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REPORT

EMBODIED AI: CHINA'S AMBITIOUS PATH TO TRANSFORM ITS ROBOTICS INDUSTRY

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ABOUT THE CHINA TECH OBSERVATORY

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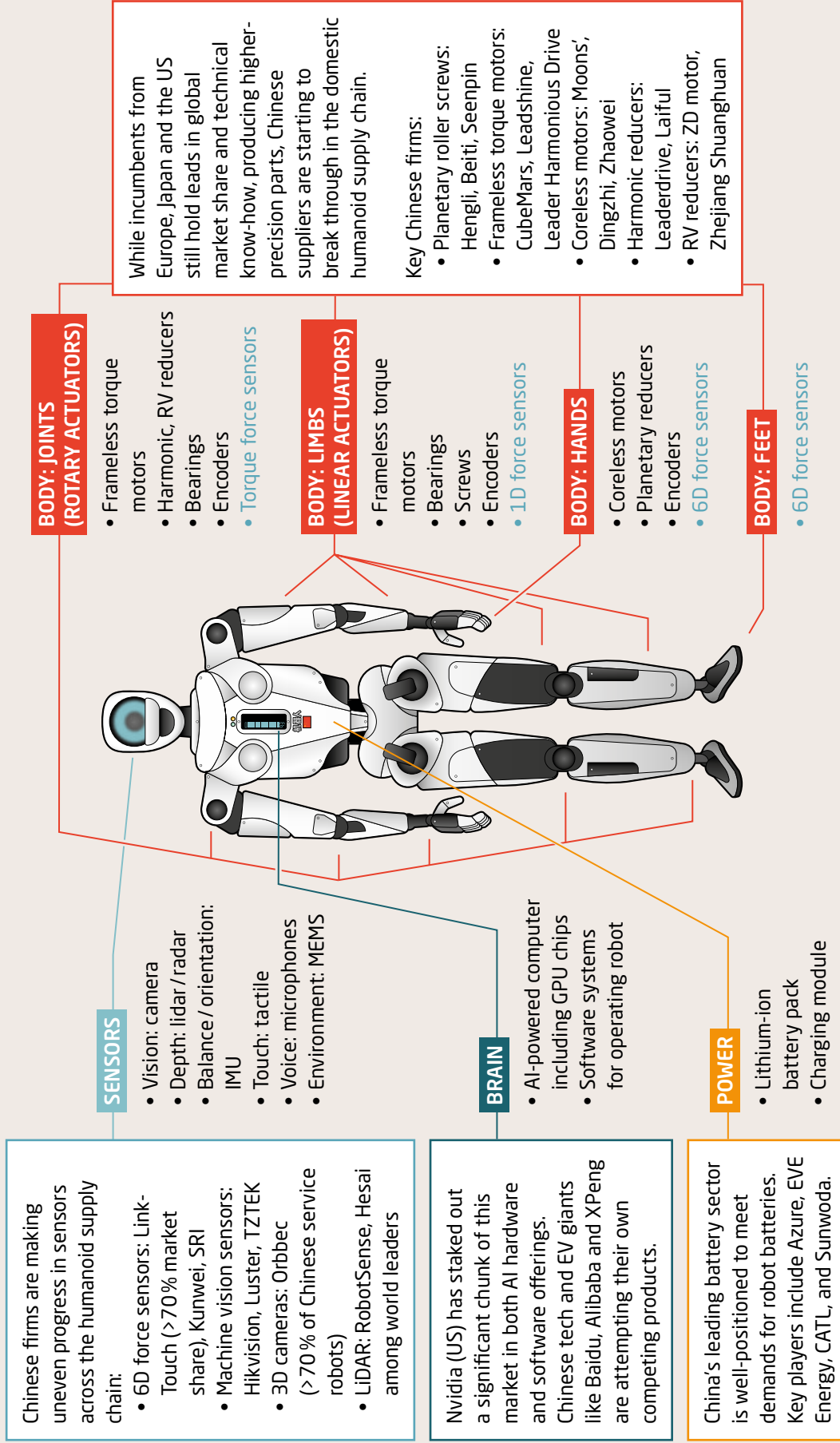
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KEY FINDINGS

- **With the world's largest installed base of industrial robots, China is now actively exploring humanoid robotics.** The sector is dependent on Nvidia's AI chips and software ecosystem, but rapidly localizing its hardware supply chain.
- **Xi Jinping's techno-solutionism to economic, social and governance problems has created an array of national policies and funds to promote robotics, support research and development, and assist startups.** Core policies envisage AI technologies and tools being diffused throughout society.
- **China's big industrial robotics sector and lead in EVs gives it an edge in developing so-called embodied AI.** As the EV-makers' supply chains already contain batteries, sensors and other components, many EV firms have added robotics to their repertoire.
- **China's humanoids still lack precision and dexterity and are mostly deployed in limited tasks and in site-specific trials.** They remain far from being fully autonomous machines capable of perceiving and responding in real time in the physical world.
- **China's humanoids are cheaper than those of western competitors but still far too expensive for widespread deployment.** For commercial viability, the costs would have to fall by at least half.
- **China's government is pressing ahead with its vision despite structural risks to the labor market that could jeopardize economic growth and strain the Chinese Communist Party's social contract.** It sees AI diffusion as a solution and competitive gain that is worth the risks.
- **European firms could easily find themselves facing a repeat of the race for EVs, outpaced by China's blend of industrial capacity and state support.** As the sector evolves, Chinese firms may also find solutions to the high-end components they currently rely on western and Japanese firms to provide.

China is moving fast to localize the humanoid supply chain, starting with hardware



Sources: Beijing Unbank, 36Kr, Morgan Stanley Research, TrendForce, Shanghai Metal Market, Zhiyuan Consulting, Elight Tech

EMBODIED INTELLIGENCE: A TEST CASE FOR BEIJING'S TECHNO-SOLUTIONISM

At this year's Consumer Electronics Show (CES), a major industry event, which took place in January in Las Vegas, physical artificial intelligence (AI) took center stage. In the humanoid robotics section, more than half the exhibitors were from China. Meanwhile, US AI chip giant Nvidia unveiled new foundation models – AI neural networks trained on massive unlabeled datasets to handle a wide variety of tasks – and simulation platforms for AI-powered robotics.¹ This is a division of labor that could shape the global economy for decades.

Key drivers behind China's robot expansion include a manufacturing chain dominated by automobiles and electronics as these sectors provide easy technical crossovers, plus the economic, social and political pressures of a growing labor shortage, rising labor costs and ambitious state policies aiming to keep entire industrial value chains within China.

Physical AI enables autonomous agents to perform complex actions in the real world. For China's policymakers, this kind of “embodied” (具身)² artificial intelligence (EAI) is an appealing conduit for AI's “deep integration” (深度融合) in the economic and social fabric.³ Perceived benefits include driving growth, augmenting economic and military power and (possibly) achieving artificial general intelligence (AGI).⁴ EAI's strategic importance to the Chinese Communist Party (CCP) was clear from its inclusion in the 2025 annual government work report.⁵ It even features as a priority in the newly released 15th Five-Year Plan for China's socioeconomic development until 2030.⁶

Embodied AI is of strategic importance to the Communist Party

President Xi Jinping has consistently emphasized two things; that emerging digital technologies should contribute to the “real economy” (实体经济)⁷ and they should enable a “smart society” (智慧社会)⁸ under “smart governance” (智治).⁹ Diffusing cognitive, human-like AI within the physical world to fix domestic challenges, such as replacing a shrinking workforce, closing gaps in Beijing's powerful surveillance infrastructure, or modernizing military systems would be consistent with this vision. China is scaling up the competition for everyone, but internally it is also staking its future on this technology.

China's vast, diverse manufacturing base gives it an advantage in industrial robotics. The “AI Plus” national strategy (AI+) envisions robots as one of the “intelligent terminals” diffusing AI throughout China's economy.¹⁰ Chinese robotics firms are focused on integrating AI to build robots that can think, learn, and work alongside humans.

If they succeed, the future could look like this: components from Germany and Japan go into smart robots made in China that work autonomously inside dark factories, producing massive quantities of the goods that German and Japanese companies used to make best, such as cars – with unmatched precision and at a fraction of the cost. China could then replace imports of components, software, and machine tools with its own supply chains, becoming more self-sufficient in robotics.

While humanoids are the shiniest face of AI embodiment, the seamless collaboration between humans and machines that Beijing envisions goes much deeper. Foundation models are reinventing robot training, as increasingly advanced AI models are being developed that understand, predict, and operate within the physical world. This field is not yet mature, but Chinese firms and research institutes are actively exploring it. However, Chinese robotics and humanoid firms remain reliant on the physical AI stack of a US technology company, Nvidia.¹¹

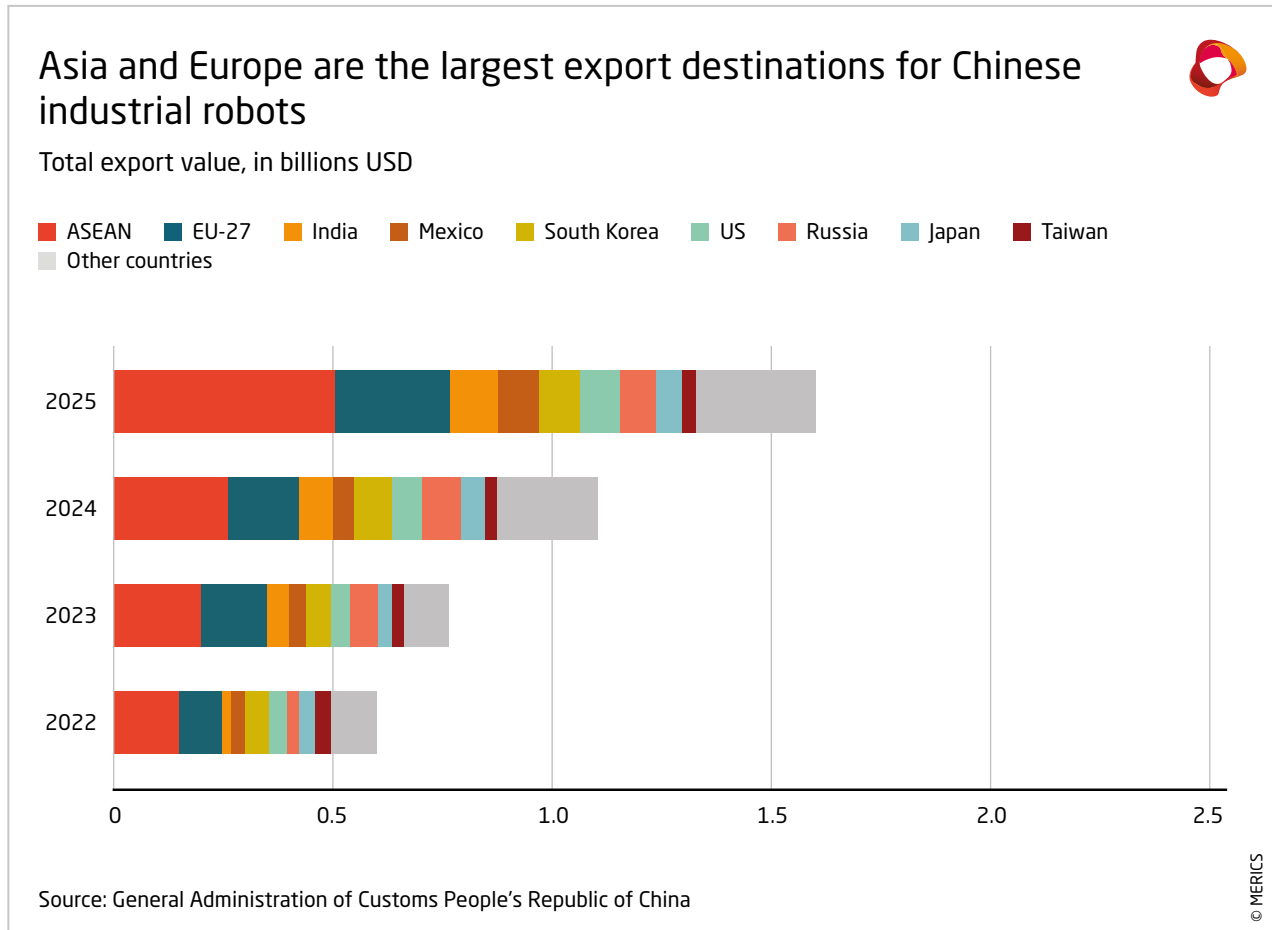
AI embodiment is likely to create challenging disruptions that could strain the CCP’s social contract. China’s domestic debate on the risks to employment, and hence ultimately to growth, is becoming increasingly lively.

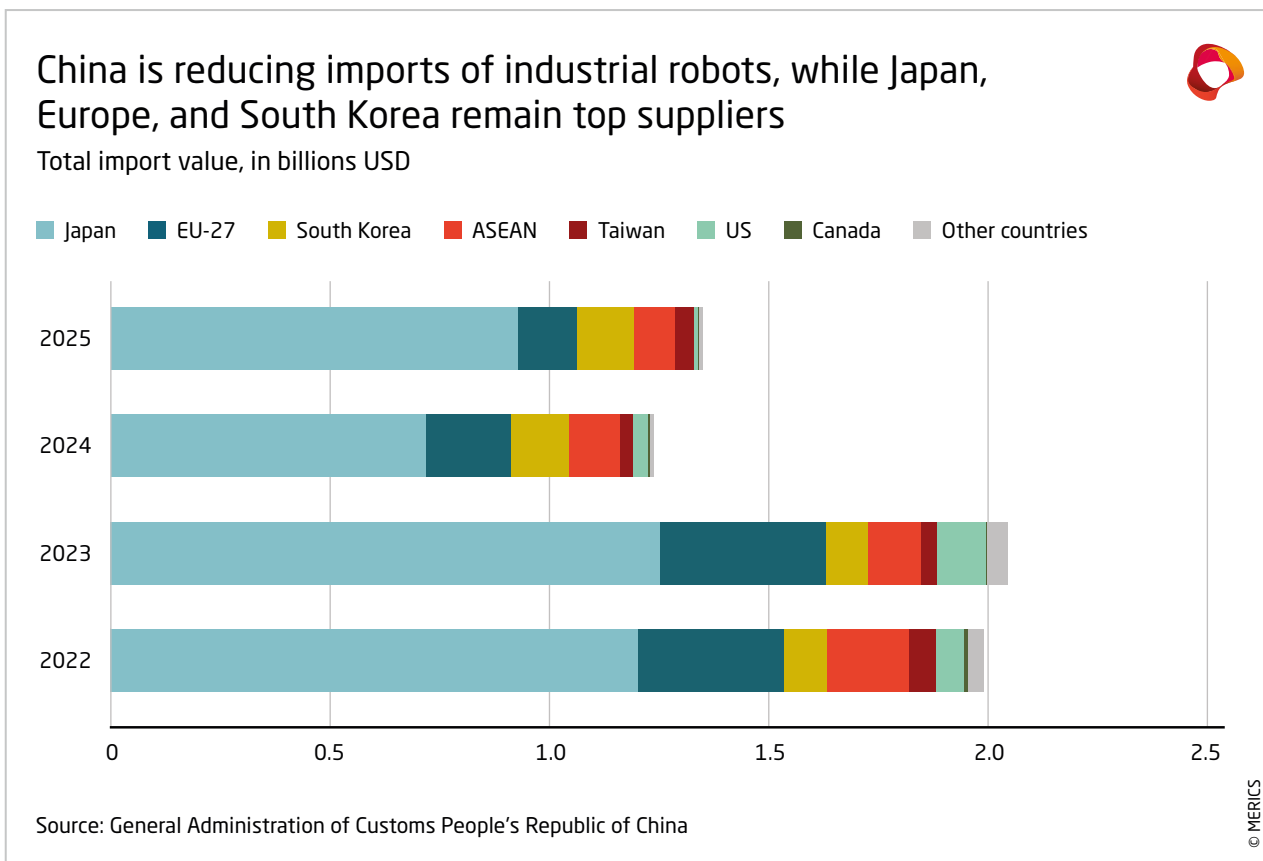
For Europe, the world’s boldest experiment in AI diffusion raises competitive challenges and monitoring it is vital. With its strong industrial base, leading position in robotics, and young physical AI startups,¹² the continent is still very much in the game. This short report surveys China’s latest technological experiments in developing and applying EAI, focusing on industrial robotics and physical AI models. It also examines China’s advantages, weaknesses and the key risks along the way.

TOWARDS INTELLIGENT INDUSTRIAL ROBOTICS: CHINA LEVERAGES ITS LARGE MARKET AND SUPPLY CHAINS

China’s industrial robotics industry is catching up to foreign competitors in both innovation and deployment. The country is already the world’s largest market for industrial robots: factories in China installed more industrial robots over the last five years than all other countries combined. The domestic market is also shifting decisively in favor of home-grown manufacturers: Chinese companies supplied over 57 percent of the domestic market in 2024, overtaking foreign competitors for the first time.¹³

Exhibit 2





The mass number of industrial robots deployed across Chinese factories today are quite different from the embodied AI envisioned by policy. Most are fixed, single-purpose machines built for precision in tasks like assembly, inspection, material handling, picking, and sorting. Despite being featured prominently at global tech events, humanoid robots make up a tiny segment of overall robot production.

In 2025, China produced 12,800 humanoids, about 90 percent of the global total, mainly for use in training centers, research labs, logistics, and manufacturing settings.¹⁴ It was a sharp increase over 2024, but dwarfed by annual production of industrial robots (556,000 units).¹⁵ Replacing workers with humanoids remains difficult – humanoids in Chinese factories are still “only half as efficient as humans,” according to the founder of the leading Chinese humanoid-maker UBTech. They lack dexterity and rarely exceed human performance.

Startups focused on AI-driven robotics are currently testing their prototypes in industry and not yet deploying them at full scale. Leading domestic players like Kepler Robotics’ K2 robot handles simple logistics tasks, such as carrying loads up to 30 kg.¹⁶ Similarly, UBTech is testing the Walker series humanoids in EV factories where they perform limited, task-specific functions, such as quality inspections, simple component assembly and sorting materials.¹⁷ Last year, Midea’s six-armed humanoid, MIRO U, was deployed to support assembly at its washing machine plant in Wuxi.¹⁸

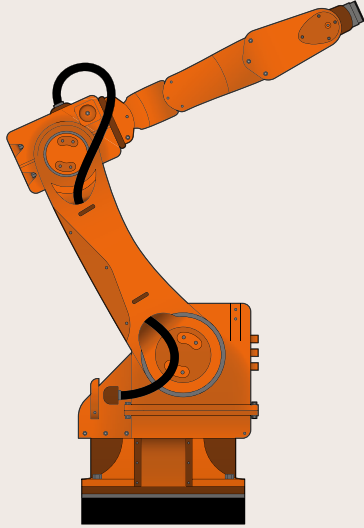
China’s policy initiatives on embodied AI seek to achieve global leadership

Beijing has launched major state policies to support robotics and AI integration in industrial settings: the “Robot+” (机器人+) initiative and “AI + Manufacturing” roadmap aim to build humanoid robot pilot lines and double China’s manufacturing robot density by 2030.¹⁹

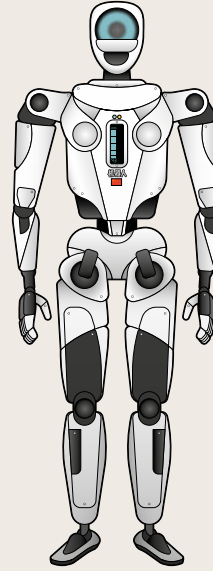


China is the world's largest market for industrial and humanoid robots

Industrial Robots



Humanoid Robots



VS.

Production capacity

773,074 produced in China in 2025

12,870 produced in China in 2025

Numbers installed

295,000 installed in China in 2024, about 54 % of global deployments (170,000 from Chinese suppliers)

12,800 installed in China in 2025, more than 80 % of global installations

Top producers in China

Estun (China), FANUC (Japan), KUKA (Germany, owned by Chinese company), Inovance (China), ABB (Switzerland)

Unitree, AgiBot, UBTEch (all China)

Top installing industries in China

Electronics, automotive, metal and machinery

Research labs, logistics, manufacturing, automotive sectors

Sources: International Federation of Robotics, China's State Council Information Office, MIR Databank, Counterpoint, industry reports, open-source data

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The Ministry of Industry and Information Technology (MIIT) set up the Standardization Committee for Humanoid Robots to oversee rule-setting.²⁰ Provincial and municipal governments are pursuing different approaches, too: Shanghai's "Action Plan for the Development of the Embodied Intelligence Industry 2025-2028," for example, targets "algorithmic breakthroughs" in EAI.²¹ The central leadership has made EAI a national priority, listing it in 2025 as a target for accelerated development and as a top "new industry track" in the 15th Five-Year Plan (2026-2030).²²

Central government is using a range of policy tools to hasten deployment. The recently launched National Venture Capital Guidance Fund and three regional funds (Beijing-Tianjin-Hebei) allocated CNY 1 trillion (EUR 120 billion) of investment over the next 20 years to back domestic robotics companies and other emerging technologies.²³ The MIIT and local governments in Beijing, Shanghai and Shenzhen have launched innovation and testing centers for industrial applications.²⁴ By linking academia, startups, and industrial players, the government is cultivating a full-stack ecosystem for EAI. Some provinces and municipalities subsidize up to 30 percent of project costs for innovation in automation technologies, or discounts for purchases of humanoids.²⁵ Large robotics training centers are coordinating training data for startups in Beijing, Shanghai, and Hefei.

Beijing's strategic, domestic security and military objectives also provide a strong supportive ground for the robotics industry, even though many firms try to distance themselves from non-civilian applications. China has a history of supporting military robotics and unmanned systems,²⁶ with increased interest in AI platforms in recent years.²⁷ As the national strategy of "military-civil fusion" strongly shapes innovation and technology production, companies may find it increasingly challenging to avoid defense or police ties.²⁸

China aims to become a global leader in robotics

China's policies and investments suggest it aims to become a global leader in robotics and industrial automation. As Unitree CEO Wang Xingxing has said, "Robotics is where EVs were a decade ago, a trillion-yuan battlefield waiting to be claimed."²⁹

Developing smart robots: hardware strengths, software weaknesses

China's manufacturing strength in industrial robots and EVs provides a major advantage in developing embodied AI. Major EV-makers have become robotics manufacturers too, as technological overlaps enable components to be repurposed for robotics applications. EV-derived batteries are used in GAC's GoMate robot and Spirit AI's Xiaomo.³⁰ Lidar and cameras developed for autonomous driving can be applied to robotics. XPeng's Iron robot uses sensors with autonomous-driving algorithms for navigation.

China's dominance of the EV supply chain gives domestic manufacturers a cost advantage: it controls 63 percent of the key companies in the global supply chain for humanoid-robot components.³¹ These include many types of actuators (components responsible for motion) and rare earths needed for high-strength permanent magnets used in actuators and robotic motors. Hardware-forward companies like Unitree can therefore develop products at less than half the price of international competitors. However, China has weaknesses in at least three areas:

First, software, particularly software for AI training, sensing, and control, remains dominated by foreign firms such as Nvidia.

Second, China remains heavily dependent on European and Japanese companies for high-end robotic components; for example, Germany's Schaeffler and Japan's THK and NSK provide 90 percent of special ball screws used for precise positioning applications in robotics.³² A Chinese report from ZY&YR Innovation Hub on overall competitiveness in key components (including motors, reducers, screws, sensors) ranks Japan as "A", China and Europe as "B", and the United States as "C".³³

Cost is an obstacle to widespread adoption of industrial humanoids, as China's average CNY 300,000-500,000 each (EUR 36,000 – EUR 62,500). Even domestically made components

remain expensive. Guotai Securities calculates humanoid’s commercial viability threshold at CNY 160,000 based on annual labor costs of CNY 80,000 and a two-year ROI period.³⁴ China’s robotics industry needs to prioritize cost reduction, despite already having more cost-effective humanoids than western competitors. Unitree’s G1 costs around €11,650, compared to Boston Dynamics’ Atlas (~ €120,000+) and Tesla Optimus (~ €25,800), comparable models.³⁵

The third challenge is precision. Foreign industrial robot-makers like Swiss-Swedish group ABB and Japanese multinational FANUC still dominate the high-end market, whereas Chinese firms lead in low- and mid-range segments.³⁶ Chinese humanoids struggle with multi-step coordination, fine manipulation, and hand-eye coordination tasks like cable assembly or small-part insertion.³⁷

Today, most humanoids are used in “small-scale, single-point trials,” usually performing limited, auxiliary tasks.³⁸ Mass deployment would require cost reduction or efficiency improvements, plus extensive scenario-based training. China’s huge manufacturing base, and policy support, could give its robotics sector an edge by evolving more testing grounds.

KICKBOXING ROBOTS LOOK GOOD BUT ARE FAR FROM BEING TRULY AUTONOMOUS

Sleek corporate videos often create the impression breakthroughs in humanoids are imminent. Many show humanoids moving freely — dancing, kickboxing, and performing tasks requiring dexterous hand movements. These impressive demonstrations are misleading as the robots are seldom acting autonomously in real time, but either preprogrammed or tele-operated.³⁹ They remain far from being general-purpose intelligent robots that continuously take inputs from their environment then decide on actions in the physical world.

It was the rise of generative AI and large language models (LLMs) that foregrounded the idea of imbuing robots with artificial intelligence. Around 150 Chinese companies are making humanoid robots, according to the National Development and Reform Commission (NDRC).⁴⁰ It is a large and varied group, focused on different aspects of robotics, whether creating humanoids with superior motor skills or large AI models of the physical world to train robots in autonomous working. Some focus on the building blocks of robotics companies, such as software development platforms and key hardware components. The field is competitive, nascent with fast developments in many directions, but characterized by active dialogue to determine the next major direction.

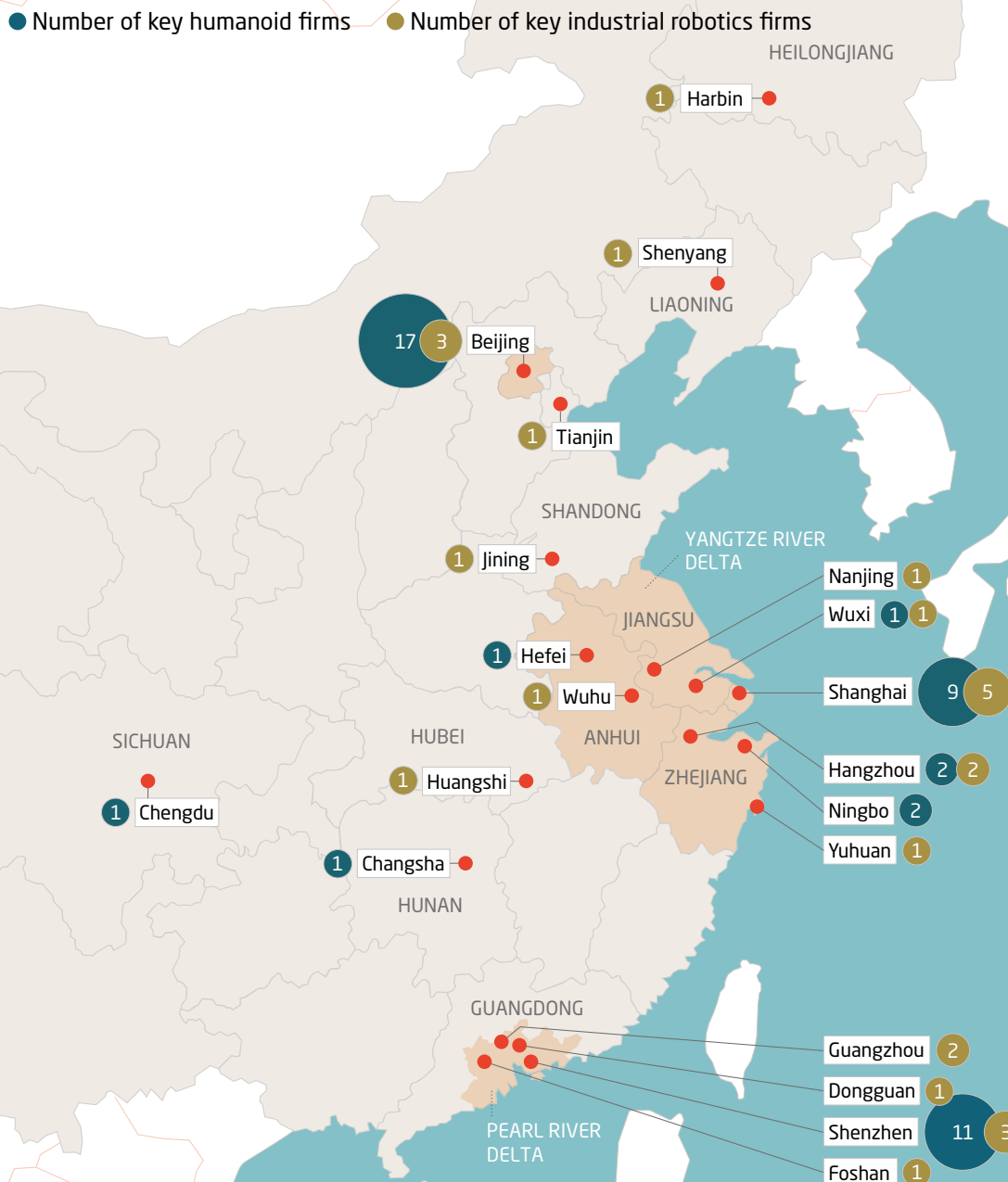
Autonomous robots: there is a gap between scripted automation and embodied AI

China is still in the early phases of exploring the robotic brain

China’s robot industry (and arguably the global one too) is still in the early phases of exploring the robotic brain, or the ability to process sensor data to interact with the environment in real time. For breakthroughs in AI intelligence, it still looks to US-based research, for instance on visual-language-action (VLA) models. The ZY&YR ranking awards US companies an “A” for overall competitiveness in computation, data processing, and communication modules, and in modules such as robot hands, ahead of Chinese ones.⁴¹

The rise of LLM and multi-modal models has given robotic intelligence a new direction: end-to-end “vision-language-action” (VLA) models that can take input, feed it to a language model to interpret, then take immediate robotic actions.⁴² Google DeepMind originated VLA with its RT-2 model and remains a leader with Gemini Robotics. Other notable players are Nvidia’s GR00T and Stanford’s OpenVLA. Figure AI’s humanoids are powered with their Helix VLA.

Robotics firms cluster in Beijing, Yangtze River Delta, and Pearl River Delta areas



Top humanoid robotics firms:
Shanghai: AgiBot, Fourier, Ti5 robot
Hangzhou: Unitree
Shenzhen: UBTEch, Leju, Engine AI, LimX Dynamics, PaXini, Astribot, Elephant Robotics
Beijing: RobotEra, Booster, Galbot, CloudMinds, X-Humanoid

Top industrial robotics firms:
Shanghai: Shanghai Electric, STEP Electric, Flexiv, JAKA
Nanjing: Estun
Hangzhou: Hikrobot
Wuhu: Efort Intelligent
Shenzhen: Inovance
Foshan: Midea
Shenyang: Siasun
Beijing: Aubo

Sources: Omdia, JazzYear, Qianzhan, The Wire China

Chinese teams are accelerating VLA efforts, making progress in targeted areas but still lacking foundational generalist models. Leading companies include AgiBot, Galbot, and AI² Robotics. AgiBot announced its first general model GO-1 in 2025, which uses a visual-language model but is not a full VLA.⁴³ Galbot has an intelligence-first approach and aspires to reliable, fully autonomous mobile pick-and-place tasks. Its G1 robot's three models have narrow remits that illustrate the difficulty of building fully autonomous robots: GraspVLA for dexterous robot hands, TrackVLA for navigation and GroceryVLA for retail scenarios.⁴⁴

Another developing frontier for embodied AI is the concept of world models, based on the idea that smart cars and robots need a representation of the world around them to interact with it. Although broad and ill-defined, many practitioners see world models as the way forward in EAI, beyond the predictive capabilities of LLMs. World Labs, founded by AI pioneer Fei Fei Li in San Francisco, has launched Marble to generate 3D worlds based on text and image input.⁴⁵ Famed AI researcher Yann LeCun founded AMI Labs in Paris to explore his own learning framework.⁴⁶ Google DeepMind, Meta, Nvidia and other leading companies are pursuing similar projects. In China, many research entities are delving into developing world models. Prominent corporate players include SenseTime⁴⁷, Huawei, and XPeng.

There is an explosion of activity in China's autonomous robotics field

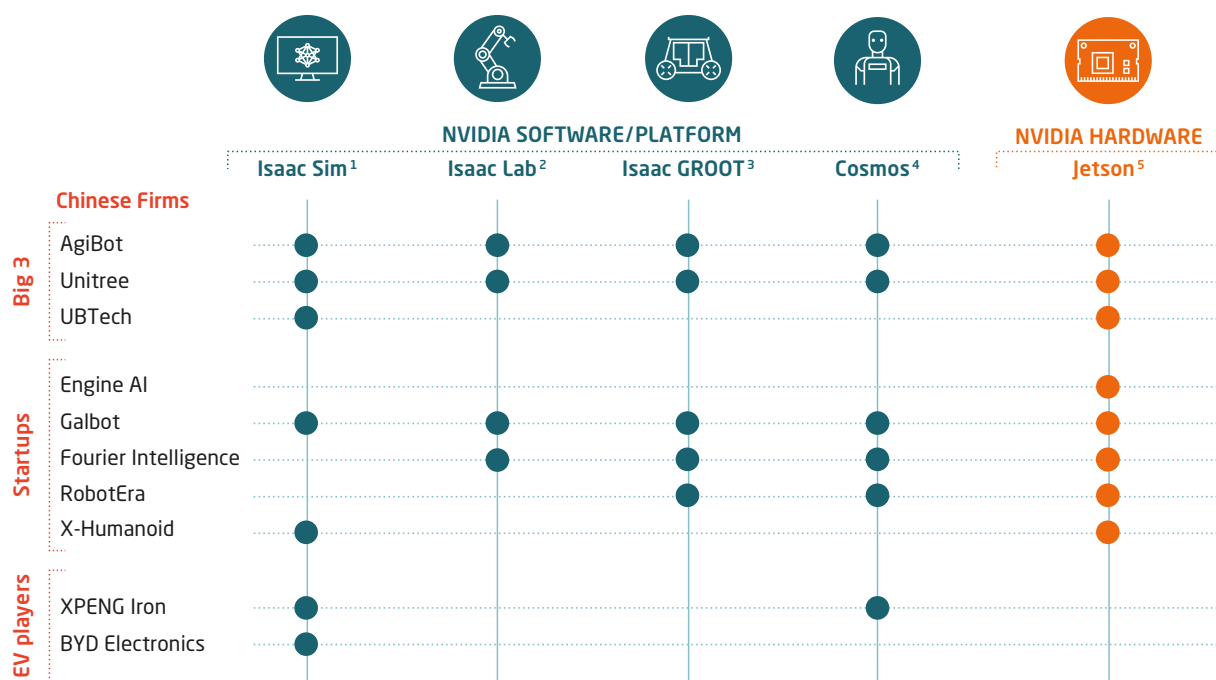
Gathering data to train autonomous robots is notoriously difficult, as they require multiple types of data (image, language, touch, spatial) which remain scarce, unlike the large text corpus for training LLMs. Datasets are also difficult to share, as there is little standardization in either the software or hardware models. Strategies to overcome the lack of data include attempts to use human video content to aid robot understanding. AgiBot builds dedicated facilities to generate training data by deploying robots in different scenarios.⁴⁸ Galbot prefers synthesized data. Its DexGraspNet is a simulated dataset for robotic hand grasps, built using Nvidia's Isaac Sim software.⁴⁹ Unitree trains its robots in complex actions in simulation, using Nvidia's reinforcement training framework Isaac Lab.

US company Nvidia has positioned itself as a major player in the robotics space, providing key tools for development work. Most major Chinese players are working with its products in some way.⁵⁰ Nvidia's Jetson modules are designed to be embedded in AI robots, combining its Blackwell GPUs, Isaac development platform, plus other capabilities such as sensor signal processing. Chinese robotics companies UBTech, Galbot, Unitree, EngineAI and AgiBot were among the first to receive the latest Jetson Thor module.⁵¹ Nvidia is gaining traction as an essential supplier of key building blocks of the oncoming robotics revolution, as it has in generative AI.

The strong dependence on the Nvidia ecosystem poses risks for the nascent industry in China. The GPUs used in Jetson modules have strong computation powers but relatively low memory bandwidth and lack the ability to connect to other chips, capabilities that are crucial for model training in data centers. These types of edge computing chips have not been the focus of the US export control scheme, but as they become more powerful, and as the robotics revolution wears on, that may yet change.

There is an explosion of activity in China's autonomous robotics field, with players angling to enter the market with varied technology and market strategies. Despite lagging behind in foundational software, China's strength in hardware could still enable economies of scale that would trigger widespread use across manufacturing and give China market dominance in the long run.

Leading Chinese humanoid companies rely heavily on Nvidia hardware and software



¹ Isaac Sim: robotics simulation framework
² Isaac Lab: robot learning framework built on Isaac Sim (open source)
³ Isaac GROOT: open vision-language-action (VLA) model for robots
⁴ Cosmos: open world foundation model and platform
⁵ Jetson: AI computers in compact form, including logic and memory chips

Sources: Nvidia blog, RobotEra, Sina Finance, People’s Daily

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The EV race unfolded in a similar fashion. One leading Western player (Tesla) competed with many Chinese players who enjoyed state support and figured out how to make cheap vehicles; those players gradually became technologically competent and are now poised to conquer the global market.

CHINA’S JOURNEY TO EMBODIMENT CARRIES RISKS – ALSO FOR EUROPE

China’s progress and ambitions in EAI are at the heart of an important strategic question: Will the CCP’s techno-solutionist gamble pay off? President Xi Jinping has outlined an era of “tripartite integration between people, machines and objects” (人、机、物三元融合).⁵² Policy documents hail AI diffusion and EAI as panaceas for many things — industrial upgrading, efficient healthcare and elderly care, consumption stimulus and even stronger interpersonal relationships. This optimistic outlook has been a consistent feature of PRC AI policy.⁵³

The relationship between humans and AI is mostly discussed in collaborative terms, with early AI governance principles stressing “human-machine harmony” (人机和谐).⁵⁴ An August 2025 NDRC policy document about AI’s impacts on employment invites PRC citizens to think about “empowerment” (赋能范式) rather than substitution” (替代范式).⁵⁵

Anxiety around embodied AI's impact on jobs grows

For all the official talk of collaboration and harmony, the numbers tell a different story, and citizens know it. The public increasingly worries about job security amid estimates that robots could replace at least 70 percent of China's manufacturing jobs.⁵⁶ Production targets of 10,000+ humanoid units by 2025, projections of halving robot prices and China's aggressive automation trajectory conjure an uneasy future for its workforce. Chinese experts seem concerned, especially given the country's weak social safety net.⁵⁷

Several studies conclude AI will displace jobs in China much faster than it creates them, straining employment, wages and the social security system.⁵⁸ Superficially, EAI may seem the perfect fix for the aging population and shrinking labor force, but these are complex problems requiring deep economic, social, and institutional adaptation.

China's nearly 300 million migrant workers, who typically have precarious jobs and no social safety net, could be especially vulnerable to automation.⁵⁹ Another structural imbalance is the AI industry's talent shortage of 5 million, even as youth unemployment remains high at around 17 percent and China graduates more STEM researchers than any other country.⁶⁰

Policy documents, including the newly released 15th Five-Year plan, contain signs that the government, traditionally worried about social stability, is now paying more attention to potential AI-driven job losses.⁶¹ But as Xi's administration has no intention of building a welfare state, the policy solutions will need to be found elsewhere.

Beijing still bets on embodied AI as a productivity driver

AI-related risk mitigation has a long way to go

Altogether, Beijing will continue to bet on EAI as a productivity driver. Its approach presupposes massive robotics investments will translate into greater manufacturing competitiveness. The CCP's embrace of EAI rests on the core idea that AI would be an economic input. For now, the reality looks different with lots of humanoid robot companies waging a price war and burning money in an R&D-intensive industry not fully ready for commercialization.

Robotics is already linked to the wider concern about "involution" (内卷), a term describing China's familiar cycle of self-defeating competition and low profits fueled by excessive production and a prevailing lack of standardization.⁶² Officials are starting to recognize the problem. Tellingly, an NDRC representative acknowledged publicly that an overcrowded humanoid market could generate overcapacity and reduced R&D funding.⁶³ The MIIT's new standardization committee may precipitate a cull.

But risk mitigation has a long way to go, especially given the scale of potential socio-economic disruptions. Chinese experts forecast the scale and potential impact of AI-related risks will massively increase as machine intelligence gets integrated with physical and biological agents at scale, connecting with systems like military infrastructure and power grids.⁶⁴

Yet capability development is vastly outpacing safety research.⁶⁵ To fill this gap, in September 2025 a team from Shanghai AI Lab, East China Normal University and Tsinghua University proposed a roadmap for "safe and trustworthy embodied intelligence" (安全可信具身智能).⁶⁶

How China approaches this exercise in complex systems engineering — where the information, physical, biological and social domains intersect — will be vital to watch. The party state has some experience, having applied Chinese cybernetics in the construction of hyper-surveilled smart cities powered by digital technologies.⁶⁷ Moving up from testbeds and localized applications to large-scale AI embodiment is where the major challenge will lie.

China's hardware-first robotics revolution poses strong competition for European incumbents

Even as China's existing industrial robotics sector grows market share domestically and abroad, Beijing is directing the field to develop AI-empowered humanoid robots at scale. European companies should monitor the supply chain and be especially alert to Chinese firms working to replace components traditionally supplied by Western or Japanese manufacturers.

China's leading humanoid robot companies have made a strong start, building competitive robots at relatively low prices compared to Western ones. European observers should also take note of the strong collaboration between robotics companies and other industries, such as EV and battery-makers, which furthers the development of smart robots and their industrial integration.

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