
INDUSTRY OVERVIEW

The information and statistics set out in this section and other sections of this document were extracted from the report prepared by Frost & Sullivan, which was commissioned by us, and from various official government publications and other publicly available publications. We engaged Frost & Sullivan to prepare the Frost & Sullivan Report, an independent industry report, in connection with the [REDACTED]. However, the information from official government sources has not been independently verified by us, the Joint Sponsors, [REDACTED], any of their respective directors and advisers, or any other persons or parties involved in the [REDACTED], and no representation is given as to its accuracy. For more details of the risks relating to our industry, see “Risk Factors” in this Document.

GLOBAL ROBOTICS SOLUTIONS MARKET OVERVIEW

Definition and Classification of Robotics Solutions

Robotics solutions refer to application-oriented robotics offerings that combine robots, control and navigation software, perception and safety module to deliver task outcomes for specific industries. It focuses on industrial and commercial applications, covering farms and livestock facilities, construction sites, and facility management across campuses and public venues. These systems are designed for professional environments where operations demand reliability, precision, and regulatory compliance, and where automation enhances consistency and labour efficiency. The global robotics solutions market is organised by application domains within which the following segments:

- Agriculture and livestock robotics solutions, covering field operations, orchard and greenhouse tasks, livestock monitoring and feeding, and farm-facility services.
- Construction robotics solutions, covering scanning, layout, inspection, material handling, site cleaning and finishing, and on-site 3D printing or prefabrication tasks.
- Facility management robotics solutions specially for commercial cleaning, landscaping, and related operations across public venues, including ground cleaning (floor scrubbing, vacuuming), and vertical façade cleaning.
- Other robotics solutions, covering industrial and service applications outside the three focus domains. This segment encompasses a broad range of mature and emerging robotics categories that support automation across multiple industries, including manufacturing and assembly in automotive and electronics, logistics and warehousing for e-commerce fulfilment, healthcare service robots, mining and energy inspection, and service robots used in retail, hospitality, and public environments for customer interaction, delivery, and security functions, etc.

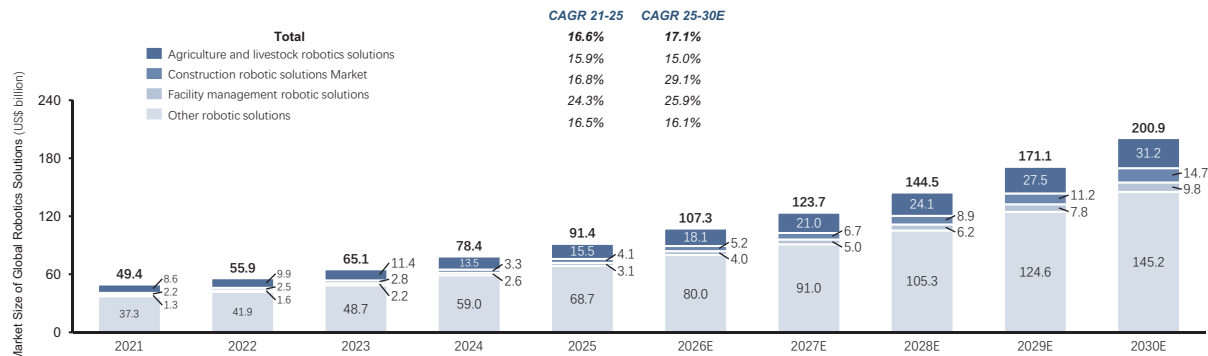
Market Size of Global Robotics Solutions Market

The market size of the global robotics solutions market increased from US\$49.4 billion in 2021 to US\$91.4 billion in 2025, reflecting a CAGR of 16.6%. It is projected to reach US\$200.9 billion by 2030, reflecting a CAGR of 17.1% from 2025. Market growth is driven by increasing adoption supported by continued advances in perception, navigation and control software, ageing demographics alongside labour scarcity and rising labour costs, the need for traceable and standardised operations. Furthermore, declining hardware and integration costs enable pilot implementations to scale into multi-site deployments.

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By industry application, the market can be categorized into agriculture and livestock, construction, facility management and other robotics solutions. In 2025, the combined market position of the agriculture and livestock, construction, and facility management segments accounted for about 24.9% of the global total and is expected to increase to around 27.7% by 2030. The remaining portion comprises other robotics solutions. Market growth among these segments is driven by practical objectives of enhancing human wellbeing and freeing up labour for higher-value work, including reducing exposure to repetitive and hazardous tasks, extending service availability and consistency, raising productivity and quality, and improving cleanliness and safety in workplaces and public spaces.

Market Size of Global Robotics Solutions, 2021-2030E



Source: Frost & Sullivan

Penetration Rate of Global Robotics Solutions Market

The penetration of global robotics solutions in the agriculture and livestock farming, construction, and facility management segments stood at less than 11.0%, less than 1.0%, and less than 15.0%, respectively, in 2025. This penetration is expected to grow to approximately 15.0%, approximately 1.0%, and less than 23.0%, respectively, in 2030.

GLOBAL REAL WORLD MODELING MARKET OVERVIEW

Definition of Real World Modeling

Real world modeling refers to the creation of high-fidelity digital representations of physical environments by integrating multimodal sensing technologies (e.g., GNSS positioning, LiDAR SLAM, computer vision, deterministic algorithm, electrification and automatic control). It serves as a foundation to enable robots and intelligent systems to achieve advanced spatial modeling, environmental perception, and decision-making capabilities. Real world modeling has been applied across a wide range of industries, including agriculture and livestock farming, construction, facility management, and others. Unlike conventional automation modules, real world modeling can both support standalone commercialisation in niche scenarios and act as an embedded enabler within integrated robotics solutions.

Market Size of Global Real World Modeling

From 2021 to 2025, the global real world modeling market expanded from US\$6.7 billion to US\$19.1 billion, representing a CAGR of 29.9%. Growth has been driven by early commercialization in scenarios such as campus scanning and tree posture recognition, together with wider adoption in smart cities, manufacturing, energy, utilities, and transportation. This has been further supported by progress in IoT connectivity, reality-capture technologies, BIM integration, and data-driven operations.

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Looking ahead, the global real world modeling market is projected to reach approximately US\$140.0 billion by 2030, at a CAGR of 48.9%. The market is projected to expand rapidly over the next five years, supported by the transition from pilot projects to scaled deployments across multiple industries. Adoption is further underpinned by advances in physics-based and AI-driven simulation, which improve planning and optimization, as well as by connected assets that enable remote operations and predictive maintenance. In addition, tightening ESG and energy-efficiency requirements are driving broader application of real world modeling in measurement, benchmarking, and reporting.

GLOBAL AGRICULTURAL AND LIVESTOCK FARMING ROBOTICS SOLUTIONS MARKET OVERVIEW

Definition and Classification of Agricultural and Livestock Farming Robotics Solutions

Agricultural and livestock farming robotics solutions refer to intelligent, automated systems designed to improve productivity, precision, and consistency in modern agricultural and livestock farming. Operating with minimal human intervention, these solutions are increasingly deployed to perform core functions such as autonomous navigation, precision spraying, water and input management, water management, seeding, feeding, manure cleaning, milking, and health monitoring. They integrate advanced technologies including GNSS positioning, LiDAR SLAM, computer vision, deterministic algorithm, electrification and automatic control, and proprietary algorithms to enable highly efficient, data-driven operations across crop cultivation and livestock management.

The global agricultural and livestock farming robotics solutions market includes both precision agriculture solutions and livestock farming robotics solutions. According to application and function, these solutions can be broadly classified into:

(i) **Precision agriculture** solutions, which include:

Guidance and steering systems, water management systems, precision seeding equipment control systems, precision spraying auto-steering systems, precision harvesting systems, and other systems that optimize field coverage and reduce input waste.

(ii) **Livestock farming** robotics solutions: encompass intelligent systems designed to automate and optimize livestock farming operations. Key solution types include:

Precision feeding and manure cleaning systems, milking robotics systems, livestock identification, monitoring and tracking systems, integrated analytics platforms.

This category excludes conventional mechanized equipment without autonomous features and systems reliant solely on manual or remote control without embedded intelligent automation.

Value Chain of Global Agricultural and Livestock Farming Robotics Solutions Market

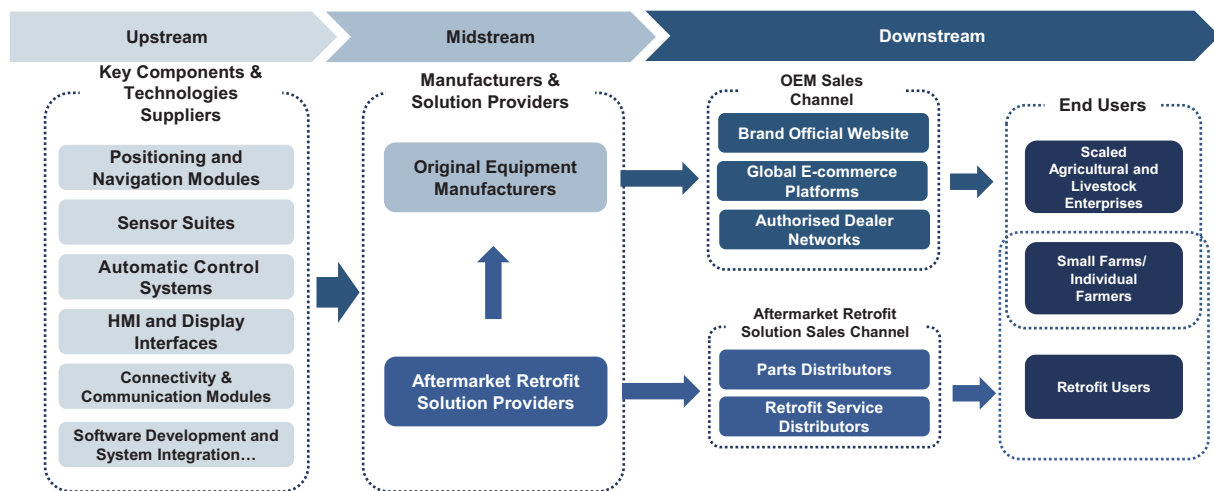
The global agricultural and livestock farming robotics solutions value chain comprises three key segments: upstream component and technology providers, midstream manufacturers and solution providers, and downstream distribution channels and end users.

Upstream participants supply the core technologies that enable autonomous operation and intelligent control. These include high-precision positioning and navigation modules, such as GNSS and RTK), sensor suites (LiDAR and vision), automation control systems, connectivity and communication modules, human-machine interface (“HMI”) components including display terminals, and software development and system integration, comprises network services.

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The midstream segment consists of two categories: (i) Original Equipment Manufacturers (“OEMs”) that integrate autonomous functionalities into next-generation agricultural and livestock machinery; and (ii) aftermarket retrofit solution providers, who offer modular kits to upgrade existing equipment. These retrofit solutions are delivered through two channels: OEM-integrated components embedded into new machinery platforms, and standalone upgrades sold directly to end users.

Downstream distribution is structured into two primary channels based on integration and delivery models: (i) OEM Sales Channel, including official brand websites, global e-commerce platforms, and authorized dealers. This channel primarily serves commercial-scale agricultural operations and medium-to-large farms, while also reaching some smallholders; and (ii) aftermarket retrofit sales channel, comprising parts distributors and retrofit service providers, caters to users upgrading conventional equipment with intelligent modules. This channel is especially active in markets with a large base of legacy machinery and primarily serves small farms and individual operators.



Source: Frost & Sullivan

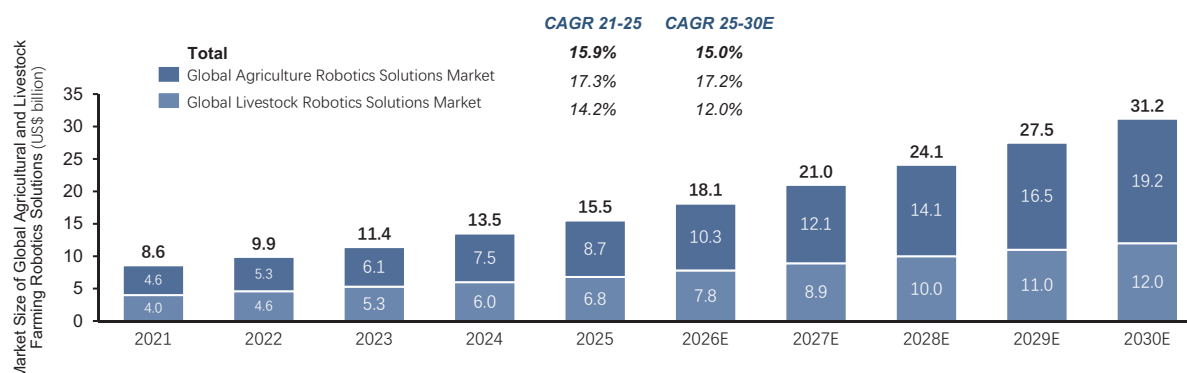
Market Size of Global Agricultural and Livestock Farming Robotics Solutions

Driven by the growing need for operational efficiency, labour substitution, and round-the-clock functionality, agricultural and livestock robotics solutions have become integral to the advancement of smart farming worldwide. The global market is broadly segmented into precision agriculture solutions and livestock robotics solutions. From 2021 to 2025, the total agriculture and livestock farming robotics solutions market in terms of revenue expanded from approximately US\$8.6 billion to US\$15.5 billion, representing a CAGR of 15.9%. Revenue from agriculture robotics solutions rose from US\$4.6 billion to US\$8.7 billion, supported by the increasing adoption of auto-steering systems, water management systems, precision seeding and planting, precision pesticide application, precision harvesting and GNSS-enabled platforms. Livestock robotics solutions grew from US\$4.0 billion to US\$6.8 billion, driven by rising demand for automated feeding, animal monitoring, and milking systems, particularly within intensive farming operations.

Historical growth was underpinned by rising global food demand, increasing productivity pressures, persistent rural labour shortages, accelerating technological maturity, and enhanced policy support for sustainable, resource-efficient agriculture in key markets. Looking ahead, the global market is projected to reach approximately US\$31.2 billion by 2030 from 2025. Agriculture robotics solutions are expected to grow at a CAGR of 17.2%, reaching US\$19.2 billion and increasing their share of total market from 56.1% in 2025 to 60.5% in 2030. Livestock robotics solutions are forecast to reach US\$12.0 billion, reflecting a CAGR of 12.0% over the same period.

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Market Size of Global Agricultural and Livestock Farming Robotics Solutions, 2021-2030E



Source: Frost & Sullivan

Market Size of Global Agricultural Auto-Steering System Kits Market

The global agricultural auto-steering system kits market increased from approximately US\$1.2 billion in 2021 to US\$2.1 billion in 2025, representing a CAGR of 16.5%. Within this market, the retrofit agricultural auto-steering system kits segment reached around US\$1.1 billion, accounting for 50.7% of the total in 2025. Its growth has been driven by strong replacement and upgrade demand from existing agricultural machinery fleets, as downstream consumers increasingly adopt automation retrofits to enhance precision and efficiency without purchasing new equipment.

By contrast, the OEM-integrated segment, which mainly serves new tractor or harvester sales and targets customers seeking factory-installed precision systems with higher upfront costs, reached approximately US\$1.0 billion in 2025, representing 49.3% of the total market.

Looking ahead, the total market is projected to expand to around US\$3.7 billion by 2030, reflecting a CAGR of 11.6%. Over the same period, the retrofit segment is expected to grow from US\$1.1 billion in 2025 to US\$2.0 billion in 2030, representing a CAGR of 13.7%, with its market share increasing to around 55.5%. The OEM-integrated segment is forecast to reach US\$1.6 billion by 2030, reflecting a CAGR of 9.4%. Overall market expansion will continue to be supported by the wider adoption of GNSS-based retrofit solutions, which enhance operational accuracy, productivity, and labour efficiency.

Market Drivers of Global Agricultural and Livestock Farming Robotics Solutions

Rising food demand and need for scalable productivity. The continuous growth of the global population and heightened concerns over food security are placing increasing pressure on agricultural systems to deliver higher yields. Intelligent agricultural and livestock robotics solutions offer a viable pathway to improve productivity, reduce input waste, and ensure consistent operations. Especially in densely populated areas, these technologies support scalable and sustainable farming practices. As a result, the penetration of intelligent robotics within the broader agricultural and livestock machinery markets is steadily increasing, transforming traditional operations with digital efficiency.

Labour shortages driving automation adoption. Structural labour shortages caused by demographic shifts and rural-to-urban migration are accelerating the need for robotic automation in both crop and livestock farming. According to the *FAO Statistical Yearbook 2024*, global employment in agriculture, forestry, and fishing declined by 13% between 2000 and 2022, including a dramatic 47% reduction in Europe. According to the United States Department of Agriculture’s (“USDA”) 2022 Census of Agriculture, the average age of agricultural workers in the United States ranges between 46

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and 58 years. In Japan, data from the Ministry of Agriculture, Forestry and Fisheries (“MAFF”) indicate that the average age of core farming personnel rose to 68.7 years in 2023, reflecting acute ageing pressures and a shortage of younger replacements in the sector. These trends are making intelligent robotic systems an essential solution for maintaining productivity and continuity in agricultural operations, further increasing their share in the overall agricultural machinery landscape.

Technology advancements enabling precision and autonomy. Rapid progress in enabling technologies, such as GNSS positioning, LiDAR SLAM, computer vision, deterministic algorithm, electrification and automatic control is creating a strong digital infrastructure for autonomous agricultural and livestock robotics. These technologies enable precise sensing, autonomous navigation, real-time analytics, and AI-driven decision-making. The integration of such features is driving adoption among OEMs and aftermarket providers, and contributing to the growing penetration of smart robotics in the total agricultural equipment ecosystem.

Environmental pressures and demand for sustainable practices. With increasing global focus on sustainability and climate resilience, intelligent robotics solutions offer tangible benefits in optimizing input usage and reducing environmental impact. Precision application of fertilizers and pesticides, enabled by smart systems, reduces overuse and runoff, while automated guidance lowers fuel consumption and soil compaction. These improvements help farmers align with regulatory climate targets and meet the sustainability criteria demanded by governments and agricultural supply chain partners, thus reinforcing the market share of robotic systems in modern farm machinery.

Policy support accelerating market penetration. Public-sector initiatives across major regions are playing a vital role in advancing the adoption of smart farming technologies. Government-backed programs ranging from equipment subsidies and tax incentives to research funding are actively supporting the development and deployment of autonomous agricultural robotics. In the EU, for example, the *Common Agricultural Policy (2023–2027)* allocates over €387 billion to sustainable farming, with specific emphasis on digital and precision technologies. In April 2024, the U.S. Department of Agriculture (USDA) and the National Science Foundation (NSF) jointly issued the “**Dear Colleague Letter**” encouraging research proposals in the field of agricultural robotics and automation, including areas such as autonomous harvesting, precision field operations, and humanrobot collaboration. Meanwhile, in May 2024, the Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan published the the Promotion of Smart Agriculture” policy, emphasising the transformation of production methods through smart agricultural technologies, including robotics, in response to a declining farmer population and labour shortages. These coordinated policy directions are significantly contributing to the rising penetration of robotics in agricultural and livestock robotic markets globally.

Future Trends of Global Agricultural and Livestock Farming Robotics Solutions

Transition from point-based automation to integrated system solutions. The development of agricultural and livestock robotics is moving beyond single-function automation, such as seeding, fertilization, or feed distribution towards fully integrated, system-level solutions. These advanced systems often combine multiple platforms and centralized control hubs, to enable coordinated, data-driven operations across the entire farming cycle. This evolution enhances precision, real-time visibility, and comprehensive farm-level optimization, contributing to the growing penetration of intelligent robotics in overall agricultural machinery systems.

Intelligent robotics as the core enabler of precision agriculture. Intelligent robotics solutions are expected to become a central force in the advancement of agricultural automation. These systems enable smarter sensing, real-time decision-making, and fully autonomous task execution. Applications include optimized resource allocation, early livestock health diagnostics, and improved yield

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forecasting. By leveraging advanced algorithms and perception systems to process multisource data from crops and animals, farms will benefit from more adaptive, resource-efficient, and low-waste operations.

Diverging adoption trajectories across global markets. Future adoption of agricultural and livestock robotics will show significant regional divergence. Mature markets like North America and Europe are transitioning toward complete ecosystems with scalable OEM infrastructure and integrated solutions. In contrast, emerging regions such as Asia, Africa, and Latin America are entering a high-growth stage, driven by labour shortages, digitalization policies, and rising food security needs. As a result, future deployment strategies will increasingly focus on regional customization, localized service models, and phased rollouts tailored to varying development stages.

Cross-sector scalability of emerging players. The rapid emergence of new players is playing an increasingly influential role in shaping the global landscape of agricultural robotics. Backed by investment in RTK positioning, intelligent control platforms, and system integration technologies, these companies are building scalable and competitive industrial ecosystems. Many are designing core systems with modular scalability, enabling their adaptation across multiple sectors from agriculture to construction robotics and smart facility management. This cross-scenario flexibility not only accelerates innovation but also broadens global market potential.

COMPETITIVE LANDSCAPE OF GLOBAL AGRICULTURAL ROBOTICS SOLUTIONS MARKET

Ranking and Market share of Global Agricultural Robotics Solutions Providers

The global agricultural robotic solutions market was relatively concentrated in 2025. In terms of agricultural robotic solutions revenue, the Group ranked between 21st and 30th globally in 2025, with a market share of 0.8%. In terms of revenue of agricultural auto-steering system kits in 2025, the top six companies accounted for approximately 74.5% of the global market share, with the Group ranking sixth and holding a 3.4% market share. In terms of shipment of agricultural auto-steering system kit in 2025, the top five companies accounted for approximately 73.4% of the global market share, and the group ranked third among key participants, capturing a market share of 9.7%.

Ranking and Market Share of Global Agricultural Robotics Solutions Market by Revenue of Agricultural Auto-steering System Kit, 2025

Ranking	Agricultural Auto-steering System Kit Providers	Revenue of Agricultural Auto-steering System Kit (US\$ Million)	Market Share (%)	Year Founded
1	Company A	634.7	30.8%	1837
2	Company B	404.3	19.6%	1990
3	Company C	196.7	9.5%	2013
4	Company D	116.4	5.7%	1932
5	Company E	113.6	5.5%	1975
6	The Group	69.2	3.4%	2017
Top six		1,534.9	74.5%	
Total		2,060.0	100.0%	

Notes:

- Company A, founded in 1837 and listed on the New York Stock Exchange, is primarily engaged in the manufacture and sale of agricultural, construction, forestry, and turf equipment, as well as precision agriculture technologies and related services.

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2. Company B, founded in 1990 and listed on the New York Stock Exchange, is primarily engaged in the manufacture and provision of agricultural machinery and precision technology, including auto-steering systems, precision agriculture solutions, and related services.
3. Company C, founded in 2013 and listed on the New York Stock Exchange, is primarily engaged in the manufacture and sale of agricultural and construction equipment, as well as powertrain solutions.
4. Company D, founded in 1932 and listed on the Tokyo Stock Exchange, is primarily engaged in the development and provision of precision measurement and positioning technologies, including surveying instruments, construction solutions, smart agriculture systems, and optical and ophthalmic equipment.
5. Company E, founded in 1975 and listed on the Nasdaq Stockholm, is primarily engaged in digital reality solutions, combining sensor, software, and autonomous technologies to enable precision measurement, positioning, and automation across industries including agriculture, construction, and manufacturing.

Source: Frost & Sullivan

Ranking and Market Share of Global Agricultural Robotics Solutions Market by Shipment of Agricultural Auto-steering System Kit, 2025

Ranking	Agricultural Auto-steering System Kit Providers	Shipment of Agricultural Auto-steering System Kit (Thousand Sets)	Market Share (%)	Year Founded
1	Company A	116.2	27.0%	1837
2	Company B	93.3	21.7%	1990
3	The Group	41.9	9.7%	2017
4	Company F	32.7	7.6%	2003
5	Company C	31.8	7.4%	2013
Top five		315.9	73.4%	
Total		430.0	100.0%	

Source: Frost & Sullivan

Agricultural auto-steering system kits can be categorized into front-fit (OEM) auto-steering system kits and retrofit auto-steering system kits. Front-fit agricultural auto-steering system kits are integrated into new agricultural machinery at the manufacturing stage, offering higher system compatibility, better user experience, and a perception of being a complete, factory-grade solution. In contrast, retrofit agricultural auto-steering system kits are designed for existing machines or mixed-brand fleets, enabling faster market penetration and higher per-unit margins for suppliers, albeit with potential variability in installation quality, user experience, and technical support.

The global agricultural robotics solutions market remained concentrated in 2025, with the top five providers accounting for approximately 61.2% of revenue of retrofit agricultural auto-steering system kits. The Group ranked fourth among key participants, capturing a market share of approximately 6.6% in terms of revenue of retrofit agricultural auto-steering system kits globally in 2025. In terms of shipment of retrofit agricultural auto-steering system kit in 2025, the top five companies accounted for approximately 73.6% of the global market share, and the group ranked second among key participants, capturing a market share of 17.5%.

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Ranking and Market Share of Global Agricultural Robotics Solutions Market by Revenue of Retrofit Agricultural Auto-steering System Kit, 2025

Ranking	Agricultural Auto-steering System Kit Providers	Revenue of Retrofit Agricultural Auto-steering System Kit (US\$ Million)	Market Share (%)	Year Founded
1	Company B	254.2	24.2%	1990
2	Company A	178.8	17.0%	1837
3	Company D	74.3	7.1%	1932
4	The Group	69.2	6.6%	2017
5	Company C	65.9	6.3%	2013
Top five		642.4	61.2%	
Total		1,050.0	100.0%	

Source: Frost & Sullivan

Ranking and Market Share of Global Agricultural Robotics Solutions Market by Shipment of Retrofit Agricultural Auto-steering System Kit, 2025

Ranking	Agricultural Auto-steering System Kit Providers	Shipment of Retrofit Agricultural Auto-steering System Kit (Thousand Sets)	Market Share (%)	Year Founded
1	Company B	55.1	23.0%	1990
2	The Group	41.9	17.5%	2017
3	Company F	32.7	13.6%	2003
4	Company A	29.1	12.1%	1837
5	Company D	17.7	7.4%	1932
Top five		176.5	73.6%	
Total		240.0	100.0%	

Source: Frost & Sullivan

GLOBAL CONSTRUCTION ROBOTICS SOLUTIONS MARKET OVERVIEW

Definition and Classification of Construction Robotics Solutions

Construction Robotics Solutions refer to intelligent systems and automated equipment designed to digitalize and optimize key processes throughout the construction lifecycle. These technologies enhance operational efficiency, precision, and real-time visibility, while mitigating labour dependency. Increasingly adopted in civil infrastructure, urban development, and public engineering projects, such solutions enable construction firms to address labour shortages, improve build quality, and implement data-driven site management.

Based on application, construction robotics solutions can be classified into two primary categories:

- (i) **Construction Machine Control Solutions**, which include *3D Machine Guidance Systems*, and *Control Systems for Construction Machinery*.

In addition, retrofit MC solutions are broadly applicable across multiple categories of construction machinery, enabling guidance, automated blade and boom control, and consistent grading and leveling performance across equipment types.

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- (ii) **Digital Twin in Construction Solutions**, cover laser scanning, mapping, modeling and simulation technologies that enable a virtual representation of physical construction environments. Key solution types include *LiDAR Scanners*, *3D Modeling Systems*, *Real-time Point Cloud Processing Software*, and *GNSS RTK Receivers*.

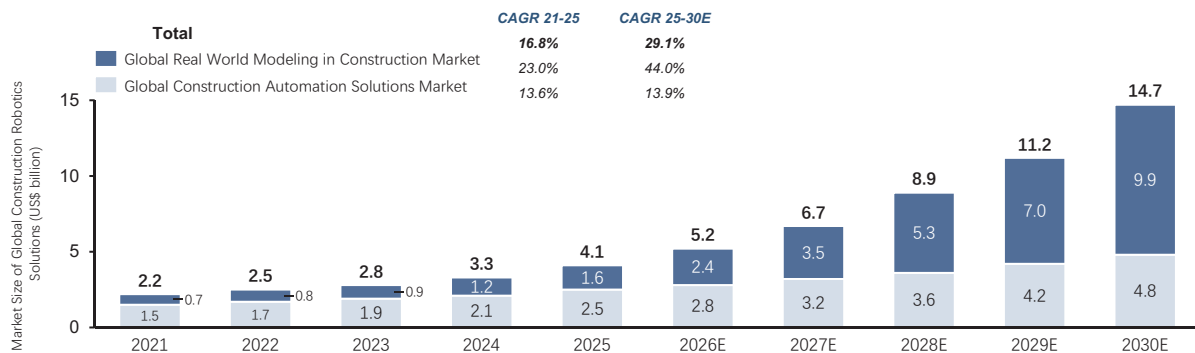
Market Size of Global Construction Robotics Solutions

Driven by the increasing demand for construction efficiency, digital site management, and reduced reliance on manual labour, construction robotics solutions are emerging as a critical enabler of smart infrastructure development worldwide. Applications span automated excavation, digital terrain modeling, and autonomous equipment control, with adoption accelerating across both public and commercial sectors.

From 2021 to 2025, the global construction robotics solutions market grew from approximately US\$2.2 billion to US\$4.1 billion, reflecting a CAGR of 16.8%. This growth was supported by large-scale infrastructure investment, increasing adoption of smart construction concepts, advancements in high-precision mapping and modelling technologies, and active policy support across key regions.

Looking ahead, the market is projected to reach approximately US\$14.7 billion by 2030, growing at a CAGR of 29.1% from 2025 to 2030. Growth will be further driven by increasing demand for lifecycle-integrated digital systems, rising retrofit and upgrade requirements, and the proliferation of adaptable robotic platforms suited to fragmented and dynamic construction environments.

Market Size of Global Construction Robotics Solutions, 2021-2030E



Source: Frost & Sullivan

Market Drivers of Global Construction Robotics Solutions Market

Expansion in global infrastructure investment. Rising infrastructure spending by governments and large-scale developers is driving demand for intelligent construction technologies. To boost economic growth and urban resilience, construction robotics solutions, such as GNSS-guided excavator systems, automated blade control modules, and aerial mapping tools are increasingly deployed in civil infrastructure, industrial, and public sector projects to enhance efficiency, precision, and site digitalization.

Acceleration of smart construction adoption. The construction industry is undergoing a digital transformation, with smart construction practices reshaping planning, execution, and post-construction workflows. Machine control systems and digital twin technologies enable real-time monitoring, reduce

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manual errors, and standardize build quality. With construction accounting for an estimated 20% to 25% of global workplace fatalities, safety-driven automation and remote operation are becoming essential drivers of adoption.

Advances in high-precision mapping and modelling. Rapid progress in LiDAR scanning, GNSS RTK positioning, and real-time 3D modeling is improving the accuracy and efficiency of site data acquisition. These technologies support broader implementation of digital twin systems, streamline BIM workflows, and improve accessibility of site-level 3D modeling. As integration and usability continue to improve, adoption across the project lifecycle is accelerating.

Policy support across key regions. Government policies are playing a catalytic role in promoting construction automation and digitalization. In China, MOHURD’s smart construction pilot zones mandate the use of digital twin platforms and intelligent equipment. *The U.S. Infrastructure Investment and Jobs Act (2021)* earmarked over US\$1.2 trillion for modernizing infrastructure, including support for robotic excavation and site digitization. In Europe, programs like *Horizon Europe (2021–2027)* and *Digital Europe Programme* are funding robotics innovation and standardization. These initiatives are prompting OEMs, retrofit providers, and contractors to align with national digital strategies and invest in next-generation construction technologies.

Future Trends of Global Construction Robotics Solutions Market

Lifecycle-integrated digital systems. Construction robotics solutions are evolving from task-specific automation toward integrated digital systems that span the entire project lifecycle. This shift is driven by growing demand for real-time visibility, enhanced build precision, and seamless team coordination. Technologies such as GNSS RTK modules, LiDAR scanning, and real-time 3D modeling software are increasingly embedded into infrastructure and public works projects. As firms seek to mitigate labor shortages and reduce delays, end-to-end digital robotics platforms are becoming essential for ensuring execution certainty and quality.

Regional adoption diverging with market maturity. Adoption trends vary significantly by region. In mature markets like North America and Europe, construction robotics solutions are moving toward standardization in mainstream applications, particularly in automation and digital twin integration. In emerging markets such as Southeast Asia and Latin America, early-stage adoption is being fueled by infrastructure development, rising quality standards, and increasing awareness of construction safety. Scalable retrofit platforms and localized system integration capabilities will be key to unlocking growth in these markets.

Expansion of Chinese construction robotics solutions suppliers. Chinese solution providers are rapidly expanding their global footprint, leveraging core strengths in GNSS/RTK positioning, equipment control modules, and integrated system design. By developing modular, software-definable platforms adaptable to various construction and landscaping scenarios, they are addressing global demand for cost-effective automation and intelligent retrofitting. Supported by competitive manufacturing, cross-sector deployment experience, and strong integration capabilities, Chinese suppliers are expected to play a pivotal role in shaping the next phase of global construction robotics market evolution.

GLOBAL FACILITY MANAGEMENT ROBOTICS SOLUTIONS MARKET OVERVIEW

Definition and Classification of Facility Management Robotics Solutions Market

Facility management robotics solutions refer to commercial-grade, automated systems designed to enhance the efficiency, consistency, and cost-effectiveness of facility maintenance in professional indoor and outdoor environments. These solutions typically operate with minimal human intervention

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and are increasingly adopted in commercial premises, public spaces, commercial premises, sports facilities, and other public areas. By integrating technologies such as autonomous navigation, RTK/GNSS positioning, obstacle detection, and proprietary algorithms, these systems perform repetitive or precision-dependent tasks with high reliability.

According to application and function, facility management robotics solutions can be classified into the following categories:

- (i) **Landscaping robots** are commercial-grade robotic systems for outdoor turf and grounds management, explicitly excluding consumer/home-use devices. These solutions cover robotic mowers, line-marking robots, turf-care units, and multi-function platforms (e.g., mowing, line marking, fertilization, and ground flattening). Typically powered by electric drives with embedded control units, sensor arrays, and advanced navigation, they automate core landscaping tasks while improving precision and labor efficiency. Deployments are concentrated in sports fields, golf courses, campuses, airports, public parks, municipal grounds, etc..
- (ii) **Cleaning robots** are commercial-grade autonomous systems for professional cleaning applications, covering floor-scrubbing robots, large-scale vacuum robots, and façade-cleaning robots. Equipped with embedded control units, sensors, and navigation systems, these solutions automate repetitive cleaning tasks with high efficiency. They are deployed in warehouses, shopping malls, airports, and other large public spaces, where they reduce manual labor requirements and enhance service consistency. Residential devices, swimming-pool cleaners, and industrial process-cleaning equipment are excluded.

Market Size of Global Facility Management Robotics Solutions Market

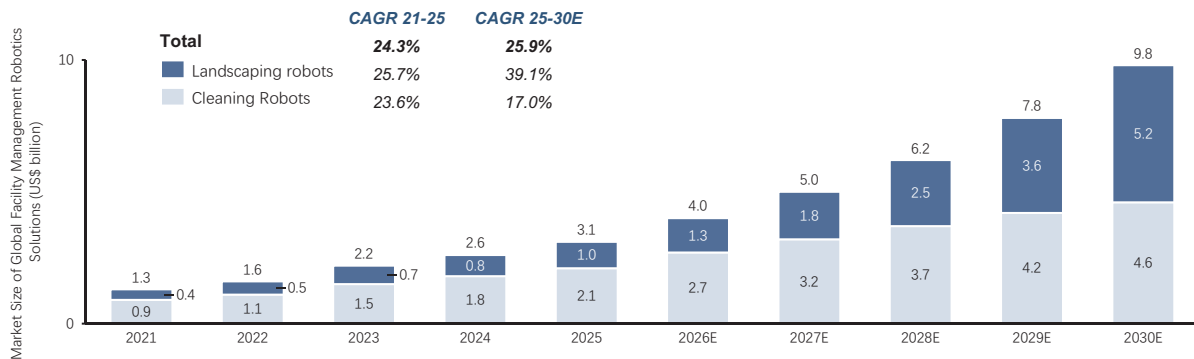
Between 2021 and 2025, the global facility management robotics solutions market’s sales value increased from US\$1.3 billion to US\$3.1 billion, reflecting a CAGR of 24.3%. This growth has been primarily driven by advancements in smart navigation technologies, rising consumer demand for smart living and convenience, and tightening environmental regulations. These factors have supported the steady adoption of robotic mowers in commercial-grade applications and on large residential properties, as well as the uptake of line-marking robots in professional settings. Looking forward, the market is projected to grow to US\$9.8 billion by 2030, reflecting a CAGR of 25.9% from 2025. Continued expansion will be underpinned by ongoing technological upgrades, the rising penetration of smart models, and increasing demand for fully automated yard solutions.

The market size of landscaping robots increased from US\$0.4 billion in 2021 to US\$1.0 billion in 2025, reflecting a CAGR of 25.7%, with growth increasingly shaped by commercial adoption as municipalities, campuses, sports venues, and landscaping contractors scale deployments alongside ongoing technological upgrades and tightening environmental regulations. It is projected to reach US\$5.2 billion by 2030, reflecting a CAGR of 39.1% from 2025. Demand in these scenarios is driven by clear unit economics and the replacement of high-cost manual labour with automated systems, supported by the scalability of robotic fleets across campuses, sports facilities, airports, warehouses, and retail complexes. Labour substitution remains the primary driver of adoption.

The market size of cleaning robots, increased from US\$0.9 billion in 2021 to US\$2.1 billion in 2025, reflecting a CAGR of 23.6%, driven by enterprise rollouts in commercial scenarios such as retail, transportation hubs, healthcare and large public venues, with rising labor costs, higher hygiene requirements and ongoing technological upgrades accelerating deployment across multiple sites. It is forecast to reach US\$4.6 billion by 2030, reflecting a CAGR of 17.0% from 2025.

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Market Size of Global Facility Management Robotics Solutions, 2021-2030E



Source: Frost & Sullivan

Market Drivers of Global Facility Management Robotics Solutions Market

Expansion in green infrastructure and sustainable urban development. Governments, municipalities, campuses and commercial parks are increasing investment in green infrastructure and low-carbon urban renewal. To meet sustainability targets while maintaining service quality, operators are deploying facility-management robotics, such as professional robotic mowers, line-marking robots and others to lift resource efficiency, reduce noise and emissions, and deliver consistent large-area maintenance.

Rapid maturation of IoT, data and AI stacks. Advances in RTK/GNSS positioning, multi-sensor fusion and edge AI enable reliable navigation, obstacle handling and adaptive path planning in semi-structured indoor and outdoor environments. With cloud/IoT connectivity, devices stream performance and telemetry into asset platforms for remote diagnostics, workflow orchestration and data-driven optimisation.

Diverse and scenario-specific requirements driving differentiated solutions. Use cases across public parks, campuses, logistics hubs, and retail estates vary in acreage, terrain, compliance and service windows, driving product stratification by endurance, terrain capability, safety redundancy and integration interfaces, and promoting bundled equipment, consumables and services offerings. In higher-end professional scenarios such as stadiums, tournament venues and golf courses, stringent surface-quality standards and premium service levels further favour specialised, commercial-grade solutions.

Future Trends of Global Facility Management Robotics Solutions Market

Digital platform integration. Robots, chargers and consumables are expected to connect directly with CAFM/CMMS and work-order systems. A single dashboard will show location, utilisation, battery/paint levels, asset health and SLA status. Tasks will be pushed to devices and proof-of-work recorded automatically. Standardised application programming interfaces (APIs) will support multi-site, centralised operations and ESG reporting. This integration is set to define how facility teams plan, execute and verify services.

Functional modularity and scalable architectures. A common chassis with swappable toolheads and sensor packs enables task expansion from mowing to line marking, inspection and light cleaning to extending asset life and improving returns. Batteries, deck width and safety/perception modules can be configured by scene, while OTA software adds functions without full replacement.

Convergence of robots with digital platforms. Facility management robots, charging units and consumables are expected to connect with facility systems via standard interfaces, providing a single view of fleet status, task progress and service quality. Work orders will be issued automatically, and

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completion evidence with performance data will be recorded to support SLA management and compliance. Common data standards will enable mixed-brand fleets and multi-site control, while live operating data will trigger maintenance and replenishment; regular software updates will keep fleets aligned. This platform-native operating model is expected to lower oversight costs, improve uptime and make service quality measurable, and is set to become a future trend in the facility management robotics solutions market.

Opportunities and Challenges of Global Robotics Solutions Market

Opportunities:

High-growth potential across multiple application sectors. The adoption of robotics solutions is expanding across sectors such as agricultural and livestock farming, construction and facility management, driven by rising labour costs, increasing operational complexity, and ongoing digital transformation. Governments and enterprises are increasingly promoting automation technologies to enhance productivity, operational efficiency, and service consistency, creating strong growth opportunities for robotics solutions across diverse end-user environments.

Integration with smart and digital management platforms. The growing adoption of IoT, BIM, BMS, and other digital management systems is creating opportunities for robotics solutions to provide real-time data, traceability, and multi-site coordination. As industries shift towards data-driven operations, robotics systems become integral to enabling predictive maintenance, sustainability, and energy-efficiency objectives.

Equipment modernisation and efficiency upgrades. Across sectors such as agricultural and livestock farming and construction, ageing equipment fleets are generating demand for retrofit kits and digital upgrades. Modular, easy-to-deploy robotic systems provide an attractive solution for operators seeking efficiency improvements without full equipment replacement.

Challenges:

Distribution network. The fragmented and geographically dispersed end-user base across agricultural and livestock farming, construction and facility management presents a significant distribution challenge. Effective market penetration often requires localized strategies, on-site demonstrations, and strong after-sales support. Limited presence of established channel partners in certain regions may further constrain market reach and adoption.

Infrastructure and integration constraints. Deployment of robotics systems may be challenged by fragmented OEM ecosystems, limited connectivity infrastructure, and inconsistent power supply across operating environments. In applications such as smart facilities and construction, systems may also need to integrate with elevators, building management systems, BIM platforms, and other third-party systems, increasing implementation complexity.

Operational and maintenance requirements. Robotics solutions typically operate in complex environments such as agricultural fields, construction sites, large campuses, and public venues where dust, humidity, and uneven surfaces may accelerate wear on system components. Regular maintenance of sensors, navigation modules, batteries, and other key components is required to maintain performance, reliability, and safety.

SOURCES OF THE INDUSTRY INFORMATION

We commissioned Frost & Sullivan to analyse and prepare a report regarding global agricultural and livestock farming robotics solutions market, global construction robotics solutions market, and global facility management robotics solutions market during the period of 2021 to 2030. Frost & Sullivan is an independent global consulting firm, which was founded in 1961 in New York, offering industry research and market strategies and provides growth consulting and corporate training. We

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agreed to pay a commission fee of RMB500,000 to Frost & Sullivan pursuant to a service agreement reached by arm’s length negotiation. Except as otherwise noted, all of the data and forecasts contained in this section are derived from the Frost & Sullivan Report.

In preparing for the report, Frost & Sullivan conducted both primary and secondary research and relied on various sources. The primary research was conducted via interviews with key industry experts and leading industry participants. The secondary research involved analysis of market data obtained from several publicly available data sources, such as World Bank, National Bureau of Statistics and other industrial associations. The market projections in the Frost & Sullivan Report are based on the following key assumptions: (i) the global social, economic, and political environment are expected to remain stable during the forecast period; (ii) global economic and industrial development are likely to maintain a steady growth in the forecast period; (iii) related industry key drivers are likely to drive the growth of global agricultural and livestock farming robotics solutions market, global construction robotics solutions market, and global facility management robotics solutions market in the forecast period; and (iv) there is no extreme force majeure or industry regulation in which the market may be affected dramatically or fundamentally.

Our Directors confirm that, to the best of their knowledge, after making reasonable inquiries and exercising reasonable care, there is no material adverse change in the market information since the date of the relevant data contained in the Frost & Sullivan Report which may qualify, contradict or have an impact on the information in this section.