



14th Five-Year Plan for the construction machinery industry

(Release)

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As a cornerstone industry in Chinas national economic development, the construction machinery sector has rigorously implemented the CPC Central Committees strategic directives during the 13th Five-Year Plan period. Through vigorous advancement of supply-side structural reforms, the industry has achieved remarkable progress across multiple dimensions. Key enhancements include strengthened brand influence, increased international competitiveness, technological innovation capabilities, expanded production scale, improved product quality, optimized value chain management, and elevated development standards. The sector has also witnessed significant advancements in manufacturing technologies, production processes, and equipment sophistication. Cutting-edge innovations such as advanced technical systems, premium construction machinery products, and next-generation equipment integrating state-of-the-art technologies have made substantial contributions to national economic development.

Over the past decade, Chinas construction machinery industry has achieved rapid growth. While still lagging behind international leaders in some areas, it has secured a prominent position in the global construction machinery sector. At this new historical juncture, we

are entering a transformative era of comprehensive innovation. Cutting-edge technologies like intelligent systems, internet connectivity, big data analytics, and 5G networks will inject fresh momentum into the industrys development.

China is actively advancing a new development paradigm featuring domestic circulation as the cornerstone, with domestic and international dual circulation mutually reinforcing each other. While steadily expanding its global presence, the construction machinery industry continues to implement supply-side structural reforms. This dual approach ensures that the domestic market provides robust support for international markets and overseas investments, while international operations inject innovative momentum into domestic production and sales. Through this integrated strategy, the industry achieves new heights in high-quality development within the evolving economic landscape.

The 14th Five-Year Plan period marks the first five years for China to embark on a new journey of building a modern socialist country and advancing toward the second centenary goal. This period follows the successful completion of building a moderately prosperous society in all respects and achieving the first centenary goal. To help the construction

machinery industry seize this crucial historical opportunity and drive high-quality development, this plan has been specially formulated.

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I. Overview of the development of construction machinery industry during the 13th Five-Year Plan

During the 13th Five-Year Plan period (2016–2020), Chinas construction machinery industry achieved significant progress across multiple dimensions: Economic performance, labor productivity, R&D investment intensity, digitalization and intelligentization achievements, and green development metrics all saw marked improvements. Enterprises demonstrated enhanced self-development capabilities and stronger internal growth momentum. Industrial structure optimization, product portfolio refinement, and strategic layout adjustments were implemented. Capital structure optimization was achieved through mixed-ownership reforms, driving more efficient resource allocation. The talent pipeline underwent upgrades, with entrepreneurs, top-tier managers, R&D teams, and master craftsmen becoming key drivers of high-quality development. Market structure became more balanced, with strengthened resilience against external risks and market fluctuations. Brand-building efforts also made substantial strides. The industrys overall development quality reached its highest historical level during this period.

(1) Rapid growth of industry scale

In 2016, the industry emerged from the trough of five consecutive years. During the 13th Five-Year Plan period, Chinas construction machinery industry showed a comprehensive improvement in scale, efficiency, brand value, internationalization, innovation and research and development, and intelligent manufacturing, and made steady progress on the road of high-quality development.

The industrial scale of the construction machinery industry has grown from 457 billion yuan at the end of the 12th Five-Year Plan (2015) to 775.1 billion yuan in 2020.

Table 1 Operating revenue in 2015 and during the 13th Five-Year Plan period (in RMB billion)

a particul ar year	2015	2016	2017	2018	2019	2020
operating receipt	4570	4795	5403	5964	6681	7751
on year-on- year basis %	-11.7	4.93	12.7	10.4	12.0	16.0

Table 2 Sales of Major Construction Machinery Products in 2015 and the 13th Five-Year Plan Period (units)

<div><div>a part icul ar year</div><div>class</div></div>	2015	2016	2017	2018	2019	2020 Express
excavator	60514	73390	144867	211214	235695	327605
loader	73581	75445	99063	133466	123615	131176
ballgrader	2620	3184	4522	5261	4348	4483
soil shifter	3682	4061	5719	7600	5807	5907
road roller	10388	11959	17421	18376	16978	19479
paver	1804	1971	2390	2319	2773	2610
wheel crane	9327	9568	20434	32278	42959	54176
tower crane	20000	7000	11000	23000	40000	50000
forklift	327626	370067	496738	597252	608341	800239
concrete pump	3628	3817	5100	5412	7035	7682
concrete batching plant	3715	5873	6873	6987	8353	12200
concrete mixer truck	32067	24442	35656	62193	74641	105243
concrete pump truck	4012	2811	3532	4795	7179	11917

Table 3 Import and export situation in 2015 and the 13th Five-Year Plan period (in US dollars)

<div><div>a particula r year</div></div>	2015	2016	2017	2018	2019	2020
amount of imports	33. 67	33. 17	40. 86	48. 99	40. 38	37. 53
on year-on- year basis	-21. 4%	-1. 50%	23. 2%	19. 9%	-17. 6%	-7. 05
amount of exports	189. 78	169. 6	201. 05	235. 82	242. 76	209. 69
on year-on- year basis	-4. 11%	-10. 6%	18. 5%	17. 3%	2. 94%	-13. 6
Import/Export	223. 45	202. 77	241. 91	284. 81	283. 14	247. 22
on year-on- year basis	-7. 19	-9. 26	19. 3	17. 7	-0. 59	-12. 7

(2) Achieving the development goals of the 13th Five-Year Plan

1. In 2020, the operating revenue of the whole industry reached 775.1 billion yuan, achieving the total scale target of the plan.

2. Great progress has been made in informatization and digitalization, breakthroughs and application results have been achieved in intelligentization in many fields, and phased goals of informatization and intelligentization have been achieved.

3. During the 13th Five-Year Plan period, the total import and export volume of construction machinery reached 126 billion US dollars, an increase of 4.39% compared with the 12th Five-Year Plan period. Among them, the cumulative export volume reached 105.9 billion US dollars, an increase of 13.4%.

Imports totaled \$20.1 billion, down 26.45%. In 2019, the total import and export volume of construction machinery products reached \$28.3 billion, with exports amounting to \$24.2 billion. US\$7.6 billion, nearing the completion of the US\$25 billion export target. Due to the global impact of the COVID-19 pandemic, the global economy has suffered a significant blow. In 2020, the global trade volume of construction machinery declined sharply, with Chinas construction machinery exports reaching nearly US\$21 billion, down by over 13.6% compared to 2019.

4. Significant progress has been made in achieving industrial structural development goals: A number of enterprises have entered the global top tier of construction machinery, with export and overseas revenue projected to exceed 30% of total income; Several projects have become smart manufacturing demonstration pilots and application promotion models; Several international brands have emerged; Standardization efforts have achieved remarkable results; The self-sufficiency rate of high-end components has increased significantly; Inspection, verification, and testing methods have been strengthened.

(3) Significant progress was made in structural adjustment

1. Continuous optimization of industrial structure

The degree of industrial concentration has been steadily improved, and the industrial distribution has become more efficient and intensive. A reasonable distribution of the eastern, central and western regions has been formed, and an industry structure has been formed that is organically combined, complementary, mutually promoted and coordinated.

The industrial chain has achieved coordinated development, with significant improvements in component manufacturing capabilities, product quality, and reliability. A synergistic development model has emerged where whole machine manufacturers integrate component R&D and testing with component producers technological innovation and manufacturing process optimization. This complementary relationship between whole machine enterprises and specialized component manufacturers has effectively driven the transformation and upgrading of the component industry.

The manufacturing services sector is growing rapidly, encompassing equipment delivery, training, maintenance, leasing, upkeep, fuel supply, equipment condition monitoring, spare parts supply, second-hand equipment trading, and component remanufacturing. A number of service providers are offering standardized, high-quality services alongside manufacturing operations.

The enterprises server has formed an organic supplement and become a rapidly developing link in the construction machinery industry chain.

The industrial internet has been further integrated into the construction machinery sector, driving the transformation and upgrading of manufacturing through smart manufacturing, intelligent products, and smart management. Industry players have successively established their own digital R&D systems, management systems, and service systems, thereby advancing the modernization of R&D, management, and services.

2. Changes in market demand structure

With the continuous upgrading of the demand for construction machinery in national economic construction and the economic construction of all countries in the world, the demand for major technological equipment, high-end construction machinery products and new high-tech construction machinery integrating digital, information, intelligent, lightweight and Internet is increasingly strong.

After over a decade of rapid development, Chinas construction machinery industry has expanded significantly, effectively meeting the surging demands

of national economic growth. The sector has accumulated substantial equipment reserves aligned with economic development needs. The industry is now transitioning from a demand structure dominated by incremental market expansion to one that equally emphasizes inventory management and market upgrading. It is evolving from a focus on cost-performance ratios to prioritizing high performance, quality, reliability, and adaptability. The demand structure is shifting from single-purpose models to diversified requirements and comprehensive construction technology solutions. The rapid advancement of Chinas economic strength, technological capabilities, national competitiveness, and living standards, coupled with new construction environments (such as high-altitude and extreme cold zones) and safety-efficient construction methodologies, are driving the development of innovative machinery and the leapfrog upgrade of existing equipment.

3. Steady progress in internationalization and further improvement of global industrial layout

As a key industry in international production capacity cooperation, the construction machinery sector has steadily embarked on an internationalization path through rapid development and exploratory practices during the 12th and 13th Five-Year Plans. From rapid expansion during the 12th Five-Year Plan to quality improvement and efficiency enhancement during the 13th Five-Year Plan, it has established overseas branches, improved overseas marketing and service systems, and actively acquired global resources while setting up overseas R&D, manufacturing, and service bases. Having undergone stages of development from strategic vision internationalization and marketing service internationalization to partial enterprises achieving R&D and production internationalization and brand and management system internationalization, the industry has formed a "five-in-one" international development model encompassing export trade, overseas plant construction, cross-border mergers and acquisitions, global R&D, and international talent cultivation. The construction machinery industry has actively implemented the Belt and Road Initiative, optimized its global layout, enhanced competitiveness in overseas markets, and continuously narrowed the gap in competition with international giants, fully demonstrating the growing global competitive strength and advantages of the China brand. By the end of the 13th Five-Year Plan, the proportion of construction machinery

exports and overseas business revenue is expected to reach 30%.

(4) Remarkable achievements in innovation and development

During the 13th Five-Year Plan period, the construction machinery industry has deeply implemented the innovation-driven development strategy, made new breakthroughs in the research and development and application of core technologies of high-end and intelligent products, fully met the needs of major national economic construction projects, and produced a large number of scientific research achievements, which have become an important driving force for the sustained growth of the industry.

The project "Key Technologies and Applications in the Design and Manufacturing of Full-Section Alien-shaped Tunneling Machines" was awarded the Second Prize of National Science and Technology Progress Award in 2018. Meanwhile, the project "Independent R&D and Industrialization of Large-scale Marine Screw-type Dredging Equipment" received the Special Prize of National Science and Technology Progress Award in 2019, becoming one of the three Special Prize-winning projects in that years National Science and Technology Progress Award.

During the 13th Five-Year Plan period, the construction machinery industry won 3 special prizes, 10 first prizes, 32 second prizes and 64 third prizes of China Machinery Industry Science and Technology Award.

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Innovative development has led to breakthrough development achievements in all major fields of the construction machinery industry, promoting technological progress and high-quality development of the industry:

1. Rapid development of intelligent construction machinery

During the 13th Five-Year Plan period, the construction machinery industry accelerated the application of new technologies such as control technology, electro-hydraulic technology, computer technology and communication technology in intelligent monitoring, maintenance, testing, safety protection and management, remote operation management and multi-machine coordination of construction machinery, and accelerated the development of intelligent construction machinery.

The construction machinery industry has initially formed a cooperative mechanism for intelligent product research and development integrating scientific research institutions, colleges and universities, complete machine manufacturing enterprises, parts and system integrators, software development institutions, construction and contracting enterprises, and has initially achieved research and development results and been applied in some fields.

A group of intelligent construction machinery with auxiliary operation, unmanned driving, state management, machine group management, security protection, special operation, remote control, fault diagnosis, life cycle management and other functions have been put into practical application, which has greatly solved some difficult problems in construction.

2. Major technical equipment has been upgraded

During the 13th Five-Year Plan period, China developed advanced engineering machinery and major technical equipment to meet the nations construction needs. These innovations replaced imported complete machines, automated manual labor, phased out inefficient traditional methods, and eliminated environmentally harmful construction practices. The breakthroughs in new construction techniques and extreme working conditions enabled the successful implementation of Chinas major infrastructure projects.

—The application of integrated system integration technology for tunnel boring machines has been achieved. Through the application of key technologies and systems such as high-pressure sealing technology, atmospheric pressure cutter replacement technology, chilled cutter head technology, slurry radial cutter head technology, intelligent control of circulation systems, advanced detection and reinforcement technology for shield tunneling in high-pressure water-rich multi-cave strata, drive telescopic oscillation technology, and visual construction technology, a series of shield tunneling technologies and equipment suitable for various construction environments have been developed, effectively expanding the application scope of shield tunneling. The technology has enabled the construction of ultra-large diameter slurry shield machines over 15 meters and ultra-small diameter (≤ 4.5 meters) shield machines. Various specialized shield machines and large-diameter hard rock tunneling machines have provided high-level solutions for urban construction and major transportation/water conservancy projects under special geological conditions.

— Large and super-large excavator technologies have achieved gradual maturity. The development of 50-ton-class and above excavators has successfully implemented key innovations including dual-power unit coupling control systems, intelligent high-pressure

monitoring with fault self-diagnosis, modular dual-power hydraulic drive systems, electro-hydraulic control systems, self-replenishing adaptive chassis tensioning systems, large structural component manufacturing technologies, and dynamic reliability analysis with optimized design. These advancements have enabled mass production and practical deployment of large excavators. The industry now features super-large hydraulic excavators exceeding 100 tons, with some models reaching 700 tons, which have been successfully applied in mining operations. High-speed wheeled excavators have effectively addressed specialized construction demands in China.

— Development and Application of Ultra-Large Cranes. Building on the successful domestic application of 4,000-ton crawler cranes in construction lifting, multiple units have been delivered and successfully deployed in international markets. Ultra-large cranes including 2,000-ton all-terrain cranes, 52,000 kN·m capacity models, and large internal climbing boom tower cranes have been extensively utilized in major construction sectors such as chemical plants, nuclear power facilities, super-tall buildings, and mega-bridge projects.

— Large-scale high-end pile-driving machinery provides efficient, eco-friendly, and reliable construction solutions for underground pile foundation

projects. 2-meter and larger fully hydraulic rotary drilling rigs have been mass-produced.

The new hydraulic grab for underground continuous

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walls has gained wider
application in urban
underground construction.

Widespread application; the more efficient and environmentally friendly double-wheel milling machine for underground continuous wall has achieved good application effects in underground continuous wall and deep foundation engineering in five aspects: ultra-deep, ultra-thick, ultra-hard, ultra-large (volume) and joint.

--Special engineering machinery, including all-terrain engineering vehicles, fire rescue vehicles for demolition of super high-rise buildings, engineering machinery for special environments such as polar regions, multi-functional rescue vehicles, snow and ice removal equipment, and snowplows, have been born and put into practical use, breaking the foreign technology monopoly.

Beyond the aforementioned major technical equipment, the construction machinery industry has achieved significant progress in R&D, manufacturing, engineering applications, and key components for large-scale earthmoving and transportation machinery, intelligent eco-friendly concrete and asphalt mixing equipment, electric smart warehousing and logistics systems, heavy-duty boom-type lifting platforms, large-scale integrated road construction and maintenance equipment, multi-arm intelligent control drilling rigs, ultra-large electric wheel self-dumping trucks, long steel boom pump trucks, and large container front-load cranes.

3. Performance, quality, reliability and durability are further improved

During the 13th Five-Year Plan period, the construction machinery industry achieved significant quality improvements through three key strategies: optimizing critical components including design, working mechanisms, and structural elements; upgrading manufacturing technologies; and strengthening quality control systems. The industry also accelerated the adoption of smart workshops and digitalization initiatives, which collectively enhanced product reliability and durability. Furthermore, by extending the service life of critical components such as boxes, bridges, and large structural elements, manufacturers significantly improved the overall performance and longevity of machinery systems.

According to the analysis of the sampling test results of loader reliability, the average failure interval time in 2017 was 749 hours, the average failure interval time in 2018 was 865 hours, and the average failure interval time in 2019 was 886 hours. By the end of the 13th Five-Year Plan, the reliability index of loader had been close to the international advanced level.

We have further implemented advanced modern analytical technologies for fatigue life prediction and reliability/durability research, which has enhanced quality consistency control of components and progressively strengthened reliability testing methods, thereby comprehensively improving product reliability and durability. Simultaneously, we developed testing equipment, methodologies, specifications, and standards for critical components including complete machines, transmission systems, hydraulic systems, control systems, and braking/steering systems, further standardizing reliability verification processes. The overall reliability of certain complete machine products now approaches international advanced levels.

4. Industrial Internet is widely used

During the 13th Five-Year Plan period, the construction machinery industry leveraged national conditions and sector-specific realities to establish an industrial internet ecosystem. By systematically developing network infrastructure, platform systems, and security mechanisms, it created a new type of network infrastructure that enables comprehensive connectivity among human, machine, and material

elements. This innovation fostered emerging business models and application patterns for intelligent development. The industry established a digitalized, networked monitoring system capable of reconstructing operational scenarios and providing real-time feedback on operational parameters. These advancements effectively supported efficient operations across all stages of construction machinery development, manufacturing, construction management, safety management, collaborative operations, emergency rescue, maintenance services, and early fault diagnosis. Furthermore, the accumulation of large-scale equipment status data laid the foundation for enhancing product performance and service capabilities, driving high-quality development throughout the entire product lifecycle of the industry.

5. Remarkable achievements in green development

During the 13th Five-Year Plan period (2016–2020), Chinas construction machinery industry embraced green development principles by implementing technological upgrades focused on intelligent manufacturing and eco-friendly production. The sector widely adopted innovative solutions including eco-conscious coating technologies, welding dust control systems, energy-efficient material-saving techniques, vibration and noise reduction technologies, and remanufacturing

processes. By the end of this development phase, a number of enterprises had successfully achieved environmental compliance standards.

The coating technology has achieved full coverage and the welding dust emission has reached the standard; the utilization rate of materials has been continuously improved, the comprehensive energy consumption per 10,000 yuan of added value has been effectively controlled; the remanufacturing technology has been applied in practice.

During the 13th Five-Year Plan period, Chinas construction machinery industry successfully transitioned to the National III emission standards for non-road mobile machinery, achieving a significant upgrade in emission regulations. This transformation effectively reduced total atmospheric pollutant emissions while ushering in a new market demand peak for construction equipment. With the imminent implementation of the National IV emission standards for non-road machinery, manufacturers and supporting enterprises are actively preparing through technical preparations including PEMS (Particulate Emission Measurement System) host testing, PN (Particulate Number) compliance verification, smoke opacity testing, and durability certification, all in preparation for the upcoming emission standard transition.

(5) Standardization work has been steadily promoted, and the role of group standards in meeting the needs of industry development has become prominent

During the 13th Five-Year Plan period, the standardization work in the construction machinery industry carried out the integration and streamlining of mandatory standards and the centralized review of recommended standards as planned. In coordination with the Belt and Road Initiative, efforts were made to promote the "going global" of standards. The institutional construction of group standards became further standardized, and significant achievements were made in the formulation, publication, and dissemination of group standards. These efforts played an irreplaceable foundational role in advancing industry technological progress and engineering applications, further improving the industrys standardization system.

During the 13th Five-Year Plan period, we focused on the construction of a green manufacturing standard system, with the focus on high efficiency and energy conservation, advanced environmental protection and resource recycling, and strengthened the formulation of basic standards, performance testing method standards and evaluation and management standards for energy conservation and environmental protection, so as to improve the consistency between standardization work and the promotion of high-quality development of the industry.

1. The standardization system was further improved

The coordinated advancement of national, industry, and group standards has enabled Chinas industry standardization bodies to play a more significant role in the international standardization system, with improved standardization levels and

Its role in the technological progress of the industry is more prominent.

During the 13th Five-Year Plan period (2016–2020), Chinas construction machinery industry underwent significant standardization reforms. The sector revised 139 national standards and 109 industry standards covering construction equipment, earthmoving machinery, industrial vehicles, rock drilling systems, aerial work platforms, and mobile cranes. Additionally, 202 international standards were converted into domestic standards, with 7 international standards developed under Chinas leadership and 20 others co-developed through collaborative efforts. The industry also completed 37 English translations of national standards, 8 of which were adopted by international regional organizations.

2. High-quality group standards are being widely used

By the end of 2020, 111 group standards had been promulgated, covering foundational standards, safety standards, product standards, method standards, key component standards, energy conservation and environmental protection standards, technology transfer standards, and vocational training standards. Through the "addressing gaps, enhancing standards, and filling voids" approach of group standards, the industry rapidly responded to

technological innovations and market demands, resolved issues of outdated or missing standards, and increased effective standard supply. An effective standard coordination mechanism was established between regulatory authorities, manufacturing enterprises, and user entities, making group standards truly "practical, user-friendly, and effective." The pilot program for the first batch of group standards was successfully completed, guiding enterprises in the construction machinery industry to actively adopt and promote these standards.

For four consecutive years, 22 construction machinery group standards have been selected for the "100 Group Standards Application Demonstration" project in the industrial and communication sector organized by the Ministry of Industry and Information Technology. Among these, T/CCMA0056-2018 "Hydraulic Excavator Reliability Testing Method with Multiple Samples" has been included in the National Science and Technology Support Program "Key Technologies for Energy Conservation and Emission Reduction in Construction Machinery". This breakthrough resolved long-standing challenges in reliability research and validation for hydraulic excavators in China. Meanwhile, T/CCMA0066-2018 "Environmental Emission Limits for Asphalt Mixing Equipment" standardized testing protocols for eco-

friendly parameters in asphalt mixing plants. These innovations filled critical gaps in pollution control management during industrial applications, establishing clear benchmarks for evaluating environmentally sustainable asphalt mixing equipment in the market.

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3. Actively promote the "going global" of the construction machinery industry.

China has conducted research on the standard requirements for the "going global" of construction machinery equipment, and for the first time released the "China Construction Machinery Going Global Standard White Paper". For the first time in the equipment manufacturing industry, a "going global" standard catalog has been proposed, creating conditions for establishing the brand of Chinas construction machinery products in the global market.

Commissioned to conduct the research projects "China-Brazil Standard Application Cooperation and Promotion of Excavators" and "China-Brazil Standard Comparison of Construction Machinery and China Standard Application and Promotion Research", we have delved into the study of Brazils construction machinery standards and regulations, promoting the application of China standards in Brazil and South America.

It was commissioned to carry out the project of "International Comparison and Analysis of Safety and Environmental Protection Standards of Construction Machinery", which compared and analyzed the current safety and environmental protection standards of Chinas construction machinery field with those of major countries and regions, and strengthened the mutual

recognition of safety and environmental protection standards with relevant countries.

(6) Remarkable achievements in major sub-industries

To address its inherent weaknesses and meet the market demand for high-end development, the mining machinery industry has intensified innovation and R&D efforts. This has led to the emergence of digitalized, intelligent, unmanned/distant-controlled, and large-scale excavators, effectively expanding their application fields and versatility. The technical performance, reliability, durability, and operational efficiency of these products have been significantly enhanced, narrowing the gap with international leading standards.

The tunnel boring machine (TBM) industry is experiencing its most prosperous era in history. Domestic TBM manufacturers have broken foreign technological monopolies, capturing over 90% of the global market share. China has independently developed and deployed complete drilling and blasting tunneling systems, achieving full-process mechanization. The industry is now advancing towards informatization, networking, data-driven operations, and intelligent solutions, significantly boosting its competitiveness.

Tunnel construction with intelligent tunneling.

The road construction machinery industry has undergone structural transformations, with steady progress in product upgrades, digitalization and intelligentization achievements, as well as green product development and energy conservation initiatives. A range of energy-efficient, eco-friendly, safe, and reliable products have gained market popularity, effectively addressing diverse needs in road construction and maintenance. Autonomous pavers and rollers now employ intelligent technologies to achieve coordinated operations and end-to-end data synchronization, significantly enhancing both pavement smoothness and construction efficiency.

The pile foundation machinery industry has seized a historic opportunity for large-scale development. High-end products have achieved initial industrialization, with increased market concentration in rotary drilling rigs and significant improvements in product performance and reliability. The breakthrough of double-wheel cutter rigs has ended their stagnation phase, enabling mass production that profoundly impacts downstream geotechnical engineering sectors. This advancement will propel the industry toward product diversification, high-tech innovation, and enhanced integration capabilities.

High-altitude work machinery has maintained rapid development momentum. During the 13th Five-Year Plan period, addressing the safety shortcomings of traditional construction equipment, safety-conscious and multifunctional high-altitude work machinery products have become the primary focus of construction demands. Significant achievements have been made in modular design and multifunctional combination technologies, fall prevention systems, small component hoisting and positioning techniques, safety management informatization, and product quality control technologies. Relevant technical systems and standards have been further refined.

During the 13th Five-Year Plan period (2016–2020), industrial vehicles witnessed continuous technological advancements and accelerated product upgrades. New energy forklifts gained significant market traction, while logistics industry optimization and e-commerce expansion drove explosive demand for new energy industrial vehicles, warehouse forklifts, and Automated Guided Vehicle (AGV) systems. With sustained R&D investments and breakthrough innovations, the industry experienced accelerated technological iterations. Compared to conventional models, these new industrial vehicles emerged as the primary growth engine during this strategic planning period.

The ice and snow equipment industry has seen remarkable growth, fueled by the 2022 Winter Olympics. The Games ignited a nationwide passion for winter sports, with 300 million people actively participating, propelling the industry into a new era.

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A great opportunity for development has emerged. In the past four years, the ice and snow industry has been continuously optimized and the market demand for ice and snow has been evolving. A number of new ice and snow equipment have not only met the development needs of ice and snow sports, but also filled the gap in this field in China.

The concrete machinery industry has experienced rapid development driven by national policies including building industrialization, green construction, sponge cities, and integrated utility tunnels. Key advancements include: improved overall technical and manufacturing capabilities; enhanced safety and environmental performance metrics; accelerated internationalization; integrated development of construction materials and equipment; new material technologies driving equipment innovation; and emerging growth areas in construction waste treatment technologies and products.

On the basis of continuously improving their own service capacity and level, the steel and prestressed machinery industry has undertaken the key tasks of innovative research and development and project breakthrough in a number of major national infrastructure construction, played an irreplaceable role, and made outstanding

achievements in the "Sky Eye" project and large-scale bridge construction.

At the beginning of 2020, the COVID-19 pandemic emerged unexpectedly. Confronting the severe domestic and international situation, China mobilized nationwide efforts with comprehensive deployment and enhanced epidemic prevention measures. As crucial construction equipment for national disaster relief, engineering machinery actively participated in the construction of Wuhan Huoshenshan and Leishenshan hospitals, along with specialized medical facilities across the country. This demonstrated the equipments capabilities in social mobilization, rapid deployment, and efficient fleet operations, making significant contributions to the battle against the pandemic.

(7) During the 13th Five-Year Plan period, Chinas construction machinery industry embarked on the track of high-quality development

Over the past seven decades since the founding of the Peoples Republic of China, Chinas construction machinery industry has grown from nothing to something, from small to large, and from weak to strong. Through independent development, joint design, technology introduction, and absorption, it has formed a comprehensive industrial system with complete categories and a complete industrial chain. It has become an important part of Chinas equipment

manufacturing industry and an important pillar
industry for national economic construction.

Amid Chinas rapid economic growth fueled by reform and opening-up policies, the construction machinery industry has emerged as a global powerhouse. Benefiting from enhanced national economic strength and booming demand for infrastructure development, China now leads the world in equipment diversity, product variety, and supply chain completeness. Its infrastructure projects and major construction initiatives have driven the industrys rapid advancement in cutting-edge technologies and high-end equipment, with many innovations becoming global benchmarks in the sector.

The construction machinery industry has been committed to innovative development, aiming for global leadership and enhancing its developmental capabilities. By implementing supply-side structural reforms and achieving "three transformations", the sector has not only met the diverse needs of national economic development but also significantly increased investment in technological R&D and equipment upgrades. This has led to remarkable improvements in product quality, with reliability and durability now approaching international advanced standards. As a result, numerous globally influential brands have emerged in the industry.

While attracting foreign investment to "bring in," the construction machinery industry has actively "go global," implementing an internationalization strategy

and continuously increasing the proportion of overseas business. Currently, overseas operations cover more than 170 countries and regions, with products exported to 210 countries and regions. It has now become a key industry in implementing the Belt and Road Initiative and conducting international production capacity cooperation, achieving fruitful results.

During the 13th Five-Year Plan period, Chinas construction machinery industry has continuously improved its comprehensive strength and competitive position. The development achievements in many fields have established the international status of Chinas construction machinery industry as a representative of the international advanced level, and it has stepped forward to a higher level on the track of high-quality development.

II. Main problems in the construction machinery industry during the 13th Five-Year Plan

(1) There is a gap between the research and development capability and product performance and demand

1. There are weak links in the industrial basic capacity (core basic components, key basic materials, advanced basic processes, industrial technology foundation, basic software), and the modernization level of the industrial chain is not high.

Currently, Chinas construction machinery enterprises face relatively weak foundations in innovation and R&D. They have yet to master core technologies in some high-end product fields, which hinders the improvement of industry capabilities and product quality performance. The self-developed manufacturing and testing capabilities for key components fail to meet practical requirements, leaving critical parts and components for mid-to-high-end construction machinery and major technical equipment still reliant on imports.

2. The reliability and durability of products, that is, the overall quality and life indicators still have a gap.

Although the reliability level of the whole machine of construction machinery has been improved to some extent, there is still a gap in general, including the core components of construction machinery such as high-

end hydraulic components, transmission components and engines.

The first overhaul period of some Chinese engineering machinery products lags significantly behind that of similar leading foreign products.

The industry generally lacks finite-life design. While recent years have seen progress in static product design, dynamic analysis remains scarce, and research on load spectrum and its practical applications are limited. Reliability assessments are still confined to analogies based on design safety redundancy. Currently, there is no clear specification for the service life of major domestic construction machinery models.

The products handling, comfort, vibration and noise reduction, environmental performance, and safety still lag behind similar foreign products. For example, the noise level in the drivers ear is still more than 5 decibels in some models, and the noise level of radiation outside the machine is also 2 decibels.

Some models have not yet established a scientific energy consumption evaluation system, the energy consumption of the products themselves is high, and the environmental protection level of the whole machine still lags far behind that of developed countries and regions.

3. Lack of a shared technological collaboration platform. The application of intelligent, information-based, and networked technologies, along with product development and addressing certain technological gaps, remains fragmented among enterprises within the same industry and across the upstream and downstream industrial chains. The absence of communication, coordination, and resource sharing has prevented the formation of effective synergy, failed to leverage institutional and industry advantages, and resulted in waste of human, financial, and material resources. This has also slowed innovation and development to varying degrees. Additionally, there is a lack of integrated platforms for upstream and downstream industrial chains in small and medium-sized enterprises, and horizontal collaboration platforms within the industry have yet to be established.

There are some problems in networked equipment, such as easy disconnection due to lack of supervision, difficult to absorb communication costs, old equipment can not be connected to the network, networked equipment is biased to some machine types and new

equipment, and enterprise information system is not able to achieve industry collaboration big data.

4. There is a lack of innovation ability, insufficient technical reserves, and insufficient investment in basic research, testing and testing.

5. The level of digitalization, greening and complete set of products is still low, and the market competitiveness of high-end and large-scale construction machinery is insufficient.

6. Some enterprises still face challenges in R&D investment, low technological content in products, inadequate technological upgrades, outdated equipment, backward production methods, chaotic on-site management, lax internal governance, and disconnection between production and sales, making it difficult to meet the demands of high-quality development. Certain companies lack sufficient technical expertise and are located in remote areas, which hinders their ability to collaborate with research institutions and universities for technological innovation and upgrades. This also limits their capacity to attract high-level technical talent and enhance sustainable development capabilities. Other enterprises suffer from insufficient investment capacity, lack effective support from government agencies and financial institutions, and struggle to integrate social

resources, resulting in prolonged neglect of R&D and technological transformation efforts.

(2) It will take some time to solve the problem of unreasonable industrial structure

1. Chinas construction machinery industry ranks among the second tier globally, with no companies making the Fortune Global 500 list. Both labor productivity and corporate profitability lag behind those of benchmark enterprises in developed countries.

2. Insufficient international profitability, shortage of international talents, overseas investment and overseas business have not formed effective mutual support with domestic business.

3. The construction machinery industry has structural overcapacity, especially the excess of low-end products, serious homogeneity, and insufficient capacity of high-end products. Although some problems have been alleviated in some fields, there is still a gap between the international advanced level and the development goals of high-quality construction machinery industry.

(3) The market competition order needs to be improved

In certain sectors, issues like cutthroat competition and price wars frequently emerge, adversely affecting market order, industrial ecosystem development, and the pace of high-quality growth. The absence of effective aftermarket management has led to irregularities in second-hand equipment transactions, while the leasing industry faces significant challenges

in maintaining healthy development. Moreover, a large number of aging construction machinery units currently in use exhibit multiple safety hazards, poor equipment conditions, and non-compliant emissions. There is also no established mechanism for phasing out these outdated devices.

III. Situation facing the 14th Five-Year Plan

The 14th Five-Year Plan period is the first five years for China to build a modern socialist country in an all-round way and march toward the second centenary goal, building on the momentum of completing the building of a moderately prosperous society in all respects and achieving the first centenary goal.

At present and for some time to come, Chinas development is still in an important period of strategic opportunities, but both opportunities and challenges have taken on new features. The world today is undergoing profound changes unseen in a century.

The world is undergoing profound transformations. As the new wave of technological revolution and industrial transformation intensifies, the global power balance is undergoing profound adjustments. While peace and development remain the defining themes of our era, the international landscape has grown increasingly complex, marked by heightened instability and uncertainty. The COVID-19 pandemic continues to have far-reaching impacts, economic globalization faces countercurrents, and the world has entered a period of turbulence and transformation. Unilateralism, protectionism, and hegemonism pose threats to global peace and development. China has transitioned to a high-quality development phase, boasting institutional advantages, enhanced governance efficiency, a long-term economic outlook, a solid material foundation, abundant human resources, vast market potential, strong development resilience, and social stability. These multifaceted advantages position China for sustained progress. However, challenges persist: uneven and insufficient development remains prominent, reform tasks in key sectors and critical areas remain arduous, and innovation capabilities still fall short of meeting the demands of high-quality development.

During the 14th Five-Year Plan period, we should fully and accurately implement the spirit of the 19th National Congress of the Communist Party of China and

the second, third, fourth and fifth plenary sessions of the 19th CPC Central Committee, calmly analyze the situation, grasp the opportunities and challenges we are facing, formulate scientific and reasonable development strategies, and promote the high-quality development of the construction machinery industry to a new level.

(1) Chinas construction machinery industry is facing major challenges in the 14th Five-Year Plan period

In recent years, the global political and economic landscape has undergone accelerated transformation. Under the impact of unilateralism and protectionism, foreign trade may slow down, lose momentum, and face potential rule changes, with international economic cooperation entering a challenging restructuring phase. From an economic perspective, developed countries face mounting challenges. The U.S. economy is nearing the end of its long-term upward trajectory, likely to experience volatility in the coming years. The persistent decline in global manufacturing PMI and new orders indices, coupled with the downward trend in OECD leading indicators, signals a global economic peak followed by a downturn. Compounded by tightening global liquidity, rising interest rates, and escalating trade frictions, downward pressure on the global economy continues to intensify. This complex external

Environmental protection will bring great challenges and pressure to the development of Chinas construction machinery industry.

The 19th National Congress report clearly states that Chinas economy must transition from rapid growth to high-quality development, establishing a modern economic system that prioritizes quality and efficiency. As supply-side structural reform remains the cornerstone of sustainable development, the construction machinery industry must undergo three fundamental transformations: quality enhancement, efficiency optimization, and innovation-driven growth. This requires shifting from extensive expansion and market-driven growth models to fostering self-sustaining capabilities and internal growth momentum, ultimately achieving high-quality development.

Chinas construction machinery industry faces significant technological gaps in core foundational components, advanced manufacturing processes, critical materials, high-end general-purpose chips, essential software products, and cutting-edge production equipment. These shortcomings increasingly constrain the sectors development. As the global landscape enters a new phase of major restructuring and transformation, marked by comprehensive technological competition, Chinas growth faces more complex challenges. The reliance on foreign technologies in core areas poses a

major risk to both high-quality economic development and industrial security. The industry urgently needs to break free from technological dependence and achieve breakthroughs in key core technologies.

(2) Chinas construction machinery industry is facing good opportunities in the 14th Five-Year Plan period

During the 13th Five-Year Plan period, China has made new historic achievements in economic and social development, and its economic strength, scientific and technological strength, overall national strength and peoples living standards have reached a new level. During the 14th Five-Year Plan period, China will embark on a new journey to comprehensively build a modern socialist country.

The Outline of the 14th Five-Year Plan for National Economic and Social Development of the Peoples Republic of China and the Long-Range Objectives Through 2035 (hereinafter referred to as the Outline) proposes that by 2035, Chinas per capita GDP will reach the level of moderately developed countries, and the middle-income group will be significantly expanded.

The Outline addresses these objectives by focusing on scientific innovation, digital economy, and expanding domestic demand.

A series of strategic plans and implementation plans have been formulated on carbon peaking, rural revitalization, metropolitan areas and urban agglomerations, housing issues, population aging, delayed retirement, and commercial signing of free trade zones.

During the 14th Five-Year Plan period, China will intensify efforts to modernize its infrastructure system by developing new types of infrastructure including information infrastructure, integrated infrastructure, and innovation infrastructure. The country will enhance comprehensive transportation corridors, strengthen strategic backbone routes connecting Xinjiang and Tibet, central and western regions, as well as coastal and border areas. Capacity-constrained corridors will be upgraded and expanded in an orderly manner, while connectivity with neighboring countries will be enhanced. A rapid rail network will be established, with the "Eight Vertical and Eight Horizontal" high-speed rail system largely completed. The quality of the national expressway network will be improved, and world-class port clusters and airport complexes will be accelerated. The trunk network will be optimized through accelerated construction of conventional railways and

electrification upgrades of existing lines, while optimizing passenger and freight rail distribution. Bottleneck sections of national and provincial highways will be upgraded, and high-grade inland waterways will be expanded. Regional airports, general aviation airports, and cargo airports will be steadily developed, along with intercity and suburban railway construction. An expressway loop system will be established, and urban rail transit will be developed in an orderly manner. To improve transportation accessibility, regional railway construction will be promoted, and border-crossing highways will be accelerated.

We will continue to strengthen energy infrastructure and build a modern energy system. During the 14th Five-Year Plan period, we will build a number of large clean energy bases, coastal nuclear power plants, power transmission channels, pumped storage power stations, and oil and gas storage and transportation facilities.

In addition, the 14th Five-Year Plan will accelerate development in water conservancy infrastructure, rural infrastructure, improving the layout of new urbanization, new urban construction and livelihood security projects.

China is deeply implementing major regional strategies, accelerating the high-quality development of the Beijing-Tianjin-Hebei region, the Yangtze River Economic Belt, the Guangdong-Hong Kong-Macao Greater Bay Area, the Yangtze River Delta integration, and promoting

a new pattern of the western development, etc., which will also be an important driving force for the sustained growth of Chinas construction machinery market in the future.

Based on market demand analysis, the Outline

"14th Five-Year Plan for

proposes development

strategies, objectives, and

tasks, with emphasis on~22~

Large projects and key projects will continue to enhance the market demand for construction machinery.

In recent years, Chinas construction machinery industry has achieved remarkable progress in adopting new technologies, materials, and construction methods, significantly driving technological innovation and industrial upgrading. The application fields of construction machinery are continuously expanding, with machine replacement for human labor gaining momentum. Intelligent, digital, networked, and lightweight technologies are empowering construction machinery to broaden its application scope. Given Chinas vast economic development potential and massive infrastructure construction scale, the construction machinery market remains in an upward trajectory. Balancing the renewal of existing equipment with new demand, the sector holds tremendous growth potential during the 14th Five-Year Plan period.

(3) Building a new development pattern to promote the stable and healthy development of the industry

President Xi Jinping emphasized the need to establish a new development paradigm where domestic circulation serves as the primary driver, complemented by mutually reinforcing domestic and international dual circulation. This strategic decision, formulated in response to evolving Chinas

development stage, environmental conditions, and competitive landscape, aims to redefine the nations competitive edge in global cooperation. It represents a profound synthesis of Chinas experience in opening-up and economic development. By prioritizing the smooth operation of the national economic cycle, this new development framework holds significant importance for advancing Chinas socioeconomic progress during the 14th Five-Year Plan period and ultimately achieving socialist modernization by 2035.

In the process of building a new development pattern, the construction machinery industry should adhere to the strategy of innovation-driven development, improve the competitiveness of the industry and the initiative of development, mainly including the following aspects:

First, we need to open up the innovation chain and accelerate independent innovation.

Chinas construction machinery industry has entered a phase where "following," "running side by side," and "leading" are equally important. In some sectors, there are no established precedents or models for technological development, making it difficult to address technical "shortcomings" through mere imports. We must therefore continuously increase investment in fundamental research, accelerate independent innovation, and drive industrial upgrading and modernization of the supply chain through innovative development.

At present, we should closely combine the development needs of national economic construction and use fields, build a collaborative innovation and development pattern of government, industry, university, research and application,

promote the application of new technologies, accelerate the control of the core technology of the whole machine research and development, so that the direction of engineering machinery technology progress is more in line with the law of industrial development, suitable for the development needs of users, and meet the requirements of high-quality development.

"14th Five-Year Plan for Construction Machinery Industry"

Second, we need to strengthen the industrial chain to ensure the sustained and healthy development of the industry.

We should further accelerate the development of high-end components, focus on solving the shortcomings of reliability, durability and life of components, strengthen the construction of testing, testing and verification platforms for high-end supporting products, accelerate the solution of the industrialization of high-end components, strengthen the collaborative research and development of the industrial chain, and realize the independent control of key components.

Third, we need to stabilize the supply chain and strengthen cooperation between upstream and downstream enterprises.

For years, the construction machinery industry has faced challenges in synchronized development between upstream and downstream enterprises, with heavy reliance on imported components, which has become a bottleneck for both equipment performance and industrial growth. To establish a new development paradigm, it is essential to streamline coordination between core manufacturers and component suppliers, and to create a collaborative mechanism that integrates R&D, testing, and industrialization across the entire supply chain.

Fourth, we need to upgrade the value chain and open up at a high level.

We should continue to expand opening-up, organically integrate Chinas innovation chain, industrial chain and supply chain into the global chain, and constantly improve

the position of Chinas construction machinery industry in the global value chain division of labor.

Chinas construction machinery enterprises should continue to implement the "go global" strategy, strengthen international cooperation, enhance the integration of domestic and international markets and resources, and expand industrial development opportunities. They should further consolidate the pivotal role of Chinas construction machinery component manufacturing industry in the global economic cycle, actively participate in international trade networks across all dimensions. Additionally, efforts should be made to improve service quality for overseas engineering projects and expand the application of domestically produced high-end construction machinery in international markets.

At the same time, we will continue to support the development of foreign-funded enterprises in China and the import of high-level supporting products, so as to improve the overall strength of Chinas construction machinery industry and the international competitiveness of complete machine products.

In conclusion, construction machinery enterprises should fully leverage Chinas economic strengths—its abundant potential, strong resilience, ample flexibility, and diverse policy tools. By seizing the critical development window and implementing the dual circulation strategy (domestic and international markets), they can drive continuous optimization of the industrys structure and establish a new development paradigm for Chinas construction machinery sector.

(4) Seize the current important historical opportunity period in China to promote the high-quality development of the construction machinery industry to a new level

The Fifth Plenary Session of the 19th CPC Central Committee emphasized that the 14th Five-Year Plan period marks the first five years for China to build a modern socialist country and advance toward the second centenary goal. This period follows the successful completion of building a moderately prosperous society in all respects and achieving the first centenary goal. While China remains in a crucial strategic opportunity phase, the domestic and international environment is undergoing profound and complex transformations.

--Unprecedented changes in a century are accelerating, the impact of the COVID-19 pandemic is extensive and far-reaching, the international environment is becoming increasingly complex, the world economy lacks momentum for growth, economic globalization is facing headwinds, and the world has entered a period of turbulence and transformation.

——The global governance system and the transformation of the international order are accelerating, with countries becoming increasingly interconnected and interdependent. As the world's most populous country and the second-largest economy, China possesses strong capabilities and resources to tackle various difficulties and challenges, and has the powerful advantage of turning crises into opportunities and transforming dangers into safety.

The new wave of technological and industrial revolutions is intensifying their impact on national scientific capabilities and competitiveness, with global tech rivalry among major powers reaching unprecedented levels. Marked by big data, blockchain, artificial intelligence, quantum technology, and life sciences, the Fourth Industrial Revolution is building momentum across multiple dimensions, poised for a transformative breakthrough. This revolution will not only drive productivity leaps and catalyze emerging industries, business models, and operational paradigms, but also accelerate the adoption of intelligent technologies, internet integration, big data analytics, and 5G applications in the construction machinery sector. These developments are set to inject fresh momentum into Chinas engineering equipment industry, propelling it toward new heights of innovation.

— Currently, Chinas economy is transitioning from rapid growth to high-quality development. The country boasts significant institutional advantages, enhanced governance efficiency, long-term economic momentum, a solid material foundation, abundant human resources, vast market potential, strong development resilience, and social stability. These multifaceted advantages and conditions provide a robust foundation for continued

progress. China possesses the worlds most comprehensive and largest industrial system, featuring formidable production capabilities, well-developed supporting infrastructure, and substantial investment potential.

"14th Five-Year Plan for Construction Machinery²⁵ Industry"

The demand potential is huge.

Over the past decade, Chinas construction machinery industry has achieved rapid development. While some sectors still lag behind international benchmarks and face the challenge of being "large but not strong," the sector has secured a prominent position in the global construction machinery landscape. At this new historical juncture, as international industrial structures undergo restructuring, Chinas construction machinery industry is entering a transformative era of comprehensive innovation. During the 14th Five-Year Plan period (2021-2025), the application of big data, internet, and artificial intelligence technologies will deepen further. Breakthroughs in advanced control systems, new energy solutions, innovative materials, and domestically developed industrial software will yield substantial results, gradually unlocking vast development potential for next-generation high-tech construction machinery.

During the 14th Five-Year Plan period, China will establish a new development paradigm centered on optimizing the national economic cycle. By harnessing technological innovation to generate new growth drivers and deepening reforms to invigorate development vitality, the nation will fully leverage its super-large market advantages. Through high-level opening-up, China aims to forge new competitive edges in international cooperation.

Currently, the country is actively advancing a dual-circulation development model where domestic circulation serves as the mainstay while domestic and international markets reinforce each other. While steadily expanding global presence, the construction machinery industry continues supply-side structural reforms. This dual approach ensures domestic markets provide robust support for international operations and overseas investments, while international business injects innovative momentum into domestic production and sales. Through this integrated strategy, China is propelling high-quality development in the construction machinery sector to new heights within the new development framework.

IV. Guiding ideology and development goals of the 14th Five-Year Plan

I. Guiding principles

In his report to the 19th CPC National Congress, General Secretary Xi Jinping stated: From 2020 to 2035, building on the foundation of a moderately prosperous society in all respects, we will strive for another 15 years to basically achieve socialist modernization. The 14th Five-Year Plan is the blueprint for realizing socialist modernization.

The opening stage is also a key stage for China to realize the transformation from high-speed growth to high-quality growth in the face of complex domestic and foreign situations.

During the 14th Five-Year Plan period, the construction machinery industry should fully implement the spirit of the 19th National Congress of the Communist Party of China and the second, third, fourth, and fifth plenary sessions of the 19th Central Committee, guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. It should adhere to the innovation-driven development strategy, scientifically grasp the new development stage, thoroughly implement the new development philosophy, accelerate the construction of a new development pattern, take promoting high-quality development as the theme, and take deepening supply-side structural reform as the main line. The goal is to achieve the high-end upgrading of the construction machinery industrys foundation and the modernization of its industrial chain. Talent should be the cornerstone, and the industry should follow a development path led by talent.

We will further narrow the gap with the international leading level and promote the construction of a strong country in the construction machinery industry.

II. Development Goals

1. Technical and economic objectives

By 2025, the overall level of the construction machinery industry will be greatly improved, the innovation capacity will be significantly enhanced, the quality and efficiency will be significantly improved, and the development capacity will be further enhanced.

Table 4 Construction Machinery Industry 14th Five-Year Plan Goals

class	metric	2018	2019	2020	2025
innovation ability	Internal R&D expenditure as a percentage of main business revenue for enterprises above designated size (%)	4.18	4.66	5	5.5
	Research and development personnel in the construction machinery industry as a percentage of employees (%)	15.6	16	18)	19
harmonious development	Service industry revenue share (%)	<25	26	28	35
	Lease product penetration rate (%)	<10	12	15	25
	Industrial concentration of construction machinery industry (%)	<50	≤50	50 ¹)	≥50
green development	Energy consumption per unit of industrial added value in the construction machinery industry (ton standard coal / 10,000 yuan)	0.13	0.12	0.08 ¹)	<0.08
	Comprehensive utilization rate of industrial solid waste in construction machinery industry (%)	—	—	80 ¹)	90
	Noise limit target for main	86	85	82	<80

	products				
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"14th Five-Year Plan for

class	metric	2018	2019	2020	2025
Open sharing	Exports (billion USD)	235.8	243	210	280 6% annual growth
	Export share of construction machinery industry in international market (%)	10 ²)	9.9 ²)	9.9 ²)	122)
market size	Operating revenue (billion yuan)	5964	6681	7751	9000 An average annual growth rate of 3–5%
Quality and efficiency	Mean time between failures (h)	600	610	630 ¹)	>800
	Industrial added value rate of construction machinery industry (%)	25	28	30 ¹)	≥30
	Annual labor productivity of all employees in the construction machinery industry (10,000 yuan/person)	45	55	60 ¹)	65
	Key process CNC rate (%)	85	≤90	≈90	95
	Smart product ratio (%)			5%	10%

D: The “13th Five-Year Plan” targets are calculated based on the per capita industrial added value index.

2: International market data is sourced from “China Construction Machinery”.

Table 5: Quality Forecast Targets for Major Construction Machinery Products during the 14th Five-Year Plan Period

product	14th Five-Year Plan MTBF forecast in hours	remarks
hydraulic crawler excavator	900	1000h reliability test on a single sample
wheeled loader	700	1000h reliability test on a single sample
Engineered crane	600	1000h reliability test on a single sample
forklift	480	1000h reliability test on a single sample

crawler dozer	750	1000h reliability test on a single sample
road roller	500	Single-sample 600h reliability test

In terms of safety, environmental protection and health standard research and formulation, we should learn from the advanced experience and practices of standardized development in developed countries, and combine with the actual development of Chinas construction machinery industry, especially in terms of noise and pollutant emission. The industry should focus on improving during the 14th Five-Year Plan period, as shown in the table below.

Table 6 Noise Limits for Major Construction Machinery Products during the 14th Five-Year Plan Period

count ry and re gi on	product	Current driver Location noise Limit	14th Five- Year Plan Driver noise Voice threshol d	remarks

EU	Hydraulic excavator, wheeled loader, graders, tracked bulldozers, rollers, dump trucks	80dB (A)		As specified in the mechanical instructions
China	excavator	80dB (A)	72dB (A)	
	wheel loader	86dB (A)	<80dB (A)	
	ballgrader	85dB (A)	<80dB (A)	
	crawler dozer	92dB (A)	<80dB (A)	
	road roller	87dB (A)	<80dB (A)	
	dumper	82dB (A)	<80dB (A)	

2. Development goals of major fields of construction machinery in the 14th Five-Year Plan

I. Mining machinery industry	
<p>Brand building: 1-2 China brand excavator enterprises with total sales enter the global top 5; 2-3 enter the global top 10; 1-2 parts suppliers enter the global top 10.</p> <p>Product quality and reliability: the service life of the whole machine is more than 20,000 hours, and the reliability basically reaches the international mainstream level.</p> <p>Market share: The overall domestic market share of domestic brands remains above 60%, among which the market share in the high-end large excavator market exceeds 55%.</p> <p>Overseas market size: Exports continue to grow, accounting for more than 15% of the total domestic production and sales.</p> <p>Industrial infrastructure construction: the core components are fully independent and controllable, and the localization rate of core hydraulic parts is over 60%.</p> <p>Industrial support level: more than 70% of the parts have competitive advantages in the market, 25% of the parts have the ability to replace imports, and the proportion of</p>	

completely dependent on imported parts is less than 5%.

Scale of operations: Market concentration: CR4 \geq 60%, CR8 \geq 80%.

Network level: The network connection rate of new devices is \geq 60%.

2. Industrial Internet of construction machinery industry

Strengthen the development of new infrastructure for industrial internet in the construction machinery sector. Establish and improve the standard system for industrial internet in construction machinery to maintain Chinas initiative in this field. During the 14th Five-Year Plan period, we aim to establish and implement 5-6 industry standards related to industrial internet, with the goal of achieving a pre-installation rate of 70% for Beidou terminals in major construction machinery products.

Establish a big data platform for the construction machinery industry to enhance its capacity to support government operations and serve the sector. Leverage big data from construction machinery to build an ecological cloud platform for environmental management, and promptly implement vehicle-to-everything (V2X) data integration for pollution control in key areas of the Beijing-Tianjin-Hebei region and its surrounding 2+26 cities.

To build an industrial internet ecosystem for the construction machinery industry and elevate its digitalization, intelligence, and high-end development. By 2025, we will establish a dual-iteration system of intelligent design and production, creating cross-brand, cross-model, and cross-domain platforms for both customers and smart construction. This will enable a new intelligent manufacturing ecosystem powered by data-driven smart services and construction solutions.

3. Road construction and maintenance machinery

Structural adjustment objectives: Enhance innovation and manufacturing capabilities for mid-to-high-end products, while encouraging key supporting enterprises to upgrade specialized technologies. The industry concentration ratio (CR5) of large asphalt mixing equipment should exceed 40%. Green manufacturing goals: Ensure all emission and noise levels of asphalt mixing equipment meet comprehensive standards.

T/CCMA0066-2018 "Emission Limits for Asphalt Mixing Equipment" requirements.

Digitalization and Intelligent Objectives: Asphalt mixing equipment will achieve digital and information-based management, with remote management services accounting for over 10%. Key maintenance equipment such as asphalt spreaders, synchronous sealers, and slurry sealers will have remote information management coverage exceeding 5%. Intelligent pavement paving and compaction operations will be implemented, with enhanced technical capabilities.

Basic R&D and Product Testing: Enhance fundamental research on equipment-object interactions, with a focus on vibration patterns and compaction efficiency of vibratory rollers. Aim to achieve substantial progress in developing onboard soil vibration density meters for vibratory rollers, laying a solid foundation for intelligent compaction.

4. Building lifting machinery

Product performance and reliability objectives:

- 1) Carry out product safety and reliability design research to improve product safety and reliability.
- 2) Carry out product ergonomic design technology: improve safety, driving comfort, control flexibility, carry out technical research on product vibration, noise, exhaust emission control and other aspects.
- 3) Import substitution of key components such as transmission and electronic control.

4) Promote advanced technology and intelligent manufacturing technology to realize intelligent manufacturing of key components.

5) Improve the intelligent level of products and the intelligent and safe management level of machine group operation.

6) Research on green design and manufacturing technology of products.

Key breakthrough technologies:

1) Structural technology research: new material application research, truss structure efficient intelligent manufacturing technology research, structural parts internal and external corrosion protection technology, tower crane structural parts fatigue life assessment technology.

2) Transmission technology research: wide speed ratio transmission technology, high reliability braking technology, new material suspension technology.

3) Control technologies: frequency conversion drive control technology, big data collection and application technology for environmental conditions and equipment data, 5G-based data transmission technology, AI-powered edge computing technology, and comprehensive

Life cycle management technology.

4) Intelligent technology: unmanned technology, Internet of things;

Key development equipment

1) Development of large and extra-large tower cranes; 2) Development of hydraulic extra-large boom tower cranes; 3) Wind power tower cranes; 4) Development of fast-installation and fast-disassembly urban tower cranes; 5) Development of unmanned tower cranes.

V. INDUSTRIAL VEHICLES

Structural Adjustment Objectives: 1) By 2023, electric vehicles will surpass internal combustion engine vehicles in market share, with their proportion reaching over 65% by 2025. The share of lithium-ion industrial vehicles within the electric vehicle sector will see rapid growth. 2) Industrial vehicles will achieve customization, intelligence, and automation, while accelerating the development of differentiated products like logistics solutions and mid-to-high-end models. 3) Forklift aftermarket services will experience accelerated growth.

4) During the 14th Five-Year Plan period, internationalization and global expansion will achieve new breakthroughs. 5) The process of horizontal and vertical mergers, acquisitions, integration, and joint ventures in the industrial vehicle industry chain will accelerate further.

Key development areas:

Upgrade of complete machine products —— applying digital, intelligent, green and networked technologies to accelerate production

Product innovation and upgrading, product differentiation and mid-to-high-end development; increasing electric vehicles and new energy

Development of source vehicles, driverless vehicles and system solutions.

Key components and platform technologies—breakthroughs have been made in key components and technologies such as medium and high-end hydraulic parts, efficient transmission, green power, vehicle networking platform, logistics solutions and systems.

Applications of the Internet and 5G technology—Remote monitoring and fleet management tasks are realized through the Internet and control systems.

VI. Concrete products machinery

The goal of industrial structure adjustment is to meet the increasing demand for new and exquisite building materials production processes, as well as for mechanical equipment for concrete products that incorporate advanced technologies such as digitalization, informatization, intelligence and industrial Internet.

Innovation capacity goal: During the 14th Five-Year Plan period, digital, information and intelligent upgrading will be accelerated, and the proportion of r&d expenditure of enterprises above designated size in their main business income will reach more than 5%.

Product Performance and Reliability Objectives: The focus will be on developing noise reduction technologies, with vibration forming equipment aiming to keep noise levels below 110 decibels for main units and 80 decibels for other types. Equipment reliability will be enhanced, with single-unit vibration forming machines targeting an average trouble-free

operation time exceeding 210 hours, while other single-unit machines aim for over 300 hours. For automated production lines composed of multiple units, the average trouble-free operation time under normal working conditions will be optimized to reach over 96 hours.

Energy saving and green manufacturing objectives: improve the mechanical dust prevention and dust reduction technology of concrete products, and ensure that the dust emission of the main production machine meets the relevant specifications.

Opening to the outside world index: Implement the "go global" strategy, maintain the steady growth of the export of concrete products machinery industry, and strive to account for more than 30% of the annual total sales of the industry by 2025.

Digital indicators: integrate advanced technologies such as digital, information, intelligent and industrial Internet into concrete product production lines, and strive to achieve 70% of concrete product production lines using digital technology by 2025.

7. Rock drilling machinery and pneumatic tools industry

Development Goals: By leveraging hydraulic drilling rigs and remote-controlled intelligent all-hydraulic drilling vehicles as breakthrough products, we will continuously enhance product reliability and service life. Through applying ergonomic design principles to pneumatic tool series, we aim to develop "miniaturized" high-performance integrated products that combine compact size with precision, driving sustainable industry and corporate growth. Upgrading lightweight pneumatic drilling equipment should focus on intelligent assistance and unmanned operations, while heavy-duty models should adopt combined pneumatic-liquid control systems for smart digital management. This approach will ultimately achieve green manufacturing and intelligent production.

Innovation and development areas:

(1) R&D and promotion of high-end products with high performance and high reliability; development of hydraulic and pneumatic tools with high efficiency, energy saving, low noise, vibration reduction, multi-machine combination and microcomputer control;

(2) Intelligent drilling machinery and pneumatic tools promote construction labor-saving; in terms of drilling machinery, advanced products with hydraulic power and integrated mechanical, electrical and hydraulic systems are developed; new pneumatic-hydraulic power tools are developed.

(3) Information and digitalization enable full life cycle management of drilling machinery and pneumatic tools; advanced fully hydraulic drilling equipment featuring microcomputer control and intelligent features.

(4) The development and selection of high-end basic components and reliability products to improve the overall product quality.

8. Engineering crane industry
Science and technology development goals: During the 14th Five-Year Plan period, the engineering crane industry will adhere to the continuous upgrading of the industry, adhere to the development direction of series, lightweight, large-scale, intelligent, reliability, customization, and further promote the Internet + intelligent control technology. Key scientific and technological breakthroughs: 1. Module integration and lightweight technology; 2. Intelligent technology application and informatization; 3. Customized services and differentiated design; 4. Core technology R&D in the industrial chain to achieve independent control.
IX. Snow and Ice Equipment
overall objective :

According to the preparation process of the Beijing Winter Olympics, by 2022, the annual sales revenue of Chinas ice and snow equipment industry will exceed 20 billion yuan, with an average annual growth rate of more than 20%. By 2025, the ice and snow equipment industry

The annual sales revenue of the industry is close to 35 billion yuan, and an industrial system of ice and snow equipment and equipment with the foundation for high-quality development has taken shape.

1. Achieve technological breakthroughs and industrialization of major ice and snow equipment; 2. Continuously improve the self-production rate of high-end supporting components; 3. Establish a standardized system for the ice and snow equipment industry. 4. Build a national-level inspection and testing center for ice and snow equipment to serve the industry.

Key development areas:

Snowmaking machines, snow groomers, magic carpets, snowmobiles, cable cars, and other ski resort equipment; ice resurfacing vehicles, ice rink ice machines, and other ice rink equipment; snow rescue boats, snow rescue cabins, and other ice and snow rescue equipment.

Development priorities and main tasks:

Establish a sound industry standardization system; accelerate the construction of a post-market service platform for ice and snow equipment; establish an inspection and testing institution for ice and snow equipment; strengthen the research and development of core components of ice and snow

equipment.

X. Construction machinery aftermarket service

Promote the construction machinery service industry to the high end of the value chain:

The industry will develop intelligent service-oriented agents, leasing companies, and service providers, offering R&D design and construction technical services, logistics services, information services, financial services, energy-saving and environmental protection services, leasing services, business services, human resource management and training services, among others. By 2025, the construction machinery leasing industry will see significant consolidation, with an initial formation of industry tiers. The top 100 leasing companies are expected to achieve revenues exceeding 50 billion yuan, while leading enterprises will surpass 7 billion yuan. The leasing

scale of individual products will rapidly expand, cross-industry integration within the supply chain will accelerate, and innovative development models such as operational leasing + internet + finance are beginning to yield results.

Informationization and digitalization realize the whole life cycle management of construction machinery:

Through the integration of big data from the Internet of Things (IoT) in construction machinery and equipment, and the gradual development of industry-specific platforms, the system leverages AI-powered fault diagnosis, AR-enhanced reality, and drones for rapid delivery of components and tools.

Video guidance, customer maintenance and other technical means to improve equipment management efficiency, reasonable matching of supply and demand, optimize management process, achieve post-market service upgrade.

Building a team of senior management personnel and professional and technical personnel

To cultivate a group of high-end talents who have a deep understanding of construction machinery leasing, management, maintenance and other aftermarket, with a foundation in modern information technology and finance, as well as a team of professional equipment and spare parts management and maintenance service personnel who have a deep understanding of construction engineering technology and construction methods.

Improve the second-hand equipment trading platform:

Establish a fair, transparent and efficient trading platform for second-hand construction machinery and build a service system to support the high-quality development of construction machinery.

11. Concrete machinery industry

Science and technology development goals:

By fully implementing digital design, we have elevated design efficiency and quality to world-leading standards. Digital prototypes demonstrate consistent performance metrics with experimental tests, achieving a 10% improvement in product quality. New national standards and regulations have been fully implemented for emissions compliance. Through big data analytics, we conduct predictive life assessments to extend product lifespan while enabling early fault detection, diagnosis, and resolution. A comprehensive testing methodology and evaluation criteria have been established for concrete machinery components and complete equipment.

By 2025, the Mean Time Between Failures (MTBF) of complete machines and key components will increase by 10%.

The reliability of the whole machine reaches the international advanced level.

By integrating vehicle internet technologies, the system enables dynamic big data management for concrete pump trucks, concrete mixer trucks, and on-board pumps. It provides real-time monitoring of online availability, operational efficiency, location tracking, historical trajectories, anomaly alerts, equipment health checks, fault diagnostics with early warnings, predictive maintenance analysis, intelligent fleet management, smart dispatching, electronic fencing, area vehicle inspections, driving behavior analysis, fuel consumption monitoring, material theft prevention, and system-generated reports.

The pumping product achieves digitalization, intelligence, and

new energy transformation, with human-machine collaboration and machine cluster coordination. Concrete mixing station equipment, starting from the products entire lifecycle and industrial chain, realizes intelligent and digital product development.

Digitization, visualization, and multi-machine collaboration ultimately achieve a highly autonomous and unmanned smart concrete factory. The key innovative products under development

(1) New energy mixing transport vehicles; (2) Intelligent mixing stations; (3) Complete sets of wastewater treatment equipment;

(4) Multi-functional pump truck: a single machine for multiple uses (concrete pumping, firefighting, and special liquid handling); (5) High

Energy-saving and efficient pumping technology; (6) Intelligent construction: cluster construction of stations, vehicles and pumps; (7) Professional

Construction equipment: tunnel concrete equipment, mine concrete equipment, urban emergency concrete equipment; (8) high-reliability lightweight mixer truck (equipped with lightweight technology, 360-degree safety view, etc.);

(9) Intelligent concrete mixer trucks (equipped with online quality monitoring systems, station-pump coordination, and self-learning diagnostic capabilities); (10) Customized specialized products, including multi-roadway mixer trucks for tunnels, mining, rail, and tracked applications, as well as multi-functional equipment such as mixer pump trucks, self-loading mixer trucks, and belt-conveying mixer trucks.

12. Tunneling machinery industry

Science and technology development goals:

To address the localization and industrialization challenges of critical components including the roadheaders main bearings, core controller, and high-end sealing parts; to develop ultra-large diameter (over 12m) horizontal and vertical tunneling equipment.

Preparation; initially establish a digital twin application platform integrating tunnel operation scenarios and model simulation; build a number of industrial bases with the ability to test complete machines and core components.

Key development areas:

Large/diameter tunnel boring machine technology —— earth pressure balance shield machines ($\geq 12\text{m}$), slurry balance shield machines ($\geq 16\text{m}$), and rock tunnel boring machines (TBM) $\geq 10\text{m}$;

Shaft boring machine —— diameter $\geq 6\text{m}$, well depth $\geq 25\text{m}$;

Mini TBM (Tunnel Boring Machine) —— a compact machine with a diameter of $\leq 3\text{m}$;

Adit boring machine—diameter $\geq 6\text{m}$, length $\geq 1000\text{m}$, maximum slope $\geq 40^\circ$.

Development priorities and main tasks:

Accelerate the progress of the project to address weaknesses, and establish an independent core components R&D—manufacturing—supply system

and industrial bases; promote intelligent technology clothing and applications; use new information technologies such as industrial Internet and 5G to establish digital twin demonstration projects and bases for construction scenarios.

13. Basic components

Science and technology development goals:

The reliability and durability of core basic components have reached or close to the international advanced level, and the self-sufficiency rate has reached 90%; the consistency and quality stability of components have been improved.

Key development areas:

Electrical control components and systems, high-pressure hydraulic components and systems, transmission components, power systems, electric drive systems, intelligent components and functional parts for smart construction machinery, accessories

Development priorities and main tasks:

We will promote an integrated development model where whole machine manufacturers combine component R&D, testing, and manufacturing with component producers technological innovation and process optimization. This approach fosters complementary relationships between whole machine manufacturers prototype development and specialized component enterprises industrialization, effectively driving the transformation and upgrading of the component industry. Accelerating the performance evaluation and installation testing of domestically produced components, we will enhance quality standards and related specifications for critical

components such as seals and sensors.

V. Development priorities and key tasks

(1) Accelerate scientific and technological innovation and strive to realize the modernization of the construction machinery industry around the innovation-driven development strategy

By applying modern scientific and technological advancements to the construction machinery industry, we focus on innovative R&D that aligns with construction methodologies, working environments, and technical requirements, while staying closely connected with user needs. This approach enhances our independent development capabilities, expands product functionalities and service coverage, and continuously develops new, practical,

efficient, and eco-friendly high-tech construction machinery tailored to emerging market demands.

Build an industrial collaborative innovation system covering mainframe equipment and key components, and accelerate

Breakthroughs in core components and shared key technologies, along with their industrialization and widespread application, will establish a world-class advanced construction machinery industry cluster. Confronting the new wave of global technological transformation spearheaded by artificial intelligence, we will fully implement the innovation-driven development strategy to achieve green, digital, intelligent, and networked construction machinery products, thereby leading the next-generation industrial revolution in this sector.

— Strengthen R&D of core technologies. Targeting the industrys strategic high ground and bottleneck issues, enhance the capability for forward engineering of complete machines and key components. Promote the establishment of national technology innovation demonstration enterprises and corporate technology centers, and fully engage more enterprises in building the nations strategic scientific and technological capabilities.

--Promoting the industrialization of scientific and technological achievements. Establish and improve the mechanism for the transformation and application of scientific and technological achievements, actively

participate in the construction of sharing platforms, increase investment in facilities for test verification and assessment, and actively integrate social capital to establish pilot bases engaged in technology integration, maturation and engineering.

Leading enterprises should innovatively establish dedicated open innovation platforms to enhance their specialized service capabilities. These platforms should integrate global innovation resources through mechanisms like "resource openness and sharing" and "resource matching and coordination." By consolidating innovation resources across the entire industrial chain, they can incorporate cutting-edge technologies and construction methodologies in engineering projects to fully meet downstream technical demands. Furthermore, leveraging new technologies, materials, and products from upstream industries, these enterprises can facilitate cross-sector collaboration and establish partnerships with domestic and international technology suppliers.

— Enhance intellectual property utilization. Strengthen the intellectual property reserves of core technologies in key enterprise sectors, and develop patent portfolios and strategic layouts oriented toward

industrialization. Fully leverage intellectual property to compete in the market and promote collaborative use of IP among enterprises.

— Promote the optimization and upgrading of the construction machinery industry. Deepen the implementation of green manufacturing and intelligent manufacturing, develop new service-oriented manufacturing models for construction machinery, achieve intelligent, high-end, and green transformation across the entire industrial chain, and cultivate an advanced new industrial system for construction machinery. Upgrade and transform engineering machinery.

To optimize the industrial chain layout and structural adjustments in the construction machinery sector, we will implement the Special Program for Enhancing Core Competitiveness and Technological Upgrading. This initiative will promote the widespread application of advanced practical technologies, accelerate equipment modernization, and drive large-scale adoption of new products. Concurrently, we will deepen the Quality Enhancement Action to expand product varieties, improve quality standards, and establish strong brand recognition in the construction machinery industry.

(2) Comprehensively enhance the basic capacity of the industry and strive to realize the high-end construction machinery industry

The weak industrial foundation capabilities, including core basic components (components), advanced basic processes, key basic materials, industrial technology foundation, and basic software (referred to as the "five bases"), have constrained the industrys innovation, development, and quality improvement. By adhering to the principles of problem-oriented, production-demand integration, collaborative innovation, and key breakthroughs, we will focus on breaking through the bottlenecks that hinder industry development.

Strengthen forward-looking basic research to address key common technologies impacting the performance and stability of core basic components (elements). Establish a foundational process innovation system and develop a basic database for the construction machinery industry, while enhancing the collection, management, application, and accumulation of enterprise testing data and metrological data. Support the development and promotion of foundational software industries. Increase support for R&D in the "Five Basics" field, guiding industrial investment funds and venture capital funds to invest in key projects within this domain.

Prioritize demand-side incentives, integrate production with application, and collaborate on breakthroughs. Guide whole-machine enterprises, "Five Basic" enterprises, universities, and research institutes to connect supply and demand, forming a new model of collaborative innovation and industry-application integration that drives market-driven development of foundational industries, thereby enhancing the self-reliance level of major equipment. Implement demonstration applications for strengthening foundational capabilities, refine policies for first-of-a-kind (first-unit) and first-batch equipment, and support the promotion and application of core basic components (elements), advanced foundational processes, critical basic materials, and foundational software.

Demonstration applications will be carried out, and a reward and risk compensation mechanism will be established to support the first batch or cross-field of core basic components (components), advanced basic processes, and key basic materials.

Application of the domain. Strengthening platform support, laying out and establishing a number of strong foundation engineering research centers, creating a number of public service platforms, and improving the technical foundation system of key industries.

By 2025, more than 90 percent of core basic components and key basic materials will be independently guaranteed, 80 kinds of landmark advanced processes will be widely used, and some will reach the international leading level. A relatively complete industrial technology basic service system will be established, and a pattern of industrial innovation and development with complete machine traction, basic support and coordinated interaction will gradually take shape.

(3) Further improve the product quality of construction machinery and enhance the brand value

During the 14th Five-Year Plan period, enterprises in the construction machinery industry should continue to enhance technological innovation and optimize product upgrades. They must increase R&D investment in key components, address shortcomings in testing and validation, and focus on improving component reliability and service life. The goal is to achieve a 30% improvement in reliability levels of major construction machinery products by the end of the 14th

Five-Year Plan. Additionally, efforts should be made to elevate smart manufacturing capabilities to ensure product quality stability. Simultaneously, greater investment in process inspection and testing methods will be implemented, with strengthened quality control over externally sourced and outsourced components to elevate overall equipment quality.

— Promote advanced quality management technologies and methodologies. Establish a certification platform for key product compliance to ensure technical and safety standards meet international advanced benchmarks. Conduct quality benchmarking and industry leadership initiatives to disseminate best practices including performance excellence, lean production, quality diagnostics, and continuous improvement. Support enterprises in enhancing online quality monitoring, real-time control, and full lifecycle traceability capabilities. Implement process optimization programs in key industries to improve critical process control. Strengthen quality management for SMEs through training, diagnostics, and coaching programs focused on quality assurance.

— Accelerate product quality enhancement. Implement the industry product quality improvement action plan by addressing key common quality challenges that have long hindered construction machinery development. Strengthen the development and application of reliability design, testing, and verification technologies. Promote the adoption of advanced forming and processing methods, online inspection systems, intelligent production and logistics systems, and testing equipment. These measures will ensure that critical physical product indicators—including performance stability, quality reliability, environmental adaptability, and service life—reach internationally advanced levels comparable to similar products.

——Promote the construction of manufacturing brands. Guide enterprises to improve and enhance their brand management systems, focusing on the entire process of R&D innovation, production, quality management, and marketing services, to enhance internal quality and consolidate the foundation for brand development. Create distinctive, competitive, and reputable regional brand clusters in the construction machinery industry. Foster a brand consumption concept to increase brand added value and soft power. Accelerate the

internationalization of Chinas construction machinery brand value evaluation and establish a positive image for Chinas manufacturing brands.

(4) Comprehensively promote green development and build a green manufacturing system for construction machinery

We will intensify R&D efforts in advanced energy-saving and environmental protection technologies, processes, and products, while accelerating green transformation and upgrading of construction machinery enterprises. By actively promoting low-carbon development, circular economy, and intensive resource utilization, we aim to enhance industry efficiency. Through comprehensive green management throughout product life cycles, we strive to establish an efficient, clean, low-carbon, and circular green manufacturing system, driving the realization of carbon peaking and carbon neutrality goals.

— Accelerate the development of eco-friendly products. Construction machinery enterprises should fulfill environmental protection requirements with a strong sense of social responsibility. They must not only continue R&D investments in energy-efficient, high-performance, and eco-friendly internal combustion engine products, but also speed up the development, industrialization, and market promotion of new energy

products such as hybrid and pure electric vehicles,
while exploring innovative energy-saving solutions.

Emission reduction technical roadmap. Implement emission control standards for non-road mobile construction machinery in phases, with enterprises completing technical reserves and productization as soon as possible to ensure compliance with the latest emission standards, thereby meeting environmental upgrade requirements.

China has implemented the third-stage emission limit standard on October 1, 2015, and will implement the fourth-stage emission standard for non-road construction machinery during the 14th Five-Year Plan period, gradually improving the emission level of construction machinery products and narrowing the emission gap with the developed countries of the European Union and the United States.

—— Establish a product market access system. Based on the identification code and equipment registration of construction machinery, establish a unified product access and supervision system for construction machinery, and establish and improve the access and supervision system for imported construction machinery.

— Emphasize the entire lifecycle with green production and construction. Upgrade the concept of green products and fully implement green development, achieving green manufacturing in the equipment manufacturing phase and eco-friendly construction during usage. Strengthen green supervision and improve the legal and regulatory framework for energy conservation and environmental protection. Enhance the application of noise and dust reduction technologies to improve equipments environmental performance, ensuring green production and application of machinery.

— Promote efficient resource recycling. Support enterprises in enhancing technological innovation and management to strengthen green lean manufacturing capabilities, significantly reducing energy, material, and water consumption. Continuously increase the proportion of green and low-carbon energy usage. Leverage the advantages of construction machinery in solid waste recycling and green building material production to create eco-friendly environments and sustainable structures. Vigorously develop the remanufacturing industry by implementing high-end and intelligent remanufacturing, advancing product

certification, and fostering the continuous healthy development of the remanufacturing sector.

(5) Accelerate the integration of Internet + and construction machinery industry, and promote the digital development of the industry

By building a network, platform and security function system, we will build a new type of network infrastructure that connects people, machines and things, form a new business form and application mode for intelligent development, and build a key infrastructure for the new industrial revolution characterized by digitalization, networking and intelligence.

Based on Chinas national conditions and industry realities, we will strategically integrate and promote cutting-edge technologies including industrial internet, IoT, 5G, AI, and blockchain for the construction machinery sector. During the 14th Five-Year Plan period, these innovations will be fully implemented across the entire value chain, covering intelligent design, smart manufacturing, smart services, and smart construction.

--Strengthening the construction of new infrastructure for the industrial Internet of construction machinery

Establish and improve the standard system of industrial Internet of construction machinery, accelerate personnel training, strengthen technological innovation ability, break through core technologies, improve safety protection ability, grasp the initiative of the development of industrial Internet of construction machinery in China, and consolidate the construction of

new infrastructure of industrial Internet of construction machinery.

By 2023, we will initially build an industrial Internet network infrastructure with low latency, high reliability and wide coverage, basically establish a relatively complete and reliable industrial Internet security guarantee system, basically build a vehicle-to-internet system covering major products in all industries, and initially realize a green and networked intelligent service system.

By 2025, China will fully leverage its indigenous system software, chip technologies, and Beidou navigation infrastructure to achieve comprehensive mastery of core technologies. The nation aims to establish an efficient, innovative, and eco-friendly supply chain system, along with a highly customized, personalized, and high-end intelligent manufacturing framework. Additionally, a digitally integrated, green, and networked smart construction system will be developed. These technological advancements will position China as a global leader in key sectors, achieving world-class standards in major fields.

During the 14th Five-Year Plan period, we will strive to establish and implement 5-6 industry standards related to industrial Internet, and strive

to achieve a pre-installation rate of 70% for Beidou terminals connected to the Internet of Vehicles for major host products.

— Establish a big data platform for the construction machinery industry to enhance its capacity to support the government and serve the industry

By leveraging big data from construction machinery, we will establish an ecological cloud platform for environmental management. This platform will conduct research on precise measurement of pollution emissions and their contribution levels. We aim to rapidly implement vehicle-to-everything (V2X) data integration for pollution control in key areas of the Beijing-Tianjin-Hebei region and its surrounding "2+26" cities. During the 14th Five-Year Plan period, we will strive to progressively incorporate more operational and newly added V2X data, thereby enhancing the comprehensive capabilities of the construction machinery industrys ecological cloud platform.

— Build an industrial Internet ecosystem for the construction machinery industry to enhance digitalization, intelligence, and high-end capabilities across the sector

To build an intelligent manufacturing industrial Internet ecosystem for the construction machinery industry that is adapted to Chinas national conditions, enhance the innovation capacity of business models in the whole industry,

and provide intelligent design, intelligent production, intelligent service, intelligent construction and other intelligent manufacturing value chain applications for upstream, middle and downstream users of the industry.

Accelerate the development of industrial internet platforms in the construction machinery sector. Prioritize the use of Chinas independently developed BeiDou navigation system and IoT chips as core infrastructure. Break through key technological bottlenecks in data connectivity, platform management, development tools, microservice frameworks, and modeling analysis. Establish a robust technical and industrial ecosystem to support industrial internet platform development. Create efficient cross-brand and cross-model intelligent application scenarios for smart design, smart production, smart services, and smart construction in the construction machinery industry.

By 2023, the construction machinery industry will establish an initial industrial internet ecosystem. This includes developing a cross-brand and cross-model super customer service platform, building enterprise-level intelligent manufacturing platforms to support digital, networked, and smart transformation, and creating industry-specific applications for targeted use cases. Leveraging edge

computing-capable smart vehicle terminals and wearable devices, the initiative will initially implement artificial intelligence systems, intelligent expert databases, and knowledge management frameworks.

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The system demonstrates intelligent operation and maintenance (O&M) applications through human-machine dialogues, machine-to-machine interconnections, and real-time condition sharing, enabling efficient closed-loop smart production and construction. The established industrial internet platform for construction machinery provides real-time, accurate, and efficient data support for government initiatives in ecological environment governance, workplace safety, and emergency response.

By 2025, we will focus on breakthroughs in the application of the whole value chain of intelligent design, intelligent production and intelligent construction, form a two-way iteration of intelligent design and intelligent production, realize the cross-brand, cross-model and cross-field industry super customer platform and intelligent construction platform, and realize a new intelligent manufacturing ecosystem of data-driven intelligent service and intelligent construction.

— Transform business philosophies and innovate the "Internet+" online marketing model. The new sales paradigm centered on online experience, device selection, purchase, and training will evolve with the deepening adjustment of supply-demand relationships and the rapid development of technologies like "Internet+", big data, AI, 5G

communication, and VR. This digitalized, networked, and user-centric sales model is poised to become the development direction in the new environment. The industry should seize opportunities in online and digital economies, keep pace with trends, continuously expand sales channels, and explore new market territories.

(6) Improve the level of international development and strive to achieve steady growth of overseas business

Seize the historical opportunity of the Belt and Road cooperation initiative, strengthen market research, enhance localized cooperation with local partners, and innovate development concepts and business models in a location-specific manner to establish a foothold in overseas markets as soon as possible. Promote industry enterprises to introduce and absorb advanced foreign technologies and experiences through various means such as international cooperation, joint development, and equity investment, aiming to build a globally influential brand of construction machinery. Conduct in-depth research on international markets, laws, finance, standards, and related issues to deepen and broaden alignment with international standards. Establish and utilize international marketing service and after-sales

service systems to build close ties with relevant international markets.

— Enhance foreign investment utilization and

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international cooperation.

Guide foreign investment

toward high-end manufacturing.

The government encourages foreign enterprises and research institutions to establish global R&D centers in China. It promotes active participation of domestic companies in building cooperative zones such as overseas industrial clusters, economic cooperation zones, industrial parks, and special economic zones. These initiatives aim to create well-developed regional investment environments with comprehensive infrastructure and supportive policies, fostering agglomeration and spillover effects. This strategy guides domestic enterprises to collectively expand overseas through clustered "going global" strategies.

— Enhancing Cross-border Operational Capabilities and International Competitiveness. Support the development of multinational corporations to accelerate core competitiveness through global resource utilization, business process reengineering, industrial chain integration, and capital market operations. Encourage enterprises to conduct overseas mergers and acquisitions, equity investments, and venture capital investments, while establishing R&D centers, experimental bases, and global marketing and service systems. Leverage internet technologies for collaborative online design, precision marketing, value-added service innovations, and media

brand promotion to build a global industrial chain system. This will enhance international operational capabilities and service standards, steadily increase market share, and optimize domestic and overseas industrial layouts and revenue structures. Guide enterprises to integrate into local cultures, strengthen social responsibility awareness, and improve investment and operational risk management to boost localization capabilities abroad. Develop risk response plans to effectively prevent and mitigate project execution risks. Encourage long-term development by establishing local roots, enhancing localization in employment and procurement, strengthening employee training, and actively promoting local employment and economic growth.

— Deepen international industrial cooperation and steadily promote enterprises to “go global”. Actively participate in and promote international production capacity cooperation, implement major initiatives such as the Belt and Road Initiative, accelerate infrastructure connectivity with neighboring countries, and deepen industrial cooperation. Strengthen policy guidance to extend industrial cooperation from primarily processing and manufacturing to high-end areas such as joint research and development, joint design, marketing, and

brand cultivation, thereby enhancing the level of international cooperation.

— Standardize overseas business operations. Companies must strictly comply with host country laws and regulations, respect local culture, religion, and customs, protect employees legal rights, safeguard intellectual property, maintain ethical business practices, and combat commercial bribery. They should prioritize resource conservation, environmental protection, and social responsibility. Establish evaluation mechanisms for overseas operations to promote credit system development. Strengthen risk management in foreign investments, enhance inter-enterprise coordination, uphold fair competition, and resolutely prevent disorderly and malicious competition.

(7) Strengthen the construction of talents and strive to improve the overall quality of talents in the construction machinery industry

Enhancing the capabilities of professionals in the construction machinery industry is crucial for building comprehensive competitiveness. Strengthening talent supply across key areas including forward-looking strategic planning, cutting-edge technology breakthroughs, product development, manufacturing, business innovation, and financial services forms the core of

establishing a high-quality, sustainable industrial ecosystem.

— Emphasizing the cultivation of innovative talents. Centered on industry development strategies, we will leverage major R&D initiatives as key platforms and corresponding innovation ecosystems. By fully utilizing global and domestic scientific resources, we aim to build a talent pool with original innovation capabilities, fostering world-class teams and high-level innovation groups. We will focus on nurturing a large contingent of young professionals with international perspectives and future-ready talent reserves. Through exemplary guidance, we will encourage enterprises to become primary drivers of technological innovation, motivating corporate talents to engage in cutting-edge innovation activities.

— Focus on cultivating international business professionals and marketing teams. Strengthen demand planning and systematic training programs for global talent, intensify efforts in developing and attracting international business professionals, and explore comprehensive approaches to enhance their competencies through job rotation, overseas training assignments, and targeted corporate training initiatives. Fully leverage

corporate training programs, specialized universities,
and social training institutions.

Establish a multi-level training system, focusing on strengthening knowledge in project management, engineering technology, international procurement, international marketing, legal contracts, local language and social customs, and improving job competence. Improve the salary system to create a good environment for "attracting and gathering talents".

— Establishing the continuous enhancement of vocational skills training. Develop industry-specific online and offline training platforms to leverage sector-specific training resources, gradually building a comprehensive vocational skills training system. Establish standardized and regulated training mechanisms with strict quality control, actively promote the development of vocational skills training standards for industrial chains, and systematically conduct vocational skill level evaluations to cultivate high-quality skilled professionals for the industry.

——Enhance talent evaluation and incentive mechanisms. Actively reform talent cultivation and utilization systems, establish talent development platforms, and foster an innovation-friendly environment. Through continuous efforts in talent recruitment and

training, we aim to build a pyramid-shaped talent team with rational structure, multi-level composition, high quality, and interdisciplinary expertise. This will establish a world-class talent hub and create intellectual advantages in the field.

(8) Supervise market order, resist unfair competition and strive to create a good market environment

To guide the industry to rationally address structural adjustments and cyclical patterns in market demand, we must prepare for potential short-term market corrections. This requires deepening supply-side structural reforms, strictly controlling investments in new production capacity, accelerating the elimination of outdated capacity and industry consolidation, improving overall capacity utilization rates, steering market development toward healthy growth, and preventing drastic fluctuations in the sector.

Establish a more perfect market monitoring system, and build a more professional market demand forecasting system by combining with new technologies such as big data and artificial intelligence, so as to provide reference for guiding industry development and enterprise decision-making.

(9) Actively develop service-oriented manufacturing and strengthen post-market management, and establish a withdrawal mechanism for old construction machinery

Manufacturers and distributors should move beyond traditional manufacturing and sales models, transitioning from production to manufacturing services. By integrating production, sales, and service operations, they should leverage cloud platforms and big data to deliver customized maintenance and repair services. Strengthening aftermarket management will drive brand differentiation and innovation in products and services through service excellence, ultimately extending the value chain.

Actively develop commercial leasing to achieve better control over the entire product lifecycle. By leveraging economies of scale, automated management can be implemented to reduce users operational costs. Leverage the supporting role of finance in the industry by expanding financial leasing services. Strengthen the integration of industry and finance to achieve mutual benefits, thereby promoting the healthy development of construction machinery leasing.

Through advanced technological solutions, we will implement comprehensive lifecycle supervision for construction machinery. The phased rollout of equipment

identification codes will be progressively expanded. By applying emerging technologies like blockchain, we will manage transaction and usage data throughout the equipments lifecycle, ensuring full-process monitoring of operational machinery. Leveraging next-generation ICT, we will establish government-regulated platforms and refine equipment supervision regulations. Through remote collection of operational and emission data, we will enhance industry oversight capabilities. Policy incentives including tax breaks and trade-in subsidies will be introduced to encourage voluntary retirement of used machinery.

VI. Key breakthrough technologies and industrialization innovation projects

(1) New high-tech engineering machinery innovation pilot project

1. High-end intelligent construction machinery innovation project

Targeting foundational and key common technologies in intelligent high-end construction machinery, and

To explore the cutting-edge research in intelligent technological innovation for construction machinery, the development direction of smart construction site technologies, and the demand for intelligent construction equipment, we encourage enterprises to focus on preliminary research, experimentation, and application of advanced intelligent construction machinery products. This includes conducting technological studies in areas such as full lifecycle design, intelligent control of heavy-load operations, and smart service technologies. By leveraging new technologies like industrial internet, artificial intelligence, and blockchain, we aim to accelerate the R&D and widespread adoption of intelligent construction machinery products.

We will intensify R&D efforts and pioneer breakthroughs in technologies such as dynamic multi-sensor environmental perception, 5G high-speed remote operation, autonomous decision-making, and human-machine interaction data control. Following a three-phase approach, we will progressively achieve the intelligent development goals for construction machinery products.

In the first phase during the initial stage of the 14th Five-Year Plan, the main products of construction machinery will achieve auxiliary human operation, slope

control, compaction control, effective load capacity, monitoring, and remote operation, realizing modular intelligence and autonomous safety management functions, and being put into practical application. This will enhance construction safety and meet the requirements of efficient, energy-saving, and high-quality construction.

In the second phase, by the end of the 14th Five-Year Plan period, key construction machinery products will achieve intelligent operation management features such as single-machine intelligent operation, unmanned operation, human-machine collaboration, and multi-machine collaboration. These products will demonstrate promising application prospects in industrial trials and evaluations, with practical implementation cases achieved. Partial unmanned operations will also be realized.

The third phase, beginning with the 14th Five-Year Plan, will focus on applied research and exploration of technologies such as artificial intelligence and autonomous construction systems. This phase aims to achieve full-scenario, all-equipment, and round-the-clock connectivity across construction sites. Through preparatory technical groundwork and localized pilot studies utilizing advanced technologies—including data connectivity, construction operation planning, and autonomous machine cluster systems—this phase will

establish the necessary conditions for subsequent R&D and application research after the 14th Five-Year Plan period.

2. Pilot project of electric construction machinery

With the gradual implementation of the "Action Plan

"14th Five-Year Plan for

for Promoting the

Electrification of Vehicles in

the Public Sector", ~50~

Environmental emission requirements are becoming increasingly strict, and the development of electric construction machinery has become a new development direction. In recent years, domestic and foreign research on electric construction machinery has been deepened, and some electric construction machinery products have been launched.

The development of electric construction machinery during the 14th Five-Year Plan period requires overcoming several key technologies: whole-vehicle battery thermal management control, battery safety management, and dynamic power matching control for complex operating conditions to achieve automatic optimization of power matching. It also involves developing critical components including high-efficiency power battery packs, integrated controllers, high-power charging piles, and high-capacity charging units. Furthermore, breakthroughs in whole-vehicle electrification control technology must be achieved.

Priority should be given to advancing the electrification of power systems in small and medium-sized non-road mobile machinery, with the goal of achieving ultra-low and zero emissions. Simultaneously, efforts should be accelerated to promote the adoption of new energy-powered non-road mobile machinery, while actively exploring business models that facilitate user acquisition, operation, and maintenance. In key urban

areas, regulations should be implemented to restrict the use of high-emission non-road mobile machinery, encouraging the prioritization of electric or clean energy-powered alternatives.

(2) Intelligent manufacturing promotion project of construction machinery

Focusing on foundational and key common technologies in intelligent manufacturing of high-end construction machinery and its critical components, we track the cutting-edge advancements in intelligent manufacturing and robotics innovation. By integrating 5G internet technologies, digital management, digital design, information technology, communication systems, sensor technologies, new materials, and advanced processes, we implement comprehensive solutions across production stages—from structural component forming, welding, and heat treatment to precision metal forming, standardized structural manufacturing, critical component production, assembly of parts and complete machines, and flexible intelligent coating. Through accumulated experience and phased implementation, we synergize industrialization and informatization to establish an intelligent manufacturing system and service ecosystem that spans the entire lifecycle of high-end construction machinery.

Intelligent manufacturing development. Enhance the intelligence level of production, realize the digitalization and information communication of the whole cycle from demand, design, production and delivery, realize personalized customization on the scale of assembly line, drive product personalization with information flow automation, innovate the new paradigm of construction machinery industry, and achieve differentiated competition.

The intelligent manufacturing of the upstream and downstream of the industrial chain realizes the docking of information flow and digital flow, builds an efficient, lean and digital industrial chain system, and realizes the digital coverage of the whole life cycle of parts, complete machine manufacturing, equipment use management, maintenance service, remanufacturing and equipment recycling.

(3) Engineering to improve the reliability of construction machinery products

The reliability of construction machinery is influenced by numerous factors. To comprehensively assess these elements, it is essential to establish a product quality reliability evaluation system. This system should accurately evaluate the technical quality status of construction machinery products, benchmark against internationally advanced

counterparts, and plan product upgrades while developing innovative technologies and manufacturing processes. Furthermore, it requires establishing comprehensive verification methods and evaluation frameworks for both complete machinery and components, including diversified reliability assessment approaches for whole machines and product consistency evaluation methodologies.

Select 3-5 categories of typical engineering machinery products (industrial vehicles, excavators, earthmoving and transportation equipment, engineering and construction lifting machinery, etc.) for reliability enhancement projects. Innovations will focus on enterprise management, production management, production process management, and supply chain management. Efforts will strengthen theoretical research on reliability, develop testing, verification, and validation methods, design methodologies, and evaluation standards for equipment, while advancing equipment development. A multi-pronged approach will be adopted to achieve breakthroughs as soon as possible.

During the 14th Five-Year Plan period, we will further implement systematic reliability enhancement projects and establish a comprehensive reliability technology system covering product design,

manufacturing, component production, testing, and maintenance.

The technical framework requires the refinement of technical standards, specifications, and corresponding testing platforms. Key technologies to be developed and enhanced include: (1) Reliability data acquisition and analysis technologies; (2) Reliability design technologies for complete systems and critical components; (3) Key technologies and equipment for improving manufacturing process reliability; (4) High-efficiency reliability testing technologies, equipment platforms, and standard specifications.

(5) Key component life prediction technology. The project will focus on building a comprehensive reliability testing base for construction machinery, including: (1) A typical construction machinery whole-machine driving durability test site;

(2) Special reliability test platform for key components; (3) Material failure analysis test platform; (4) Environmental simulation laboratory; (5) Reliability test platform for construction machinery, etc.

(4) Construction of digital platform for testing, testing and evaluation of construction machinery

Leverage the existing national capabilities of industry entities, including national testing and inspection centers, key national laboratories, national engineering laboratories, national engineering (technology) research centers, national enterprise

technology research centers, and research institutes and universities, to accelerate the digital and intelligent transformation of testing equipment. To meet the digital and intelligent upgrade requirements of construction machinery products, swiftly fill gaps in common technology testing platforms, verification platforms, multi-parameter integrated testing platforms, and large-scale comprehensive test sites. Pilot platform construction projects may initially select 4-6 enterprises, test sites, and research institutes for implementation.

Establishing a host test, inspection, and system analysis platform will further support the development of technological innovation systems and research platforms. The construction of an electromagnetic compatibility laboratory for complete engineering machinery and electronic components holds irreplaceable strategic significance for advancing electromagnetic compatibility technology in Chinas construction machinery industry. The establishment of a comprehensive testing ground enables performance benchmarking tests, compliance verification, validation trials, type certification, reliability assessments, and intelligent control experiments for group operations. This provides enhanced confidentiality and targeted research for new products, technologies, and

processes, while driving innovation and breakthroughs in testing technology development.

By the end of the 14th Five-Year Plan period, China is expected to develop comprehensive testing and analysis capabilities for complete construction machinery systems and critical components. This will help identify and resolve bottlenecks in the application of core technologies across major construction equipment, effectively enhancing industry testing and validation standards. The initiative will improve the reliability and safety of critical construction machinery products, drive industrial transformation and upgrading, and provide full-spectrum services to support the industrialization of these products.

(5) Strengthening the foundation of the construction machinery industry chain

Construction machinery industry chain foundation development project: construction machinery core basic components, construction machinery basic materials, construction machinery basic process, industrial basic technology and basic software and other five main areas.

Establish a host-led "one-stop" organizational structure: Further promote the integration and mutual support between component R&D and testing by OEMs and technological innovation and manufacturing process improvement by component manufacturers. Complement the

trial production of OEM components with the industrialization of specialized component enterprises, effectively driving the transformation and upgrading of the component industry.

In terms of core basic components, we will focus on supporting independent research and development of hydraulic components for construction machinery. The focus will be on critical components including plunger pumps, main control valves, and hydraulic motors, as well as hydraulic systems, power systems, power shift transmissions, drive axles, walking reducers, controllers, and sensors. During the 14th Five-Year Plan period, China aims to achieve 90% self-sufficiency in core foundational components, bring green manufacturing processes to international advanced levels, and make breakthroughs in key common technologies such as product reliability evaluation, digital and intelligent design, green manufacturing, and ergonomic product design.

In terms of industrial foundational technologies and core software: Key support will be provided for integrated machine control systems and software, reliability evaluation of construction machinery and its core components, intelligent control technologies for construction machinery, as well as energy-saving, emission-reduction, lightweight, and user-friendly design solutions. "14th Five-Year Plan"

Finally, the performance and reliability of a batch of domestic construction machinery control systems and components passed the strict industrial assessment. All kinds of construction machinery realized the independent control of controllers, human-machine interfaces, sensors and electric control and executive components, and the localization rate reached 30%~50%.

(6) Construction of industrial Internet application platform for construction machinery industry

We will accelerate the development of an industrial internet infrastructure featuring low latency, high reliability, and extensive coverage. This includes establishing a robust security framework for industrial internet operations, deploying vehicle-to-everything (V2X) systems that cover major products across all industries, and creating an intelligent service system with green and networked capabilities. During the 14th Five-Year Plan period (2021-2025), we aim to progressively integrate data from both existing and new connected vehicles, build an ecosystem cloud platform for the construction machinery industry, implement sustainable and precise environmental governance, and achieve green manufacturing, eco-friendly maintenance, and sustainable construction practices.

By the end of the 14th Five-Year Plan period, China will fully leverage its indigenous system software, chip

technologies, and BeiDou navigation infrastructure. The nation aims to master core technologies, establish an efficient, innovative, and eco-friendly supply chain system, develop a highly customized, personalized, and high-end intelligent manufacturing framework, and create a digitally integrated, green, and networked smart construction ecosystem. Key technological fields will achieve international advanced standards, while critical sectors will attain global leadership.

This cloud-based data management platform for the construction machinery industry serves upstream and downstream enterprises and construction contractors, establishing a unified national system. It enhances the industrys business model innovation capabilities, intelligent service capabilities, and smart manufacturing capabilities, providing end-to-end smart manufacturing value chain applications including intelligent design, production, services, and construction for users across the industry.

During the 14th Five-Year Plan period, the industrial internet platform system for the construction machinery industry will be initially established, forming a super customer platform and intelligent construction platform that spans brands, machine types, and fields. A number of enterprise-level platforms will be built to support the digital,

networked, and intelligent transformation of enterprises.

The platform develops industrial applications tailored for specific use cases and scenarios. By leveraging edge computing-capable smart vehicle terminals and wearable devices, it enables human-machine dialogue, machine-to-machine connectivity, and AI-powered expert database systems with knowledge graphs.

-Seamless integration of operational conditions, enabling efficient collaboration and closed-loop applications for intelligent manufacturing, smart services, and smart construction. The industrial internet platform for construction machinery will comprehensively provide real-time, accurate, and efficient data support for scientific management of ecological environment governance, production safety, and emergency rescue operations by the government.

VII. Safeguard measures and related recommendations

(1) Strengthen government guidance and deepen institutional reform, create a favorable environment for the high-quality development of the construction machinery industry to a new level and build a new development pattern

During the 14th Five-Year Plan period, we must accelerate the establishment of a new development paradigm featuring domestic circulation as the main driver, with domestic and international dual circulation mutually reinforcing each other. In the construction

machinery sector, we should strengthen the cultivation of national strategic scientific and technological capabilities, enhance enterprises technological innovation capacity, and protect their momentum for innovative development. We need to further unleash the potential of domestic economic growth, address bottlenecks in the domestic circulation system, and create a favorable environment for this new development pattern. By continuing to deepen reforms, establishing effective incentive mechanisms, and fostering an institutional environment that encourages innovation, we will eliminate institutional and systemic barriers hindering the market-oriented allocation of production factors and the circulation of goods and services. Furthermore, we should refine financial, tax, and quality supervision regulations to establish a high-standard, market-oriented, legally compliant, and internationalized business environment. This will elevate the global standing of Chinas construction machinery industry and propel it to become a leading sector that pioneers international development, ultimately securing a dominant position in the global market.

1. Strengthen the formulation and implementation of development strategies, plans, policies and standards for the construction machinery industry.

2. Improve the collaborative innovation mechanism
among government, industry,
academia, research, and
application, and reform the
management system for
technological
innovation~56~

"14th Five-Year Plan for

The project funds allocation, achievement evaluation and transformation mechanism will be promoted to promote the capitalization and industrialization of scientific and technological achievements and stimulate the innovation vitality of construction machinery enterprises.

3. Proceed with a prudent, phased approach to implement the upgraded emission standards for non-road mobile machinery. Further refine and eliminate provisions in systems, standards, and regulations that hinder the high-quality development of the construction machinery industry, address bottlenecks in the domestic economic cycle, and accelerate the establishment of a new development paradigm.

4. Accelerate the promotion and application of new energy construction machinery by creating a user-friendly policy environment for procurement, operation, and maintenance. Implement monitoring and management systems for operational machinery, enforce emission restrictions in key urban and regional areas, and establish incentive programs to prioritize the adoption of electric construction equipment.

5. Improve the clearance and upgrading of outdated equipment and production capacity, including those with environmental pollution or excessive emissions. Provide necessary financial support, ensure proper resettlement of workers, and handle

debt repayment. Gradually establish a scrapping and replacement mechanism for old construction machinery in use, along with supportive policies, and improve the market exit mechanism.

6. Deepen financial sector reforms to expand financing channels for construction machinery enterprises and reduce financing costs. Implement effective measures to standardize second-hand construction machinery trading channels, lower transaction costs, and resolve bottlenecks in the second-hand construction machinery market.

7. Give full play to the role of policy banks and development financial institutions, expand the financing channels of enterprises through various ways and innovative financial products, expand the coverage of export credit insurance for construction machinery, and support overseas investment enterprises to carry out overseas financial consumer credit and financial leasing business.

8. Give full play to the role of industry organizations in industry management, industry development, policy consultation, industry standards and regulation of industry order.

(2) Trade organizations shall earnestly perform their duties of trade management, promote technological progress in the industry, and create a market environment of fair competition

During the 14th Five-Year Plan period, the construction machinery industry organization should fully implement the spirit of the 19th National Congress of the Communist Party of China and the second, third, fourth, and fifth plenary sessions of the 19th CPC Central Committee, guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. It should adhere to the innovation-driven development strategy, take supply-side structural reform as the main line, and promote high-quality development of the industry. It should focus on structural optimization, wage a tough battle to "advance the industrial foundation and modernize the industrial chain," and build a high-level, independently controllable supply chain system. It should accelerate the establishment of a new development pattern with domestic circulation as the main body and domestic and international dual circulation promoting each other. It should adhere to talent as the foundation and follow a talent-led development path. Further narrowing the gap with international leading levels, it should advance the construction of a strong country in the construction machinery industry.

1. Strengthen the capacity building of industry organizations, improve the level of service capacity, and enhance the role of industry organizations in

promoting industrial technological progress, improving industrial management level, formulating group standards, reflecting the demands of enterprises, feedback on the implementation of policies, putting forward policy suggestions, and promoting the standardized and healthy development of the industry.

2. Strengthen industry self-discipline, improve the level of industry governance, standardize competitive behavior, and create a good production and operation environment for enterprises.

3. Promote the establishment of a support and guarantee mechanism to guide construction machinery enterprises to carry out structural adjustment and transformation and upgrading by means of market.

4. Strengthen the construction of social responsibility of construction machinery enterprises.

5. Strengthen the overall planning and classified guidance for the development of talents in the construction machinery industry, organize and implement the talent training plan for the construction machinery industry, increase the training of professional and technical personnel, management personnel and skilled personnel, and improve the training and assessment system of vocational skills.

6. Strengthen the prediction of industrial talent demand, improve the information database of various

talents, and build an industrial talent level evaluation system and information release platform.

7. Accelerate the development of overseas support service institutions and enhance their capabilities by establishing a public service platform for foreign investment and a technical trade service platform for export products, while improving trade response mechanisms.

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Early warning and coordination mechanism for major issues related to friction and overseas investment.

8. Encourage enterprises to invest in innovation projects, promote the demonstration effect of industry-university-research collaborative innovation led by enterprises, and promote the implementation of pilot projects of innovative application in the construction machinery industry.

(3) Accelerate the transformation of the growth mode and promote the high-quality development of construction machinery enterprises to a new level

During the 14th Five-Year Plan period, enterprises in the construction machinery industry should seize the important development opportunities in China, grasp the new stage of development scientifically, thoroughly implement the new development concept, accelerate the construction of a new development pattern, take promoting high-quality development as the theme, take deepening supply-side structural reform as the main line, and focus on their own affairs.

1. Commit to innovative development by continuously enhancing corporate service capabilities and product quality standards. Address critical weaknesses including low self-sufficiency rates in high-end equipment and components, as well as significant gaps in reliability and durability. Aim for international technological leadership by

overcoming existing constraints and strengthening R&D capabilities and testing rigor. Achieve breakthroughs in intelligent and digital technologies, while ensuring full compliance with market demands for emergency rescue machinery, winter sports equipment, and specialized engineering machinery.

2. Commit to green development by upgrading engine emissions to meet standards and requirements; further promote green manufacturing and construction to ensure green, safe, and efficient products throughout their entire life cycle.

3. Maintain coordinated development by proactively adjusting and refining corporate management and market expansion strategies to adapt to evolving market demands and shifting growth models. Accelerate the establishment of a comprehensive, efficient, stable, and reliable industrial chain system. Continuously enhance core industrial capabilities, improve fundamental R&D capacities, and elevate testing, certification, and quality assurance standards to achieve high-level sustainable development in the construction machinery sector.

4. Adhere to open development and continue to expand new areas in building a new development pattern.

New markets, further expanding international market space and areas of international cooperation, enhancing the competitiveness and international status of Chinas construction machinery industry. Implementing the Belt and Road Initiative, continuing to improve overseas business capabilities and scale, strengthening localized operations and international brand building, and building a first-class international construction machinery enterprise.

In foreign trade exports, we must prioritize addressing the growing number and scope of trade remedy investigations targeting Chinese enterprises. First, we should strengthen domestic capabilities by enhancing product competitiveness. This requires shifting export growth models to focus on increasing technological sophistication and value-added content, thereby expanding into broader and more diversified international markets. Second, standardized operations and regulated export procedures must be implemented to prevent disorderly competition. Third, export companies should adopt International Financial Reporting Standards (IFRS) for financial management, ensuring timely submission of valid documentation during trade sanctions. Additionally, cultivating a culture of respecting multilateral rules and mechanisms is crucial. This

involves training both professional legal teams and corporate legal staff to effectively resolve trade disputes within the WTO framework.

5. Adhere to the development of sharing, strict industry self-discipline, strict control of business risks, strict control of marketing links of all kinds of behaviors and practices that are not conducive to the sustainable, stable and healthy development of the industry, and avoid the phenomenon of drastic ups and downs in the economic operation of the industry.

Key technologies, products and key components for the construction machinery industry during the 14th Five-Year Plan period

I. Technologies to be encouraged during the 14th Five-Year Plan period

1. Green and energy-efficient technologies (electromagnetic compatibility, VOCs coating, noise control, emission reduction, and post-treatment)
2. High-end hydraulic transmission technology
3. High-end hydraulic mechanical transmission technology
4. Reliability Technology
5. Digital intelligent control technology
6. Key parts and whole machine inspection and testing technology

2. Key equipment to be developed during the 14th Five-Year Plan period

1. Large land wind power lifting equipment
2. Intelligent construction machinery and intelligent auxiliary devices
3. New energy construction machinery (pure electric, hybrid, etc.)
4. Eco-friendly construction machinery (including engines with low emissions, low dust, and low exhaust)

3. Key support and encouragement for the development of construction machinery products and key components

Serial Number Product Name		Main technical specifications of the host	Key components and main indicators
Excavator and dump truck			
1	hydraulic crawler excavator	The total weight of the machine is $\geq 40\text{t}$; the rated power is $\geq 200\text{kW}$	Pump valve motor (32MPa), electronic control system, rotary support, and rotary motor assembly (Rated pressure $\geq 28\text{MPa}$; displacement $\geq 180\text{ml/r}$), walking reducer, sensor
2	soil shifter	(1) Hydraulic-mechanical transmission bulldozers: rated power $\geq 220\text{ Hp}$; (2) Static pressure transmission bulldozers: rated power $\geq 95\text{ kW}$;	Torque converter, electric proportional automatic transmission, pump valve motor, and reducer
3	loader	Rated load capacity is $\geq 7\text{ tons}$;	Torque converter, wet brake drive axle, electronically controlled automatic

			transmission, and pump valve (electro-hydraulic proportional control multi-port valve) (25MPa)
4	mining dump vechicle		

Large lifting machinery

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order number	product name	Main technical specifications of the host	Key components and main indicators
1	crawler crane	Maximum lifting capacity $\geq 500\text{t}$	$\geq 500\text{L/min}$ multi-port valve, variable displacement motor ($\geq 250\text{cc/r}$), high-pressure closed plunger pump ($\geq 180\text{cc/r}$), hydraulic multi-port valve ($\geq 500\text{l/min}$, $\geq 35\text{Mpa}$), electrically controlled
2	All-terrain crane	Maximum lifting capacity $> 100\text{t}$; specific power ≥ 6	Open variable pump with a displacement of $\geq 140\text{ mL/r}$, closed variable pump with a displacement of $\geq 70\text{ mL/r}$ Multi-port valve with $\geq 500\text{L/min}$ flow capacity, high-speed variable displacement plunger motor with $\geq 5000\text{r/min}$ speed and $\geq 200\text{mL/r}$ displacement, high-pressure motor with $\geq 35\text{MPa}$ pressure rating, and large-load disconnectible axle
3	autocrane	Maximum lifting capacity $\geq 70\text{t}$; specific power ≥ 5.9	Chassis, transmission, open variable pump $\geq 140\text{ mL/r}$, closed variable pump $\geq 70\text{ mL/r}$, multi-port valve $\geq 500\text{ L/min}$, high-speed variable piston motor $\geq 5000\text{ r/min}$, and high-pressure motor $\geq 200\text{ mL/r}$, all exceeding 35 MPa .
4	truck crane	Maximum lifting capacity $\geq 50\text{t}$; maximum lifting moment of basic boom $\geq 2400\text{kNm}$; maximum lifting height of longest main boom $\geq 48\text{m}$	Chassis, transmission, high-speed variable -piston motor ($\geq 5000\text{ rpm}$, $\geq 35\text{ MPa}$), hydraulic steering gear ($\geq 500\text{ ml/r}$), swashplate-type Variable displacement plunger pump ($\geq 60\text{ mlr}$, $\geq 35\text{ Mpa}$)
5	tower crane	Maximum lifting capacity $\geq 60\text{t}$; maximum lifting moment $\geq 2000\text{ kNm}$;	High-reliability reducers with wide speed ratios, dedicated to tower cranes above 200kW , featuring motor control systems and high torque capabilities
6	Desert off-road tire crane	Maximum lifting capacity $\geq 85\text{t}$, desert driving speed $\geq 15\text{ km/h}$, ground operation unevenness $\geq 1.5^\circ$	Desert off-road tires, chassis, transmission, radiator
7	Track crane	Maximum rated lifting capacity $\geq 5000\text{t}$; maximum lifting moment $\geq 100000\text{tm}$	Large truss arms, heavy-duty winches, high-strength steel pipes, and high-power engines
Industrial Vehicles			
1	Container overhead crane	Maximum lifting capacity is $\geq 25\text{ tons}$	Transmission system (transmission, torque converter), electronic control
2	fork lift truck	Lifting capacity $\geq 9\text{t}$	Transmission system (transmission, torque converter), electronic control

Tunneling machinery and equipment			
1	Large cross-section tunnel boring machine	(1) TBM: cutter head diameter $\geq 12\text{m}$ (double-helical TBM $\geq 6\text{m}$) (2) TBM (Tunnel Boring Machine): cutter head diameter $\geq 7\text{m}$; (3) Shaft boring machine: excavation diameter $\geq 6\text{m}$; shaft depth $\geq 150\text{m}$	Main drive bearing, pump (750 mLr pump), valve motor (500 mL/r motor) Pressure $>32\text{ MPa}$), permanent magnet synchronous motor, electronic control, main drive reducer (gear ratio ≥ 81 ; output power $\geq 200\text{ kW}$)
2	Non-excavation horizontal directional drilling rig	Retraction force $\geq 4000\text{ kN}$; power head torque $\geq 14000\text{ N}\cdot\text{m}$	Pump, Valve, Motor
3	Tunnel pre-cutting slot equipment	The slot depth must be $\geq 6\text{m}$; the tunnel slot radius (inner diameter of the arch slot) must be $\geq 5\text{m}$; the rock and soil compressive strength must be $\geq 10\text{ MPa}$; the rated installed power must be $\geq 500\text{kW}$	Pump (750 mL/h pump), valve motor (500 mL/h motor) ($\geq 32\text{ MPa}$), permanent magnet synchronous motor, electric control

piling machinery			
3	Underground diaphragm wall equipment	Wall thickness $\geq 550\text{mm}$; wall depth $\geq 50\text{m}$; compressive strength of stratum $\geq 10\text{MPa}$; rated output power $\geq 240\text{kW}$	Variable control methods include pump valve motor (rated pressure $\geq 35\text{MPa}$, peak pressure 42MPa) and electric proportional closed-loop control.
4	Hydraulic two-wheel milling machine	The wall thickness must be $\geq 1500\text{mm}$; the wall depth must be $\geq 150\text{m}$; the compressive strength of the stratum must be $\geq 50\text{MPa}$	Variable control systems including pump valve motor (rated pressure $\geq 35\text{MPa}$, peak pressure 42MPa) and electric proportional closed-loop control; engine power exceeding 500kW
5	Excavator	The power head delivers a torque of $\geq 400\text{kNm}$, with a drilling diameter of $\geq 2.5\text{m}$ and a depth of $\geq 100\text{m}$.	The axial piston pump/motor features a rated pressure of $\geq 35\text{ MPa}$, a peak pressure of 42 MPa , and employs variable control methods including electric proportional closed-loop control.

High-altitude working machinery and emergency rescue equipment

order number	product name	Main technical specifications of the host	Key components and main indicators
1	Fire truck with raised platform	Minimum working height: 47m; Maximum boom tip load capacity (for long-distance rescue operations): 200kg; Minimum fire pump flow rate: 40L/s	
2	Track-type all-terrain engineering vehicle	The slope is $\geq 45\%$	
3	Multi-functional snowplow	Snow removal capacity $\geq 250\text{t/h}$; maximum snow removal depth $\geq 1\text{m}$; maximum snow removal speed $\geq 10\text{km/h}$; maximum snow throw distance $\geq 15\text{m}$	
4	overhead working truck	Maximum working height $\geq 20\text{m}$; rated load $\geq 300\text{ kg}$, working radius $\geq 10\text{m}$; maximum working height $\geq 22\text{m}$ (Blue plate vehicle)	Chassis (power over 130KW), pump valve motor (20Mpa), precision electronic control, various sensor components, lightweight high-strength steel plate
5	Elevator platform	Minimum working height: 58m; Maximum load capacity: 460kg	Electric control pumps, chip-type proportional multi-way valves, walking reducers, rotary reducers, oscillating cylinders, lithium batteries, multi-motor combined drive controllers, high-power low-voltage AC motors, along with matching reducers, safety controllers (CAT3, SIL2, PL \geq d), various sensors, and high-strength steel plates.
Reinforcement and prestressing machinery			
1	Steel flexible automatic welding mesh production line	A fully automated production line for perforated wire mesh, integrating steel bar straightening, cutting, material distribution, welding, and output. The welded mesh features steel bars with diameters of 6-12mm, achieving a maximum welding speed of over 200 points per minute.	
2	Steel bar mesh automatic bending production	An all-in-one automated production line for steel mesh fabrication, featuring mesh capture, positioning, multi-station bending, and output. Capable of processing mesh with maximum bar diameter $\leq 12\text{mm}$ and maximum width $\leq 4\text{m}$.	

	line		
3	Steel truss welding production line	An automated steel truss welding production line that integrates rebar straightening, bending, welding, cutting, and output, with a processing speed of $\geq 8\text{m/min}$ and a maximum truss height of $\geq 400\text{mm}$.	
4	Steel bar processing production line	Automated processing of prefabricated steel reinforcement skeleton, with main bar spacing accuracy $\leq 4\text{mm}$	
5	Third generation nuclear power pre-stressed anchoring system	Anchorage hole position ≥ 55	
6	Nuclear power anti-aircraft impact steel joint and supporting equipment	Maximum bar diameter $\geq 40\text{mm}$	

Rock drilling equipment

1	Multi-arm rock drilling rig	Single-arm rated power $\geq 30\text{kW}$; drilling speed $\geq 3\text{m/min}$; working width $\geq 16\text{m}$, working height $\geq 12\text{m}$, coverage area $\geq 180\text{m}^2$;	Pump valve motor ($\geq 32\text{Mpa}$), electronic control system, drive axle, sensor
2	hydraulic drill	Weight: 200–250kg; Working pressure: 15–22MPa; Impact power: 20–25kW; Impact frequency: 38–48Hz; impact flow rate 110–130L/min; rotary torque 1500–2000N.m; borehole diameter 89–140mm	

Ice and snow sports equipment

1	Heat recovery carbon dioxide ice making system	The cooling capacity is $\geq 600\text{kW}$; the ice surface temperature can be adjusted from -10 to -3°C with control accuracy of $\pm 0.5^{\circ}\text{C}$; it is equipped with a built-in heat recovery system, and the heating capacity is $\geq 720\text{kW}$	
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order number	product name	Main technical specifications of the host	Key components and main indicators
2	Integrated block unit for environmental refrigeration and cooling	The system features a cooling capacity of $\geq 650\text{kW}$, with adjustable ice surface temperature ranging from -3 to 10°C . It has an installed rated power of $\geq 200\text{kW}$, designed for standard indoor short track speed skating rinks ($60\text{m}\times 31\text{m}$). The equipment utilizes eco-friendly refrigerant R513 and natural refrigerant R744.	
3	Ice Creamer	The rated power of the traction motor is $\geq 2\times 9.6\text{kW}$; the ground speed is $\geq 16\text{kmh}$; the turning radius is $\leq 4.8\text{m}$	
4	Snowplow	Rated power $\geq 360\text{ hp}$; maximum climbing capacity $\geq 45^{\circ}$; walking speed $\geq 18.5\text{kmh}$; can be used for alpine ski slopes, cross-country ski slopes and snow park maintenance, and can transport passengers	Transmission system (transmission, torque converter), electronic control
5	Snow sightseeing transport rescue vehicle	Minimum speed $\geq 22\text{km/h}$; maximum climbing angle $\geq 30^{\circ}$; ground contact pressure $\leq 10\text{kPa}$; maximum load capacity $\geq 1500\text{kg}$ (20 people)	
6	Ejector Traction Device	The projectile target must have a mass of at least 80 kg and a sliding speed of at least 30 m/s , with adjustable parameters.	
7	Cross-country skiing trajectory analysis and projection lead system	$\leq 5\text{cm}$ athlete position tracking error; $\leq 1\text{cm/s}$ athlete speed tracking error; $\geq 3\text{h}$ random flight duration; $\geq 5\text{h}$ data relay machine airborne duration; $>4\text{MB/s}$ data link transmission speed; adaptable to high-altitude and low-temperature environments (altitude $\geq 4000\text{m}$, temperature $\leq 30^{\circ}\text{C}$)	
8	snowmaker	At a marginal temperature, the multi-core reactor system achieves optimal snow quality and production capacity with a snowmaking rate of $107\text{m}^3/\text{h}$.	Nuclear reactor, nozzle, filter, temperature sensor, etc
9	Gondola/cable car at the ski resort	Available in detachable/fixed configurations; suspended cabins/chairs; with seating for 2/4/6/8 people	Drive motor, steel wire rope, box body, etc
10	magic carpet	Speed range: $0.1\text{--}1.0\text{m/s}$, normal operating speed: $0.6\text{--}1.0\text{m/s}$, energy efficiency ratio speed: $0.75\text{--}0.9\text{m/s}$, start, maintenance, emergency speed: 0.6m/s	Electrical control cabinet, text display, track, etc
11	Snowmobile	Two-stroke, four-stroke, etc	Engine, cylinder, sled board, etc

12	Carbon dioxide transcritical direct cooling ice making and heating unit	The refrigeration unit employs a two-stage compression system. With an evaporation temperature of -13°C , it delivers a total cooling capacity of $Q \geq 720\text{ kW}$ (including low-pressure and high-pressure compressors and a CO2 hermetically sealed pump). The ice surface maintains a uniform temperature across 1830 m^2 with a maximum temperature difference of $\leq 0.3^{\circ}\text{C}$, while ensuring horizontal surface precision within 3m of $\leq \pm 3\text{ mm}$. Utilizing CO2 refrigerant, the system features a built-in three-stage heat recovery system.	
13	400m speed skating Ice rink carbon dioxide refrigeration system	The system delivers a cooling capacity of $\geq 1131\text{ kW}$, with a coefficient of performance (COP) ≥ 2.768 under $-17^{\circ}\text{C}/+36^{\circ}\text{C}$ conditions. It maintains a temperature difference of $\leq 0.4^{\circ}\text{C}$ across the entire 9600 m^2 ice surface, ensuring horizontal precision within $\pm 3\text{mm}$ within a 3-meter radius. The system employs carbon dioxide as the refrigerant. Agent, with built-in heat recovery system.	
Road construction and maintenance machinery			
1	paver	The paving width should be $\geq 7\text{m}$ ($\geq 4\text{m}$ for curved surface pavers), with a minimum thickness of 30 cm and a maximum gradient of 45° .	
2	Grader	Grave width $\geq 1.5\text{m}$	
3	Hot air microwave composite in-situ thermal regeneration unit	A single hot air wall unit must be at least 9 meters long, with a microwave power of at least 450kW and a local heat regeneration capacity of at least 120 tons per hour.	
4	Asphalt pavement cleaning site hot regeneration unit	The maximum regenerative thickness is 60 mm , with a width of 4500 mm and a speed of 6 m/min . The emission concentration of asphalt fumes meets the requirements of the Technical Specification for Regeneration of Highway Asphalt Pavement (JTG/T5521-2019).	Pump motor (45MPa), drying and heating system, steering drive axle, high-temperature resistant stainless steel plate
5	Continuous asphalt mixing and regeneration dryer drum	The recycled mixing capacity must be $\geq 300\text{T/h}$, with a maximum RAP (Reclaimed Asphalt Paving) blending ratio of $\geq 70\%$.	
6	Super large multi-function	The paving width is $\geq 12\text{m}$ ($\geq 4\text{m}$ for curved surfaces), with a thickness of $\geq 50\text{cm}$ and rated power of $\geq 250\text{kW}$. It is suitable for	

	paver	asphalt mixture and stabilized soil paving construction.	
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order number	product name	Main technical specifications of the host	Key components and main indicators
7	Cement pavement resonance crushing equipment	Minimum working width: 3m, minimum crushing depth: 200mm, minimum working speed: 3m/min	
8	Electric drive fiber stone crushing synchronous sealing vehicle	The chassis is powered by a fuel engine with a power output of $\geq 200\text{kW}$, while the working device is electrically driven. It achieves a driving speed of $\geq 100\text{km/h}$, operates at a speed of 2-7m/min, and delivers a spray volume of 0.3-3.0L/m ² .	
9	Multi-purpose curb structure slip-form paver	Maximum paving width on the side shall be $\geq 2\text{m}$; maximum height of structures shall be $\geq 1.3\text{m}$; precise linear control, full automation of construction	Control system, sensor, special mold, etc
10	Hedge trimmer maintenance vehicle	Maximum working range $\geq 4000\text{ mm}$; rated lifting capacity $\geq 500\text{kg}$; grass cutting omission rate $\leq 8\%$; hedge trimming omission rate $\leq 8\%$; branch trimming tear rate $\leq 10\%$; debris recovery rate $\geq 80\%$	
11	Railway and road dual-purpose engineering rescue robot	With a slope of $\geq 45\%$, it delivers an effective traction force of $\geq 20,000\text{N}$ and a speed of $\geq 80\text{km/h}$. Featuring full electric drive and multi-functional capabilities, it is suitable for both road and rail transportation.	
12	Anti-Collision Buffer	It can protect passenger cars from impact at speeds above 100km/h, with a warning distance of at least 200m.	Anti-collision buffer device, test standard
13	Heavy-duty crash cushion	It can withstand the impact of heavy trucks over 10 tons at speeds above 60km/h, with a warning distance of at least 200m.	Anti-collision buffer device, test standard
		Municipal and sanitation machinery	
1	dumpcart	Rated load capacity $\geq 8\text{t}$	
2	sweeping machine	The cleaning efficiency should be $\geq 92\%$, with a cleaning width of 2800-3500mm.	
3	Wash car	The cleaning width ranges from 8 to 28 meters, with a water cannon range of at least 38 meters and a working pressure of at least 10 MPa.	
4	Smart cleaning	Pure electric, driverless, 6-hour battery life, operating speed 0-	

	robot	5km/h, positioning accuracy $\leq \pm 10\text{cm}$	
Concrete machinery and concrete products machinery			
1	Large concrete pump truck	Pump height $\geq 50\text{m}$	Chassis, transmission, pump, valve, motor ($\geq 32\text{MPa}$), high-strength steel plate, and high-pressure high-speed large-displacement main oil cylinder for concrete pump trucks over 60 meters (rated pressure $35\text{MPa} \sim 50\text{MPa}$; speed $1\text{m/s} \sim 2\text{m/s}$)
1	hacking machine	Either overhead or floor track, grab or hoist type, with a cycle time of no more than 10 minutes and a lifting capacity of at least 25t	Winch mechanism, walking mechanism, bracket mechanism, and electronic control
2	High-speed concrete feeder	The operating speed should be no less than 70m/min , and the effective volume should be no less than 2m^3	Inverter, reducer
3	Smart spiral fabricer	Fabric dispensing speed $0.5\text{--}1.5\text{m}^3/\text{h}$, the walking speed of the large car is $0\text{--}30\text{m/min}$, the speed of the small car is $0\text{--}10\text{m/min}$, with automatic fabric dispensing function.	Mixing shaft, screw shaft, electric control
4	Energy saving three-layer curing kiln	Solar energy or air source heat pump is introduced as the auxiliary heat source, and the heating system parameters and structure of the maintenance kiln are rationally planned.	Electrical control, insulation board
5	High efficiency and low noise vibration table	The vibration duration should not exceed 2 minutes, with noise levels capped at 85 dBA. The system operates through either high-frequency one-dimensional or low-frequency three-dimensional vibration modes.	Vibrator, electric control, pump
6	Stacker and palletizer	No manual assistance is required for attachment or detachment. The operation can be automated with a cycle time of no more than 6 minutes.	Winch mechanism, bracket mechanism, and electronic control
7	Digital Smart PC Factory	PC component production data, component performance traceability, energy utilization and analysis, fault diagnosis and analysis	drive-by-wire

order number	product name	Main technical specifications of the host	Key components and main indicators
8	Automatic extrusion wall panel production line	The annual production capacity should be no less than 500,000 m ² , with wastewater recycling and zero waste discharge. The dimensional tolerances are: length ± 5 mm, width ± 2 mm, and flatness ≤ 2 mm. The panel surface must be free of through cracks, with crack dimensions ranging from 50–100 mm in length and 0.5–1 mm in width. No more than 2 per board	Or alternatively: Stationary 200-type wall panel extrusion molding machine, Stationary extrusion molding steel bar embedding system
9	Automatic tube piercing machine	The system can extract or thread 70 pipes per cycle, with a maximum speed of 8 minutes per cycle.	hydraulic pressure system
10	Multi-functional lightweight wall panel forming machine	The length error is $\leq \pm 5$ mm, the width error is $\leq \pm 2$ mm, and the flatness of the plate surface is ≤ 2 mm. The daily output of single mode is 36m ² , which is suitable for the production of lightweight wall panels with hollow, solid, various materials and various components reinforcement processes.	templet
11	Wall panel joint molding robot	The multifunctional lightweight wall panel forming machine enables automatic installation and removal of molds, with a single operation capable of handling 10 molds in one cycle, and the operation speed does not exceed 8 minutes per cycle.	Walking mechanism, positioning and guidance mechanism
12	Wall panel foam remover	Process 10 cavities per cycle with a maximum duration of 8 minutes, and limit the number of honeycomb pores (5–30mm long diameter) to ≤ 3 per sheet.	Walking mechanism, positioning and guidance mechanism, vibration device
13	Foamed cement lightweight wall panel formula	The compressive strength must be ≥ 4 MPa, with a bending load capacity (self-weight multiple) of ≥ 1.6 . After seven impact tests, the plate surface must show no cracks, surface layer detachment, or frosting defects.	
14	Fly ash concrete lightweight wall panel formula	The compressive strength must be ≥ 4 MPa, with a bending load capacity (self-weight multiple) of ≥ 1.6 . After seven impact tests, the plate surface must show no cracks, surface layer detachment, or frosting defects.	
15	Autoclaved aerated concrete	For aerated concrete blanks with a bottom surface thickness of ≥ 45 mm, perform splitting operations at speeds ranging from 0 to 7m/min using at least 68 hydraulic cylinders and an intelligent	hydraulic pressure system

	production line board machine	control system.	
16	Autoclaved aerated concrete production line cutting machine	The cutting length tolerance is $\leq \pm 5\text{mm}$, width tolerance is $\leq \pm 2\text{mm}$, thickness tolerance is $\leq \pm 1.5\text{mm}$, and surface flatness is $\leq 2\text{mm}$. The cutting pass rate exceeds 95%.	Wire lock and lifting mechanism
17	Integrated mold removal and installation machine for autoclaved aerated concrete production line	Equipped with automatic loading/unloading mold cart, precision positioning, and anti-disengagement technology, with a lifting capacity of at least 16t, traveling speed of 0-60m/min, and lifting speed of 0-10m/min.	Walking mechanism, anti-disengagement mechanism, lifting mechanism
18	Specialized transport vehicle for prefabricated concrete components	Maximum transport weight ≥ 25 tons, maximum transport length ≥ 9 meters, maximum transport height ≥ 2.5 meters	The semi-trailer must be ≤ 13 meters long, ≤ 2.55 meters wide, and ≤ 3.6 meters high.
19	Prefabricated concrete element surface treatment machine		
20	Fully automatic installation equipment for prefabricated concrete components		

Construction machinery spare parts

1	Digital	Rated pressure $\geq 35\text{Mpa}$; flow rate $\geq 125\text{L/min}$; speed range ≥ 500	
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	Hydraulic Motor	times; minimum speed ≤ 2 r/min	
2	Digital Hydraulic Valve	Rated pressure ≥ 35 MPa; Flow range: 0-300 L/min; Digital spool proportional servo valve: 0-2000 L/min	
3	High-flow electro-hydraulic proportional two-way spool valve and electro-hydraulic proportional valve	Rated pressure ≥ 35 MPa; flow rate ≥ 200 L/min	

order number	product name	Main technical specifications of the host	Key components and main indicators
4	Digital Hydraulic Cylinder	Rated pressure $\geq 35\text{MPa}$; Stroke: 0-2m; Speed range: $\geq 500\text{x}$; Repeated positioning accuracy: $\pm 0.1\text{mm}$; The integrated cylinder body and digital servo control system, combined with a single valve and feedback mechanism, enables closed-loop control of chamber volume.	
5	Electric wheel mining dump truck transmission system	Generator: Rated power $\geq 1050\text{kW}$, rated current $\geq 325\text{A}$; Resistance box: Brake resistor power Rated voltage: 1500V; Motor: Rated power $\geq 1000\text{ kW}$, rated current $\geq 780\text{A}$; Minimum vehicle tonnage: 200t	
6	Pure electric loader gearbox	Designed for 3-7 ton applications, featuring automatic gear shifting with noise $\leq 88\text{ dB(A)}$	
7	High Cleanliness, Longevity High-pressure wear-resistant hydraulic oil	Cleanliness $\geq \text{NAS7}$, oil change interval $\geq 5000\text{h}$, hydraulic system pressure $\geq 35\text{MPa}$	
8	Heavy-duty hydraulic transmission oil	Meets the specifications of heavy-duty hydraulic transmission oils such as Caterpillar TO-4 and ASTM PTF-3.	
9	Engine oil for ultra-long life off-road machinery meeting four-stage emission specifications	The oil change interval is 1500h (currently 500h), meeting the American Petroleum Institute (API) APICK-4 specification and four-stage emission standards.	
10	Cryolubricant oil for new environmentally friendly refrigerants	Meet the requirements of new environmentally friendly refrigerant (R513) and natural refrigerant (R744).	

11	Hydraulic cylinder for super large mining dump truck	The system operates within a rated pressure range of 12MPa to 28MPa. The hydraulic cylinder runs at a maximum speed of 1m/s, with a starting pressure of ≤ 0.15 MPa. It functions in an ambient temperature range of -40°C to $+80^{\circ}\text{C}$, with a service life of $\geq 500,000$ directional changes and a Mean Time To Failure (MTTF) of $\geq 5000\text{h}$. The suspension cylinder requires maintenance using inert gas every 30 days, and the equipment is designed for applications with a total weight of $\geq 320\text{t}$.	Sealed and leak-free operation time $\geq 5000\text{h}$; Corrosion resistance index of piston rod: neutral salt spray test 244h ≥ 9 grade.
12	High reliability mining excavator hydraulic cylinder	Rated pressure: 35 MPa; Cylinder speed: <1 m/s; Oil temperature: -20°C to 90°C ; Mean Time To Failure (MTTF): $\geq 5000\text{h}$; Service life: $\geq 12000\text{h}$. Applicable to vehicles with a total tonnage of $\geq 75\text{t}$.	Corrosion resistance of piston rod: CASS test for 64 hours, grade ≥ 9.8 ; bushing lubrication interval ≥ 200 hours.
13	High reliability hydraulic cylinder for all road cranes over 1,000 tons	The system operates with a rated pressure range of 30MPa to 60MPa, a hydraulic cylinder speed of $\leq 1\text{m/s}$, and a load efficiency of 92%. It features a minimum 300,000-directional switching cycles and a Mean Time To Failure (MTTF) of $\geq 2200\text{h}$. The integrated main unit delivers a maximum lifting capacity of $\geq 1000\text{t}$.	Piston rod corrosion resistance: 200 hours of neutral salt spray test (Class 9 or higher), and ≥ 550 cycles of coating bending fatigue test (no cracks); leak-proof operation time $\geq 2000\text{h}$.
14	Long life tire crane hydraulic cylinder	Rated pressure: $20\text{ MPa} \leq \text{Nominal pressure} \leq 45\text{ MPa}$; Minimum stable operating speed: $\leq 0.02\text{ m/s}$; Operating temperature range: -40°C to $+50^{\circ}\text{C}$; Reversal cycles: $> 300,000$; Mean Time To Failure (MTTF): $\geq 2300\text{ h}$. Maximum lifting capacity of the accompanying main unit: $\geq 20\text{ t}$.	Piston rod corrosion resistance: 200 hours of neutral salt spray test (Class 9 or higher), and ≥ 550 cycles of coating bending fatigue test (no cracks); leak-proof operation time $\geq 2000\text{h}$.
15	High-precision motor	Rated pressure $\geq 40\text{MPa}$; displacement $\geq 160\text{ml/r}$; minimum output speed $\leq 50\text{r/min}$ under rated load; maximum output speed $> 5000\text{r/min}$	
16	Long stroke thin wall lightweight hydraulic cylinder	Travel distance $> 10\text{m}$, pressure $\geq 30\text{MPa}$, wall thickness $\leq 8\text{mm}$	

order number	product name	Main technical specifications of the host	Key components and main indicators
17	High pressure large displacement closed pump	Rated pressure ≥ 40 MPa; displacement ≥ 125 ml/r; speed > 2500 r/min;	
18	High pressure high flow balance valve	Rated pressure ≥ 40 MPa; flow rate ≥ 500 L/min, hysteresis $\leq 8\%$	
19	High-strength fiber rope	Diameter $\phi 10 - \phi 28$ mm, the highest breaking strength is equivalent to the performance of the same specification steel wire rope, working temperature: $40 \sim 85^{\circ}\text{C}$	
20	Wireless length sensor	For measuring distances ≥ 10 m, with a precision of ± 0.1 mm and repeatability of ± 0.5 mm; operating temperature: $(40 \sim 100)^{\circ}\text{C}$; Protection rating IP68 or higher; Features: High-voltage and deformation-resistant absolute displacement and speed measurement.	
21	Body posture monitoring device	Output frequency: ≥ 500 HZ; Startup time: ≤ 0.1 s; Measurement accuracy: $\pm 5\%$; Response time: ≤ 10 ms; operating temperature: $-35^{\circ}\text{C} \sim 70^{\circ}\text{C}$, protection rating: IP67, mean time between failures (MTBF): ≥ 9000 h, wireless transmission range: 100m.	
22	High-performance big data processing controller	Processor clock speed: > 1 GHz; integer performance: 22KDMIPS (million instructions per second); small 80GFLOPS arithmetic performance, delivering 800 billion floating-point operations per second; high-definition image processing at 6Gpix/sec (pixels per second); and five types of big data streaming interfaces including audio-video encoding/decoding, millimeter-wave radar, infrared sensors, and LiDAR.	
23	High power and high precision fault diagnosis multi-way valve	Rated pressure ≥ 40 MPa; maximum flow capacity ≥ 600 L/min; valve core displacement detection accuracy ≤ 0.1 mm; displacement hysteresis $\leq 5\%$; equipped with self-diagnosis function integrating valve core displacement, pressure, temperature, and other parameters	

24	uprated engine	Output torque $\geq 3300\text{Nm}$, power $\geq 540\text{kW}$, failure-free operation $\geq 2000\text{h}$, service life $\geq 20000\text{h}$, emissions meet China VIb standards	
25	Dynamic wireless tilt sensor	Rolling accuracy: 0.1° , resolution: 0.01° ; Pitch accuracy: 0.1° , resolution: 0.01° ; Transmission frequency: $\geq 10\text{HZ}$; Start-up delay: $\leq 100\text{ms}$; Battery life: $\geq 8\text{h}$; Operating temperature: $-35^\circ\text{C}\sim 70^\circ\text{C}$	
26	Large complex structure torque limiter	Comprehensive accuracy: 3%; Operating temperature: -20°C to 70°C ; Operating voltage: 9 to 36V; Shock: 30g; Air discharge Voltage: $>8\text{kV}$; Electromagnetic radiation immunity: 100V/m; Protection ratings: Outdoor IP67, Indoor IP65	
27	Model-based controller for construction machinery	Code auto-generation; Operating temperature: $40^\circ\text{C}\sim 80^\circ\text{C}$; Operating voltage: 9~36V; PWM current output accuracy: $<5\text{mA}$; Output response: $\leq 30\text{ms}$; Impact: 30g; Air discharge: $>8\text{kV}$; Electromagnetic radiation immunity: 100V/m; Protection rating: IP 67	
28	A dedicated camera for construction machinery with edge computing capabilities	Edge computing capability; Frame rate: $>25\text{fps}$; Operating temperature: $40^\circ\text{C}\sim 80^\circ\text{C}$; Operating voltage: 9~36V; Shock: 30g; Air discharge: $>8\text{kV}$; Electromagnetic radiation immunity: 100V/m; Protection rating: IP67	
29	High reliability electric control handle	CAN bus output; with vibrator; over 10 million cycles.	
30	high strength welded steelpipe	yield strength $\geq 770\text{MPa}$, tensile strength $\geq 820\text{MPa}$, elongation A (%) $\geq 15\%$	