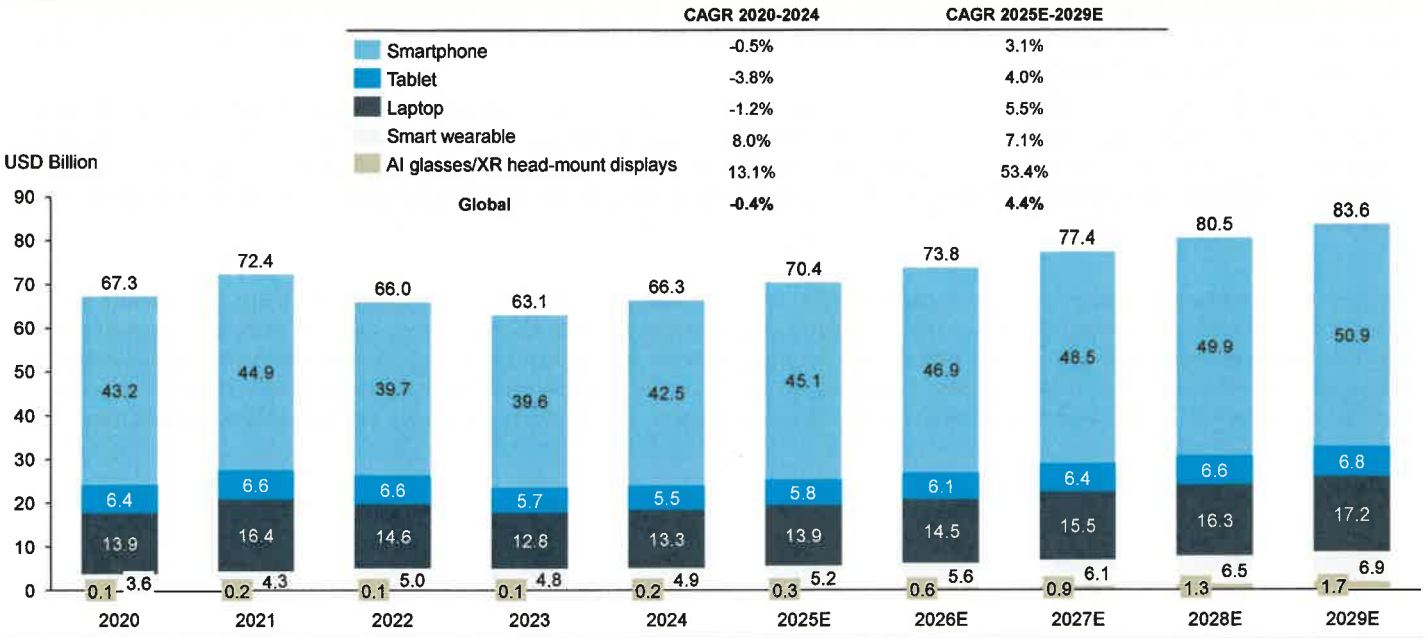
Source: Interviews with Industry Experts, Frost & Sullivan

Overview of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Market Size of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry by Application

Market Size of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry by Application, 2020-2029E



Source: Interviews with Industry Experts, Frost & Sullivan

Overview of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Market Size of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry by Application

- By application scenarios, global consumer electronics precision structural parts integrated solution industry can be categorized into smartphone, tablets, laptop, smartwatch, and VR/AR device. In 2024, the market share of smartphone, tablet, laptop, smart wearable, AI glasses/XR head-mount displays has reached 64.0%, 8.3%, 20.0%, 7.5% and 0.2%, respectively. Among them, smartphone represents the largest segment. By 2029, the market size of global consumer electronics precision structural parts integrated solution industry for smartphone is expected to reach USD50.9 billion. In addition, fueled by the ongoing advancements in AI technology and the increasing number of AI glass products introduced by diverse brands, the global market size of consumer electronics precision structural parts integrated solution for AI/XR glasses, is expected to reach USD 1.7 billion by 2029, with a rapid CAGR of 53.4% from 2025.

Source: Interviews with Industry Experts, Frost & Sullivan

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Overview of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Market Drivers and Trends of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry (1/2)

Recovery of the Consumer Electronics Industry and the Application of Foldable Screens and AI Technologies

The recovery of the global consumer electronics industry, particularly the growth in the smartphone and laptop markets, has brought new business opportunities for the global consumer electronics precision structural parts integrated solution industry. The market size of global AI industry grew from approximately USD0.2 trillion in 2020 to about USD0.6 trillion in 2024, and is expected to exceed USD3.0 trillion by 2029, with a CAGR of 37.8% from 2024 to 2029. The development and application of AI technology will further drive the growth of the global consumer electronics market, particularly in segments such as smartphones, laptops, and AI/XR glasses.

As technology of foldable screen becomes more popularized and AI functionalities advance, smartphone designs are moving toward personalization and high-end features. The global shipment of foldable smartphone is expected to grow rapidly from 23.8 million units in 2024 to 69.7 million units in 2029, with a CAGR of 24.0%. This rapid development of foldable smartphone raises the demand for higher-quality structural parts and functional modules, especially in terms of flexible screens. For example, ultra-thin flexible glass (UTG) is driving the increase in the structural part value for smartphone, as it combines the advantages of both glass and plastic while remaining bendable.

Additionally, the rapid development of AI technology is accelerating smartphone replacement cycles. Global shipment volume of AI smartphone is expected to grow from 235.0 million units in 2024 to 1,069.8 million units in 2029, with a CAGR of 35.4%. At the same time, as major smartphone manufacturers release more powerful flagship models with better user experiences, the market for high-end smartphones is witnessing significant growth. The market share of high-end smartphones (priced over USD600) is expected to increase from 27.2% in 2024 to 33.0% in 2029. In the future, smartphone may also seamlessly connect with other devices, becoming the core of a personal digital ecosystem. This will further drive the upgrading and optimization of precision structural parts integrated solution for smartphone and contribute to the market growth.

Future laptop will evolve towards more efficient processors, ultra-thin designs, integration with AI technologies, and longer battery life to meet the needs of remote work and creative endeavors. Meanwhile, innovation in material for laptop will push products toward higher-end offerings, providing better protection and further enhancing the user experience. Glass material for laptop screen covers, compared to other materials, have higher hardness and scratch resistance, along with better transparency and display effects, offering more durable protection and superior visual experience. The penetration rate of glass material in laptop screen is expected to rise significantly in the future. Additionally, other laptop components, such as keyboards and touchpads, are expected to integrate glass materials, bringing better user experiences and protection.

AI glasses are smart eyewear that integrate AI technology, including built-in AI processors, to deliver enhanced functionality and a more intelligent, interactive user experience. These glasses support features such as voice interaction, visual AI assistance, and wireless connectivity, allowing users to seamlessly access information and perform tasks in real time. The rapid advancement of AI technology is driving significant growth in the AI glasses market, as more brands introduce innovative products with enhanced functionalities. This surge in demand for AI glasses is, in turn, boosting the need for precision structural parts for AI glasses, such as frames and lenses. As AI glasses become more sophisticated and widely adopted, the demand for high-quality, durable and precisely engineered structural parts continues to rise, playing a critical role in supporting the overall growth of the industry.

Source: Frost & Sullivan

Overview of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry

Market Drivers and Trends of Global Consumer Electronics Precision Structural Parts Integrated Solution Industry (2/2)

Breakthroughs in Emerging Technologies and Materials

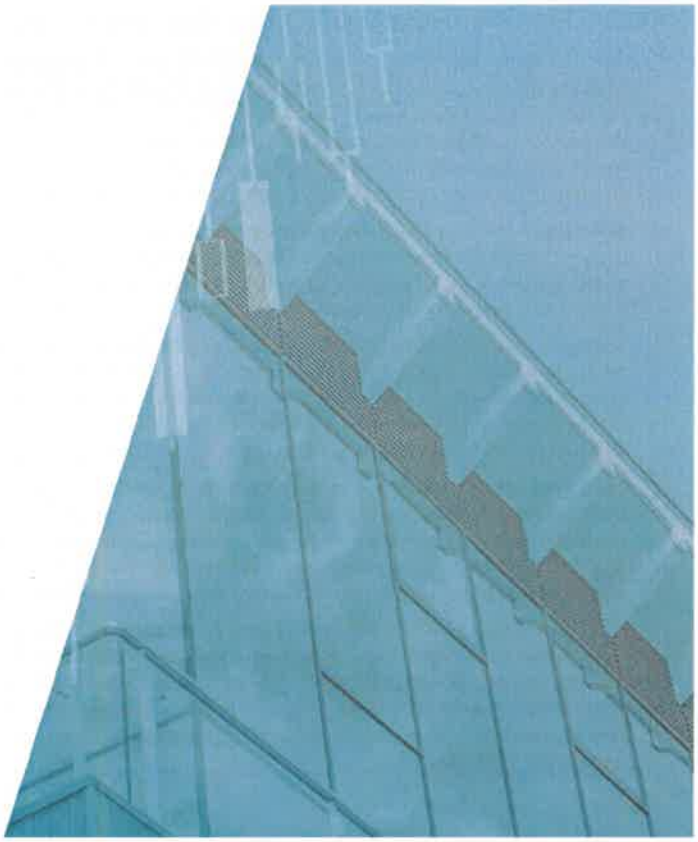
With the rapid iteration of consumer electronics, emerging technologies and materials are continuously driving innovations in the consumer electronics precision structural parts integrated solution industry. For example, leading companies are continuously exploring the development of emerging technologies, including advanced anti-fingerprint coating technology, specialized chemical tempering processes, and ultra-thin, high-adhesive ink applications. In the field of emerging materials, current materials for foldable smartphone cover primarily include colorless polyimide film (CPI) and ultra-thin flexible glass (UTG). Due to its multiple performance advantages, UTG material has gradually replaced CPI materials and become the mainstream choice for foldable smartphone flexible covers. Leading companies are also developing the next generation of foldable ultra-thin glass technology—variable thin glass (VTG). Compared to UTG, VTG offers higher strength, impact resistance, and scratch resistance while maintaining the same light transmittance and excellent bending performance. For material deployed in smartphone's middle frame, leading solution providers possess mature die-casting or computer numerical control (CNC) methods for aluminum alloy middle frame production process, achieving high product yields, relatively low costs, light weight, and excellent thermal conductivity. This drives the widespread application of aluminum alloy as smartphone middle frame material. Additionally, sapphire, known for its high strength and scratch resistance, has increasingly been used by consumer electronics manufacturers to highlight product designs. Use of sapphire in smartphone camera covers and smartwatches provides better protection while enhancing the product's aesthetic and user experience.

Integration of Smart Manufacturing and Automation

Smart manufacturing hardware and automation technologies are driving the global consumer electronics precision structural parts integrated solution industry toward a new stage. Through the integration of industrial robots, smart equipment, smart detection systems, automated production lines, and the industrial internet, solution providers have significantly improved production efficiency and product quality while reducing costs and ensuring product consistency. Leading solution providers such as Lens Technology have developed automation equipment and industrial robots in-house, using artificial intelligence, big data, and cloud computing technologies to achieve seamless integration of software and hardware in the production process, ensuring high precision and stability of the products while meeting customers' customized production line needs. Meanwhile, the application of smart detection systems enables data monitoring and quality traceability across all stages of production, effectively reducing internal inefficiencies within factory systems and facilitating the progress of industry chain integration.

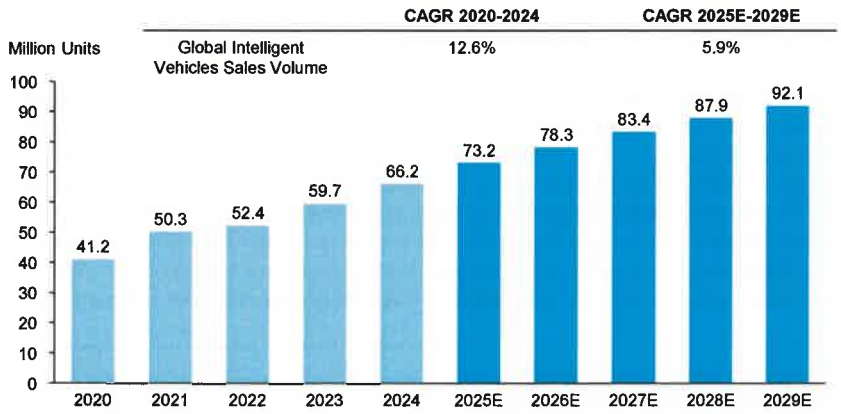
Source: Frost & Sullivan

Agenda



Overview of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Definition of Intelligent Vehicle Interactive Structural Parts Integrated Solution



- In recent years, the intelligent vehicle industry has been developing rapidly, with global demand for intelligent vehicle continuing to grow, especially driven by both policy support and technological advancements. As governments increase support for environmental protection and smart transportation, and as electric and autonomous driving technologies progress, the momentum for the widespread adoption of intelligent vehicle is strengthening. In the future, the "Dual Intelligent Transformation of ICE Vehicles and New Energy Vehicles Strategy" will become an important trend in the industry. Additionally, vehicles will be equipped with more intelligent interaction systems to meet consumers' increasingly elevated driving and riding experiences. This trend not only helps balance environmental protection with transportation convenience but will also drive the wider application and adoption of smart vehicles globally. The global sales volume of intelligent vehicles is expected to grow from 41.2 million units in 2020 to 66.2 million units in 2024, and is projected to reach 92.1 million units by 2029, with a CAGR of 5.9% from 2025 to 2029.

Definition of intelligent vehicle interactive structural parts integrated solution

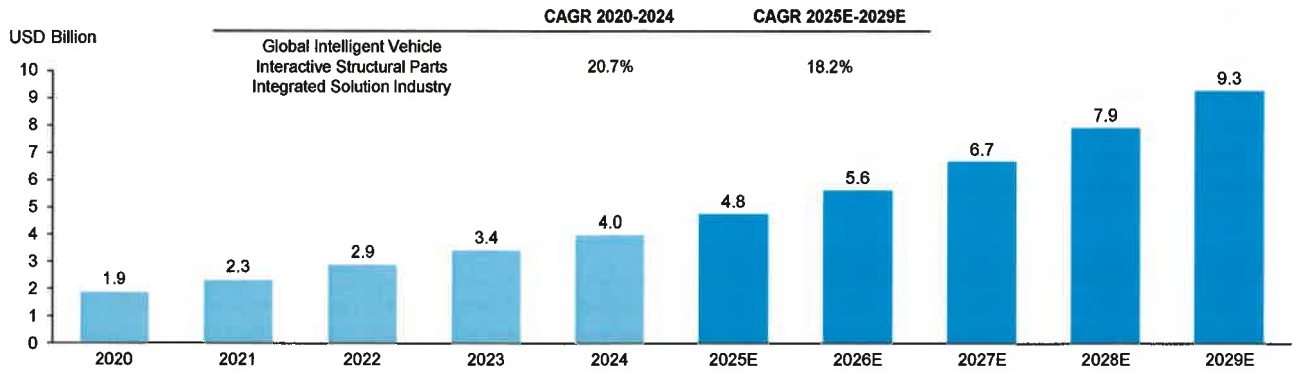
- The smart vehicles interactive structural parts integrated solutions refers to a one-stop solution encompassing the design, manufacturing and integration of core exterior structural parts and related functional modules for smart vehicles interaction systems. These systems include central control screens, intelligent B-pillar, intelligent instrument panel, HUD and streaming rearview mirror. In addition, with the advancement of technology, multi-functional glass applied in windows and windshields has gradually been used in smart vehicles. This type of glass offers various intelligent and functional services, providing users with a better interactive experience, making it an important interactive structural part of smart vehicles. Providers of intelligent vehicle interactive structural parts integrated solutions can offer comprehensive core external structural parts, functional modules, and related services such as touch modules, display modules, camera modules, etc., tailored to customer needs.

Source: Association of Automobile Manufacturers, Frost & Sullivan

Overview of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Market Size of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Market Size of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry, 2020-2029E



- Driven by the growth of demand for smart cockpits, autonomous driving technology, and in-vehicle intelligence technology, the market for intelligent vehicle interaction systems structural parts integrated solutions is expanding rapidly. As display technology, multi-functional glass, and sensing systems continue to evolve, the demand for integrated solutions is steadily increasing. Intelligent vehicle interactive structural part integrated solution suppliers need to offer comprehensive services from one-stop design to manufacturing to gain an edge in the competitive market. In the future, innovative technologies, high-quality services, and strong R&D capabilities will become key factors driving the market. The global market size for intelligent vehicle interactive structural parts integrated solutions is expected to grow from USD1.9 billion in 2020 to USD4.0 billion in 2024 and reach USD9.3 billion by 2029, with a CAGR of 18.2% from 2025 to 2029.

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Source: Interviews with Industry Experts, Frost & Sullivan

Overview of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Global Penetration Rate of Key Intelligent Vehicle Interaction Systems

Global Penetration Rate of Key Intelligent Vehicle Interaction Systems, 2020, 2024 & 2029E

Interaction System	2020	2024	2029E
Central Control Screens	70.0%	90.0%	98.5%
Intelligent Instrument Panels	12.0%	40.0%	65.0%
HUD	4.2%	11.0%	50.0%
Streaming Media Rearview Mirror	0.7%	4.0%	25.0%
Intelligent B-pillar	0.8%	15.0%	29.0%

- As intelligent technologies become more widespread in the automotive industry, vehicle owners' demand for smart interaction experiences is increasing, leading to a rapid growth in demand for intelligent vehicle interactive structural parts. Core interaction components such as central control screens, intelligent instrument panels, HUD, and streaming media rearview mirrors are increasingly becoming key elements of automotive intelligence. The penetration rate of central control screens will rise from 70.0% in 2020 to 98.5% in 2029, while the penetration rate of intelligent dashboards will increase from 12.0% in 2020 to 65.0% in 2029. Additionally, by 2029, the penetration rates for central control screens, intelligent instrument panels, HUD, streaming media rearview mirrors, and intelligent B-pillar are expected to reach 98.5%, 65.0%, 50%, 25%, and 29%, respectively. The increased penetration of these core interaction systems in vehicles will further drive the flourishing development of the global intelligent vehicle interactive structural parts integrated solutions market.

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Source: Interviews with Industry Experts, Frost & Sullivan

Overview of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Market Drivers and Trends of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Demand for Automotive Intelligence Driving Growth

In recent years, the transformation towards automotive intelligence has been accelerating. With continuous breakthroughs in autonomous driving technology, the penetration of smart cockpits has been steadily increasing, and vehicle human-machine interaction systems are evolving towards personalization, convenience, and multimodality. Additionally, the maturity of vehicle networking technology has accelerated the interconnection of real-time automotive information, contributing to the creation of a smart transportation ecosystem. Driven by both policy support and technological innovation, automotive intelligence will continue to deepen, further driving the growing market demand for intelligent vehicle interaction systems and related structural parts integrated solutions.

Advancements in Glass Technology

The progress and innovation of glass, and other structural components are key factors driving the growth of the smart vehicle interactive structural parts market. The internal display interfaces of vehicles are continuously evolving towards larger screens, touch interfaces, curved surfaces, and transparency. The widespread adoption of in-vehicle touch screens and HUDs is making automotive interfaces increasingly technology-oriented, enhancing the driving experience. At the same time, the application of multi-functional glass in side windows, windshields and sunroofs is rapidly expanding. Glass components such as side windows and sunroofs not only maintain traditional transparency functions but also offer a variety of intelligent, functional services to improve the interactive experience, such as automatic adjustment of light transmittance based on light changes, UV protection, heat insulation, water resistance, anti-fog, conductivity, and image projection. These features integrate with in-vehicle display information and interactive experiences, offering owners a more comfortable, safe, and efficient experience.

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Source: Frost & Sullivan

Overview of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Market Drivers and Trends of Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Industry

Requirements of Safety and Convenience

As autonomous driving technology develops, the safety and convenience requirements for in-vehicle and vehicle-body interaction systems are continuously increasing. For example, the intelligent B-pillar in vehicles can be integrated with sensing modules to facilitate owner identification and unlock functions. By using a key card or electronic device, convenient unlocking and starting features can be activated, improving vehicle safety and ease of use. Additionally, the camera modules integrated into the intelligent B-pillar can be used for surrounding monitoring and driving assistance systems, enabling the detection of obstacles or pedestrians around the vehicle and supporting features such as automatic parking, blind spot monitoring, and lane-keeping, thereby enhancing driving safety and convenience. The integration of these features will further drive the demand for smart vehicle interaction system structural parts.

Deeper Collaboration between OEMs and Supply Chain

As the smart vehicle industry value chain deepens, collaboration between original equipment manufacturers (OEMs) and suppliers is strengthening, transitioning from traditional, single-product supply to deeper collaborative innovation. OEMs' demand for intelligent interactive structural parts is no longer limited to individual product delivery but now emphasizes whether suppliers can provide comprehensive, integrated system solutions. This collaborative model not only creates more market opportunities for intelligent vehicle interactive structural parts integrated solutions providers but also drives the integration and innovation of industry technologies, prompting upstream and downstream supply chain companies to break through technological bottlenecks together and improve the overall performance and user experience of intelligent interaction systems.

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Source: Frost & Sullivan

Agenda

Overview of Global Smart Retail Industry

Development Analysis of Smart Retail Terminals and Electronic Shelf Labels

Introduction to Smart Retail Terminals and Electronic Shelf Labels

Smart retail terminals and electronic shelf labels are the core devices in the smart retail field, driving the integration of online and offline operations and the enhancement of the consumption experience. Smart retail terminals integrate advanced technologies and support multiple payment methods. They can achieve real-time transactions and data transmission through the Internet or mobile networks. The hardware devices feature multi - functional integration, high performance, and high security, and are mostly made of tempered glass, metal, and plastic. In July 2024, a leading third-party payment platform (with a market share of over 30% in the third-party payment industry) launched the "Tap-to-Pay" payment mode. Consumers don't need to unlock their phones or show the payment code. They can simply complete the payment by touching with NFC, which is easy to operate and improves payment efficiency and fun. The "Tap-to-Pay" payment device adopts an integrated design, with a 3D glass cover plate and a metal appearance, ensuring the stability and performance of the device. Electronic shelf labels replace traditional paper labels through e-paper display technology, updating product information in real time, supporting remote control and batch modification. They are widely used in supermarkets, shopping malls, convenience stores, and other places, improving the efficiency of product information updates and the shopping experience of customers.

Classification of Smart Retail Terminals and Electronic Shelf Labels

Smart Retail Terminals

Bank Card **QR Code** **Mobile Wallet** **NFC**

Bank card transactions involve payments using credit, debit, or other bank cards, including both offline swipes and online payments. QR code scanning allows mobile phones to retrieve information or make payments, commonly through platforms like Alipay and WeChat Pay. NFC (Near Field Communication) enables contactless payments between mobile phones and terminals. A mobile wallet stores payment methods and digital credentials, enabling users to make payments or transfers via smartphones.

Electronic Shelf Labels

Electronic Shelf Labels (ESL) offer significant convenience by enabling real-time updates of prices, promotions, and product information remotely, reducing labor costs and manual errors. They improve inventory management by displaying real-time stock levels, enhance the customer experience with clear, up-to-date details, and support sustainability by eliminating the need for paper tags. ESLs also provide flexibility in design and content, making them a valuable tool for modern retail operations.

Source: Frost & Sullivan

Overview of Global Smart Retail Industry

Market Size of Smart Retail Terminals and Electronic Shelf Labels （1/2）

Market Size of Global Smart Retail Terminals Industry, 2020-2029E

Under the wave of digitalization and the continuous development of smart retail terminal technologies, consumers' dependence on smart retail terminals is increasing day by day. Innovative payment devices like the "Tap-to-Pay" are becoming widely popular due to their convenience. With the continuous progress of global smart retail terminals and NFC technologies, the market for smart retail terminals will continue to grow. It is expected that the global market size of smart retail terminals, calculated at the ex-factory price, will increase from USD2.9 billion in 2025 to USD4.4 billion in 2029, with a CAGR of 11.0%. This change will drive the payment industry towards a more efficient and intelligent direction.

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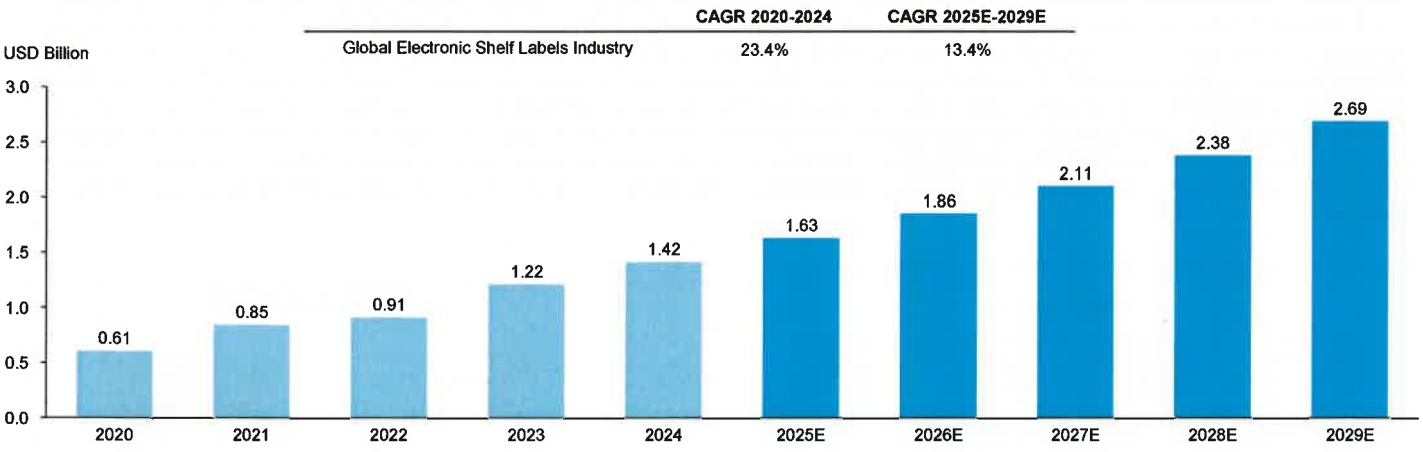
Source: Frost & Sullivan

Overview of Global Smart Retail Industry

Market Size of Smart Retail Terminals and Electronic Shelf Labels （2/2）

Market Size of Electronic Shelf Labels Industry, 2020-2029E



At the same time, as an important part of new retail, electronic price tags, through real-time information updates, low energy consumption, and remote management, are rapidly replacing traditional paper labels and becoming essential tools for the intelligent management of the retail industry. It is expected that the global market size of electronic price tags, calculated at the ex-factory price, will increase from US$1.63 billion in 2025 to US$2.69 billion in 2029, with a CAGR of 13.4%. These intelligent devices not only revolutionize people's payment methods but also drive the payment industry and the retail industry towards a more efficient and intelligent direction, bringing more convenience and possibilities. Precision manufacturers will play an important role in providing high-quality and low-cost production solutions.

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Source: Frost & Sullivan

Overview of Global Smart Retail Industry

Analysis of Smart Retail Terminals and Electronic Shelf Labels

Smart Retail Terminals

- In July 2024, a dominant third-party payment platform (holding a market share exceeding 30% in the industry) launched the "Tap-to-Pay" model. Under this framework, consumers complete transactions through a single tap between their mobile devices and merchant terminals via NFC technology, eliminating the need to unlock devices or present payment codes. This frictionless payment mechanism not only reduces transaction latency by **approximately 30%** but also introduces gamified engagement elements, driving rapid adoption across retail ecosystems. The Tap-to-Pay device embodies a unibody design incorporating 3D glass surfaces and aerospace-grade metal casings, guaranteeing structural integrity and superior performance under high-frequency usage scenarios.

Electronic Shelf Labels

- Electronic shelf labels represent intelligent labeling solutions utilizing electronic display technology to replace traditional paper tags in presenting real-time product pricing, specifications, and barcodes. These labels primarily employ e-ink (electronic ink) displays, enabling instant content updates, centralized remote management, and batch configuration capabilities, while delivering ultra-low power consumption, crisp high-definition visuals, and 180-degree viewing angles. Deployed extensively in supermarkets, shopping malls, and convenience stores, they streamline price synchronization workflows, enhance inventory turnover accuracy, and elevate customer shopping experiences through dynamic digital interactivity.

Source: Frost & Sullivan

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Overview of Global Intelligent Robot Industry

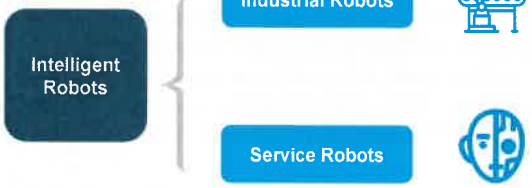
Definition and Classification of Intelligent Robots

Definition of Intelligent Robots

Intelligent Robots are autonomous or semi-autonomous machines equipped with advanced sensors, artificial intelligence (AI), and decision-making algorithms that enable them to perceive their environment, process information, and perform complex tasks with minimal human intervention. These robots learn from experience (via machine learning), adapt to dynamic conditions, and interact with humans or other systems through natural language processing, computer vision, or other adaptive interfaces. Key characteristics include autonomy, adaptability, learning capability, and the ability to operate in unstructured environments (e.g., homes, hospitals, factories). Examples include humanoid service robots, industrial collaborative robots (cobots), and autonomous drones.

Intelligent robots can be categorized into industrial robots and service robots, among which humanoid robots are a new type of service robot. An industrial robot is a multi-purpose mechanical arm that can be automatically controlled and programmed, typically possessing the capability for programming on three or more axes. These robots are mainly used in industrial applications. They can be either stationary or mobile, such as articulated robots, cartesian robots, and selective compliance assembly robot arms (SCARA robots). A humanoid robot refers to a robot that is designed to resemble the human form in both shape and size, and is capable of mimicking human movements, expressions, interactions, and locomotion.

Classification of Intelligent Robots



An industrial robot is a multi-purpose mechanical arm that can be automatically controlled and programmed, typically possessing the capability for programming on three or more axes. These robots are mainly used in industrial applications. They can be either stationary or mobile, such as articulated robots, Cartesian robots, and Selective Compliance Assembly Robot Arms (SCARA robots).

A humanoid robot refers to a robot that is designed to resemble the human form in both shape and size, and is capable of mimicking human movements, expressions, interactions, and locomotion.

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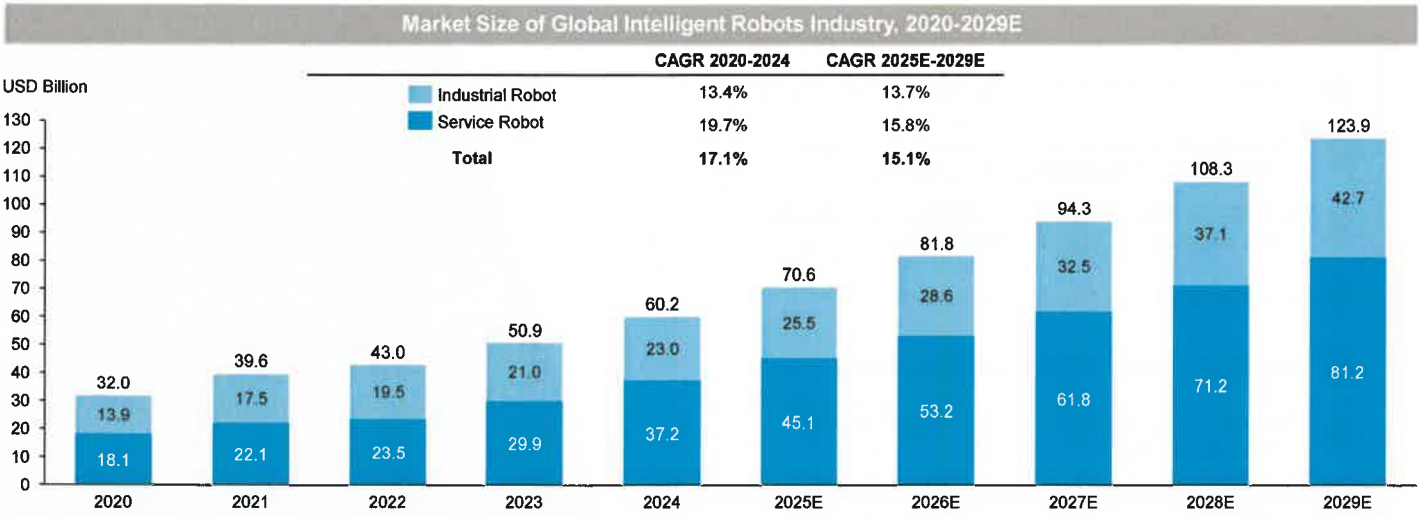
Source: Frost & Sullivan

Overview of Global Intelligent Robot Industry

Market size of Global Intelligent Robots Industry



The global market size of intelligent robots increased from USD32.0 billion in 2020 to USD60.2 billion in 2024, with a CAGR of 17.1%, and it is expected to reach USD123.9 billion by 2029. As an important segment of intelligent robots, service robots have received widespread attention in recent years. It is expected that the market size of service robots will grow from USD45.1 billion in 2025 to USD81.2 billion in 2029, with a CAGR of 15.8%.

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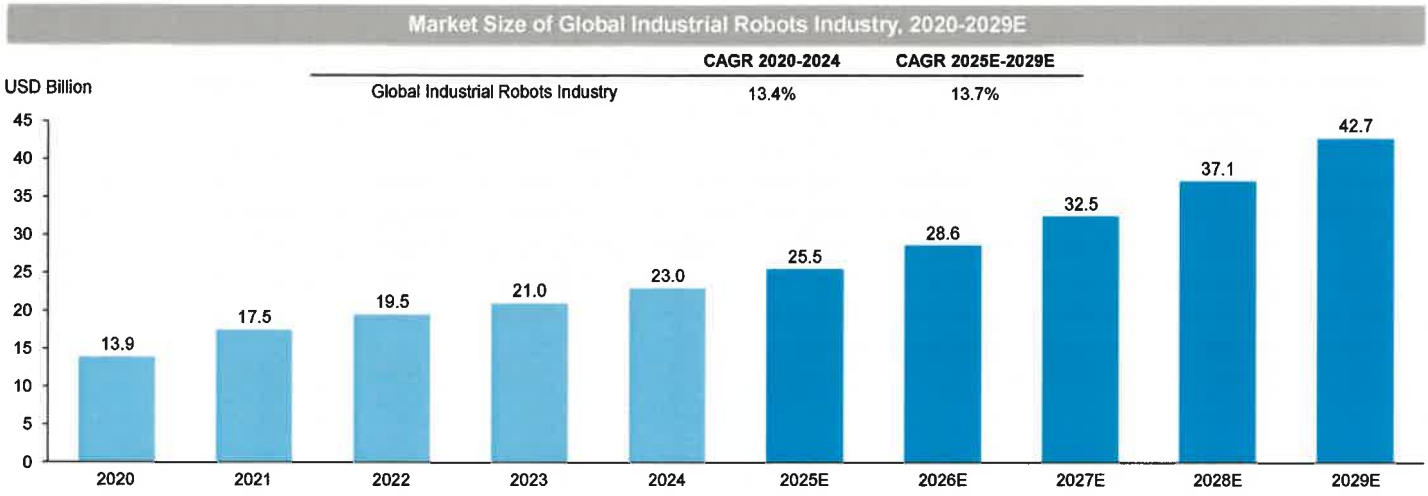
Source: Frost & Sullivan

Overview of Global Intelligent Robot Industry

Market size of Global Industrial Robots Industry



- Industrial robots are evolving toward cognitive automation, enhanced flexibility, and human-robot collaboration. Breakthroughs in artificial intelligence (AI), IoT, and big data analytics have endowed these systems with self-optimizing decision-making and adaptive learning capabilities, enabling dynamic reconfiguration to meet diverse production demands. The global industrial robot market stood at USD23.0 billion in 2024 and is anticipated to grow from USD25.5 billion in 2025 to USD42.7 billion by 2029, yielding a CAGR of 13.7%. Cost-performance improvements and technology democratization will accelerate adoption among SMEs, fueling deployment across smart manufacturing, automated logistics, and Industry 4.0 initiatives.

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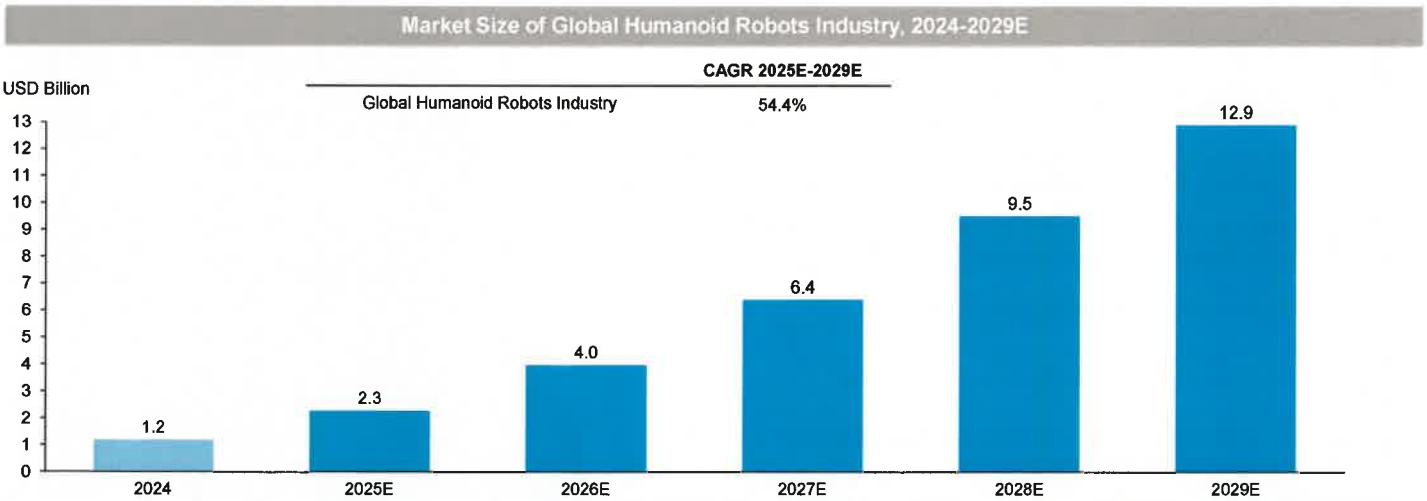
Source: Frost & Sullivan

Overview of Global Intelligent Robot Industry

Market size of Global Humanoid Robots Industry



- Humanoid robots are achieving quantum leaps in environmental perception, cognitive computing, and social interaction fidelity, empowering their deployment in high-complexity roles such as personalized healthcare assistance, adaptive education tools, and AI-driven customer service. Concurrent advancements in biomimetic design and locomotion mechanics are enhancing their anthropomorphic realism, broadening applicability across medical, educational, and hospitality sectors. The global humanoid robot market is set to skyrocket from USD2.3 billion in 2025 to USD12.9 billion by 2029, representing a CAGR of 54.4%. This exponential growth will simultaneously drive demand for robotic touch panels to enable intuitive human-machine interfaces (HMIs), real-time data visualization, and tactile control functionalities.

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Source: Frost & Sullivan

Overview of Global Intelligent Robot Industry

Analysis of Global Intelligent Robots

- With the acceleration of the industrialization of humanoid robots, structural components and modules, as the core carriers, have characteristics such as high technical barriers and great process complexity. This has prompted manufacturers of complete machines to tend to outsource structural components such as joint modules, dexterous hands, and trunks to professional suppliers. These enterprises achieve modular production of high-precision structural components through technological research and development. This can not only reduce the cost of complete machines but also improve the efficiency of the supply chain, and at the same time, promote the industry to evolve towards standardization and modularization. Relying on professional production experience and large-scale manufacturing capabilities, leading enterprises in structural components and modules are expected to enter the market for assembling complete humanoid robots and provide full-chain solutions from components to complete machines. Leading precision manufacturing enterprises, such as Lens Technology, with its comprehensive advantages in new material research and development, structural component manufacturing, touch and fingerprint modules, display modules, as well as precision assembly and data testing, can provide one-stop vertically integrated services from design to mass production for the humanoid robot industry through software interactions such as intelligent perception, intelligent analysis, and intelligent decision-making.

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Source: Frost & Sullivan

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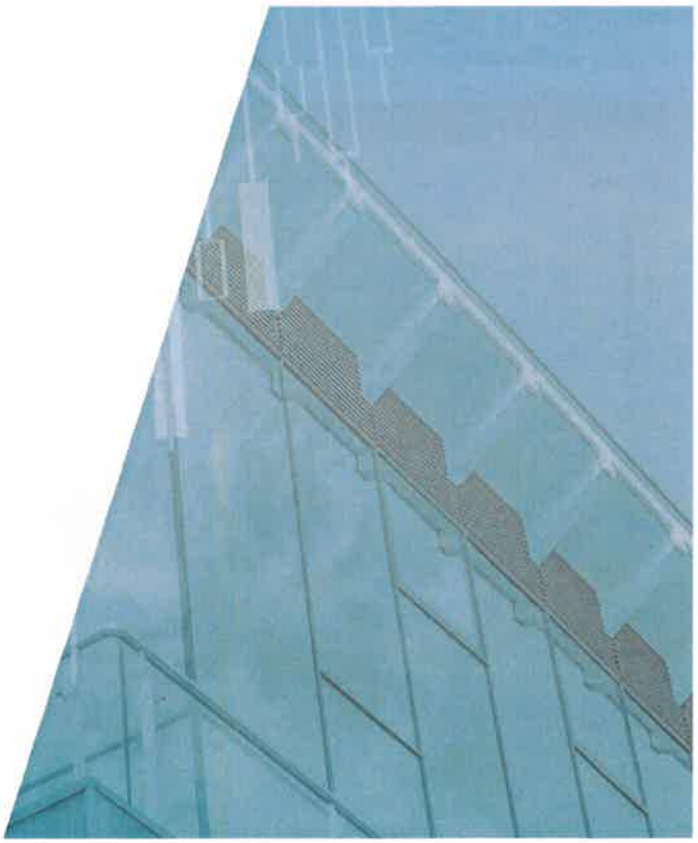

Entry Barriers and Raw Material Analysis of Global Precision Manufacturing Industry

Industry Barrier Analysis (1/2)

1 Customer and Supplier Relationship Barriers

- The success of precision manufacturing companies relies heavily on solid customer and supplier relationships. In the precision manufacturing industry, customers have strict certification processes for suppliers, and the verification period is lengthy. As a result, customers tend to maintain stable relationships with long-term partners, and the track record of cooperation with downstream clients in production and R&D is crucial for precision manufacturers to secure orders. Additionally, customers typically prioritize brand reputation and track record. Large, well-established brands with strong technical expertise and quality assurance are often the preferred choice. Existing companies, having accumulated years of experience, have built a reliable brand image and earned customer trust. In contrast, new entrants must invest significant time and resources to achieve a similar level of market recognition. In addition, precision manufacturing companies without long-term relationships with upstream suppliers may face greater challenges in ensuring the procurement of high quality raw materials and maintaining stable supply. These factors collectively heighten market entry barriers and sustain the competitive advantages of leading industry players.

2 Solution Customization Barriers

- The precision manufacturing industry often involves highly customized products, with clients demanding stringent quality and technical requirements. Suppliers must offer highly tailored designs, materials and manufacturing solutions for each product generation. In addition, the ability to provide full-process services-from concept design to final production delivery-is an important selection criterion for clients. Leading companies possess a vertically integrated supply chain, enabling them to quickly and efficiently respond to clients' diverse needs. New entrants, lacking relevant experience and flexible service capabilities, face difficulty meeting clients' high standards for customized solutions.

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Source: Frost & Sullivan

Entry Barriers and Raw Material Analysis of Global Precision Manufacturing Industry

Industry Barrier Analysis (2/2)

3 Technology Innovation Barriers

- Precision manufacturing is a technology-intensive industry. With rapid technological advancements, the demand for advanced manufacturing and intelligent technologies is increasing, requiring companies to have multidisciplinary technical expertise. Some leading companies in the precision manufacturing industry own numerous patents and unique production processes. Furthermore, some leading companies collaborate with strategic clients to establish R&D centers worldwide. This global R&D network allows them to quickly access cutting-edge technological information and enhance their innovation capabilities. New entrants must overcome these technological research and development barriers, and without breakthroughs in innovation, it is challenging to catch up technologically.

4 Production and Manufacturing and Capital Barriers

- Precision manufacturing demands highly stable production capabilities. Leading companies achieve this by being the first to develop and widely implement automated intelligent equipment, integrating industrial internet and AI technologies to build efficient, smart production systems. This enables the automation, digitization, and intelligent upgrade of the entire production process, significantly boosting operational efficiency and product quality, while achieving the goals of efficient production and rapid delivery. In contrast, new entrants must invest substantial resources to establish supply chain management and production systems, making it difficult for them to quickly attain sufficient production capacity and stable production lines. Additionally, large companies benefit from economies of scale, effectively reducing the production cost per unit, which is hard for new entrants to match in the short term. Moreover, the high capital investment required in the industry creates a significant entry barrier. This includes expenses for production equipment, factory construction, and R&D. Therefore, new entrants face significant financial pressure.

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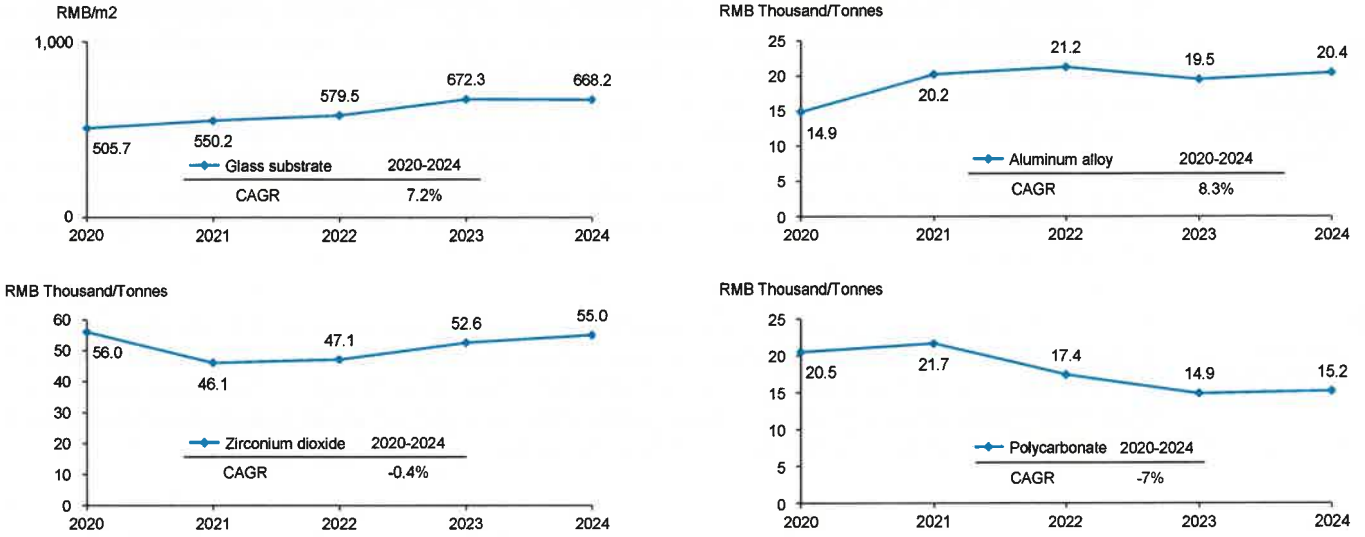
Source: Frost & Sullivan

Entry Barriers and Raw Material Analysis of Global Precision Manufacturing Industry

Price Trend Analysis of Raw Materials (1/2)

Price Trend of Major Raw Materials used in the Smart Device Enclosure and Module Solution Industry (China), 2020-2024



Source: National Bureau of Statistics, Frost & Sullivan

Entry Barriers and Raw Material Analysis of Global Precision Manufacturing Industry

Price Trend Analysis of Raw Materials (2/2)

- The primary raw materials for precision manufactured components include glass substrates, aluminum alloy, zirconium dioxide, and polycarbonate. Glass substrate is a special glass material used in the manufacturing of high-end electronic and optoelectronic devices. It usually features high flatness, a low coefficient of expansion, high light transmittance, and excellent chemical stability.. The price of glass substrate has increased from RMB505.7 per square meter in 2020 to RMB668.2 per ton in 2024, with a CAGR of approximately 7.2%. Aluminum alloy is widely used in the production of metal frames and is a common material for consumer electronics precision manufactured components. The price of aluminum alloy has increased from RMB14,900 per ton in 2020 to RMB20,400 per ton in 2024, with a CAGR of 8.3%. Zirconium dioxide is a key raw material for precision ceramic components. Zirconium ceramics made from zirconium oxide powder are more cost-effective and offer superior fracture toughness compared to glass and sapphire. Moreover, its non-conductive nature and minimal signal interference have led to increasing use in the consumer electronics industry. From 2021 to 2024, due to rising production material costs and supply shortages, the price of zirconium dioxide has increased from RMB46,100 per ton in 2021 to RMB55,000 per ton in 2024. Polycarbonate, which is widely used in the plastic structural components segment, experienced high price volatility due to the historical price imbalance of supply and demand, declining from RMB20,500 per ton in 2020 to RMB15,200 per ton in 2024, representing a CAGR of -7.0%.

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Competitive Landscape of Global Precision Manufacturing Industry

Global Top Five Consumer Electronics Precision Structural Parts Integrated Solution Providers by Sales Revenue, 2024

Global Top 5 Consumer Electronics Precision Structural Parts Integrated Solution Providers by Sales Revenue, 2024

Ranking	Company	Revenue (USD Billion)	Market Share
1	Lens Technology	8.6	13.0%
2	Company A	8.0	12.1%
3	Company B	3.8	5.7%
4	Company C	3.7	5.6%
5	Company D	2.4	3.6%
		Subtotal	40.0%

- In 2024, the global consumer electronics precision structural parts integrated solution industry has reached USD66.3 billion. The top five participants in the market account for 40.0% of the total market share, indicating a relatively concentrated market. Among them, Lens Technology's revenue in 2024 has reached USD8.6 billion, ranking the first among global consumer electronics precision structural parts integrated solution providers, with a market share of 13.0%. Leading global participants in the consumer electronics precision structural parts integrated solution industry have advantages in areas such as deep collaboration with customers, technological R&D, smart manufacturing, multi-step industry chain layout, and highly customized products.

Source: Frost & Sullivan

Competitive Landscape of Global Precision Manufacturing Industry

Global Top Five Intelligent Vehicle Interactive Structural Parts Integrated Solution Providers by Sales Revenue, 2024

Global Top 5 Global Intelligent Vehicle Interactive Structural Parts Integrated Solution Providers by Sales Revenue, 2024

Ranking	Company	Revenue (USD Billion)	Market Share
1	Lens Technology	0.8	20.9%
2	Company C	0.7	17.6%
3	Company E	0.3	7.7%
4	Company F	0.2	5.3%
5	Company G	0.2	4.2%
		Subtotal	55.7%

- In 2024, the global market size for intelligent vehicle interactive structural parts integrated solution industry is expected to reach approximately USD4.0 billion. The top five participants will account for 55.7% of the market share, with Lens Technology generating USD0.8 billion in revenue in 2024, ranking the first, and holding a market share of 20.9%. The global automotive intelligent vehicle interactive structural parts market is relatively centralized, and the head enterprises continue to expand their market share through technological innovation, strategic cooperation and mergers and acquisitions.

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Source: Frost & Sullivan

Agenda

Appendix

- In 2004, Lens Technology started provided mobile phone cover glass and camera protective glass for the world's first mobile phone series that sold over 100 million units.
- In 2007, Lens Technology provided cover glass for the world's first smartphone.
- In 2010, Lens Technology began automating and upgrading production facilities, and began independently developing and processing sapphire materials to enable large-scale production and explore its applications in consumer electronics.
- In 2011, Lens Technology worked with customers on 3D curved glass development, obtained key technology on 3D curved glass and achieved mass production.
- In 2018, Lens Technology pioneered the application of function modules and 3D glass to the world's first premium smart electric vehicle.
- Lens Technology lays the foundation for being one of the first companies in the industry to undertake large-scale production of key components and complete device assembly for humanoid robots and AI glasses/XR head-mount displays.
- Lens Technology is the central control screens and intelligent B-pillar supplier for the world's first premium smart electric vehicle.
- With the largest number of automotive brands served in the industry, Lens Technology continues to expand its smart vehicle business sector.
- Lens Technology is one of the few solution providers in the global consumer electronics supply chain with advanced processing capabilities in both glass and metal.
- VTG has become one of the key research and development areas of leading companies in the industry.
- Based on revenue in 2024, Lens Technology is (i) the primary supplier of cover glass for mid-to-high-end smartphone brands globally, and (ii) the main supplier of central control screens and intelligent B-pillars for the world's largest battery electric vehicle brand.
- Lens Technology has pioneered the application of materials such as glass, sapphire and ceramics in premium smart devices. Lens Technology independently developed and pioneered process innovations such as CNC glass machining, fully-automatic silk-screen printing and intelligent transfer printing and coating, which have become industry standard technologies.
- Lens Technology achieved long-term sustainable growth and solidified position as a global leader in integrated one stop precision manufacturing with comprehensive coverage of the entire industry value chain.
- Lens Technology industry-first single-piece flow production method has significantly reduced various production costs and lead times, ultimately creating value for customers.
- Lens Technology was one of the few solution providers in the global consumer electronics supply chain with advanced processing capabilities for both glass and metal.

Source: Frost & Sullivan

Appendix

- Lens Technology actively invested in the research and development of new technologies such as UTG and VTG, and Lens Technology has developed the capability for rapid mass production of foldable screen structural parts and modules.
- Lens Technology entered into an in-depth strategic cooperation with a leading AI glass company for its entire range of AI glasses, helping it to accelerate bulk delivery and providing core support for the expected explosive growth in AI glasses globally in 2025.
- As a pioneer in the Chinese smart manufacturing landscape, Lens Technology champions and leads the industry by being one of the earliest companies to focus on the research, production and large-scale application of automated equipment, industrial robots and smart manufacturing production system.
- Lens Technology has successfully developed the industry's first automatic glass printing line and baking line.
- Lens Technology designed and established the first single-piece flow production line in the industry, which strings multiple processes into one straight production line extending over hundreds of meters, enabling the seamless and efficient production of products.
- Lens Technology is among the first in the industry to apply cutting-edge technologies such as machine vision to product exterior inspection.
- Lens Technology was the first to introduce CNC techniques in the processing of cover glass, significantly increasing product yield and precision and opening up possibilities for more product specifications and customizations.
- Lens Technology was the first to use sapphire and ceramics in smartphones and wearable products.
- Lens Technology's breakthrough of high-adhesion ultra-thin ink set industry benchmarks by enabling sleeker, more durable device designs and improved product yields.
- Lens Technology was the pioneer in China to adopt glass hole polishing and cross-section polishing technologies to solve the problem of glass being easily broken to microcracks.
- Lens Technology was the pioneer in adopting the yellow light process in the manufacturing of three-dimensional cover glass
- Lens Technology Innovation Research Institute is working on creating lightweight, durable materials, establishing Lens Technology as a main provider for global leading brands in AI-enabled devices.
- Lens Technology is one of the earliest companies to develop and implement automated equipment in production processes, which significantly increases efficiency, precision and consistency in production.
- As a result of Lens Technology's advanced technologies and equipment, from 2022 to 2024, the product yields for Lens Technology products and complete device assembly were well above the industry average.

Source: Frost & Sullivan

Research Methodologies

- Frost & Sullivan is an independent global consulting firm, which was founded in 1961 in New York. It offers industry research and market strategies and provides growth consulting and corporate training. Its industry coverage includes automotive and transportation, chemicals, materials and food, commercial aviation, consumer products, energy and power systems, environment and building technologies, healthcare, industrial automation and electronics, industrial and machinery, and technology, media and telecom.
- The Frost & Sullivan's report includes information on global precision manufacturing industry.
- Frost & Sullivan has conducted detailed primary research which involved discussing the status of the industry with certain leading industry participants and conducting interviews with relevant parties. Frost & Sullivan has also conducted secondary research which involved reviewing company reports, independent research reports and data based on its own research database. Frost & Sullivan has obtained the figures for the estimated total market size from historical data analysis plotted against macroeconomic data as well as considered the above-mentioned industry key drivers.
- Frost & Sullivan's Market Engineering Forecasting Methodology integrates several forecasting techniques with the Market Engineering Measurement-based System. It relies on the expertise of the analyst team in integrating the critical market elements investigated during the research phase of the project. These elements include:
  - ✓ Expert-opinion forecasting methodology
  - ✓ Integration of market drivers and restraints
  - ✓ Integration with the market challenges
  - ✓ Integration of the Market Engineering Measurement trends
  - ✓ Integration of econometric variables
- In compiling and preparing the Report, Frost & Sullivan has adopted the following assumptions:
  - ✓ The social, economic and political environment of the globe is likely to remain stable in the forecast period
  - ✓ Related industry key drivers are likely to drive the market in the forecast period

Source: Frost & Sullivan