



Deutsche Bank
Research

Humanoid Robot (II): Six visions for 2026 – Scaling, iterating and diversifying

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Executive summary: Six visions for 2026 – Scaling, iterating and diversifying (1)



The rapid advancements in AI have propelled its application in the physical world, with humanoid robots emerging as a prominent example. The hardware supply chain has already demonstrated impressive improvements and continues to evolve, prioritizing enhanced dexterity, superior sensing capabilities, reduced weight, and lower costs. While a gap remains for AI models to fully comprehend and interact with the physical world, we believe the evolution of AI models is progressing swiftly and could reach an inflection point in the foreseeable future. As AI models scale, we anticipate a significant increase in the deployment of humanoid robots in the physical world in the coming years.

We update our forecasts for the global humanoid robot market in this report and present **six key visions for the market in 2026:**

- 1) China dominates with rapid scaling; US shipment to also gradually ramp up:** We forecast the strong growth of the global shipment of humanoid robots to continue and to approach **~50,000 units in 2026E**, after exceeding 15,000 units in 2025 from 3,000 units in 2024. In 2025, the growth was primarily driven by Chinese OEMs, contributing to over 85% of the global shipment, whilst deliveries from US OEMs were slow. In 2026E, we expect China to remain the largest humanoid robot market, with units more than doubling to over 35,000. Shipments from US OEMs, led by Tesla and Figure, are anticipated to demonstrate strong growth from a low base as they scale up production. In the long term, we believe total shipments from US OEMs will gradually converge with those from Chinese OEMs. Additionally, humanoid robot shipments from other regions, including Europe, Japan, and South Korea, are also expected to increase.
- 2) Increasing entrants from more verticals and regions:** Independent vendors and automotive OEMs still dominate the humanoid robot market. However, new entrants have emerged from verticals beyond automotive since 2025 - electronics manufacturers Hon Hai (Taiwan) and Honor (China), household appliance maker Midea (China), and industrial manufacturer Hexagon (Sweden) have launched their first humanoid robots, and Apple (US) and Meta (US) are reportedly exploring humanoid robots. Regionally, companies outside the US and China, such as Softbank (Japan), FANUC (Japan), Yaskawa (Japan), Hyundai (South Korea), and Hexagon (Sweden) have intensified their efforts in AI robots.
- 3) Impressive iteration; Still awaiting the "ChatGPT moment" for the brain:** While humanoid "brains" are improving quickly, we believe the software stack is still short of a ChatGPT-like inflection where a single, general-purpose model can be deployed broadly and perform reliably across diverse real-world tasks. Current architectures are converging toward a dual-system VLA (a slower reasoning/planning layer paired with a fast reactive controller for high-rate motor execution), to balance generality with reaction speed. World models add a "predict before act" layer that can improve planning quality and scale synthetic scenarios, but they are data/compute intensive and prone to hallucination/compounding errors over long horizons, which could risk poisoning downstream policy training. Overall, we see this field as still at an early stage where the foundational models are evolving rapidly, leading teams are iterating across multiple "robot brain" designs but have not yet settled on a single solution.

Executive summary: Six visions for 2026 – Scaling, iterating and diversifying (2)



- 4) **Hardware evolution continuing:** We believe the design for Tesla's Optimus V3 is nearing finalization, with mass production for internal use anticipated to ramp up in 2H26. Meanwhile, discussions for Optimus V4 are already in progress, with a potential launch for external sales by late 2027. Key hardware updates for Tesla's Optimus V3, based on our channel checks, include: **(a) increased Degree of Freedom (DoF)** and more actuators – number of body actuators to increase from 28 to over 35, primarily driven by more rotary actuators; **(b) more dexterous hands** with a doubled DoF of 22 per hand, integrating electronic skin, tendons and screws; **(c) adoption of lighter-weight materials** such as polyetheretherketone (PEEK) and ceramic balls; **(d) extended battery life;** and **(e) more powerful chips.** Although component cost is dropping, the bill of materials (BOM) of for advanced humanoid robots does not necessarily decline due to the increasing DoF and sensors.
- 5) **Diversification of supply chain:** As shipments scale up, the humanoid robot supply chain is diversifying across several key perspectives: **(a) Geography:** while Chinese suppliers remain highly active, non-Chinese suppliers, such as Nidec, Yaskawa, and NSK from Japan, and Schaeffler from Germany, have become more proactive since 2025; **(b) Production:** to mitigate geopolitical risks, suppliers are establishing production capacities outside their home countries. This trend is particularly evident among Chinese companies, who are targeting Thailand, Mexico, and the US as primary production locations. Meanwhile, Japanese companies such as Harmonic Drive Systems, Yaskawa, and FANUC have also recently expanded their capacities in the US; and **(c) Verticals:** Automotive suppliers continue to dominate the supply chain, but established suppliers from other verticals, particularly electronics, such as Luxshare, Lens Technology, and Hon Hai, have also joined the supply chain.
- 6) **Government policies to watch:** Since 2025, policy announcements globally have increasingly focused on AI and embodied AI. **China** was the first to implement humanoid robot-specific policies and, in our view, currently offers the most supportive regulatory environment. China's Proposal for the 15th Five-Year Plan (FYP), covering 2026-30, emphasizes technological self-reliance and innovation, introducing embodied AI for the first time as one of the "future industries" for development. **The US** is aiming to domesticate robot manufacturing, with a potential Executive Order on robotics expected in 2026 from the Trump administration. The federal government may be prohibited from acquiring humanoid robots from foreign entities, including China, under the Humanoid ROBOT Act of 2025. Meanwhile, the US has initiated a Section 232 investigation into robotics and industrial machinery imports, with the possibility of imposing tariffs. Both **Japan** and **South Korea** are expediting humanoid robot development, while **the European Union** has implemented regulations on AI, emphasizing ethical integration.

Executive summary: Stock implications (1)



APAC Automation & Industrials sector – Covered by Iris Zheng

We expect continued market interest in humanoid robots, driven by the impending mass production at Tesla, rapid progress from Chinese humanoid robot OEMs, and the evolution of AI models. A clear trend emerging since 2025 is that, in addition to Chinese supply chain companies, share price of peers in Japan, South Korea, and Germany have also begun to respond to humanoid robot news as companies in those regions have accelerated investment in this space.

We favor companies that could (1) benefit from share gain and average selling price (ASP) expansion, (2) penetrate the supply chain as new technology suppliers, and (3) demonstrate resilience against a potential vehicle market downturn in China in 2026E. Our preferred names for the humanoid robot theme in 2026E are:

- **Hengli Hydraulic (601100.SS, BUY):** We believe Hengli could become a key linear component supplier for humanoids, leveraging its strong expertise in precision machining. We assume a 35% market share for Hengli in body screws, 5% in linear actuators, and 10% in hand screws by 2030E. The recovering excavator market also provides support. Other growth opportunities include components for bionic robotic legs and arms, space applications, and machine tools.
- **Geekplus (2590.HK, BUY):** Geekplus launched its first wheeled humanoid robot, Gino1, in February 2026. We believe the company could be among the first to demonstrate the commercial viability of humanoid robots, given the structured warehouse environment and its high international sales exposure. We anticipate the company's order growth could accelerate to 35-40% in 2026E from 32% in 2025.
- **Harmonic Drive Systems (6324.T, BUY):** Based on our channel checks, Tesla could potentially increase the number of rotary actuators for Optimus from 14 to over 20 per robot. This is favorable for HDS as a global leading strain wave reducer supplier. We forecast humanoid robots to account for 4%, 6%, and 15% of group revenue in FY25E, FY26E, and FY27E, respectively. We expect its core business to also recover, driven by healthy trends from traditional robots and semiconductors.

Additionally, we also like **Shuanghuan Driveline (002472.SZ, BUY)** and **Inovance (300124.SZ, BUY)** in this space.

US Autos & Mobility sector – Covered by Edison Yu

Within our coverage, the following companies are well-positioned to benefit from the burgeoning humanoid robotics industry.

- **Tesla (TSLA.US, BUY):** Optimus represents a high performance vertically integrated design for a humanoid with plans to ramp-up production later this year. Importantly, the hand has been a hardware bottleneck but should be resolved now, further supported by greater compute capacity to train the models. We expect a step-up in internal deployments by 4Q26 followed by external sales in late 2027/early 2028 for industrial use cases.
- **Mobileye (MBLY.US, BUY):** Following the acquisition of Mentee Robotics earlier this year, Mobileye aims to offer a relatively low-cost humanoid for warehouses and other commercial applications. Mentee's BoM even at very low volume is ~\$50k with path to reduce by 50% as volumes scale up into the thousands which may happen in 2028-29. Tactically, we think Mentee's efforts are largely underappreciated and could surprise to the upside in the next 9-12 months.

Executive summary: Stock implications (2)



China Auto & Auto Tech sector – Covered by Bin Wang and Wei Huang

Within our coverage of the Chinese auto supply chain, the following companies are well-positioned to benefit from the burgeoning humanoid robotics industry.

- **Joyson Electronics (600699.SS, BUY):** In April 2025, Joyson established a wholly-owned subsidiary dedicated to the R&D and commercialization of humanoid robot components. The company's efforts are concentrated on critical systems such as the artificial cerebrum (decision-making) and cerebellum (motor control), energy management, and high-performance materials. Joyson has already launched an integrated product matrix including robotic heads, chassis, central domain controllers (DCUs), and thermal management systems. Notably, they are already supplying and sampling products to leading domestic and overseas robotics firms like AGIBOT, Galbot, and RIVR.
- **Johnson Electric (0179.HK, BUY):** The company has entered the Chinese humanoid robotics market via two joint ventures (JVs) with Shanghai Mechanical & Electrical Industrials (SMEIC), a subsidiary of Shanghai Electric Group, backed by a total investment of RMB150 million. Johnson Electric will hold a controlling 51% stake in the Shenzhen R&D and manufacturing JV and a 49% stake in the Shanghai sales and marketing JV. The JVs will focus on developing 30-40 different joint modules for functions like waist/hip rotation and dexterous hands, with Johnson Electric supplying core components like motors and motion systems. The company is also leveraging its global footprint to explore robotics opportunities outside of China.
- **Minth (0425.HK, BUY):** Minth has established a multi-faceted strategy through key partnerships. A strategic collaboration with AGIBOT, initiated in March 2025 and expanded in December, positions Minth as the European OEM for certain AGIBOT models, a preferred component supplier, and the European distributor for select robots. More recently, in February 2026, Minth formed a 60%-owned JV with Leaderdrive to design, manufacture, and commercialize humanoid robot joint modules for the North American market. This move strategically utilizes Minth's established production network in North America and Leaderdrive's expertise in transmission systems, enabling Minth to leverage its global manufacturing footprint to capture growth in the humanoid robotics component market.

EU Auto Parts sector – Covered by Christoph Laskawi

- **Schaeffler (SHA0N.DE, HOLD):** Schaeffler is actively investing in the humanoid space, with an estimated revenue target of USD1.8bn by 2030. While no concrete order intake has been secured so far and will need to develop over the next quarters, the company is engaged in prototype development with OEMs across the USA, Europe, and Asia. Initial prototype orders, primarily for actuator platforms, have already been received from multiple OEMs. This early-stage investment, together with Schaeffler's existing product portfolio (actuators, bearings, e-motors, sensors, power electronics) that addresses over 50% of a humanoid's bill of material, highlights its potential as a relevant component supplier in this market. We value this humanoid optionality to add EUR4.5 to Schaeffler's target price, reflecting its relevance for share price.

Executive summary: Comp sheet



Ticker	Company	Rating	DB Analyst	Curr	Current Price	Target Price	Market Cap (USD mn)	1M	Price chg in 3M	YTD	1Y	FY25E	P/E FY26E	FY27E	FY25E	P/B FY26E	FY27E	FY25E	EPS growth FY26E	FY27E	FY25E	ROE FY26E	FY27E	Div yield FY26E
6954.T	FANUC	Hold	Iris Zheng	JPY	6,202	6,000	39,414	2.6%	4.2%	-1.6%	44.1%	36.6x	32.7x	30.5x	3.3x	3.2x	3.1x	8%	12%	7%	9%	10%	10%	1.8%
002050.SZ	Sanhua Intelligent	Hold	Iris Zheng	CNY	47.5	53.0	27,785	-6.4%	6.1%	-15.6%	53.1%	44.8x	40.4x	35.2x	5.9x	5.6x	5.0x	26%	11%	15%	16%	15%	15%	0.7%
300124.SZ	Inovance	Buy	Iris Zheng	CNY	68.0	83.9	27,723	-9.4%	-6.4%	-13.2%	-8.2%	33.9x	29.5x	24.9x	5.2x	4.6x	4.1x	26%	15%	19%	17%	17%	17%	0.9%
601100.SS	Hengli Hydraulic	Buy	Iris Zheng	CNY	104.6	129.0	20,517	-2.7%	-1.8%	-7.9%	30.3%	48.3x	39.4x	33.9x	7.8x	6.8x	5.9x	16%	23%	16%	17%	18%	19%	1.0%
6506.T	Yaskawa Electric	Buy	Iris Zheng	JPY	4,641	5,500	7,997	-2.7%	-2.7%	-6.5%	14.8%	33.9x	27.4x	23.9x	2.7x	2.5x	2.3x	-37%	24%	15%	8%	10%	10%	1.2%
688017.SS	Leaderdrive	Hold	Iris Zheng	CNY	211.2	190.0	5,731	-3.7%	37.9%	10.5%	32.0%	337.9x	220.8x	158.7x	11.0x	10.5x	10.0x	88%	53%	39%	3%	5%	6%	0.1%
002472.SZ	Shuanghuan Driveline	Buy	Iris Zheng	CNY	38.3	52.0	4,785	-5.6%	-6.6%	-18.5%	4.1%	26.1x	22.2x	19.0x	3.2x	2.9x	2.5x	21%	18%	17%	13%	14%	14%	0.8%
2590.HK	Geekplus	Buy	Iris Zheng	HKD	20.7	32.0	3,677	-26.2%	-19.5%	-10.4%	16.7%	119.4x	78.0x	39.6x	-7.3x	-8.0x	-9.9x	-292%	53%	97%	6%	7%	15%	0.0%
2049.TW	HIWIN	Buy	Iris Zheng	TWD	241.5	265.0	2,706	5.0%	23.2%	23.2%	-19.8%	72.1x	54.8x	39.6x	2.3x	2.2x	2.2x	-40%	32%	39%	3%	4%	6%	0.8%
6324.T	Harmonic Drive	Buy	Iris Zheng	JPY	4,240	4,840	2,641	27.3%	16.3%	10.4%	2.7%	321.8x	118.1x	64.6x	5.3x	5.2x	5.1x	-64%	172%	83%	2%	4%	8%	0.5%
APAC Automation & Industrials median								-3.2%	1.2%	-7.2%	15.8%	46.5x	39.9x	34.6x	4.2x	3.9x	3.6x	12%	23%	18%	9%	10%	12%	0.8%
TSLA.OQ	Tesla	Buy	Edison Yu	USD	405.9	480.0	1,523,262	-3.8%	-10.7%	-7.3%	49.2%	244.4x	334.9x	272.0x	15.8x	15.0x	14.2x	-31%	-27%	23%	5%	3%	4%	0.0%
MBLY.OQ	Mobileye	Buy	Edison Yu	USD	8.3	15.0	7,029	-7.7%	-30.0%	-26.3%	-42.5%	23.5x	41.5x	22.9x	0.6x	0.6x	0.6x	39%	-43%	82%	2%	1%	3%	0.0%
US Autos & Mobility median								-5.7%	-20.3%	-16.8%	3.4%	133.9x	188.2x	147.4x	8.2x	7.8x	7.4x	4%	-35%	52%	4%	2%	3%	0.0%
0425.HK	Mint	Buy	Wang Bin	HKD	39.4	42.0	5,987	10.2%	17.1%	17.2%	97.4%	16.1x	13.6x	11.3x	2.0x	1.8x	1.7x	21%	18%	21%	13%	14%	15%	2.9%
600699.SS	Joyson Electronic	Buy	Wei Huang	CNY	25.9	34.0	5,654	-4.7%	-3.6%	-17.0%	36.5%	26.1x	20.2x	18.4x	2.5x	2.3x	2.1x	45%	30%	9%	10%	12%	12%	0.0%
0179.HK	Johnson Electric	Buy	Wei Huang	HKD	27.2	49.0	3,381	4.7%	-11.3%	-12.2%	90.3%	96.8x	88.0x	78.4x	9.5x	8.8x	8.1x	15%	10%	12%	10%	10%	11%	0.3%
APAC Auto & Auto Tech median								4.7%	-3.6%	-12.2%	90.3%	26.1x	20.2x	18.4x	2.5x	2.3x	2.1x	21%	18%	12%	10%	12%	12%	0.3%
SHA0n.DE	Schaeffler	Hold	Christoph Laskawi	EUR	8.2	8.5	9,003	-18.2%	10.6%	-4.9%	78.0%	34.7x	59.4x	9.4x	2.7x	2.8x	2.4x	-167%	-42%	533%	-13%	5%	27%	3.7%
EU Auto Parts median								-18.2%	10.6%	-4.9%	78.0%	34.7x	59.4x	9.4x	2.7x	2.8x	2.4x	-167%	-42%	533%	-13%	5%	27%	3.7%

Note:

- Priced as of close of 4 March 2026
- Based on estimates from respective DB analysts

Links to Deutsche Bank humanoid robot reports



Humanoid robot sector reports

- **Humanoid Robots Pulse:** [Emerging electronics and Japanese players; Humanoid policy \(4Q25 edition\) - 18 Dec 2025](#)
- **Expert call takeaway:** [Expert call with Humanoid - 4 Dec 2025](#)
- **Humanoid Robots Pulse:** [Tesla, Sanhua, AgiBot, Unitree, Figure update - 23 Oct 2025](#)
- **European marketing feedback:** [Humanoid robot, China market, ... - 5 Oct 2025](#)
- **Humanoid Robots Pulse:** [Tesla Optimus; Unitree IPO; Nvidia and Hon Hai - 12 Sep 2025](#)
- **Expert call takeaway:** [A leading Chinese humanoid robot start-up – 17 Jun 2025](#)
- **Expert call takeaway:** [Expert call with Agility Robotics - 20 Feb 2025](#)
- **Humanoid Robot sector report (II):** [Go big and go home – 14 Feb 2025](#)
- **Humanoid Robot sector report (I):** [Stay selective; Humanoid robots lift growth prospects - 23 July 2024](#)

Company report

APAC Automation & Industrials sector:

- **Harmonic Drive Systems:** [Upgrade to BUY; Humanoid opportunity under-appreciated; Recovery on path - 11 Feb 2026](#)
- **Hengli Hydraulic:** [Growth for fundamental accelerating coupled with multiple themes; BUY - 9 Feb 2026](#)
- **FANUC:** [FY3Q profit miss; FX drag on profits to continue; AI robots progressing; HOLD - 27 Jan 2026](#)
- **Leader Harmonious Drive Systems:** [High growth in 2026E; Humanoids and Space upside for the optimists; HOLD - 15 Jan 2026](#)
- **Yaskawa Electric:** [FY3Q strong orders and semis recovery outshine soft profit; BUY - 12 Jan 2026](#)

Company reports (continued)

APAC Automation & Industrials sector (continued):

- **Geekplus:** [Expert takeaways; Orders and market update; BUY; Top pick; TP to HK\\$32 - 25 Nov 2025](#)
- **Inovance:** [Upgrade to BUY; Opportunities in humanoid robots, energy and digital - 23 Nov 2025](#)
- **HIWIN:** [Soft 3Q25; Robot progressing, but slowly; Hon Hai Tech Day to watch - 11 Nov 2025](#)
- **Sanhua Intelligent Control:** [Mind the US pre-buy gap; RMB70-90bn from humanoids already in price; Hold - 31 Oct 2025](#)
- **Shuanghuan Driveline:** [3Q25 profit impressed again; 4Q25E growth guided to accelerate; Buy - 30 Oct 2025](#)

US Autos & Mobility sector:

- **Tesla Inc.:** [All in on Physical AI – 30 Jan 2026](#)
- **Mobileye:** [Show me the robots! - 23 Jan 2026](#)

APAC Auto & Auto Tech sector:

- **Minh:** [Another step in humanoid robot with Leader Harmonious JV on joint module – 9 Feb 2026](#)
- **Johnson Electric:** [JECooling liquid cooling platform to support NEV and data center growth – 27 Jan 2026](#)
- **Joyson:** [4Q 2025 recurrent net profit slight miss - up 14% YoY but down 7% QoQ – 26 Jan 2026](#)

EU Auto Parts sector:

- **Schaeffler:** [Path to E-Mob break-even more back-end weighted than hoped for – 3 Mar 2026](#)



1) China dominates with rapid scaling; US shipment to also gradually ramp up

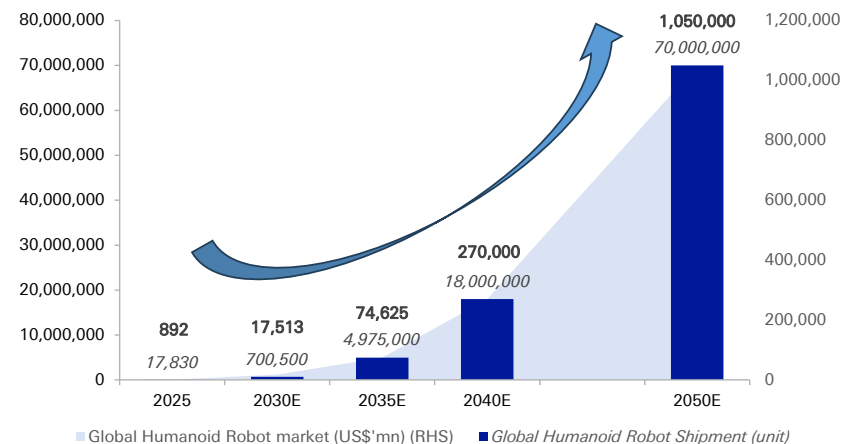
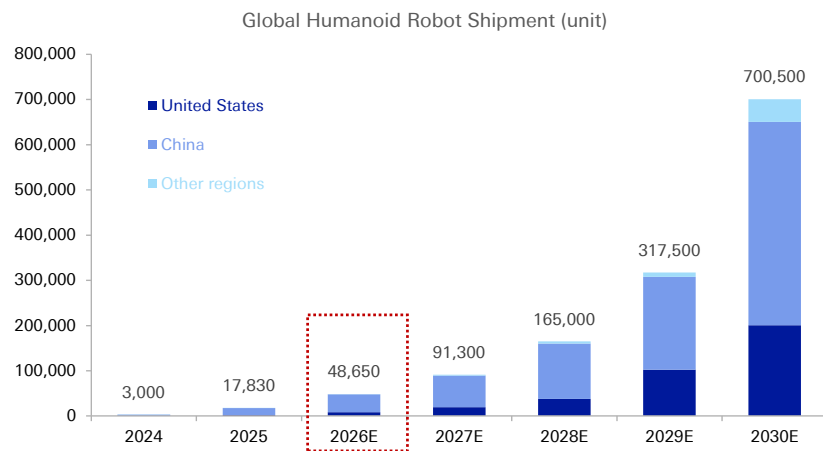
Global humanoid robot shipment to approach ~50,000 in 2026E, up from over 15,000 in 2025



In **2025**, we estimate the shipment of humanoid robots exceeded **15,000 units globally**, a significant increase from **3,000 units in 2024**. This growth was primarily driven by Chinese OEMs, led by Unitree and AGIBOT, benefiting from China's supportive policies, lower costs, and receptive customer base. In contrast, shipments from US OEMs in 2025 were slower due to hardware and software complexities and the unproven commercial viability of humanoids.

For **2026E**, we project global shipments to approach **~50,000 units**. China is expected to remain the largest humanoid robot market, with units more than doubling to over 35,000. Shipments from US OEMs, led by Tesla and Figure, are anticipated to demonstrate strong growth from a low base as they scale up production. In the long term, we believe total shipments from US OEMs will gradually converge with those from Chinese OEMs. Additionally, humanoid robot shipments from other regions, including Europe, Japan, and South Korea, are also expected to increase.

Global humanoid robot shipment (unit): We forecast to approach ~50,000 units in 2026E, and to 70mn units by 2050E



China dominates the global market, but US and elsewhere to show higher growth off a low base



We estimate humanoid robot shipments in China totaled ~15,000 units in 2025, accounting for over 85% of the global market. While we anticipate China will continue to dominate the global humanoid robot market over the next five years, total shipments from US OEMs are expected to gradually converge with those from Chinese OEMs, alongside growth from other regions.

Global humanoid robot shipment forecast

Global Humanoid Robot Shipment	2024	2025	2026E	2027E	2028E	2029E	2030E	2035E	2040E	2050E	2025 YoY	2026E YoY	2025-30E CAGR	2030E-35E CAGR	2035E-40E CAGR	2040E-50E CAGR
United States																
Tesla	100	1,000	5,000	12,500	25,000	80,000	150,000	1,500,000			900%	400%	172%	58%		
Figure	100	500	2,000	4,000	7,500	12,500	25,000	200,000			400%	300%	119%	52%		
Agility	50	150	300	800	1,500	2,500	5,000	50,000			200%	100%	102%	58%		
Boston Dynamics	50	80	250	500	1,000	2,000	7,500	75,000			60%	213%	148%	58%		
1X		100	300	500	1,000	1,500	5,000	50,000				200%	119%	58%		
Others	50	300	500	1,000	2,000	4,000	8,000	100,000			500%	67%	93%	66%		
US total	350	2,130	8,350	19,300	38,000	102,500	200,500	1,975,000	8,000,000	30,000,000	509%	292%	148%	58%	32%	14%
% of global	12%	12%	17%	21%	23%	32%	29%	40%	44%	43%						
China																
Unitree (宇树)	1,400	5,500	15,000	25,000	40,000	60,000	100,000	300,000			293%	173%	79%	25%		
AGIBOT (智元)	600	5,100	11,000	20,000	30,000	45,000	80,000	250,000			750%	116%	73%	26%		
UBTECH (优必选)	250	1,000	3,000	5,000	8,000	15,000	30,000	250,000			300%	200%	97%	53%		
Leju Robotics (乐聚)	100	1,000	2,500	5,000	8,000	15,000	30,000	200,000			900%	150%	97%	46%		
Booster Robotics (加速进化)		1,000	3,000	5,000	8,000	15,000	30,000	200,000				200%	97%	46%		
Galbot (银河通用)		800	2,500	5,000	8,000	15,000	30,000	200,000				213%	106%	46%		
Others	200	1,000	2,500	5,000	20,000	40,000	150,000	1,100,000				150%	172%	49%		
China total	2,550	15,400	39,500	70,000	122,000	205,000	450,000	2,500,000	8,000,000	30,000,000	504%	156%	96%	41%	26%	14%
% of global	85%	86%	81%	77%	74%	65%	64%	50%	44%	43%						
Other regions																
Other regions total (Europe, Japan, etc.)	100	300	800	2,000	5,000	10,000	50,000	500,000	2,000,000	10,000,000	200%	167%	178%	58%	32%	17%
% of global	3%	2%	2%	2%	3%	3%	7%	10%	11%	14%						
Global Humanoid Robot Shipment (unit)	3,000	17,830	48,650	91,300	165,000	317,500	700,500	4,975,000	18,000,000	70,000,000	494%	173%	108%	48%	29%	15%

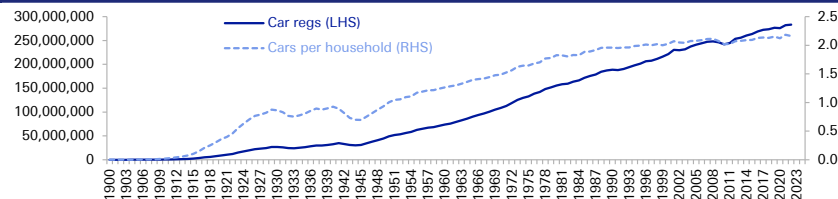
Humanoid adoption curve and penetration vs vehicles and traditional industrial robots



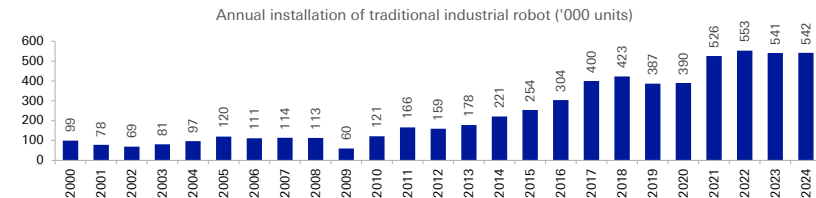
Humanoid penetration vs automobile and traditional industrial robots

	China	US	Europe	Total (Global for industrial robot)
Reference: Passenger vehicle (PV) (2024)				
Passenger vehicle stock unit (mn)	353	240	256	849
PV penetration of households	71%	181%	128%	103%
Passenger vehicle sales unit (mn)	28	16	17	60
Stock-to-sales ratio	12.8x	15.1x	15.1x	14.1x
Reference: Industrial robot (2023) from IFR				
Industrial robot stock unit ('000)	1,755	382	728	4,282
Industrial robot penetration	4.7%	3.0%	2.2%	1.7%
Industrial robot sales unit ('000)	276	38	92	541
Stock-to-sales ratio	6.4x	10.2x	7.9x	7.9x
Humanoid robot market potential by 2050				
Yearly salary (US\$)				
Manufacturing	13,342	43,873		
Hospitality	7,386	37,510		
1) Manufacturing				
Manufacturing labour (million)	37	13	32	82
Humanoid penetration %	10%	10%	8%	
Humanoids stock unit (million)	3.7	1.3	2.6	7.6
2) Hospitality				
Hospitality labour (million)	26	17	10	52
Humanoid penetration %	10%	10%	8%	
Humanoids stock unit (million)	2.6	1.7	0.8	5.0
3) Households				
No of households (million)	494	133	200	827
Humanoid penetration %	65%	90%	55%	
Humanoids stock unit (million)	321.2	119.3	110.0	550.5
Humanoids total stock unit (million)	327	122	113	563
Humanoids annual sales unit (million)	41	15	14	70
Stock-to-sales ratio	8.0x	8.0x	8.0x	

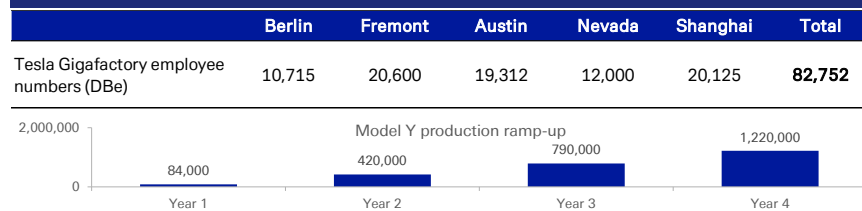
Automobile adoption in the US during early 1900s was surprisingly rapid



The adoption curve of traditional industrial robot was slow during 2000-10 but accelerated post 2009; China was the main growth driver



Number of employees at Tesla's factories globally and ramp-up of Model Y



Shipment and capacity targets by humanoid robot OEM



US manufacturers:

Tesla: Tesla is ramping up its production although it doesn't expect significant production volume until end of 2026. Tesla holds the long-term goal to have **1mn units** of Optimus at its Fremont factory. Elon Musk's compensation is dependent on delivering **1mn units** of humanoid robots.

Figure: [The company's manufacturing line has a production capacity of up to 12,000 humanoids per year.](#)

Boston Dynamics: During [an interview in January 2026](#), the CEO mentioned that the company plans to build 200-300 robots, use them to collect data in factories at Hyundai and also at Google facilities. By 2028, Hyundai plans to build a factory designed for mass production with a capacity between 10-30k units per year. By 2030, the company plans to build tens of thousands of robots per year.

1X: The company [entered into a strategic partnership with EQT](#). This deal involves shipping up to **10,000** 1X Neo humanoid robots between **2026 and 2030** to EQT's more than 300 portfolio companies.

Chinese manufacturers:

Unitree: [The CEO of Unitree announced in early 2026](#) that the company targets to ship **10,000-20,000k units** of humanoid robots in **2026**. [Unitree announced](#) that the company shipped over 5,500 units of humanoids robots in 2025, excluding the wheeled humanoid robots. In 2025, [Unitree reportedly](#) to have received over RMB1.2bn orders with over 10,000 units of robot shipments, including quadruped robots.

AGIBOT: [The R&D Director targets in early 2026](#) that the cumulative shipment to **exceed 10,000 units** in **2026**. In December 2025, [the CEO mentioned](#) that AGIBOT could reach 5,000 units of shipment in 2025 with sales of over RMB1bn.

UBTECH: In December 2025, [UBTECH was reportedly](#) to have achieved industrial humanoid robot production capacity of over 1,000 units with over 500 units delivered, and the capacity will increase to 10,000 units in 2026.

Leju Robotics: In November 2025, [Leju reportedly](#) targeted to deliver 1,000-2,000 units of humanoids robots in 2025, mainly for research and guide, with some small volume for industrial uses.

Humanoid robot configurations of selective OEMs



Humanoid robots developed by US OEMs are predominantly bipedal and are of human-like height. In contrast, robots from Chinese OEMs are available in both bipedal and wheeled configurations (wheeled versions typically being easier to control), and they exhibit varying heights.

Robot OEM	Tesla		Figure	Figure	Agility Robotics	Boston Dynamics	1X Technologies		Unitree	
Robot	Optimus		Figure	Figure 03	Digit	Atlas	NEO	G1	H2	H1
Appearance										
Launch date	Gen 1: Sep 2023 Gen 2: Dec 2023		Figure 01: Oct 2023 Figure 02: Aug 2024		Oct 2025	2019; latest update in Mar 2025	2013; latest update in Jan 2026	Oct 2025	G1: May 2024	H2: Oct 2025 H1: Aug 2023
Body part	Gen 1: 173cm		168cm		173cm	175cm	190cm	168cm	132cm	182cm
Height	Gen 1: 57kg		70kg		61kg	65kg	198 lbs (90kg)	66 lb (30kg)	35kg	70kg
Weight	n.a.		Figure 02: 1.2m/s		1.2m/s	1.5m/s	n.a.	n.a.	2m/s	n.a.
Speed	n.a.		Figure 02: 20kg		20kg	35 lbs (15.9kg)	50kg	25kg	3kg	Peak 15kg; Rated 7kg
Payload	n.a.		Figure 02: 5 hours		5 hours	Up to 4 hours	Up to 4 hours	4 hours	About 2 hours	About 3 hours
Runtime	n.a.		Figure 02: 2.25KWh		2.3KWh	n.a.	n.a.	842Wh	9000mAh	15Ah(0.972KWh)
Battery										0.864KWh

Robot OEM	AGIBOT			UBTECH		Leju Robotics		Booster Robotics		Galbot
Robot	X2 (Lingxi)	A2 (Yuanzheng)	G2 (Genie)	Walker S2	Walker S1	KUAVO (5G-A)	T1	K1	S1	G1
Appearance										
Launch date	Mar 2025	Aug 2024	Oct 2025	Jul 2025	Oct 2024	Jun 2025	Oct 2024	Oct 2025	Jan 2026	Jun 2024
Body part	131cm	169cm	179cm	176cm	172cm	166cm	118cm	95cm	179cm	173cm
Height	39kg	69kg	185kg	70kg	76kg	55kg	30kg	19.5kg	320kg	85kg
Weight	2m/s	1.2m/s	1.5m/s	2m/s	n.a.	5km/h	n.a.	n.a.	1.5m/s	n.a.
Speed	3kg	2kg (single arm)	5kg	15kg	15kg	1.6kg (single arm)	n.a.	n.a.	50kg	5kg
Payload	2 hours	3 hours	4 hours	n.a.	n.a.	n.a.	Walk 2hr; Stand 4hr	80min	8 hours	10 hours
Runtime	500Wh	700Wh	1652Wh (dual battery)	n.a.	n.a.	n.a.	10.5Ah	5Ah	30Ahx2	n.a.
Battery										

Price: US\$20,000-30,000 is the target range; lower price in China

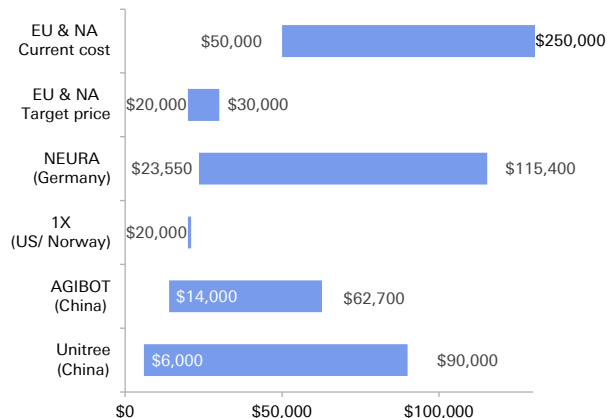


Most US and European humanoid robot manufacturers are targeting a price point of **US\$20,000-30,000** for their humanoid robots once **mass production** is achieved.

NEURA and **1X** already have offerings within this range. However, based on our channel checks, the current cost for humanoid robots ranges from US\$50,000-250,000, indicating that further cost optimization is required for widespread commercialization.

In China, prices are more competitive, with offerings from Unitree and AGIBOT of ~US\$10,000 at the low-end.

Price range for humanoid robots globally (in US\$)



Price of humanoid robots by different OEMs

Company	Product	Release time	Retail base price (RMB)	Retail base price (US\$)	Height	Weight	DoF	Max torque	Arm max payload
Unitree	H2	Oct 2025	199,000	\$27,000	1.82m	70kg	31	Arm joint: 120N.m Leg joint: 360N.m	Peak: ~15 kg Rated: ~7 kg
	H1	Aug 2023	650,000	\$90,000	1.8m (H1-2: 1.78m)	47kg (H1-2: 70kg)	19 (H1-2: 31)	H1-2: Arm joint: 120N.m; Leg joint: 360N.m	H1-2: Peak: ~21 kg; Rated: ~7 kg
	G1	May 2024	85,000	\$13,500	1.32m	35kg	23-43	Leg joint: 90N.m	2kg
	R1	Jul 2025	39,900	\$6,000	1.23m	29kg	26	n.a.	2kg
AGIBOT	Yuanzheng (远征) A2	Aug 2024	168,000	\$27,000	1.69m	69kg	40+	430N.m	
	Lingxi (灵犀) X2	Mar 2025	98,000	\$14,000	1.31m	35-39kg	25-30	120N.m	3kg
	Genie (精灵) G1	Nov 2023	450,000	\$62,700	1.3~1.8m	150kg	26		3kg

Country	Company	Release date	Model	Price (US\$)
U.S.	Tesla	1Q26	Optimus Gen3	Target \$20,000-\$30,000 at mass adoption
	Figure	09/10/2025 02/03/2023	Figure 03 Figure 01	Target retail price of under \$20,000 at high volumes
	Agility	Early 2023	Digit	~ \$250,000
	Apptronik	Aug 2023	Apollo	Roughly \$80,000 at high volumes by 2027; Ultimately below \$50,000
US/ Norway	1X	28/10/2025	Neo	\$20,000 or \$499/month
Germany	NEURA	Jan 2026	4NE1	Starting from €98,000/ \$115,400
			4NE1 Mini	€19,999/ \$23,550 for standard version; €29,999/ \$35,300 for pro version

Use case: Chinese humanoid robot OEMs

Data collection, primarily funded by local governments, and automotive factories represent the key end-market applications for large-scale orders for Chinese OEMs. We have observed a clear increase in the number of use cases in 2025 in China.



Robot OEM	Date	Customer	Region	Robot	Factories			Logistics/ Warehouses	Data collection	Guide	Inspection	Details
					Automotive	Electronics	Others					
Unitree	Jul 2025	China Mobile	China	n/a						✓		Unitree to supply small sized bipedal humanoid robots over 2025 and 2027
	Apr 2024	NIO	China	n/a	✓							Tested humanoid robot and robot dog for collaboratively picking up and delivering materials
AGIBOT	Oct 2025	Joyson Electronics (均胜电子)	China	Genie G2	✓							Commencing initial commercial deliveries for the over RMB100mn procurement contract with Joyson Electronic
	Oct 2025	Longcheer (龙旗科技)	China	Genie G2		✓						Strategic partnership to deploy humanoids for factory use
	Sep 2025	Hubei (湖北)	China	n/a					✓			Humanoid robot innovation center
	Aug 2025	Fulin Precision (富临精工)	China	Yuanzheng A2-W	✓							To deploy close to 100 units of robots
	Jul 2025	China Mobile (中国移动)	China	n/a						✓		AGIBOT to supply full sized bipedal humanoid robots over 2025-2027
	Jul 2025	Chery (奇瑞)	China	Genie G1	✓							Representative customer
	Jul 2025	Zhuhai (珠海)	China	n/a					✓			Embodied intelligence application innovation center data acquisition
	Jun 2025	Shaoxing Shangyu (绍兴上虞)	China	n/a					✓			Smart terminal procurement project for industrial data acquisition, jointly won by AGIBOT and SIR Robot (希尔机器人)
	Jun 2025	Damon Technology (德马科技)	China	n/a				✓				Signed strategic cooperation contract
UBTECH	Jan 2026	Airbus	EU	Walker S2			✓					Cooperation agreement with Airbus, which includes the purchase of Walker S2 for use in Airbus manufacturing facilities
	Dec 2025	Inner Mongolia Hohhot (内蒙古呼和浩特)	China	n/a					✓			Humanoid robot data collection and training/testing center
	Dec 2025	Guangdong Huizhou (广东惠州)	China	Walker S2					✓			Humanoid robot data collection and training/testing center
	Dec 2025	Texas Instrument	US	Walker S2		✓						Texas Instruments has acquired Walker S2 and is now deploying and testing it across its production lines.
	Dec 2025	AI platform (unnamed)	China	Walker S2					✓			Leading domestic AI large model company
	Nov 2025	Jiangxi Jiuliang (江西九江)	China	Walker S2					✓			Humanoid robot data collection and training/testing center
	Nov 2025	Guangxi Fangchenggang (广西防城港)	China	Walker S2							✓	Projects including passenger and personnel management at China-Vietnam border crossings, checkpoint patrols, logistics, commercial services, and facility inspections at large domestic steel, copper, and aluminum production bases
	Nov 2025	Sichuan Zigong (四川自贡)	China	Walker S2					✓			Humanoid robot data collection and training/testing center
	Oct 2025	Guangxi Liuzhou (广西柳州)	China	Walker S2					✓			Humanoid robot data collection and training/testing center
	Oct 2025	Well-known A-share listed automotive tech company	China	Walker S2	✓					✓		Auto factory manufacturing with embedded data collection
	Sep 2025	Miracle Automation (天奇股份)	China	Walker S	✓							Intelligent automotive equipment
	Sep 2025	Well-known domestic company	China	Walker S2								
	Sep 2025	Maxnerva Technology Services (云智汇科技)	China	n/a		✓						Signed global strategic cooperation agreement to promote UBTECH's humanoid robots in factories globally. Maxnerva is affiliated with Foxconn.
	Jul 2025	MIEE (觅亿上海)	China	Walker S	✓							MIEE is a platform company focusing on the export of Chinese automobiles and components
	Apr 2025	Dongfeng Liuzhou Motor (东风柳汽)	China	Walker S1, Walker C	✓					✓		Automobile factory production and commercial reception
	Mar 2025	Audi FAW	China	Walker S1	✓							HVAC leak detection
	Mar 2025	BAIC New Energy (北汽新能源)	China	Walker S	✓							Material inspection
	Mar 2025	Easyhome (居然智家)	China	n/a						✓		Framework agreement to purchase 500 units in 2025
	Jan 2025	Foxconn	China	Walker S1		✓						Been trained onsite in Foxconn's Shenzhen factory in China for two months, and is going to be brought into Foxconn's Zhengzhou factory for further training
	Since 2024	SF Holdings	China	n/a				✓				
	Oct 2024	BYD	China	Walker S1	✓							Performed handling tasks in coordination with autonomous logistics vehicles
	Jul 2024	FAW-Volkswagen	China	Walker S	✓							Screw tightening, part assembly and handling
	Jul 2024	Zeekr / Geely	China	Walker S Lite	✓							Tested for 21 days for material transportation
	Jun 2024	Dongfeng Motor	China	Walker S	✓							For various tasks including inspection, logo sticking and label printing during automotive manufacturing
	Feb 2024	NIO	China	Walker S	✓							Inspection and sticking the car logo at NIO's car factory
AI Robotics	Sep 2025	HKC Corporation (惠科股份)	China	n/a		✓						To deploy 1,000 units of robots in 3 years, order amount nearly RMB500mn
Galbot	Dec 2025	Baida Precision (百达精工)	China	n/a	✓							Strategic partnership to deploy more than 1,000 units of humanoid robots
EngineAI	Sep 2025	Duolun Technology (多伦科技)	China	n/a						✓		Procure no less than 2,00 units of humanoid robots over the next three years, for use in vehicle inspection and traffic management

Use case: US and European humanoid robot OEMs



Use cases in the US and Europe are predominantly focused on automotive factories and logistics, currently in the proof-of-concept phase.

Robot OEM	Date	Customer	Region	Robot	Factories			Logistics/ Warehouses	Details
					Automotive	Electronics	Others		
Figure	Nov 2025	BMW	US	Figure 02	✓				Retired after 11-month deployment at BMW's Spartanburg plant. Ran 10-hour shift Monday-Friday, and loaded 90,000+ parts. Contributed to the production of 30,000+ X3 vehicles.
	Apr 2025	UPS	US	n/a				✓	UPS reportedly in talks to use humanoid robots in its logistics network
	Aug 2024	BMW	US	Figure 02	✓				Tested for two weeks at BMW's US plant in Spartanburg to insert sheet metal parts into machines
	Jan 2024	BMW	US	Figure 01	✓				To be integrated into the manufacturing processes including the body ship, sheet metal and warehouse in the next 12-24 months
Agility Robotics	Feb 2026	Toyota Motor Manufacturing Canada	Canada	Digit	✓				After a successful pilot, TMMC plans to deploy Agility's robot, Digit, in its facilities to support employees with manufacturing, supply chain and logistics operations
	Dec 2025	Mercado Libre	US	Digit				✓	Mercado and Agility announced a commercial agreement to deploy Digit in Mercado's facility in San Antonio, Texas to support commerce fulfillment. Mercado is headquartered in Uruguay and operates online marketplaces.
	Nov 2024	Schaeffler	Germany	Digit	✓				Schaeffler made a minority investment in Agility, and intends to purchase humanoids from Agility for use in its manufacturing and warehouse network. Schaeffler sees the potential to deploy a significant number of humanoids by 2030
	Oct 2023	Amazon	US	Digit				✓	Amazon's warehouses for tote recycling
	Jun 2024	GXO	US	Digit				✓	Signed a multi-year agreement to begin deploying Digit in GXO's logistics operations. To assist with repetitive tasks such as moving totes from cobots and placing them onto conveyors
Boston Dynamics	Late 2025	Hyundai	US / South Korea	Atlas	✓				Hyundai plans to deploy Atlas in its auto production sites by end of 2025
	May 20205	DHL	US	Stretch				✓	DHL to scale robotics deployment across divisions with over 1,000 robotic units
1X	Dec 2025	EQT	US	NEO					To roll out up to 10,000 1X's humanoid robots across EQT's 300+ global portfolio companies between 2026 and 2030
NEURA Robotics	Jan 2026	Bosch	Germany	4NE1	✓				To collect real-world work, movement, and environmental physical training data in Bosch facilities
	Nov 2025	BITZER	Germany	4NE1			✓		BITZER's warehouse in Rottenburg, Germany, became the testing ground for 4NE1
	Nov 2025	Schaeffler	Germany	4NE1	✓				Schaeffler will integrate a mid-four-digit number of NEURA humanoids into its operations by 2035
Humanoid	Jan 2026	Siemens	UK	HMND 01 wheeled Alpha robot			✓		The POC focused on a tote-to-conveyor destacking task within Siemens' logistics process.
	Jan 2026	Schaeffler	UK / Germany	Beta-stage robot	✓				Bring hundreds of Humanoid's robots into Schaeffler's production facilities over 5 years. Initial deployments begin with beta-stage robots in 2026-2027.
Sanctuary AI	Apr 2024	Magna	Canada	Phoenix	✓				Sanctuary announced a strategic partnership with Magna, and Magna will pilot Sanctuary AI's humanoid for factory use
Hexagon	Feb 2026	BMW	Germany	AEON	✓				BMW to pilot Hexagon's humanoid robots at its Leipzig battery plant in Germany. To be used in battery manufacturing for energy modules and component production for exterior parts.
	Jun 2025	Pilatus Aircraft	Swiss	AEON		✓			To pilot AEON across manipulation, machine tending, part inspection and reality capture use cases.
	Jun 2025	Schaeffler	Germany	AEON	✓				To pilot AEON across manipulation, machine tending, part inspection and reality capture use cases.
Apptronik	Feb 2025	Jabil	US	Apollo		✓			Jabil will function as both a manufacturing partner – building Apollo robots – and a test case, integrating Apollo into specific manufacturing operations on the floor.
	Mar 2024	Mercedes	Germany	Apollo	✓				For logistics (bring parts for workers to assemble), while simultaneously inspecting the components. Also used to deliver the totes of kitted parts
Karlsruhe Institute of Technology (KIT)	May 2020	Ocado	UK	ARMAR-6				✓	Help workers with a range of maintenance tasks at Ocado's automated warehouse

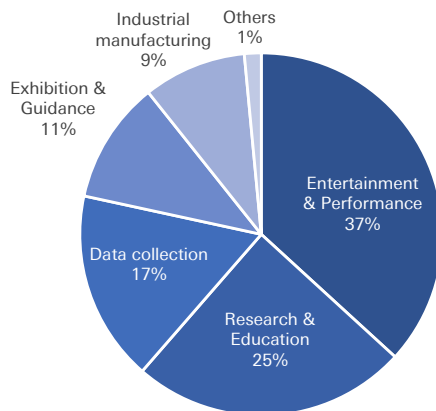
Use case: Entertainment, Research and Data collection dominated



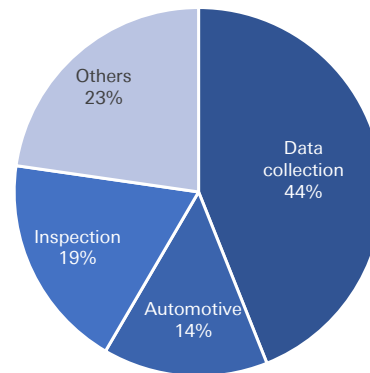
According to IDC, in 2025, 37% of humanoid robots shipped globally were utilized for entertainment and performance, followed by 25% for research and education, and 17% for data collection. The proportions for exhibition and guidance (11%) and industrial manufacturing (9%) were smaller.

We have also compiled the disclosed orders for UBTECH in 2025. Among the total RMB 1.4 billion in orders, data collection represented the largest share at 44%. These orders originated from humanoid robot data collection and testing centers of several local governments in China, underscoring government support for the embodied AI industry.

Global humanoid robot shipment by application in 2025



Order split for UBTECH by application in 2025



Comments from Elon Musk on humanoid robot plans since 2024 (1)



There have been several launch and production delays for Optimus. However, Elon Musk's dedication to humanoid robots is evident from his comments.

Date	Event	Comments from Elon Musk
28/01/2026	Tesla 4Q25 result	We're going to take the Model S and X production space in our Fremont factory and convert that into an Optimus factory, with the long-term goal of having 1mn units a year of Optimus robots in the current S/X space in Fremont. We are expecting that CapEx would be in excess of \$20bn. We'll be paying for six factories, namely the refinery, LFP factory, Cybercab, Semi, a new Megafactory, the Optimus factory. We'll probably unveil Optimus 3 in a few months. We wouldn't expect to have any kind of significant Optimus production volume until probably the end of this year. The biggest competition for humanoid robots will be from China. We think Optimus will be much more capable than any robot that we are aware of under development in China. So we think we'll be ahead in terms of the real-world intelligence, the electromechanical dexterity, especially the hand design, which is by far the hardest thing in the robot.
06/11/2025	Compensation package	Shareholders approved a compensation package for Elon Musk with potentially US\$1tn worth of stocks over the next 10 years. The package has set market-cap milestone and several operational milestones including 20mn Tesla vehicles delivered, 10mn active FSD subscriptions, 1mn Bots delivered, 1mn Robotaxis in commercial operation and milestones for adjusted EBITDA of different levels.
22/10/2025	Tesla 3Q25 result	We look forward to unveiling Optimus V3 probably in Q1. We'll have a production intent prototype ready to show off in Q1, probably February or March, and then we're going to be building a 1mn unit Optimus production line, hopefully with the production start towards the end of next year. But that production ramp will take a while to get to annualized rate of 1mn. And then, ultimately, we'll do Optimus 4 that will be 10mn units, Optimus 5 maybe 50mn to 100mn units. Optimus V3 won't even seem like a robot. It'll seem like a person in a robot suit. The forearm and hand is more difficult than the entire rest of the robot. If Optimus achieves 5x the productivity of a person per year because it can operate 24/7, it doesn't even need to charge - it's plugged in the whole time. We've made radical improvements to the design of Optimus while increasing the functionality, but making it actually possible to manufacture. Optimus 2 is almost impossible to manufacture frankly. For Optimus voice recognition, it uses Grok for voice generation. We'll be doing rolling changes for the Optimus design even after solder production.
24/07/2025	Tesla 2Q25 result	We're on Optimus version 2 right now, sort of 2.5. With Optimus 3, which is really the right design at this point, there's no significant flaws with the Optimus 3 design, but we are going to retool a bunch of things. So it's going to probably be prototypes of Optimus 3 end of this year, and then scale production next year. We're going to try to scale Optimus production as fast as it's seemingly possible to do, so we're trying to get to 1 million units a year as quickly as possible. That's a reasonable aspiration, 1 million units a year in five years. It seems like an achievable target. I'd be surprised if we are not roughly making 100,000 Optimus robots a month in 60 months.
23/04/2025	Tesla 1Q25 result	We expect to have thousands of Optimus robots working in Tesla factories by the end of this year (most of that production is going to be at the end of the year). I feel confident in getting to 1 million units per year in less than five years, maybe four years. So, by 2030, I feel confident in predicting 1 million Optimus units per year, it might be 2029. Our high-volume vehicle programs have over 85% North America content, and Shanghai vehicles have over 95% local content. Berlin has similar levels of regionalization as North America, when you exclude the battery. Now, Optimus was affected by the magnet issue from China, because the Optimus actuators in the arm do use permanent magnets. When something is volume constrained, like an arm of the robot, then you want to try to make the motors as small as possible. So, we did design in permanent magnets for those motors, and those were affected by the supply chain, by basically China requiring export license to send out any rare earth magnets. Hopefully, we'll get a license to use the rare earth magnets. For Optimus supply chain going forward, we'll have to see how things settle out. I don't know yet. We've already taken tremendous steps to localize our supply chain. With respect to humanoid robots, I don't think there's any company in any country that can match Tesla. Tesla and SpaceX are number one. I'm a little concerned that on the leaderboard, ranks 2 through 10 will be Chinese companies. But I'm confident that rank 1 will be Tesla.
29/01/2025	Tesla 4Q24 result	The training needs for Optimus humanoid robot are probably at least ultimately 10x what's needed for the car, at least to get to the full range of useful roles. A humanoid robot has probably 1,000x more uses and more complex things than in a car. That doesn't mean the training scales by 1,000 but it's probably 10x. You can do this progressively, so it doesn't mean Tesla is going to spend \$500 billion in training compute because we will obviously train Optimus to do enough tasks to match the output of Optimus robots. And obviously, the cost of training is dropping dramatically with time. I think in the long-term Optimus has the potential to be north of \$10 trillion in revenue. So you can obviously afford a lot of training compute in that situation. In fact, even \$500 billion training compute in that situation would be quite a good deal. The normal internal plan calls for roughly 10,000 Optimus robots to be built this year. Will we succeed in building 10,000 exactly by the end of December this year? Probably not. But will we succeed in making several thousand? Yes, I think we will. Will those several thousand Optimus robots be doing useful things by the end of the year? Yes, I'm confident they will do useful things. Those Optimus in use at the Tesla factories for production design one will inform how would we change for production design two, which we expect to launch next year. Now if we aspire to an order of magnitude ramp per year, perhaps we only end up with a half order of magnitude per year. It doesn't take very many years before we're making a 100 million of these things a year. If you go up by, let's say, a factor by 5x per year. For this year, Optimus could do dangerous, repetitive tasks that no humans want to do at Tesla, such as loading the hopper and transporting pieces of sheet metal to the robot welding line for the body. It's really with production version 2, which I think launches sometime next year. I'd like it to be the beginning of next year, but maybe it's more like the middle of next year. And then we have to do it with a production line that is designed for on the order of 10,000 units a month versus 1,000 units a month. The current line that we're designing is for roughly 1,000 units a month of Optimus robots. The next line would be for 10,000 units a month, the line after that would be for 100,000 units a month. I think probably with version 2, very rough guess that we start delivering Optimus robots to companies that are outside of Tesla in maybe the second half of next year.

Comments from Elon Musk on humanoid robot plans since 2024 (2)



Date	Event	Comments from Elon Musk
09/01/2025	Interview of Elon Musk	We will produce several thousands Optimus humanoid robots in 2025 to be tested at Tesla factories. Assuming things go well, we'll 10x that output next year (2026) , so we'll aim to do maybe 50,000-100,000 humanoid robots next year, and then 10x it again the following year (2027). It's like 500,000 robots in three years (2027).
23/10/2024	Tesla 3Q24 result	With Optimus, we showed a massive improvement in Optimus' dexterity movement on October 10 and our next-gen handed form which is 22 degrees of freedom , which doubles the prior handed form. I feel confident in saying that we have most advanced humanoid robot by longshot. And we're moreover the only company that really has all of the ingredients necessary to scale humanoid robots. Because the things that what other companies are missing is that they're missing the AI brain that they're missing the ability to really scale to very-high volume production.
10/10/2024	Tesla Robotaxi "We, Robot" event	Fundamentally at-scale, you should be able to buy an Optimus robot for \$20,000 to \$30,000 long-term. Optimus will basically do anything you want. So it can be a teacher, babysit your kids, it can walk your dog, mow your lawn, get the groceries, just be your friend, serve drinks, whatever you can think of, it will do.
23/07/2024	Tesla 2Q24 result	Optimus is already performing tasks in our factory, and we expect to have Optimus production version 1 and limited production starting early next year . This will be for Tesla consumption. We expect to have several thousand Optimus robots produced and doing useful things by the end of next year in the Tesla factories. And in 2026, ramping up production quite a bit. And at that point, we'll be providing Optimus robots to outside customers . That'll be production version 2 of Optimus. Optimus is intended to be a generalized humanoid robot with a lot of intelligence. So it's like saying what kind of accessories would be offered by the human. It's just really intended to be able to be backwards compatible with human tasks. So it would use any accessories that a human would use. I think the long-term value of Optimus will exceed that of everything else that Tesla combined . The utility of a humanoid robot that can do pretty much anything you ask of it, I think everyone on earth is going to want one. There's 8 billion people on earth, so it's 8 billion right there. Then you've got all of the industrial uses, which is probably at least as much, if not way more. So I suspect that the long-term demand for general-purpose humanoid robots is in excess of 20 billion units .
13/06/2024	Tesla AGM	I think the ratio of humanoid robots to humans will probably be at least two to one. One to one, for sure, which means like, somewhere around the order of 10 billion humanoid robots. Maybe 20 billion or 30 billion . I think the build rate will be probably ultimately like, a billion a year humanoid robots . If Tesla just has a 10% share of that, and there are 100 million Optimus units a year . For reference, the Auto industry is roughly a 100 million vehicles per year. And I think we could make one for a cost of maybe, at really high scale, of about \$10,000 . It's smaller, it'd be less expensive than a car. If you sell it for \$20,000 or something, Tesla would basically make about \$1 trillion of profit a year from that. So, yes. If the price/earnings multiple is 20x or 25x, that would mean a \$20 trillion market cap from Optimus alone. And probably \$5 trillion to \$10 trillion from autonomous vehicles. We have two Optimus robots in our Fremont factory that are doing basically this task, which is taking cells off the end of the line and placing them in a shipping container. And yes, we actually have quite a few of these cruising around our offices in Palo Alto. I think we've one major hardware revision , which should be done by end of this year or early next , and then we'll move into a limited production next year of Optimus, limited production for use in our factories where we'll test out the product. My prediction is next year we'll have over a thousand , maybe a few thousand Optimus robots working at Tesla. And things are going to scale up very rapidly from there. So, we'll iron out the bugs. The degree of autonomy will be radically better . You'll just literally be able to talk to it and say, please do this task, or I'm going to show you something, now do the thing that I'm showing you. I'm confident of the prediction that the ratio of humanoid robots to humans will be greater than one to one . So, there'll be more than 10 billion humanoid robots in the world, probably 20 billion or more. And Tesla is going to be by far the leader in that. I think it's actually very challenging to do Optimus as a robot startup, because what we found to make Optimus work, we've had to design from first principles, from scratch, every part of the robot (motor, gearbox, sensors, power electronics, communication system). We found that there's basically no supply chain. Our next generation has 22 degrees of freedom . It will be able to play the piano.
23/04/2024	Tesla 1Q24 result	We do think we will have Optimus in limited production in the factory doing useful tasks before the end of this year . And then I think we may be able to sell it externally by the end of next year . These are just guesses.
24/01/2024	Tesla 4Q23 result	AI technologies that we've developed for the car translate quite well to a humanoid robot because the car is just a robot on four wheels . Tesla is arguably already the biggest robot maker in the world. It's just a four-wheeled robot. So Optimus is a humanoid robot with arms and legs. I think we've got a good chance of shipping some number of Optimus units next year . But like I said, this is a brand new product. There's a lot of uncertainty in your uncharted territory, it's obviously impossible to make a precise prediction. But we will be updating the public with progress on Optimus every few months, and you can see that it's advancing very quickly.



2) Increasing entrants from more verticals and regions

Increasing entrants from more verticals and regions



Increasing entrants from more verticals and regions: New entrants have emerged, with manufacturers from various verticals, beyond automotive OEMs, launching humanoid robots since 2025. Examples include electronics assembler **Hon Hai** in Taiwan, household appliance maker **Midea**, and smartphone manufacturer **Honor** in China. Additionally, **Apple** and **Meta** are reportedly developing humanoid robots. Regionally, companies outside the US and China, such as **Softbank** (Japan), **Hyundai** (South Korea), and **Hexagon** (Sweden), have intensified their efforts in robots.

Exiters to emerge in the coming years: In [November 2025, the NDRC in China](#) warned about risks in the embodied AI industry, including the clustering of highly repetitive products. With over 150 humanoid robot enterprises currently in China and the number still increasing, we anticipate some of the smaller players will exit as the industry matures and consolidates. For example, [Dataa Robotics is reportedly undergoing a difficult time](#).

Independent vendors dominate: Most manufacturers are independent vendors specializing in humanoid robots, with some being startups founded post-2020.

Automotive manufacturers are plentiful: Auto OEMs are leveraging their expertise in autonomous driving and manufacturing know-how for humanoid robots. Tesla leads this sector, followed by Chinese auto OEMs such as XPeng and Xiaomi. Beyond in-house development, certain OEMs, including BYD, Dongfeng, and Li Auto, have tested robots from independent vendors prior to launching their own products.

Different types of humanoid robot manufacturers

Independent vendors	Automotive manufacturers	Electronics manufacturers	Others	Research labs	AI platforms (models)
Figure 1X Apptronik Sunday	Agility Boston Dynamics (Under Hyundai) Fauna Robotics	Tesla	US Apple	UCLA	Meta NVIDIA OpenAI Google Physical Intelligence (PI) Skid.ai
Mainland China					
Unitree (宇树) AGIBOT (智元) UBTECH (优必选) Leju Robotics (乐聚) Booster Robotics (加速进化) Galbot (银河通用) LimX Dynamics (逐际动力) RobotEra (星动纪元) DEEP Robotics (云深处) EngineAI (众擎) AI² Robotics (智平方) Kepler (开普勒)	XPeng Xiaomi Chery GAC Chang'an Dongfeng Sharpa (赛斯) BYD NIO Li Auto	Honor	Midea Haier	X-Humanoid (北京人形机器人创新中心)	Huawei Baidu Alibaba Tencent ByteDance iFLYTEK (科大讯飞) Horizon Robotics
Europe					
NEURA Robotics (Germany) Mentee Robotics (Israel) (acquired by Engineered Arts (UK) Humanoid (UK) Macco Robotics (Spain)			Hexagon (Sweden)	Karlsruhe Institute of Technology (KIT) (Germany)	
Japan					
Tokyo Robotics (acquired by Yaskawa)	Honda Toyota		Kawasaki	Toyota Research Institute (TRI) Waseda University	Softbank
Others					
Sanctuary AI (Canada) Addverb (India) Vanar Robots (India)	Hyundai (South Korea) Vingroup (Vietnam)	Hon Hai (Taiwan)			

Note: Companies in the grey colour are AI platforms (models) which have released models for humanoid robots

Automotive OEMs: In-house development, adoption and production accelerating



Automotive OEMs are leading in both the in-house development and factory adoption of humanoid robots. **Tesla** remains the most advanced globally, with a long-term objective of producing over 1mn units per annum. In China, **XPeng** intends to mass-produce its new-generation "Iron" humanoid robot by the end of 2026. In the US, **Boston Dynamics** plans to deploy their humanoid robots at Hyundai's factory starting in 2028, with an annual capacity of 30,000 units.

Company	Region	In-house development	Humanoid robot	Latest update time	First release time	Partners	Progress
Automotive manufacturers							
Mainland China							
Hesai Group (禾赛科技)	China	√	Sharpa North	Jan 2026	Jan 2026		The three co-founders jointly established a new company, Sharpa, dedicated to developing general-purpose humanoid robots and core components.
XPeng	China	√	IRON	Nov 2025	Nov 2024	-	XPeng unveiled its new generation IRON in Nov 2025. Mass production anticipated in 2H26.
Dongfeng (东风)	China	√	Xiaodong (小东) No.2 (二号)	Nov 2025	Nov 2025	√ (UBTECH)	Xiaodong: for service and guided shopping scenarios No. 2: for demanding, high-intensity industrial environments. Conducted practical training at Dongfeng Motor's smart factory in Dec 2025. Official deployment planned for 2026.
Chang'an	China	√	Xiao'an (小安)	Nov 2025	Nov 2025		Mass production anticipated by 2028. Expansion into household service robots planned after 2030.
GAC (广汽)	China	√	GoMate	Oct 2025 (Gen 4)	Dec 2024		Mass production of self-developed components in 2025. In 2026, GAC aims for small-batch production of complete humanoid robots, scaling up to large-scale mass production.
Chery	China	√ (AiMOGA)	Mornine (墨茵)	Mar 2025	Mar 2025	√ (AiMOGA)	Jointly developed with AiMOGA team. Over 300 units were delivered globally within 2025, making Chery the world's first automaker to mass-deliver self-developed humanoid robots.
Xiaomi	China	√	CyberOne (铁大)	-	Aug 2022	-	In Feb 2026, Xiaomi officially released and open-sourced Xiaomi-Robotics-0, its first-generation VLA large model designed for embodied AI and robot control.
BYD	China	√	Not yet launched			√ (UBTECH)	As of Dec 2025, BYD's "Yaoshunyu" humanoid robot prototype has iterated to its 7th generation. The internal deployment target is 2,000 units in 2025 and 20,000 units in 2026, with a target unit price of under RMB200k.
Li Auto	China	√	Not yet launched				Li Auto's CEO Li Xiang held an internal meeting in Jan 2026, stating the plans to enter the humanoid robot sector.
NIO (蔚来)	China	√	Not yet launched			√ (UBTECH, Unitree, Leju Robotics)	In Aug 2025, NIO registered two more "NOMI" trademarks, including humanoid robots with AI for scientific research. NIO's NOMI is its independently developed in-car AI interactive system.
Outside of China							
Tesla	U.S.	√	Optimus	Expected in 1Q26	Sep 2022		Announced to unveil Optimus V3 in 1Q26, which will be Tesla's first mass-produced humanoid robot. Tesla will convert its Fremont factory into robot-manufacturing capable of producing 1mn units of Optimus per year.
Hyundai (现代)	South Korea	√ (Boston Dynamics)	Atlas	Jan 2026	The first version in 2016		Boston Dynamics unveiled latest version of Atlas on CES 2026, planning to deploy humanoid robots at its Georgia factory from 2028. Atlas will initially handle repetitive tasks, with involvement in complex assembly projected by 2030. The annual production capacity will reach 30,000 units by 2028.
Honda (本田)	Japan	√	ASIMO	-	The first version in 2000		Production of ASIMO completely ceased in 2018, due to high manufacturing cost up to \$2.5mn per unit. In 2021, Honda announced its intention to develop Avatar Robots.
Toyota (丰田)	Japan	√	Punyo CUE6	Feb 2024	Dec 2022	√ (Boston Dynamics)	Punyo is a soft robot designed to "help people complete daily tasks at home and elsewhere." CUE6 is designed for playing basketball.
Vingroup	Vietnam	√	VinMotion Motion 1	Jun 2025	Jun 2025		Vingroup's subsidiary VinMotion announced VinMotion 1, its first "Made in Vietnam" humanoid robot prototype, in June 2025. Vingroup, founded in 1993 in Ukraine, is the largest private conglomerate in Vietnam.

Increasing entrants from more verticals: Electronics, household appliance, AI and industrials



Among **electronics manufacturers**, Chinese mobile phone maker **Honor** launched its first humanoid robot in early March 2026. Taiwanese electronic device assembler **Hon Hai** launched two humanoid robots jointly developed with NVIDIA in November 2025. **Apple** is reportedly [exploring humanoid robots](#) and [could launch its tabletop robot in 2027](#).

Among **household appliance manufacturers**, **Midea** in China launched two humanoid robot models in 2025. **Haier** has also jointly developed humanoid robots with independent vendors.

Among **AI companies**, most, such as NVIDIA and OpenAI, focus on AI platforms and large models for humanoid robots rather than manufacturing the physical robots. That said, **Meta** is reportedly [developing humanoid robots](#).

Industrial manufacturer **Kawasaki** and Swedish metrology company **Hexagon** also launched its humanoid robot in 2025.

Company	Region	In-house development	Humanoid robot	Latest update time	First release time	Partners	Progress
Electronics manufacturers							
Honor	China	✓	Commercial grade	Mar 2026	Mar 2026		Unveiled its first humanoid robot at MWC 2026, designed for shopping assistance, workplace inspections and companionship
Hon Hai	Taiwan	✓	Wheeled and legged robots	Nov 2025	Nov 2025	✓ (Nvidia)	On Hon Hai Tech Day in November 2025, Foxconn unveiled its industrial-grade AI humanoid robots jointly developed with Nvidia, including wheeled robots and legged robots.
Apple	U.S.	✓	Not yet launched				Apple is exploring both humanoid and non-humanoid robotic form factors.
Household appliance manufacturers							
Midea (美的)	China	✓	MELA (美拉) MIRO (美罗)	Sep 2025	Mar 2025		Midea's first humanoid robot began practical training at its washing machine factory in Jingzhou since Mar 2025. In Dec 2025, Midea unveiled "MIRO U", an industry-first six-armed, wheeled-legged humanoid robot. "MELA", targeting commercial and home scenarios, will be introduced into offline experience stores in 2026 to perform product guidance and demonstrations.
Haier (海尔智家)	China		HIVA (海娃) Kuavo (夸父)	Jul 2025	Mar 2024	✓ (RobotEra, Leju Robotics)	In Mar 2025, Haier signed a strategic cooperation agreement with RobotEra, to jointly introduce service robots for smart home applications. In Mar 2024, Haier and Leju Robotics jointly launched "KUAVO", a general-purpose humanoid service robot. KUAVO is capable of performing manual operations like watering and arranging flowers.
AI platforms							
Softbank	Japan	✓	Pepper	Feb 2026	Jun 2014		Unveiled in June 2014, Pepper was designed as a "companion" robot for both consumer and business use. As of early 2026, Softbank has launched "Pepper+", equipped with the latest AI technology, aiming to provide services such as demonstrating and recommending products that meet customers' needs.
Meta	U.S.	✓	Not yet launched	-	Feb 2025		Meta leadership announced that it would be launching an entirely new division dedicated to developing AI powered humanoid robots. The innovation will focus primarily on consumer humanoid robots with a goal of maximizing Llama's platform capabilities.
Others							
Kawasaki	Japan	✓	Kaleido (Gen 9)	Dec 2025	2017		The 9th generation of Kawasaki's RHP Kaleido series made its debut at 2025 International Robot Exhibition. It targets application in simple factory tasks and for communication assistance in medical/nursing care settings by 2030.
Hexagon	Sweden	✓	AEON	Jun 2025	Jun 2025	✓ (Nvidia)	In June 2025, Hexagon unveiled AEON, a new humanoid robot built in collaboration with NVIDIA. Hexagon plans to deploy AEON across automotive, transportation, aerospace, manufacturing, warehousing and logistics.

Valuation: US and European humanoid names on higher valuation than Chinese peers



According to public news surrounding the latest funding rounds of private humanoid robot companies, **Figure AI**'s valuation stands highest at US\$39 billion. **Skild AI**, which develops unified robotics foundation models, follows with a US\$14 billion valuation. Both **1X** and **NEURA** are valued at approximately US\$10 billion. In comparison, the valuations of Chinese peers are lower; leading players such as **Unitree** and **AGIBOT** are both valued at around US\$2 billion.

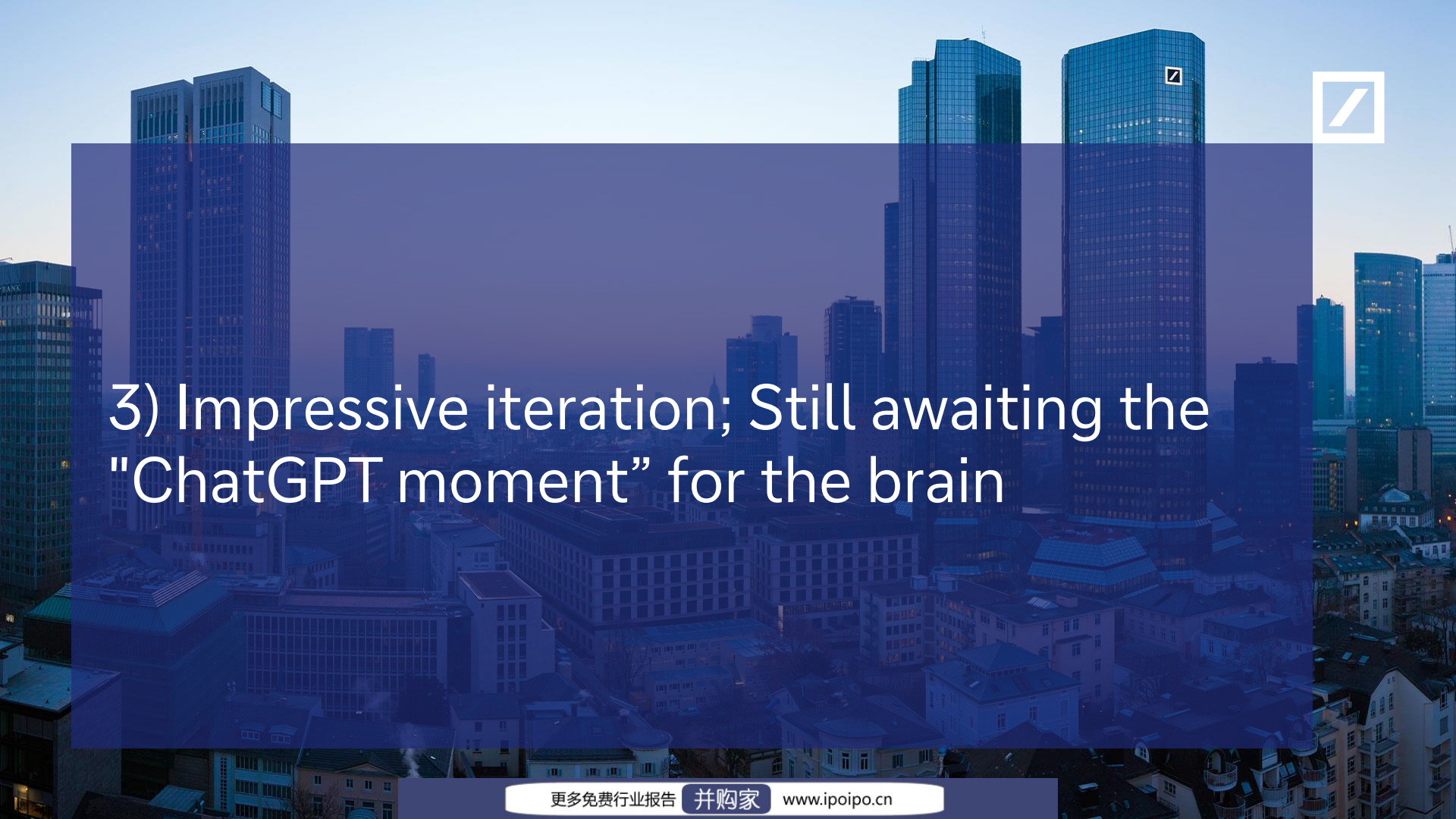
Nonetheless, many humanoid robot manufacturers are seeking public listings in 2026 and beyond. **Unitree** has publicly announced it is undergoing the IPO procedure. **AGIBOT** is reportedly targeting a public listing by 3Q26. **Galbot**, **Leju Robotics**, **DEEP Robotics** and **MagicLab** are all reported to have initiated IPO procedures. Most recently, **Galaxea AI** and **EngineAI** completed shareholding reform in January 2026, which is often considered a precursor to a public listing.

Un-listed Chinese humanoid robot companies: Funding rounds, valuation and IPO pipeline

Company	Progress	Latest funding	Completion date	Valuation (based on news)
China				
Unitree Robotics (宇树科技)	Completed IPO guidance on 11 Nov 2025; Reportedly to submit listing application in 4Q25 but delayed to 2026	C round: RMB700mn	Jun 2025	RMB12bn
AGIBOT (智元机器人)	Announced the acquisition of a 63% shareholding in Swancor Advanced Materials (上纬新材, 688585.SH) for RMB2.1bn in Jul 2025 Shareholding system reform in Nov 2025; Reportedly to submit listing application in early 2026 and complete IPO by 3Q26	B and B+ round: amount not disclosed	Mar 2025	RMB15bn post B round
Leju Robotics (乐聚机器人)	Completed IPO filing on 30 Oct 2025 Reportedly to complete IPO guidance in 2Q26	Pre-IPO: RMB1.5bn	Oct 2025	RMB9bn (market estimates)
Galbot (银河通用)	Shareholding system reform in late Nov 2025 Reportedly to initiate IPO in 2026	RMB2.5bn	Mar 2026	US\$3bn (pre-money)
DEEP Robotics (云深处)	Completed IPO filing on 24 Dec 2025 Reportedly to complete IPO guidance in 2Q26	Pre-IPO: hundreds of millions in RMB	Dec 2025	RMB10bn (market estimates)
Galaxea AI (星海图)	Shareholding system reform in Jan 2026	B round: RMB1bn	Feb 2026	Nearly RMB10bn (market estimates)
EngineAI (众擎机器人)	Shareholding system reform in Jan 2026	A1+ / A2 round	Dec 2025	
Noetix Robotics (松延动力)	n.a.	B round: Rmb1bn	Mar 2026	
Spirit AI (千寻智能)	n.a.	Latest 2 rounds: RMB2bn	Feb 2026	Over RMB10bn
X Square (自变量机器人)	n.a.	Hundreds of millions in RMB	Feb 2026	
AI² Robotics (智平方)	n.a.	B round: over RMB1bn	Feb 2026	Over RMB10bn
MagicLab (魔法原子)	Accelerating IPO process, seeking substantive news releases in 2026	Strategic funding: hundreds of millions in RMB	Jul 2025	

US and European humanoid robot companies

Company	Latest funding	Completion date	Valuation (based on news)
U.S.			
Apptронik	A-X round: US\$520mn	Feb 2026	Over US\$5.5bn
Skild AI	C round: US\$1.4bn	Jan 2026	Over US\$14bn
Physical Intelligence	Raised US\$600mn in a new round of funding	Nov 2025	US\$5.6bn
Figure AI	C round: over US\$1bn	Sep 2025	US\$39bn
Agility	Reportedly securing a US\$400mn funding round	Mar 2025	US\$1.75bn (pre-money)
Europe			
1X	Seeking up to US\$1bn in new funding	Ongoing	At least US\$10bn
NEURA	Tether exploring a US\$1.2bn investment	Ongoing	€8bn-€10bn
Humanoid	In talks to raise US\$200mn in A round	Ongoing	Not disclosed



3) Impressive iteration; Still awaiting the "ChatGPT moment" for the brain

Architecture: converging towards a dual-system VLA approach (Fast + Slow thinking)



Humanoid robots are increasingly converging toward a two-timescale VLA architecture: a slow/reasoning model (semantic planning, language grounding) plus a fast/reactive controller (instinctual responses, high-rate motor execution).

Why is the dual system replacing "one big model"?

- **One monolithic model struggles to balance generality and reaction speed:** Large VLM/VLA models are strong at semantic understanding and long-horizon task decomposition, but they are typically too compute-heavy, thus too slow to directly handle full-body, high-frequency control loop; visuomotor policies, on the other hand, are fast but not general enough.
- **A dual-system design solves this by assigning different jobs to different timescales:** The "slow" system handles scene understanding, language grounding, and subtask sequencing; the "fast" system converts that intent into continuous motion at high update rates.
- **This is not "modular" vs "end-to-end":** The trend is toward a tightly integrated, end-to-end coordinated hierarchy (separate roles by timescale, but trained/inferred together), which reduces brittle handoffs between reasoning and control.

Examples: Figure Helix (adding System 0 for more stable whole-body control), NVIDIA GROOT N1, Google Gemini Robotics VLA + ER separation, Physical Intelligence $\pi 0.5$, AGIBOT Go-1

Google Gemini Robotics 1.5: Embodied Reasoning (Orchestrator) + VLA (Actor)

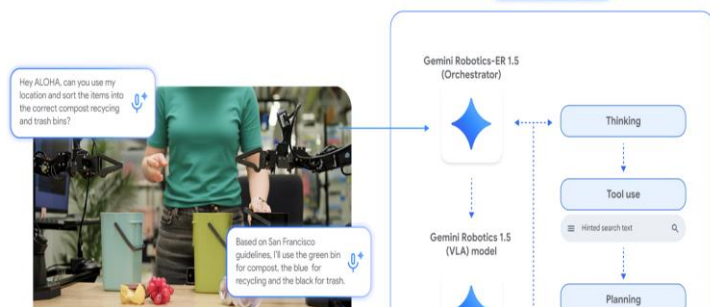
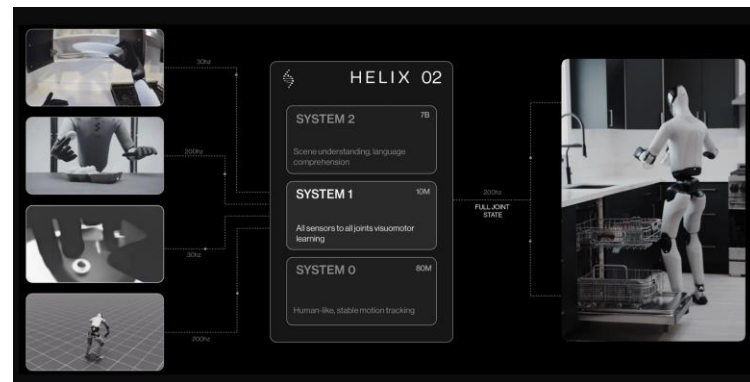
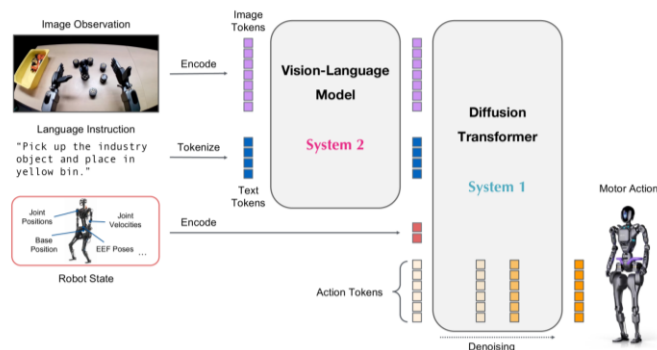


Figure Helix 02: S0 motion control + S1 fast response + S2 slow reasoning



Nvidia GROOT N1 foundation model : VLA model with a dual-system design



Architecture : World Model emerging as the next-gen above/beside VLA



What is a World Model? World Model learns/predicts how the environment evolves and how actions change future states, rather than only mapping observation to next action.

How it differs from VLA? VLA is primarily optimized to produce robot actions from observations + instructions; world models add explicit prediction/simulation of futures, which can improve planning, scenario coverage, and counterfactual reasoning.

Examples: Google Genie, Nvidia Cosmos, 1X World Model, Meta V-JEPA 2

Why is it important?

- **Augment synthetic data:** World Model can generate/predict additional training scenarios or world states (weather, lighting conditions, etc), and help scale synthetic-data pipelines, reducing reliance on teleoperation data and enabling scenario coverage expansion faster than collecting every edge case in the real world.
- **Planning quality:** they add "predict before act" capability, which is valuable for long-horizon humanoid tasks where action errors compound. An action model maps current observation to next action, but a World Model can evaluate what is likely to happen next under different action choices.

Challenges:

- **Data demand & compute-heavy:** training world models typically requires large-scale, long-horizon video or trajectory data and heavy compute for generation and rollouts.
- **"Hallucination ":** World Model as a generative model by nature suffers from "hallucination" as well, caused by compounding prediction errors in long horizons (use predicted states to predict next states), sensor noises, etc. It can produce plausible-looking but physically incorrect rollouts (object appear out of thin air, etc), which could poison the policy training.

Future: We believe World Models are likely to evolve into a complementary layer to VLA/action policies rather than a substitute. The coupling will increasingly look like a closed loop:

- 1) World Model rollout (synthetic scenario) → scoring/filters → post-training data → stronger VLA;
- 2) In more advanced systems, will query World Model for "what-if" outcomes → select a short-horizon plan/subgoal → VLA executes, with low-level safety controllers enforcing stability.

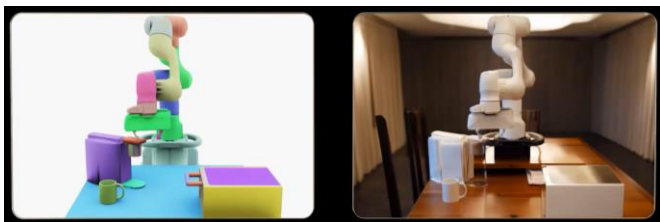
Cosmos Predict: generate future states of dynamic environments



Input video: pouring water

Output video: what if I stop pouring? How will the water flow? Will it splash out?

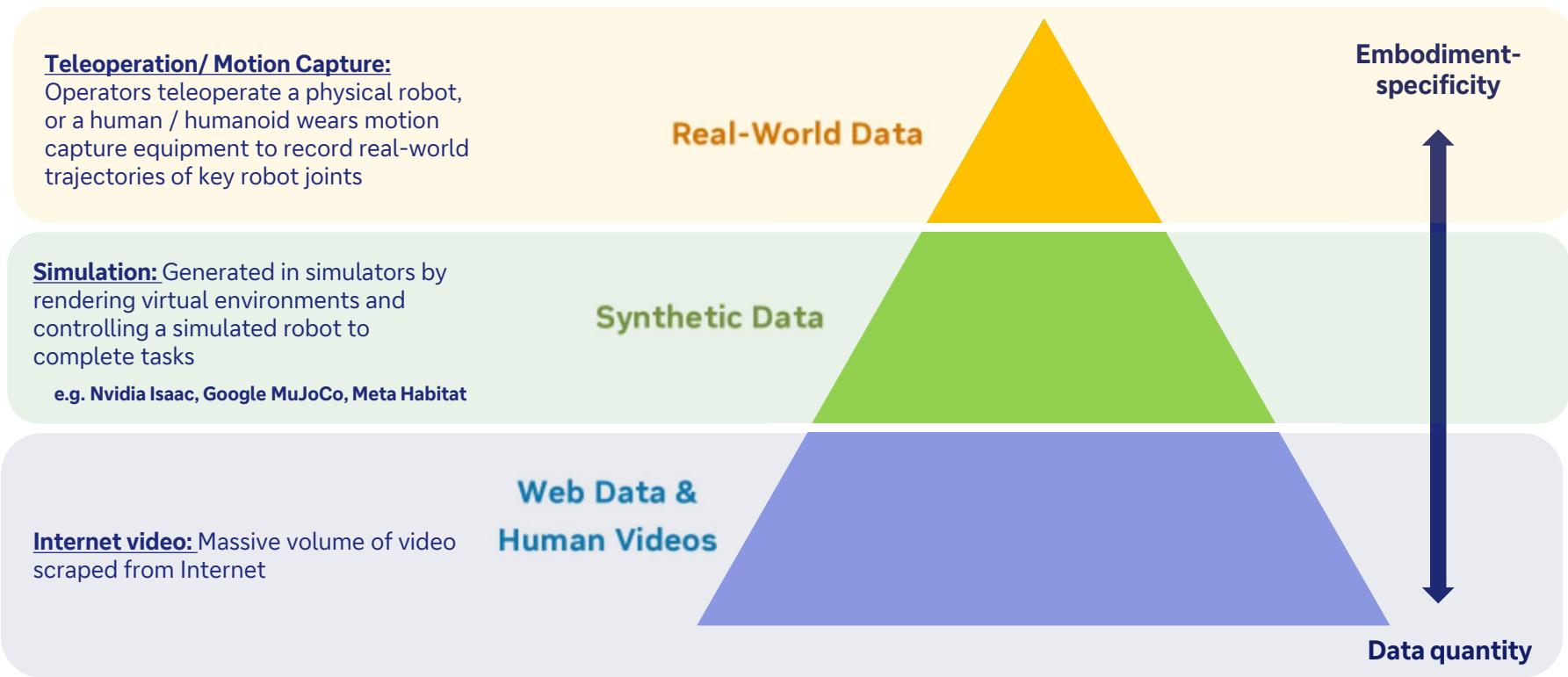
Cosmos Transfer: augment synthetic data to improve Sim2Real performance



Input video: synthetic with minimal details

Output video: high-fidelity 3D simulation across various environments and lighting conditions

Training data: the Data Pyramid for robot training



Training data: three ways to collect data



Real-world data (teleoperation)

Pros:

- High-quality, reflecting real-world physics and constraints
- Multi-modal (vision, 3D position, force, speed...)

Cons:

- Difficult to scale
- Time-consuming
- Expensive to collect
- Constrained by the robot's form factor and sensor config

Use cases: for both pre- and post-training; increasingly critical for post-training or fine-tuning to improve performance



Synthetic data (simulation)

Pros:

- More diverse data across various scenarios
- Scalable, fast to generate at high volume
- Lower marginal cost
- Multi-modal (vision, 3D, force, speed...)

Cons:

- Sim-to-real gap; may fail to capture some key effects
- Compute-intensive
- Overfitting

Use cases: more for pre-training.

- Mentee also leverages real-to-sim feedback, where real-world edge cases are fed back to the simulator to refine the physics engine



Web video data (Internet)

Pros:

- Still grounded in real-world observations.
- Massive volume, easy to acquire
- Low cost

Cons:

- Visual-only
- Limited scenarios/scenes, may not align with robot task
- May require labeling which could be expensive

Use cases: pre-training



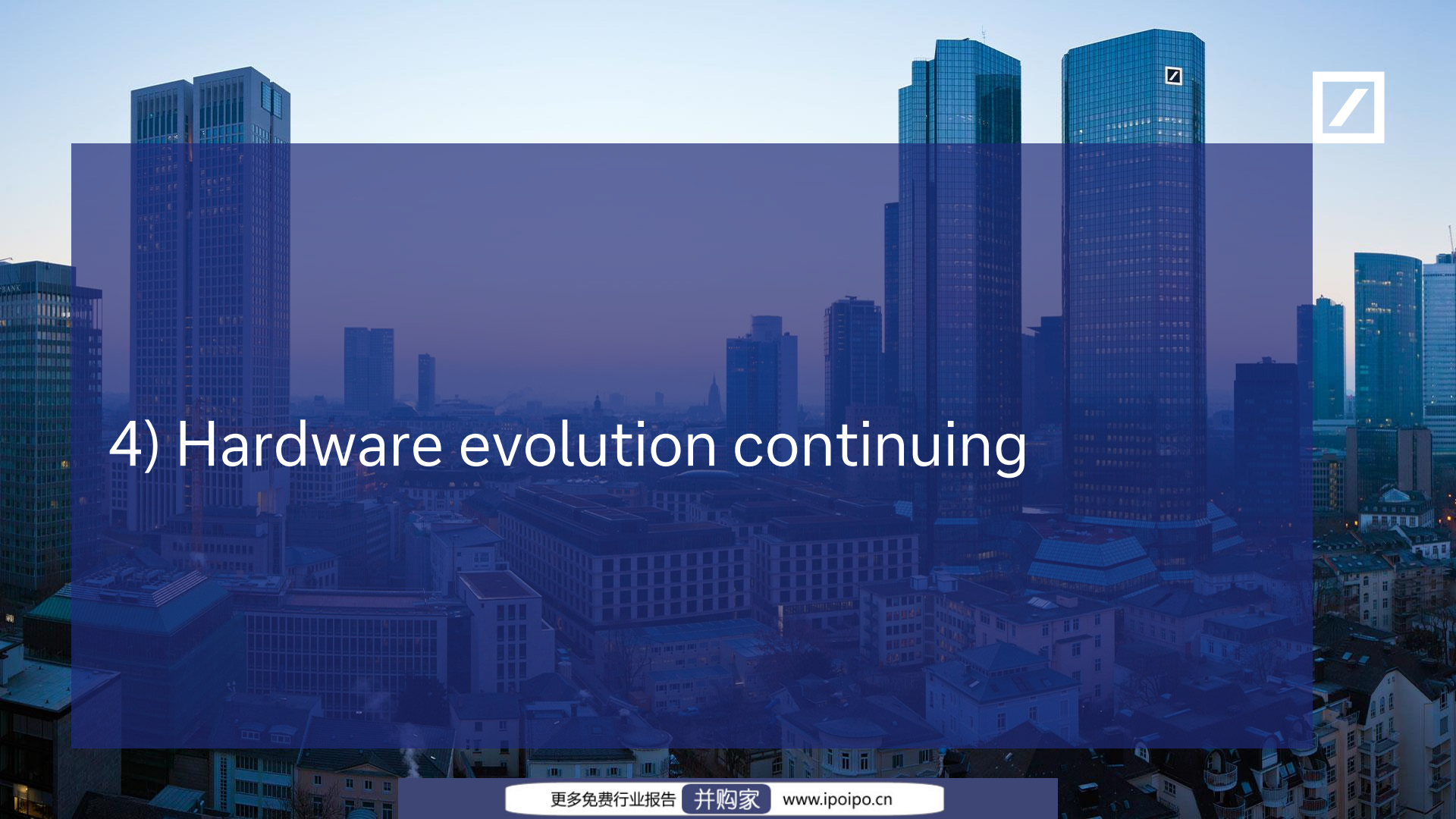
Training computes & onboard chips : NVIDIA continues to be dominant



NVIDIA continues to be the dominant onboard processor due to performance and ease-of-use. Companies using Jetson Orin or Thor include 1X, Agility, Apptronik, Boston Dynamics, Figure AI, Mentee (for now), NEURA, UBTECH, Unitree, and more.

Tesla and XPeng are using internally designed inference chips. VinMotion's Motion 2 humanoid is using IQ9 Series.

Company	Humanoid Platform	Architecture	Model Framework	Data Collection	Simulation / Training Platforms	Training Compute	Onboard Chips
Tesla	Optimus	End-to-End Multimodal VLA	Proprietary Multimodal Model	Teleoperation; transitioned to Simulation & Internet videos	Optimus Academy (Tesla's reality generator)	NVIDIA H100; adding in-house designed AI5	Transitioning to internally designed AI5
Boston Dynamics	Atlas	End-to-End VLA	Google Gemini Robotics + TRI LBM	Real-world data (Hyundai RMAC training center); Simulation	Leverage Nvidia Isaac	NVIDIA DGX	NVIDIA Jetson Thor
Figure AI	Figure 02	3-system VLA	Helix: 7B parameter pre-trained VLM (System 2) + 10M System 1 + 80M System 0	Human video	Leverage Nvidia Isaac	NVIDIA DGX	NVIDIA Jetson Thor
1X Technologies	Neo	VLA; transitioning to World Model	14B Generative Video Model + Inverse Dynamics Model (IDM)	Web scale video + 900h egocentric human video for mid training + 70h robot data for fine tuning	World model for generating video, without traditional physics-based simulators	NVIDIA DGX	NVIDIA Jetson Thor ("1X NEO Cortex")
Mentee Robotics	MenteeBot	Hybrid Modular (Perception + RL + LLM-based API)	VLM-based Perception + LLM-based high-level planner + proprietary transformers; flexibility to incorporate other models like World Model	Real2Sim2Real, heavily rely on simulation data	Leverage NVIDIA Isaac; private cloud enabled by NVIDIA RTX 6000 Ada	NVIDIA DGX	Dual NVIDIA Jetson Orin; transitioning to Thor for future
Apptronik	Apollo	End-to-End VLA	Google Gemini Robotics (major partnership)	Teleoperation + Simulation	Leverage Nvidia Isaac	-	NVIDIA Jetson AGX Orin + Jetson Orin NX
Neura Robotics	4NE-1	Layered foundational model	Leverage Nvidia Isaac GR00T foundation models	Teleoperation + Simulation	Leverage Nvidia Isaac & Cosmos; "Neura Gyms" physical training center (working with Nvidia) ; Neuraverse synthetic data	-	NVIDIA Jetson Thor
Agility Robotics	Digit	Modular RL	Google Gemini Robotics (testing)	Teleoperation + Simulation	Leverage Nvidia Isaac	AWS EC2 G6 (NVIDIA L4 GPUs)	NVIDIA Jetson Thor
Unitree	G1 / H1	End-to-End VLA; exploring World Model	UnifolM-VLA (based on Qwen2.5-VL-7B); UnifolM-WMA	Teleoperation + Simulation	Leverage Nvidia Isaac	Distributed GPU Clusters	NVIDIA Jetson Orin NX / Intel Core i7/ Rockchip RK3588
AGIBOT	G2	Enhanced VLA-type model	ACoT-VLA, Genie Operator-1 (GO-1) = ViLLA (Vision-Language-Latent-Action) = VLM + MoE (Mixture of Experts)	Teleoperation (mostly real-world data from AgiBot World dataset) + Simulation	In-house Genie Sim 3.0 simulation platform (Nvidia Isaac Sim based)	NVIDIA DGX	NVIDIA Jetson Thor/ Rockchip RK3588



4) Hardware evolution continuing

Hardware evolution to continue: Increasing dexterity and sensing against lower weight



The hardware design for humanoid robots continues to evolve. We believe the design for **Tesla's Optimus V3** is close to being finalized, with mass production for Tesla's internal use expected to ramp up in 2H26.

Meanwhile, discussions for **Optimus V4** are already underway, with a potential launch for external sales by late 2027.

Below, we summarize the key hardware updates, focusing primarily on the changes made for **Tesla's Optimus V3** based on our channel checks:

- **Degree of freedom (DoF):** For improved dexterity, Tesla could increase the DoF for the body to over 40, up from under 30 previously. Number of body actuators to increase from 28 to over 35, mainly due to increase in rotary actuators.
- **Dexterous hand:** In addition to doubling the DoF to 22 per hand, Tesla could incorporate tactile sensing (namely electronic skin) with increased coverage from fingers to palms. For the transmission system, Tesla could utilize screws and tendons.
- **Weight:** To reduce weight, Tesla V3 could adopt a titanium alloy and carbon fiber hybrid, as well as an aluminum-magnesium alloy for the skeleton. V3 could also employ polyetheretherketone (PEEK) and ceramic balls for lighter construction.
- **Battery:** Tesla could adopt a more powerful 3.2 kWh battery for V3, an increase from the previous 2.3 kWh.
- **Compute:** Tesla could use the Dojo Edge chip for its V3 Optimus.

Key hardware update for humanoid robots (we focus on Tesla's Optimus V3)

Function	Change	Details
Degree of freedom (DoF)	More DoF for body	Tesla Optimus V3 to increase body DoF from 28 to 45; number of actuators to increase from 28 to 37 , mainly due to the increase in rotary actuators (20-23 units) whilst the number of linear actuators remains at about 14.
		Figure 03 launched in Oct 2025 comes with 35 DoF for body and 20 DoF per hand . This compares to 28 DoF for body and 16 DoF per hand for Figure 02 launched in Aug 2024.
Dexterous hand	More DoF for hand	XPeng's IRON launched in Nov 2025 comes with 82 DoF , including 22 DoF per hand.
		Tesla Optimus V3 to increase DoF from 11 per hand (6 active and 5 passive) to 22 per hand (17 active and 5 passive).
		Tesla Optimus V3 to upgrade from basic force sensing to multi-layer electronic skin , with tactile feedback, capable of perceiving friction and weight. Coverage expands from fingers to palms.
	Design	Tesla Optimus V3 to use screw and tendon for motion transmission with actuators located at the forearm. This compares to using worm drive before.
		In addition to the tendon-based system, other commonly used solution is screw-based system. Strain wave reducer-based system, however, is rarely used.
Weight	Lighter material	Tesla Optimus V3 to use titanium alloy and carbon fiber hybrid , aluminum-magnesium alloy , PEEK composite material and ceramic balls to replace traditional metal.
Battery	Longer duration	Tesla Optimus V3 to improve battery to 3.2kWh from 2.3kWh previously, and to increase voltage to 72v from 48v.
Compute	Stronger computing	Tesla Optimus V3 to use one 5 nm Dojo Edge chip vs. two FSD chips before.

New components and materials in development



Our channel checks suggest ongoing discussions regarding new components and materials in development for future humanoid robot models. Some of these have already been adopted by Tesla Optimus V3, while others are potential candidates for V4 and other OEMs.

These new technologies include axial flux motors, cycloidal reducers, electronic skin, ceramic balls, PEEK, GaN, solid-state batteries, and battery swapping. We outline their advantages and features in the table below.

Technology	Advantage	Features	Application - Humanoid robot	Application - Others
Axial flux motor (轴向磁通电机)	High torque density	The rotor (转子) is positioned on the side of the stator (定子), rather than enveloped within it. This allows for a significantly larger rotor diameter, resulting in higher torque density and greater structural design flexibility	Humanoid robot (especially for legs with high load requirements and dexterous hands)	NEV, eVTOL, marine propulsion, precision equipment, wind power generation
Cycloidal reducer (摆线减速器)	High torque and impact resistance	Cycloidal reducers offer high torque and impact resistance, while also maintaining precision. Harmonic drives provide high precision but lack impact resistance and load capacity, while planetary gears have strong impact resistance but insufficient precision.	Humanoid robot (especially for hips)	Mining, chemical, lifting machinery, construction machinery
Electronic skin (电子皮肤)	Tactile sensing	A flexible electronic system that mimics human skin's structure and sensory functions. With an integrated micro-sensor array, it is capable of accurately discerning and reacting to subtle alterations in pressure, temperature, and haptic feedback, thus enabling highly sensitive detection	Humanoid robot (body and hands)	Healthcare, smart wearables, industrial monitoring and security
Ceramic ball (陶瓷球)	Lighter weight	Ceramic balls come with a density of only 40% of steel balls (can reduce robot joint weight by 60%), vickers hardness reaching 1500-1700HV (3 times that of steel balls), a lifespan of 100,000 hours (2 times that of steel balls), and a friction coefficient as low as 0.001 (1/3 of steel balls).	Humanoid robot (for reducers, screws and bearings)	NEV, machine tool, aerospace,
Polyetheretherketone (PEEK) (聚醚醚酮)	Lighter weight	Lightweight (Density: 1.3 g/cm ³ , only half of aluminum alloy), high temperature resistance (typically up to 260°C), high strength (Specific strength: 1500N-m/kg, 8 times of aluminum alloy), chemical corrosion resistance, self-lubricating	Humanoid robot (skeleton, actuators, reducers, bearings, ball screws, etc.)	Industrials, NEV, aerospace, semiconductors, medical devices
Gallium nitride (GaN) (氮化镓)	Higher efficiency	High frequency: Higher switching speed and smaller input/output capacitance Optimize size: Over 50% area reduction achieved through small-sized packaging, integrated drivers, etc. Control stability: Shorter dead time (only 10-20ns), notably improving stability during multi-motor collaborative control and reducing heat dissipation	Humanoid robot (Lidar systems, motor controllers, DC-DC converters, and battery management system)	Semiconductor, 3C, AI server, NEV
Solid state battery (固态电池)	Longer battery duration	Solid-state batteries offer a higher energy density of 400-600Wh/kg compared to traditional liquid lithium-ion batteries, thus providing more sustained power for humanoid robots' high-intensity operations	Humanoid robot (e.g. Xpeng's IRON, EngineAI's T800)	NEV, high-end consumer electronics, aerospace, energy storage
Autonomous battery swapping (hot-swappable) 自主换电 (热插拔)	Longer battery duration	Continue working with a simple battery change instead of a plug-in charge during which time it is not operational	Humanoid robot (e.g. UBTECH's Walker S2, Aptronik's Apollo)	NEV

Cost breakdown of humanoid robots

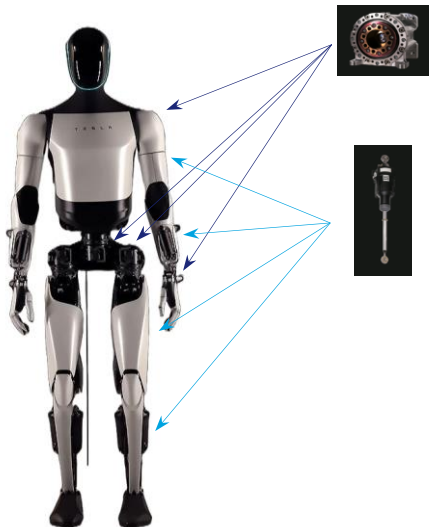


We estimate that the share of dexterous hands in the Bill of Materials (BOM) of humanoid robots has increased due to the doubling of the Degree of Freedom (DoF) and the wider coverage of electronic skin.

Optimus body	Rotary	Linear	Total
Arm (*2)		3	6
Wrist (*2)	1		2
Shoulder (*2)	3		6
Leg (*2)		4	8
Torso / Waist / Pelvis (*2)	3		6
Total	14	14	28

Note: The table above shows the 28 structural actuators for Tesla's Optimus V2 – this number is increasing to over 35 for V3

Component	Low cost scenario (2026) - China supply chain						High cost scenario (2026) - Non-China					
	Cost per unit		Quantity per robot	Cost per robot		% of total	Cost per unit		Quantity per robot	Cost per robot		% of total
	Rmb	US\$		Rmb	US\$		Rmb	US\$		Rmb	US\$	
Frameless torque motor (无框力矩电机)	500	73	20	10,000	1,453	5%	1,200	174	20	24,000	3,488	5%
Strain wave reducer (谐波减速器)	800	116	14	11,200	1,628	5%	1,500	218	14	21,000	3,052	4%
Planetary reducer (行星减速器)	600	87	6	3,600	523	2%	1,200	174	6	7,200	1,047	1%
Encoder	100	15	20	2,000	291	1%	300	44	20	6,000	872	1%
Bearings	300	44	20	6,000	872	3%	500	73	20	10,000	1,453	2%
6-axis torque sensor (六维力矩传感器)	5,000	727	4	20,000	2,907	10%	20,000	2,907	4	80,000	11,628	16%
Others	300	44	20	6,000	872	3%	500	73	20	10,000	1,453	2%
Rotary actuator per unit cost				2,940	427					7,910	1,150	
Rotary actuator total			20	58,800	8,547	28%			20	158,200	22,994	31%
Frameless torque motor (无框力矩电机)	500	73	14	7,000	1,017	3%	1,200	174	14	16,800	2,442	3%
Planetary roller screw (行星滚柱丝杠)	900	131	14	12,600	1,831	6%	2,500	363	14	35,000	5,087	7%
Encoder	100	15	14	1,400	203	1%	300	44	14	4,200	610	1%
Bearings	300	44	14	4,200	610	2%	500	73	14	7,000	1,017	1%
6-axis torque sensor (六维力矩传感器)	5,000	727	2	10,000	1,453	5%	20,000	2,907	2	40,000	5,814	8%
Others (sensors, etc.)	300	44	14	4,200	610	2%	500	73	14	7,000	1,017	1%
Linear actuator per unit cost				2,814	409					7,857	1,142	
Linear actuator total			14	39,400	5,727	19%			14	110,000	15,988	21%
Coreless motor (空心杯电机)	500	73	34	17,000	2,471	8%	1,200	174	34	40,800	5,930	8%
Micro planetary reducer (微型行星减速器)	500	73	10	5,000	727	2%	1,200	174	10	12,000	1,744	2%
Micro ball screw (微型滚珠丝杠)	200	29	40	8,000	1,163	4%	500	73	40	20,000	2,907	4%
Encoder (编码器)	100	15	34	3,400	494	2%	300	44	34	10,200	1,483	2%
Electronic skin/ sensors	15,000	2,180	1	15,000	2,180	7%	37,500	5,451	1	37,500	5,451	7%
Tendon (腱绳)	40	6	88	3,520	512	2%	100	15	88	8,800	1,279	2%
Others	300	44	34	10,200	1,483	5%	500	73	34	17,000	2,471	3%
Dexterous hand per unit cost				31,060	4,515					73,150	10,632	
Dexterous hand total			2	62,120	9,029	30%			2	146,300	21,265	28%
Inertial measurement unit (IMU; 惯性传感器)	1,000	145	2	2,000	291	1%	2,000	291	2	4,000	581	1%
Battery pack	3,000	436	1	3,000	436	1%	10,000	1,453	1	10,000	1,453	2%
AI chips	20,000	2,907	1	20,000	2,907	10%	40,000	5,814	1	40,000	5,814	8%
Head cover	2,000	291	1	2,000	291	1%	5,000	727	1	5,000	727	1%
Others (body parts, cameras, etc.)	20,000	2,907	1	20,000	2,907	10%	40,000	5,814	1	40,000	5,814	8%
Humanoid robot total				207,320	30,134	100%				513,500	74,637	100%



5) Diversification of supply chain



As shipments scale up, the humanoid robot supply chain is diversifying across five key perspectives:

- 1) Diversification in geography:** While Chinese suppliers remain highly active, non-Chinese suppliers have become more proactive since 2025. In Japan, **Yaskawa** acquired a humanoid robot startup and commenced actuator development, while **NSK** exhibited linear and rotary actuators at iREX 2025. Our channel checks suggest **Nidec** is working towards becoming a supplier for Tesla's Optimus. In Europe, **Schaeffler** has expressed its ambition to capture over 10% market share in the global humanoid robot market with a product portfolio encompassing rotary and linear actuators, sensors, and dexterous hands.
- 2) Diversification in production:** To mitigate geopolitical risks, suppliers are establishing production capacities outside their home countries. This trend is particularly evident among Chinese companies, who are targeting **Thailand**, **Mexico**, and **the US** as primary production locations. In late February 2026, Thailand announced that five Chinese companies (Seenpin, Beite, Sanhua, Tuopu, and Xusheng) plan to establish factories in Thailand for humanoid robot components. **Leaderdrive** has forged partnerships with Minth and Sanhua for sites in the US and Mexico. Meanwhile, Japanese companies such as **Harmonic Drive Systems**, **Yaskawa**, and **FANUC** have also recently expanded their capacities in the US.
- 3) Diversification of verticals:** Given the strong similarities between autonomous vehicles and humanoid robots, automotive suppliers were the first to respond to the emerging demand for humanoid robots and continue to dominate the supply chain. Meanwhile, established suppliers from other verticals, particularly electronics, have also joined the supply chain. For instance, both [Luxshare](#) and [Lens Technology](#) reportedly shipped 3,000 units of humanoid robots in 2025 with component capabilities. [Hon Hai](#) has showcased wheeled and bipedal humanoid robots developed in collaboration with NVIDIA.
- 4) Diversification of technologies:** The emergence of new technologies is introducing new suppliers to the humanoid robot ecosystem. Technologies currently being tested, and not previously present in earlier humanoid robots, include axial flux motors, cycloid and RV reducers, and electronic skin. Consequently, suppliers of these new technologies are increasingly being integrated into the supply chain.
- 5) Diversification of OEMs:** **Tesla** has been a pioneer and advocate for humanoid robots, with an ambitious goal for mass production. Consequently, supply chain discussions since 2022 have largely centered on Tesla. From 2025 onwards, the supply chain is diversifying with capacity ramp-ups dedicated to non-Tesla OEMs, fueled by the rapid growth of Chinese humanoid robot manufacturers led by **Unitree** and **AGIBOT**, and the expectations surrounding Chinese auto OEMs like **XPeng**. Nevertheless, considering Tesla's mass production progress and its price premium, the supply chain around Tesla remains pivotal for the industry.

Mapping the hardware supply chain

Note: * = listed companies



	Head		Body							
	Integrator	Vision	Rotary actuator	Linear actuator	Reducer	Planetary roll screw (行星滚柱丝杠)	Motor	Bearing		
China	Lens Tech (蓝思科技)* Joyson (均胜电子)*	Camera: Orbbec (奥比中光)* OPT (奥普特)* LUSTER LightTech (凌云光)*	Sanhua (三花智控)* Xinqun (新泉股份)* Tuopu (拓普)* Wedali (伟达立)* Yinlun (银轮股份)* Meihu (美湖股份)* RoboSense (速腾聚创)* Hesai (禾赛科技)*	Tuopu (拓普)* Hengli Hydraulic (恒立液压)* Sanhua (三花智控)* Shuanglin (双林股份)* Wedali (伟达立)* Laili Motor (江苏雷利)* Yinlun (银轮股份)*	Strain wave/ Harmonic reducer (谐波减速器): Leaderdrive (绿的谐波)* Sling (斯菱股份)* Kedali (科达利)* Hanyu Group (汉宇集团)* Longsheng (隆盛科技)* Guomao (国茂股份)* SLAC Precision (斯莱克)* FORE Intelligent (丰立智能)* Zhongda Leader (中大力德)* Reach Machinery (睿能股份)* HAOZHI (昊志机电)*	Planetary reducer (行星减速器): Zhongda Leader (中大力德)* Kofon Smart (科峰智能)* Newstart (纽氏达特)* TongLi Transmission (通力科技)* Guomao (国茂股份)* Lantai Tech (蓝泰科技)* Haoneng Tech (豪能股份)* Cycloid and RV reducer (摆线针和RV减速器): Kedali (科达利)* Shuanghuan (双环传动)* Zhongda Leader (中大力德)* Haoneng Tech (豪能股份)* Fuda Group (福达股份)*	Seepin (杭州新创) Hengli Hydraulic (恒立液压)* Beite (北特科技)* BST (贝斯特)* Shuanglin (双林股份)* XCC Group (五洲新春)* Laili Motor (江苏雷利)* Zhenyu Tech (震裕科技)* Hengrda (恒而达)* DINGS (鼎智科技)* Changsheng Sliding Bearings (长盛轴承)* Kedali (科达利)* Rongtai Industry (嵘泰股份)*	Frameless torque motor (无框力矩电机): Kinco (步科股份)* Wolong Electric (卧龙电气)* Veichi Electric (伟创电气)* Leadshine (雷赛智能)* HAOZHI (昊志机电)* Moons' Electric (鸣志电机)* Johnson Electric (德昌电机)* Hengshuai (恒帅股份)* Invoance (汇川技术)* Xiamen Voke (唯科科技)*	Axial flux motor (轴向磁通电机): Wolong Electric (卧龙电气)* Fulin Precision (富临精工)* NBTM New Materials (东睦股份)* Veichi Electric (伟创电气)* Etron Technologies (昂德龙)* Yunyi Electric (云意电气)* Kedali (科达利)*	Changsheng Bearings (长盛轴承)* XCC Group (五洲新春)* Radical (雷迪克)* Wanxiang Qianchao (万向钱潮)*
Non-China			Nidec (Japan)* Schaeffler (Germany)* Bosch (Germany)	Schaeffler (Germany)* Bosch (Germany)	Strain wave/ Harmonic reducer: Harmonic Drive (Japan)* Nidec Shimo (Japan) Sumimoto (Japan)* Planetary reducer: Nidec Shimo (Japan) Harmonic Drive (Japan)* SEW-EURODRIVE (Germany) Sumitomo Heavy Industries (Japan)* Wittenstein (Germany)	Cycloid and RV reducer: Nabtesco (Japan)*	THK (Japan)* NSK (Japan)* Schaeffler (Germany)* Rollvis (Switzerland) GSA (Switzerland) Bosch Rexroth (Germany) Moog (U.S.)* EXLAR (U.S.) CMC (U.S.)	Nidec (Japan)* Kollmorgen (U.S.) Maxon (Switzerland) TQ Robodrive (Germany) WITTENSTEIN (Germany) YASA (U.K.) (acquired by Mercedes-Benz)	Schaeffler (Germany)* NSK (Japan)*	
	Dexterous hand				Others					
	Coreless motor (空心杯电机)/ Motor	Micro screw	Electronic skin/ Glove	Tendon						
China	Veichi Electric (伟创电气)* Moons' Electric (鸣志电器)* Johnson Electric (德昌电机)* Laili Motor (江苏雷利)* Topband (拓邦股份)* Leadshine (雷赛智能)* HAOZHI (昊志机电)* Hengshuai (恒帅股份)*	Zhejiang Rongtai (浙江荣泰)* Beite (北特科技)* BST (贝斯特)* Johnson Electric (德昌电机)* Zhenyu Tech (震裕科技)*	Hanwei Electronics (汉威科技)* Harvo Safety (恒晖安防)* Smith Adhesive New Material (晶华新材)* Fulai New Materials (福莱新材)* AUDIOWELL (奥迪威)* Riyang Electronics (日盈电子)* Everwin Precision (长盈精密)* Daimay (岱美股份)* Sushi Testing (苏试试验)*	Nanshan (南山智尚)* Harvo Safety (恒晖安防)* Jdd Tech (骏鼎达)*	Body integrator: PIA Automation (均普智能)* Ningbo Huaxiang (宁波华翔)* Luxshare Precision (立讯精密)* Lens Tech (蓝思科技)* Hon Hai (鸿海)* Force sensor: Keli Sensing (柯力传感)* Hanwei Electronics (汉威科技)* Ampron (安培龙)* Link Touch (蓝点触控)* Kunwei Tech (坤维科技)* SRI (宇立仪器)*	Chips: Rockchip (瑞芯微)* Horizon (地平线)* All Winner Tech (全志科技)* Unigroup Guoxin (紫光国微)* Dawning Information (中科曙光)* Battery sensor: Triductor Tech (创耀科技)* Iluvatar CoreX (天数智芯)*	Materials: Hengbo Holdings (恒勃股份)* Daimay (岱美股份)* Carthane (凯次股份)* Mould & Plastic Tech (模塑科技)* WOTE Advanced Materials (沃特股份)* Battery: CATL (宁德时代)* Azure (蔚蓝锂芯)*	Shell (壳体): Yongmaotai (永茂泰)* Xusheng Group (旭升集团)* Everwin Precision (长盈精密)* Ceramic ball: Lixing (力星股份)*		
Non-China	Maxon (Switzerland) Faulhaber (Germany) Nidec (Japan)* Mabuchi Motor (Japan)*		Novasentis (U.S.) Tekscan (U.S.) Interlink Electronics (U.S.)* Japan Display Inc. (Japan)* Baumer (Switzerland) Fraba (Germany)		Force sensor: ATI (U.S.)* Schunk (Germany) Kistler (Switzerland) AMT (U.S.) Murata Manufacturing (Japan)*	Chips: NVIDIA (U.S.)* Intel (U.S.)*				

Hardware supply chain by humanoid robot OEM

The table below illustrates the hardware supply chain for various humanoid robot OEMs, based on our channel checks. This list encompasses both confirmed suppliers and those that have provided samples to the OEMs. This list is not exhaustive and will be updated as the supply chain continues to evolve.



The U.S.		China				Taiwan	
Teela		Figure	Unitree	AGIBOT	GaiBot	Huawei	Hon Hai
Integrator:		Reducer:		Actuator integrator:		Actuator:	
Actuator integrator:		- Leaderdrive (绿的谐波)* - Harmonic Drive Systems (Japan)*		- PIA Automation (钧普智能)* - Lens Technology (蓝思科技)* - Ningbo Huaxiang (宁波华翔)* - Bozhon Precision (博众精工)* - Lingyi iTech (领益智造)* - Minth (敏实)*		- Meihu (美湖股份)*	
Head integrator:		Reducer & Bearing:		Reducer:		Reducer:	
- Sanhua (三花智控)* - Tuopu Group (拓普集团)* - Nidec (Japan)* - Schaeffler (Germany)* - Hengli Hydraulic (恒立液压)* - Zhejiang Rongtai (浙江荣泰)*		- Zhongda Leader (中大力德)* - Leaderdrive (绿的谐波)*		- Leaderdrive (绿的谐波)* - Meihu (美湖股份)*		- Leaderdrive (绿的谐波)* - Meihu (美湖股份)*	
Foot integrator:		Bearing:		Actuator:		Screw & Bearing:	
- Carthane (凯众股份)*		- Changsheng Sliding Bearings (长盛轴承)*		- Fulin Precision (富临精工)*		- XCC Group (五洲新春)*	
Body:		Micro motor:		Actuator:		Sensor:	
Reducer:		- Moons' Electric (鸣志电器)*		- Leaderdrive (绿的谐波)* - Zhongda Leader (中大力德)*		- Keli Sensing (柯力传感)*	
Screw:		Structural parts:		Partner:		Control board:	
- Harmonic Drive Systems (Japan)* - Leaderdrive (绿的谐波)* - Longsheng Technology (隆盛科技)* - Kedali (科达利)* - Sling (斯菱股份)* - Shuanghuan Driveline (双环传动)*		- Lingyi iTech (领益智造)*		- Changsheng Sliding Bearings (长盛轴承)*		- Joyson Electronic (均胜电子)*	
Motor:		Motor:		Material / Structural parts:		Partner:	
- Nidec (Japan)* - Leadshine (雷赛智能)* - Johnson Electric (德昌电机)* - Veichi Electric (伟创电气)*		- Wolong EElectric (卧龙电驱)* - Moons' Electric (鸣志电器)*		- Kingfa Sci&Tech (金发科技)* - Zhejiang Rongtai (浙江荣泰)* - NBTM New Materials (东睦股份)*		- XPPeng	
Hand:		Sensor:		Chips:		- NVIDIA	
Micro screw:		- Hanwei Electronics (汉威科技)* - Keli Sensing (柯力传感)*		- NVIDIA* - Rockchip (瑞芯微)*		- Longsheng Technology (隆盛科技)* - XCC Group (五洲新春)* - Leaderdrive (绿的谐波)* - Haoneng Tech (豪能股份)*	
Micro motor:		Others:		Others:		- Swancor Advanced Materials (上纬新材)*	
- Moons' Electric (鸣志电器)* - Veichi Electric (伟创电气)* - Maxon (Switzerland) - Johnson Electric (德昌电机)* - Hengshuai (恒帅股份)*		TPU (聚氨酯) and Epoxy (环氧树脂):		UBTECH		- Leaderdrive (绿的谐波)*	
Others:		Plastic:		Structural parts:		Others:	
Shell:		- Mould & Plastic Tech (模塑科技)*		- Everwin Precision (长盈精密)*		Chieftek Precision (直得)*	
- Zhejiang Rongtai (浙江荣泰)* - Xusheng (旭升集团)*		PEEK (聚醚醚酮):		Others:		- Solomon Technology (所罗门)*	
Plastic:		- Daimay (岱美股份)* - Everwin Precision (长盈精密)* - Carthane (凯众股份)*		- Swancor Advanced Materials (上纬新材)*		- XCC Group (五洲新春)* - Leaderdrive (绿的谐波)* - Haoneng Tech (豪能股份)*	
Sensor:		- Hengbo Holdings (恒勃股份)*		Others:		- XCC Group (五洲新春)* - Leaderdrive (绿的谐波)* - Haoneng Tech (豪能股份)*	
- Ampron Technology (安培龙)*		- Hengbo Holdings (恒勃股份)*		Others:		- XCC Group (五洲新春)* - Leaderdrive (绿的谐波)* - Haoneng Tech (豪能股份)*	

Production locations: Suppliers are ramping up overseas factories outside of home countries



Company	Location	Date	Details
China			
			On 23 Feb 2026, Thailand's Board of Investment (BOI) announced the approval of investment applications from five leading Chinese enterprises: Hangzhou Seenpin, Beite Technology, Sanhua Intelligent Controls, Tuopu Group, and Xusheng Group . These companies will establish production factories in Thailand for humanoid robot structural parts, joints, and arm and finger control systems . The initial total investment from these five companies exceeds THB10bn (c. RMB2.2bn) and is projected to procure over THB45bn (c. RMB10bn) worth of raw materials and components annually from Thailand. Furthermore, several other leading Chinese enterprises are preparing to make additional investments in Thailand in the near future.
Five companies	Thailand	Feb 2026	1. Hangzhou Seenpin: planetary roller screws and robot ball screws, with investment amounting to THB2.12bn (c. RMB460mn). 2. Beite Technology: planetary roller screws, with an investment of THB1.67bn (c. RMB364mn). Concurrently, the company has submitted an additional application for a robot ball screw production project exceeding THB3bn (c. RMB655mn), which is currently under review by the BOI. 3. Sanhua: motion control joint modules, with an investment of THB1.8bn (c. RMB393mn). Previously, the company had received approval to invest over THB3.2bn in producing high-tech automotive components for BYD, Volvo, and Tesla. 4. Tuopu: motion control joint modules, with an investment of THB930mn (c. RMB203mn). Besides, the company also received approval for two high-tech automotive component projects, with a total investment exceeding THB3.5bn (c. RMB764mn). 5. Xusheng Group: structural parts and joint frame (Aluminum-Magnesium Alloy), used to support arms, legs, and joints of humanoid robots, with an investment of THB2.7bn (c. RMB590mn).
Leaderdrive	United States	Feb 2026	Reached a framework agreement with Minth Group to set up a joint venture in the United States. This JV will focus on the design, manufacturing, and commercialization of humanoid robot joint modules in North America. The initial capital contribution totals US\$10mn, with Leaderdrive holding a 40% stake.
Sanhua	Mexico	Apr 2023	To establish a joint venture with Sanhua in Sanhua's Mexico Industrial Park, with registered capital of no less than US\$10mn. It will be dedicated to the R&D, production, and sales of harmonic reducer-related products.
	Vietnam	Sep 2024	Built a production base in Vietnam since 2018. Phase II launched in Sep 2024, added HVAC component production lines including electronic expansion valves, receivers, etc.
Tuopu	Mexico	Oct 2022	Initiated TXV production in Mexico since 2017; in Oct 2022, Phase II officially launched.
	Thailand	Apr 2025	Proposed investment of no more than US\$300mn in Thailand to build an automotive parts production base.
Xinquan	Malaysia	Sep 2022	Phase I of Mexico factory, covering 220 mu, became operational in 2024, encompassing both interior and thermal management manufacturing facilities.
	Malaysia	Feb 2026	Establishment of Xinquan Automotive Parts in Malaysia. The total investment is US\$42mn, funded by self-raised capital.
Kedali	Mexico	Dec 2025	To increase its investment in Mexico by US\$50mn and US\$95mn, respectively, in Feb and Sep 2023. Announced an additional capital injection of US\$118mn into its Mexican subsidiary in Dec 2025.
	United States	Mar 2024	Invested US4mn of its own capital to establish subsidiary in California, and US46mn to set up Automotive Parts subsidiary in Texas
Zhejiang Rongtai	Hungary	Jun 2025	To invest up to EUR50mn to build the Phase III project for precision components for power batteries in Hungary.
	Malaysia	Oct 2024	To invest up to RMB600mn in Malaysia to build a precision components project for lithium batteries. The construction period is about 36 months, and after reaching full production capacity, it is expected to achieve an annual output value of RMB1.3bn.
	United States	May 2024	To build a production base in the U.S. for precision components for NEV power batteries. The total investment will not exceed US\$49mn (approximately RMB354mn), and it is expected to achieve an annual output value of approximately US\$70mn (approximately RMB506mn).
Sling	Thailand	Dec 2025	To establish a production facility in Thailand with annual capacity of 14,000 tons of mica paper, 4,500 tons of mica products, and 7mn sets of robot components. Total estimated investment is approximately US\$77mn (about RMB545mn). The company plans for its Thailand base to achieve stable production and supply robot-related products by 1Q26.
	Mexico	Apr 2024	To establish a subsidiary in Mexico to build production facility for 500,000 sets of NEV components annually. The total investment is estimated to be approximately US\$10.88mn.
Japan	Thailand	Feb 2025	To extend the operational readiness date for the "Robotic Component Intelligent Technology Transformation Project" from May 2026 to May 2027. Furthermore, its Thailand subsidiary will be added as a co-implementing entity for this project, with an industrial park in Thailand becoming an additional implementation site.
	Thailand	Nov 2024	Phase II of Thailand factory commenced operations in Feb 2024. Phase III investment was initiated in Apr 2024. As of Nov 2024, Thailand factory capacity utilization rate was around 70% to 80%.
Harmonic Drive	United States	FY2Q/26 call (Nov 2025)	Acquisition, not immediately but in order to enable future expansion of the factory, of a good factory site adjacent to Harmonic Drive's US subsidiary
Yaskawa	United States	Jul 2025	A new state-of-the-art robotic manufacturing facility is planned to be built at Yaskawa's newly announced campus in Wisconsin, combining multiple Yaskawa Drives and Motion facilities into one location over the next 3 to 8 years, eventually encompassing more than 800,000 square feet. When completed, the campus will house the North American headquarters for the Drives and Motion Division, as well as operations for robot production, motion control products, AC drives, and solar inverters.
	United States	Aug 2024	Yaskawa has completed an expansion to its headquarters in Ohio, which represented the first phase of Yaskawa's planned US\$200mn investment in the United States. The 185,000 square foot state-of-the-art addition will nearly double the size of the company's previous production space. It will be utilized to engineer, develop, integrate and build robotic systems .
FANUC	United States	Jul 2024	FANUC has opened its new 650,000-square-foot West Campus facility in Michigan, representing a US\$110mn investment built on 67 acres. The expansion increased the footprint to more than 2mn square feet and is part of FANUC's strategic investment plan to support and advance industrial automation in North America.

An aerial photograph of a city skyline at dusk, featuring several prominent skyscrapers with glass facades reflecting the twilight sky. The image is overlaid with a semi-transparent blue rectangle that serves as a background for the text.

6) Government policies to watch

Policy: China highly supportive; Increasing measures from US, Japan and South Korea



Since 2025, policy announcements globally have **increasingly focused on AI and embodied AI**. **China** was the first to implement humanoid robot-specific policies and, in our view, currently offers the most supportive regulatory environment. **The US** is aiming to domesticate robot manufacturing, with a potential Executive Order on robotics expected in 2026. Both **Japan** and **South Korea** are expediting humanoid robot development, while **the European Union** has implemented regulations on AI, emphasizing ethical integration.

- **China:** Keywords such as "robots," "AI+," "humanoid robot," and "embodied AI" have been prominently featured in both national and provincial policy announcements since 2023. At the national level, the Proposal for the 15th Five-Year Plan (FYP), covering 2026-30, emphasizes technological self-reliance and innovation, introducing **embodied AI** for the first time as one of the "future industries" for development. At the provincial level, leading regions such as Beijing, Shanghai, Guangdong, and Zhejiang have published targeted policies for the embodied AI/humanoid robot industry. Supportive measures include subsidies, tax reductions, dedicated R&D funding, the establishment of innovation centers and industry clusters, promotion of applications, and the drafting of standards and regulations.
- **The United States:** The Trump administration is reportedly drafting policies to bolster **domestic manufacturing of robotics**, prioritizing industrial and defense applications, with a potential executive order release in 2026. This initiative follows increased scrutiny of robotics purchases, where the federal government may be prohibited from acquiring humanoid robots from foreign entities, including China, under the Humanoid ROBOT Act of 2025. Meanwhile, the US has initiated a Section 232 investigation into robotics and industrial machinery imports, with the possibility of imposing tariffs. The Trump administration has already launched several Executive Orders in 2025 to accelerate AI development.
- **Japan:** Under the "Moonshot Program," launched in 2020, Japan aims to conduct research on **AI robots** by 2050. The program was updated in November 2025 to develop general-purpose autonomous **humanoid robot AI robots** by 2030. In August 2025, several companies joined the Kyoto Humanoid Robot Association, with the goal of producing prototypes by March 2026 and achieving mass production by 2027.
- **South Korea:** Since 2025, South Korea has introduced several policies and industry associations aimed at accelerating the development of its **humanoid robot** industry. The Manufacturing AI Transformation Alliance (M.AX) targets an annual production of at least 1,000 industrial humanoid robots from 2029. In April 2025, robot manufacturers such as Rainbow Robotics, Airobot, Doosan Robotics, LG Electronics, and Hyundai Robotics formed the "K-Humanoid Robot Alliance." This public-private partnership involves over KRW 1 trillion (~US\$700 million) in funding by 2030.
- **Europe:** Policies in the European Union regulate AI systems, and humanoid robots may be classified as "high-risk," thereby requiring compliance with strict obligations under the **EU AI Act**.

Policy – China: Policies on robots and embodied AI



Innovation, Modernisation, Security, Technology, Digital and Green are the most mentioned in the 15th Five-Year Plan

Keywords from the 15th FYP Proposal	# of mentions		
	15th FYP	14th FYP	15th vs 14th
Innovation	61	47	↑ 14
Technological innovation	13	5	↑ 8
Original innovation (原始创新)	3	2	↑ 1
Industrial innovation (产业创新)	3	-	↑ 3
Modernization	58	40	↑ 18
Chinese modernisation (中国现代化)	21	-	↑ 21
Modernized industrial system (现代化产业体系)	8	6	↑ 2
Security	57	66	↓ (9)
National security	17	15	↑ 2
Industry security	2	2	→ -
Science and technology (科技)	46	36	↑ 10
Self-reliance and strength (自立自强)	6	4	↑ 2
Digital & intelligence (数字、数智、智能)	31	23	↑ 8
Artificial Intelligence	8	2	↑ 6
Green & low carbon	25	20	↑ 5
Others			
Consumption	23	21	↑ 2
High-quality development (高质量发展)	17	11	↑ 6
New quality productive forces (新质生产力)	6	-	↑ 6
Dual circulation (双循环)	5	7	↓ (2)

Industrial & Technology policies from 15th FYP Proposal: Categorisation of traditional, emerging and future industries

Policies from the 15th FYP Proposal	Focus areas
Industrial policies (产业政策)	
Upgrading traditional industries (优化提升传统产业)	Mining, metallurgy, chemical industry, light industries, textiles, machinery, vessels, and construction
Developing emerging pillar industries (打造新兴支柱产业)	New energy, new materials, aviation and aerospace, and the low-altitude economy
Planning for industries of the future (前瞻布局未来产业)	Quantum technology, biomanufacturing, hydrogen and nuclear fusion power, brain-computer interfaces, embodied artificial intelligence , and 6G mobile communications
Building a new infrastructure system with appropriate forward planning (适度超前建设新型基础设施)	Information and communication networks, the national integrated computing network, major science and technology infrastructure, and other key systems
Technological policies (科技政策)	
Promoting breakthroughs in core technology (加强关键核心技术攻关)	Integrated circuits, industrial machine tools, high-end equipment, basic software, advanced materials, and biomanufacturing
Advancing the Digital China Initiative (深入推进数字中国建设)	Industrial Internet; computing power, algorithms, and data; AI+ Initiative and AI industrial application

Detailed policy support from local governments on humanoid robots – Fundings and subsidies, data collection and applications

Province/ City	Date	Detailed measures
Beijing	Sep 2025	China's largest humanoid robot training ground has officially commenced operations in Beijing's Shijingshan District. The training ground spans over 10,000 square meters, producing more than 6mn data records annually. All data generated by this training ground originates from real-robot operation, supporting cross-platform and cross-scenario transfer.
Beijing	Aug 2025	Beijing Economic-Technological Development Area released "Several Measures to Promote the Innovative Development of Embodied Intelligent Robots". It supports enterprises in tackling key technologies such as the "brain," "cerebellum," universal robot bodies, and critical components, providing up to RMB5mn based on project investment. By the end of 2027, E-Town will establish a mass production capacity for humanoid robots, reaching 10k units.
Shanghai	Aug 2025	Shanghai issued the "Implementation Plan for the Development of the Embodied AI Industry." It focuses to support breakthroughs in key technologies such as perception and decision-making, and motion control. Projects will receive support of up to 30% of total investment, not exceeding RMB50mn. By 2027, the plan aims to boost the core embodied AI industry to exceed RMB50bn in scale.
Guangdong	Mar 2025	Guangdong Province issued "Several Policy Measures to Promote the Innovative Development of the AI and Robotics Industry", which explicitly grants national-level manufacturing innovation centers up to RMB50mn. It also encourages enterprises to jointly tackle key components like servo motors and sensors, guides social capital towards "hard technology" fields by establishing industrial funds, and provides a maximum subsidy of RMB500k to enterprises leading the formulation of international standards.
Shenzhen	Feb 2025	Shenzhen will establish a RMB10bn artificial intelligence and robotics industry fund, focusing on areas such as AI software, hardware, and embodied AI and investing in high-growth enterprises. It proposes to open up the entire city – comprehensively across all scenarios – to AI and robots, with an additional 100 application scenarios to be opened in 2025. To be precise, it promoted government departments and state-owned enterprises to open up application scenarios such as municipal sanitation, emergency rescue, and medical and elderly care; it also encouraged manufacturing enterprises to fully open up production scenarios such as technology R&D, quality inspection, assembly line operations, and material handling.
Shanghai	Jan 2025	The Embodied AI Training Ground of National and Local Co-built Humanoid Robot Innovation Center has officially launched in Shanghai. Spanning over 5,000 square meters, it can accommodate more than 100 humanoid robots for simultaneous training. By 2025, the training ground is expected to complete the collection of 10mn high-quality physical datasets. It has allowed heterogeneous robots from different manufacturers to train together at the center, thus filling the gap in large-scale heterogeneous datasets.
Shanghai Pudong	2025	Companies engaged in the industrialization of critical humanoid robot components, including frameless torque motors, reducers, controllers, sensors, joint modules, and dexterous hands, via independent research and development, will be eligible for support amounting to no more than 10% of their initial sales contract value. The aggregate annual support for any single enterprise shall not exceed RMB5mn.

Policy – China: Policies on robots and embodied AI (national-level)



[Link to our detailed report on China's 15th Five-Year Plan covering year 2026-2030.](#) Policies on robotics in China consistently emphasize:

- **Technological advancement:** Targeting breakthroughs across “brain”, “cerebellum”, “limbs”, etc.
- **Application scenario expansion:** From industrial towards broader service and specialized-purpose robots.
- **Ecosystem development:** Fostering new enterprises, strengthening the entire supply chain with specified targets for industry scale, growth, and output.
- **Supply chain localization:** Achieving domestic self-sufficiency in critical components and manufacturing.
- **Infrastructure investment:** Bolstering foundational elements, incl. large models and computing power.

Date	Policy	National
Feb-26	MIIT: "Standards for Humanoid Robots and Embodied Intelligence (2026 Edition)" (人形机器人与具身智能标准体系(2026版)). Represents China's first national standard framework, encompassing the entire industrial value chain and lifecycle of humanoid robots . Including six key sections: Foundational Generalities, Brain-Inspired Computing and Intelligent Algorithms, Limbs and Modular Components, Integrated Machines and Systems, Applications, and Safety and Ethics.	
Nov-25	General Office of the State Council: "Implementation Opinions on Accelerating Scenario Cultivation and Opening-up to Promote the At-scale Application of New Scenarios" (国务院办公厅关于加快场景培育和开放推动新场景大规模应用的实施意见) Exploring innovative application scenarios in office, social interaction, consumption, and entertainment leveraging technologies incl. metaverse, virtual reality, intelligent computing, and robotics; expanding the application of robots in fields like healthcare, childcare, and elderly and disability support .	
Sep-25	MIIT and others: "Work Plan for Stable Growth in the Machinery Industry (2025-2026)" (机械行业稳增长工作方案(2025-2026年)) Explicitly proposing to "enhance the supply capacity of high-quality equipment" and "cultivate internationally competitive industrial clusters," while also designating " robotics+ application initiatives", large-scale promotion of intelligent manufacturing equipment, and globalization for small and medium-sized enterprises as key measures.	
Aug-25	State Council: "Opinions on Further Implementing the 'AI+' Initiative" (国务院关于进一步深入实施“人工智能+”行动的意见) 2027 goal: Achieving deep integration of AI in six key fields incl. industrial development, with the penetration of new-gen smart terminals and AI agents surpassing 70% , and rapid growth in core industries of the intelligent economy. 2030 goal: The penetration of new-gen smart terminals and AI agents to exceed 90% .	
Mar-25	The 2025 Government Work Report (2025年政府工作报告) For the first time, embodied AI and other future industries are mentioned for cultivation in annual govt work report.	
Jun-24	NDRC and others: "Measures to create new consumption scenarios and cultivate new consumption growth points" (关于打造消费新场景培育消费新增长点的措施) Expanding the functions of smart robots in cleaning, entertainment and leisure, elderly and disability care, education and training , etc., and exploring the development of humanoid robots based on AI models.	
Jan-24	Seven regulators incl. MIIT: "Opinions on Promoting Innovation and Development of Future Industry" (工业和信息化部等七部门关于推动未来产业创新发展的实施意见) Mentioned breakthroughs in humanoid robots : 1) advancing core technologies such as high-torque-density servo motors for robots, high-dynamic motion planning and control, bionic perception and cognition, intelligent dexterous hands, and electronic skin ; 2) promoting production development and application in fields such as intelligent manufacturing, home services, and special environment operations .	
Oct-23	MIIT: "Guiding Opinions on the Innovation and Development of Humanoid Robots" (人形机器人创新发展指导意见) 2025 goal: The humanoid robot innovation system will be initially established, with breakthroughs in key technologies such as " brain ", " cerebellum ", and " limbs ", ensuring the safe and effective supply of core components. Cultivating 2-3 ecological enterprises with global influence, several specialized and new SMEs, and 2-3 industrial clusters. 2027 goals: The technological capabilities of humanoid robots will be significantly improved, forming a safe and reliable industrial supply chain system, and internationally competitive industrial ecology.	
Jan-23	17 regulators incl. MIIT: "Robot+ Application Action Plan" ("机器人+应用行动实施方案") 2025 goal: Doubling robot density in manufacturing vs. 2020; focusing on 10 key areas, breaking through 100+ innovative robot technologies and solutions, promoting 200+ typical application scenarios with novel models and proven effectiveness; creating a number of "robot+" pioneering enterprises, and building various application experience and test verification centers.	

Policy – US: Potential Executive Order on Robotics to be launched in 2026



The Trump administration is reportedly drafting policies to bolster domestic manufacturing of robotics, with a potential release of an executive order in 2026. This follows the increased scrutiny on robotics purchase where the federal government is suggested to be prohibited from acquiring humanoid robots from foreign entities including China. In the meantime, the US has initiated a Section 232 investigation into the imports of robotics and industrial machinery.

Policy	Date	Topic	Details
Robot related policies			
Executive Order	Potential release in 2026	Robotics	On 3 December, news reported that the Trump administration is actively drafting a new executive order focused on robotics policy , with a potential release planned for 2026 . The administration is framing this as a move to bolster domestic manufacturing , with Commerce Secretary Howard Lutnick meeting with industry CEOs to shape a strategy that prioritizes industrial and defense applications , aiming to "remove sand from the gears" of innovation.
Department of Transportation	By end of 2026	Robotics/ Autonomous technologies	Reportedly to form a robotics working group , to be announced as part of a broader federal robotics effort to accelerate the deployment of autonomous technologies . This initiative aims to strengthen competitiveness in critical sectors, with a focus on integrating robotic systems into transportation infrastructure and enhancing AI-driven operations.
National Commission on Robotics Act	Proposed in Feb 2026	Robotics	Proposed to establish a national commission to evaluate U.S. competitiveness in robotics and provide policy recommendations
Humanoid ROBOT Act of 2025	Proposed in Nov 2025	Robotics	Suggested to prohibit the federal government from acquiring humanoid robots with integrated artificial intelligence from foreign entities , including military suppliers from China, Iran, North Korea, and Russia
Section 232 investigation	Sep 2025	Robotics	News reported that the US Department of Commerce Bureau of Industry and Security (BIS) announced the initiation of an investigation into the effects on US national security of imports of robotics and industrial machinery . The investigation could result in the imposition of tariffs or other import restrictions by Spring 2026.
Tax and reconciliation package			
One Big Beautiful Bill Act (OBBBA)	Signed into law in Jul 2025	Bonus depreciation	Permanently restored 100% bonus depreciation for qualified property acquired and placed in service after Jan. 19, 2025 (Before: only 40% deduction in the first year). This is intended to encourage investment and reduce taxable income in periods of high investment.
		Manufacturing facilities transformation	Any project started before January 1, 2029, now qualifies for 100% expensing (Before: depreciated over 39 years). That includes full builds of production facilities or expansions designed to support robotics .
		Section 179 expensing	Section 179 lets businesses immediately deduct the full purchase price of qualifying equipment, including industrial robots , when it's put into use the same year, with deduction limit increased to US\$2.5mn (Before: US\$1.25mn)
		R&D expensing	Restored full immediate expensing for domestic research and development costs starting in 2025 (Before: amortized over 5 years or 15 years for foreign R&D)
AI related policies			
Executive Order - 14365	Dec 2025	Ensuring a National Policy Framework for Artificial Intelligence	Established a federal policy aimed at addressing the growing number of state-level AI regulations governing the AI ecosystem: "to sustain and enhance the U.S.' global AI dominance through a minimally burdensome national policy framework for AI"
Executive Order	Nov 2025	Genesis Mission	The Department of Energy (DOE) will take a central leadership role in developing an integrated AI platform that brings together federal computing, data, and research resources to speed AI-enabled scientific innovation
Executive Order - 14179	Jan 2025	Removing Barriers to American Leadership in Artificial Intelligence	Outlined a blueprint for AI strategy aimed at accelerating Innovation, building U.S. AI Infrastructure, and leading in International Diplomacy & Security

Policy – Japan: Accelerating AI, AI robots and humanoid robots



The Takaichi administration identifies AI as one of its 17 key strategic sectors for investment, although robots are not specifically mentioned. That said, the Cabinet Office in Japan launched in 2020 the “Moonshot Program” to fund high-risk and high-impact research to solve by 2050 complex social issues like super-aging population and climate change – AI robots are included as one of the targets to be reached by 2050. In November 2025, the Program added the development of general-purpose autonomous humanoid robot AI robots by 2030. In August 2025, several companies joined the Kyoto Humanoid Robot Association to revitalize Japan’s humanoid robot industry.

Policy	Date	Topic	Details
Robot related policies			
			Development of AI robots that humans feel comfortable with, have physical abilities equivalent to or greater than humans, and grow in harmony with human life, by 2050 .
			Development of an automated AI robot system that aims to discover impactful scientific principles and solutions, by thinking and acting in the field of natural science, by 2050 .
Japan Moonshot Program (登月计划)	Initiated in 2020, updated in Nov 2025	Goal 3: Coevolution with AI and robots	Development of AI robots that autonomously make judgements and act in environments where it is difficult for humans to act by 2050 .
			(Addition in 2025) Development of a prototype of a general-purpose autonomous humanoid AI robot capable of completing a series of specific tasks in a designated field with human assistance by 2030 . This robot will be designed to respond seamlessly to situational changes without practical discomfort, and will be suitable for private investment.
			(Addition in 2025) Establish the foundational development elements for a general-purpose autonomous humanoid AI robot capable of responding to all situations by 2030 .
Kyoto Humanoid Robot Association (KyoHA) (京都人形机器人协会)	Feb 2026	Humanoid robot	Prototype will be released by Mar 2026 , with mass production targeted by 2027 .
	Established in Aug 2025	Humanoid robot	By the end of 2026, two types of models will be developed: one for disaster response and another for research purposes . The disaster response humanoid robot is expected to be approximately 250cm tall and designed to lift over 50kg. The research model will prioritize agility with a human-like height of 160-180cm and is planned for future provision to the RoboCup robot competition. Murata Manufacturing (村田制作所; 6981.JP) will supply sensors and communication-related components , while Mabuchi Motor (万宝至马达; 6592.JP) will develop motors to power the robots. Renesas (瑞萨电子; 6723.JP) will produce MCUs for controlling the humanoid robot’s functions, and Sumitomo Heavy Industries (住友重工; 6302.JP) will manufacture speed reducers .
AI related policies			
AI Basic Plan	Dec 2025	AI	Japanese government has approved its first basic AI plan , with the aim to establish Japan as a leader in “reliable AI” by 2026. The plan outlines four basic actions: the acceleration of the adoption of AI; the strategic strengthening of development capabilities; the taking on of the leadership role in governance, including rule-making; and the reformation of systems and frameworks.
17 Strategic Sectors	Nov 2025	AI and semiconductors	Takaichi administration has designated 17 key strategic sectors for focused investments, including AI and semiconductors, shipbuilding, aviation and space, etc.
AI Promotion Act	May 2025	AI	Japan’s Parliament approved the “Act on the Promotion of Research and Development and the Utilization of AI-Related Technologies ” (AI Promotion Act), making Japan the second major economy in the APAC region to enact comprehensive AI legislation.

Policy – South Korea: Fundings coupled with industry associations



Since 2025, South Korea has launched several policies and industry associations targeting to accelerate the development of the humanoid robot industry. The Manufacturing AI Transformation Alliance (M.AX) targets to develop a foundational AI model for industrial humanoid robots and to produce at least 1,000 units p.a. from 2029. Robot manufacturers such as Rainbow Robotics, Airobot, Doosan Robotics, LG Electronics and Hyundai Robotics formed the “K-Humanoid Robot Alliance” in April 2025 – this initiative involves a public-private partnership with over KRW1tn (~US\$700mn) in funding by 2030.

Policy	Date	Topic	Details
Robot related policies			
Manufacturing AI Transformation Alliance (M.AX) Alliance	Feb 2026		In Feb 2026, South Korea announced the plan to invest over KRW700bn (US\$487.7mn) this year to expand its manufacturing AI efforts through the M.AX Alliance.
	Sep 2025	AI and humanoid robot	Manufacturing AX Alliance (M.AX) was launched under the leadership of Ministry of Trade, Industry and Energy (韩国产业通商资源部, MOTIR), which brings together more than 1,000 firms including Hyundai, LG Electronics, Samsung, and Posco to promote AI adoption in manufacturing. By 2028, M.AX aims to develop a foundation AI model for industrial humanoid robots , with plans to produce at least 1,000 units annually from 2029 .
‘K-Moonshot’ Project	Feb 2026	AI and humanoid robot	The government will fully push forward the ‘K-Moonshot’ Project. The plan is to elevate AI research productivity to the world’s fifth-highest level by 2030 and resolve 12 national missions—selected from eight strategic fields including AI humanoid —using AI by 2035.
Budget Proposal on National Assembly	Nov 2025	AI and robotics	President Lee underscored that the 2026 budget will prioritize the AI industry. He announced that KRW10.1 trillion will be allocated to accelerate South Korea’s leap toward becoming one of the world’s top three AI powers , more than tripling 2025’s AI-related budget of KRW3.3 trillion. The government also plans to invest about KRW6 trillion over the next five years to accelerate AI-driven transformation in core industries, including robotics , cars, shipbuilding, home appliances, semiconductors and manufacturing.
National Advanced Strategic Technology	Added in May 2025	Humanoid robot	MOTIR announced the addition of “ humanoid robots ” and “core aircraft engine components” as two new national advanced strategic technologies (国家尖端战略技术). The plan aims to integrate AI and humanoid robot technology through systematic support and guidance, aspiring to reach an advanced national level by 2027 . This newly designated humanoid robot technology encompasses robot actuators, frame design, manufacturing, and engineering techniques, covering a hardware supply chain that includes AI semiconductors, sensors, and engines.
K-Humanoid Alliance	Apr 2025	Humanoid robot	MOTIE (Ministry of Trade, Industry and Energy) has brought together over 40 organizations to formally establish the “K-Humanoid Robot Alliance,” including robot manufacturers like Rainbow Robotics, Airobot, Doosan Robotics, LG Electronics, and Hyundai Robotics . Its main goals include: 1) R&D, planning to develop an AI system with autonomous decision-making capabilities to serve as the “brain” of humanoid robots; 2) hardware innovation, developing lightweight, high-performance humanoid robots, with specific targets to produce robots weighing no more than 60kg, possessing over 50 DoF, capable of carrying more than 20kg, and moving at a speed of 2.5m/s; 3) market strategy, to achieve the vision of “one humanoid robot per household,” thereby promoting widespread adoption in homes and workplaces. MOTIE has pledged to invest over KRW1 trillion (approximately US\$750mn) by 2030 to support the humanoid robot industry’s development.
AI related policies			
K-on-device AI Semiconductor Joint Development Project	To be launched officially in Mar 2026	AI and humanoid robot	South Korea government has approved the Project in Aug 2025, and will invest a total of KRW1 trillion over five years starting in 2026. The plan is to localize dedicated AI chips for four key sectors—autonomous vehicles, humanoids , and home appliances—to fill the “AI brain” with domestic technology.
National Strategy for AI	Adopted in Dec 2019, updated in Sep 2025	AI	South Korea’s comprehensive “ National Strategy for Artificial Intelligence ” has been updated, with a major “AI for All” policy launched in 2025 and a new National AI Strategy Committee inaugurated in Sep 2025 to pursue a top-three AI ranking.
Advanced Strategic Industry Fund	Mar 2025	AI and robotics	The fund, with a scale of KRW50 trillion (approximately US\$34.4bn) , will be established in the Korea Development Bank (KDB). It aims to provide broad support across high-tech strategic industries, including semiconductors, secondary batteries, biotechnology, artificial intelligence, and robotics .

Policy – Europe: Regulations on AI and humanoid robots



The European Union was early in introducing regulation around AI. Under the EU AI ACT, [humanoid robots maybe classified as “high-risk”](#), for example, when used in the workplace, for biometric identification, or in safety-critical areas, and therefore must comply with strict obligations such as risk management, technical documentation and human oversight. The Horizon Europe and Digital Europe Programme launched in 2021 targeted to provide investment in AI research and deployment of up to €4bn over 2024-27.

Policy	Date	Topic	Details
AI related policies			
EU AI ACT	Entered into force in Aug 2024, and remaining obligations will be fully applicable in Aug 2026	AI regulation	This landmark regulation aims to ensure AI systems are safe, transparent, non-discriminatory, and environmentally friendly. Humanoid robots would fall under its scope, particularly those deemed “high-risk” (e.g., in critical infrastructure, healthcare, or law enforcement).
EU Regulation 2023/1230 (New Machinery Regulation)	Entered into force in Jul 2023, and becoming mandatory in Jan 2027	AI regulation	It forces manufacturers to address cybersecurity, software updates, and human-robot collaboration , with mandatory application starting Jan 2027. Key changes include stricter conformity assessments and harmonized digital documentation requirements.
Horizon Europe and Digital Europe programme	Since 2021	AI	The AI Innovation Package has reinforced investment in AI research and deployment with the announcement of multiple initiatives valued at up to EUR4bn for the period 2024-2027 . In Jan 2026, the European Commission has launched two new calls under the ‘Digital, Industry and Space’ cluster of Horizon Europe, allocating EUR307.3mn to bolster Europe's digital innovation and competitiveness.
Ethics guidelines for trustworthy AI	Published in April 2019	AI regulation	These guidelines emphasize human agency and oversight, technical robustness and safety, privacy and data governance, transparency, diversity, non-discrimination and fairness, societal and environmental well-being, and accountability.



Stock implications

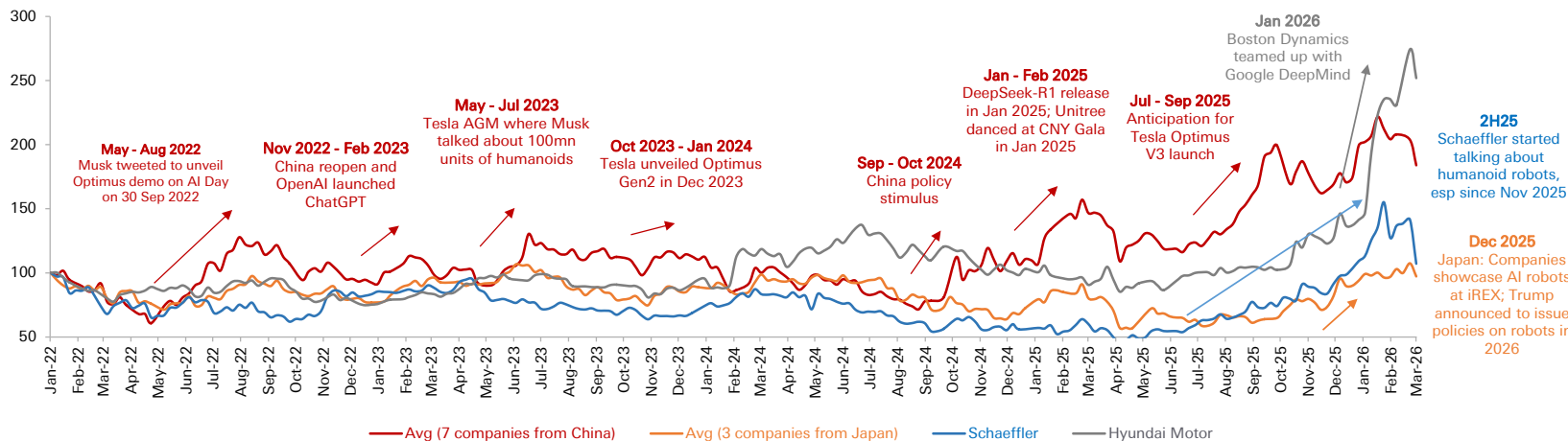
APAC Industrials: Optimism on humanoids spreading from China to Japan, Europe and South Korea



The **Chinese supply chain companies** were the first to react to Elon Musk's ambition for humanoid robots since mid-2022. The share prices of relevant companies continue to fluctuate with news flow in the sector. The most recent wave of interest centered around supply chain changes for the upcoming Tesla Optimus V3.

Since 2025, the share prices of companies outside of China have also begun to respond to humanoid robot news. In **Germany**, Schaeffler initiated discussions about humanoid robots in 2H25, outlining a revenue target of US\$1.8 billion by 2030. In **Japan**, multiple robot makers demonstrated AI robots and components at the International Robot Exhibition (iREX) held in Tokyo in December 2025, and their share prices also responded positively to the announcement that the Trump administration is considering new policies on robotics. In **South Korea**, Hyundai's share price surged following the collaboration between Boston Dynamics and Google DeepMind.

Indexed share price – Optimism on humanoids has spread from China to Japan, Europe and South Korea since 2025



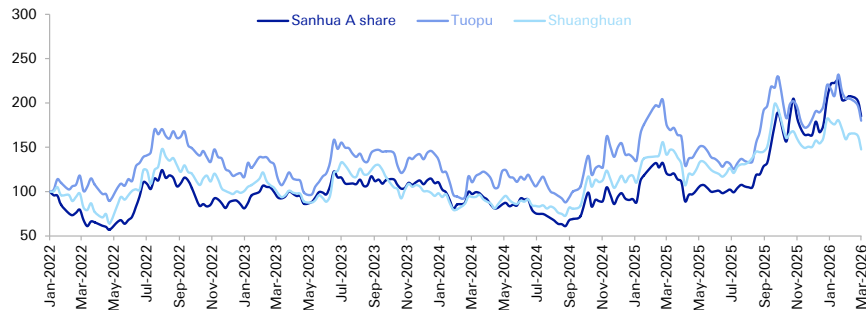
Note: 7 companies from China = Sanhua A share, Tuopu, Leaderdrive, Hengli, Shuanghuan, Xinqian, Orbtec; 3 companies from Japan = FANUC, Yaskawa, Harmonic Drive Systems; as of close of 4 March 2026

APAC Industrials: Indexed share price performance for humanoid robot companies

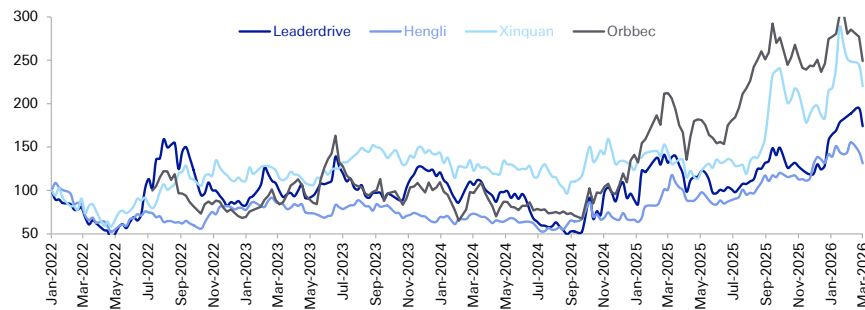


Note: Price as of close of 4 March 2026

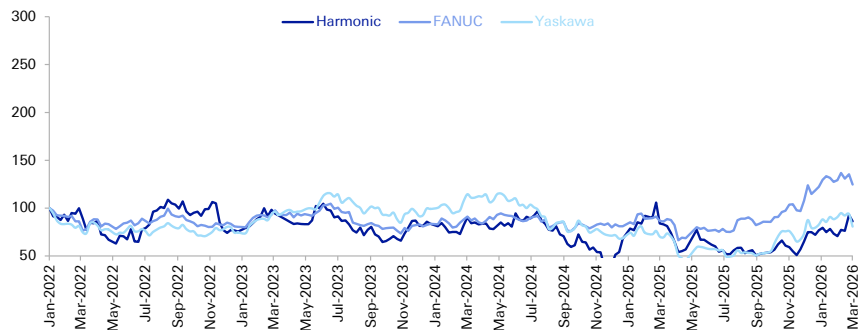
China: Auto component names have delivered mediocre performance since late 2025 due to the concerns of a potential vehicle downturn in 2026



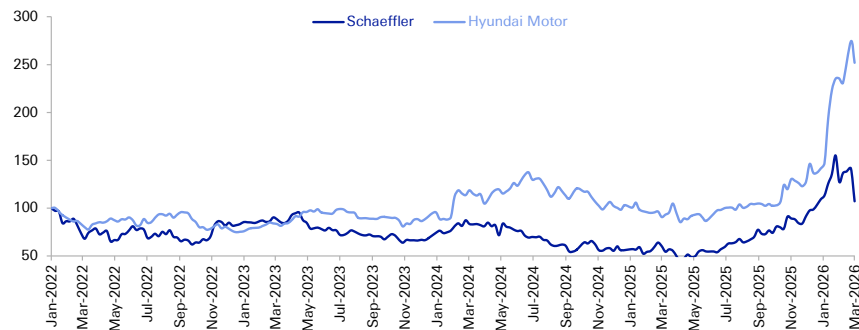
China: Performance for non-auto companies and for new suppliers (e.g. Xinquan) stood out since 2H25



Japan: Share price has inflected since late 2025, but still off the previously peak levels, except for FANUC



The share price of Hyundai and Schaeffler performed strongly since 2H25



APAC Industrials: We see upside for Hengli, Shuanghuan and Harmonic Drive Systems

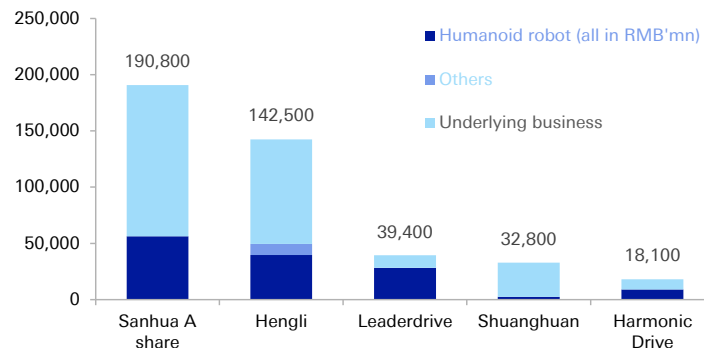


The valuation framework for humanoid robot companies commonly adopted by investors involves projecting the potential profit opportunity in 2030E, assuming a global market of ~1mn humanoid robots by that time.

On this slide, we provide a breakdown of the valuation for key humanoid robot companies within our coverage. We calculate the implied valuation of the underlying business by deducting the valuation attributed to the humanoid robot business from the current market capitalization.

Based on our calculations, the underlying businesses for **Hengli**, **Shuanghuan**, and **Harmonic Drive Systems** are currently trading below their historical average levels, suggesting potential upside for these names.

Breakdown of current market cap (RMB'mn)



Valuation: We see upside for Hengli, Shuanghuan and Harmonic Drive Systems based on the implied multiples from our assumptions of their humanoid robot business and their current market cap

Company	Current market cap (RMB'mn)	Humanoid robot business												Other businesses	Underlying business				
		ASP per unit (RMB)	Humanoid market unit by 2030	TAM (RMB'mn)	Market share	Revenue (RMB'mn)	Net profit (RMB'mn)	NPM	2030E P/E	Discount factor	Valuation (RMB'mn)	Further potential (RMB'mn)	Total humanoid valuation (RMB'mn)		Valuation (RMB'mn)	Implied valuation (RMB'mn)	2026E NP (RMB'mn)	Implied 2026 P/E	Long-term average P/E
Sanhua A share	190,800	60,000	1,000,000	60,000	20%	12,000	1,200	10%	40x	100%	48,000	8,400	56,400	0	134,400	4,885	28x	28x	-1%
Hengli	142,500	12,600	1,000,000	12,600	35%	4,410	662	15%	40x	100%	26,460	13,140	39,600	10,000	92,900	3,422	27x	31x	-13%
Leaderdrive	39,400	18,000	1,000,000	18,000	15%	2,700	405	15%	40x	100%	16,200	11,875	28,075	180	11,145	126	88x	81x	9%
Shuanghuan	32,800	4,000	1,000,000	4,000	15%	600	60	10%	40x	100%	2,400	0	2,400	0	30,400	1,450	21x	25x	-15%
Harmonic Drive	18,100	20,000	1,000,000	20,000	15%	3,000	300	10%	40x	75%	9,052	0	9,052	0	9,048	140	64x	76x	-15%

Note: Current market cap as of close of 4 March 2026

APAC Industrials: Hengli Hydraulic (601100.SS): BUY, TP RMB129



Link to latest company report: [Hengli Hydraulic: Growth for fundamental accelerating coupled with multiple themes; BUY – 9 Feb 2026](#)

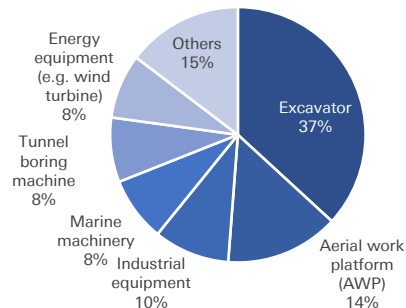
Investment thesis:

- For humanoid robot, Hengli's product portfolio includes screws for both body and hands, as well as linear actuators. Based on the company's strong know-how in precision machining, we think it is possible for Hengli to expand into reducers and rotary actuators in the future. Our valuation assumption discounts 35% market share for Hengli in body screws, 5% in linear actuators and 10% in hand screws by 2030E.
- Excavator sales (37% of sales) could accelerate in both China and overseas in 2026E lifted by a market recovery and continued share gains of Hengli.
- Additional growth opportunities from bionic robotics legs and arms, space and the machine tool market.

SOTP valuation for Hengli

	2026E (RMB mn)						Valuation		
	Sales	% of total	Net profit	NPM	P/S	P/E	In RMB mn	Per share (RMB)	% of total
Scenario: Base case									
Underlying business	12,602	96%	3,422	27.2%	9.8x	36.0x	123,194	92	71%
Humanoid robot business	168	1%	46	27.3%	235.7x	39,554.2x	39,600	30	23%
Bionic robot business	200	2%	55	27.3%	30.0x	5,945.5x	6,000	4	3%
Space business	100	1%	40	40.0%	40.0x	100.0x	4,000	3	2%
Hengli group	13,070	100%	3,562	27.3%			172,794	129	100%
Scenario: Bull case									
Underlying business							123,194	92	48%
Humanoid robot business							105,600	79	41%
Bionic robot business							24,000	18	9%
Space business							4,000	3	2%
Hengli group							256,794	191	100%
Scenario: Bear case									
Underlying business							123,194	92	84%
Humanoid robot business							19,320	14	13%
Bionic robot business							120	0	0%
Space business							4,000	3	3%
Hengli group							146,634	109	100%

Revenue breakdown by end-market for Hengli (2024)



Excavator market sales (unit) to improve in both China and overseas in 2026E



APAC Industrials: Geekplus (2590.HK): BUY, TP HK\$32



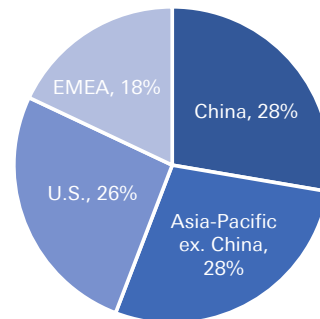
Investment thesis:

- Geekplus launched its first wheeled humanoid robot, Gino1, in February 2026, and is accelerating its investments in embodied AI. We believe Geekplus could be among the first to demonstrate the commercial viability of humanoid robots, given the structured warehouse environment and its highly international customer base.
- Comments from global warehouse automation peers during their 4Q25 results indicated continued positive market momentum and a favorable outlook for 2026E, which bodes well for Geekplus' market demand outlook.
- We anticipate a 35-40% order intake growth in 2026E (vs 32% in 2025), providing visibility for sustained healthy revenue growth into 2027E, considering the typical 9M order lead time.

Wheeled humanoid robot Gino 1 released by Geekplus on 10 Feb 2026



Over 70% of revenue from overseas markets in 2024



Growth trend from global warehouse automation peers remains encouraging

CY (YoY growth)	1Q24	2Q24	3Q24	4Q24	1Q25	2025	3Q25	4Q25
AutoStore - Order	11%	3%	-5%	-12%	-23%	6% (flat ex-FX)	6% (-6% ex-FX)	35%
AutoStore - Revenue	-7%	-12%	-5%	-7%	-38% (-18% adjusted)	-13%	-4%	9%
Kion (SCS) - Order (organic)	42%	-24%	-28%	-21%	16%	120%	24%	5%
Kion (SCS) - Revenue (organic)	-7%	2%	-1%	-1%	-6%	-1%	14%	17%
Rockwell (E-commerce & Warehouse automation) - Revenue	-18%	18%	25%	30%	45%	30%	70%	60%
Honeywell (W&WS) - Revenue	-55%	-41%	-29%	-5%	5%	-4%	2%	5%
Symbotic - Revenue	47%	51%	44%	35%	40%	26%	10%	29%
Average	2%	0%	0%	3%	8%	23%	16%	23%

APAC Industrials: Harmonic Drive Systems (6324.T): BUY, TP JPY4,840



Link to latest company report: [Harmonic Drive Systems: Upgrade to BUY; Humanoid opportunity under-appreciated; Recovery on path – 11 Feb 2026](#)

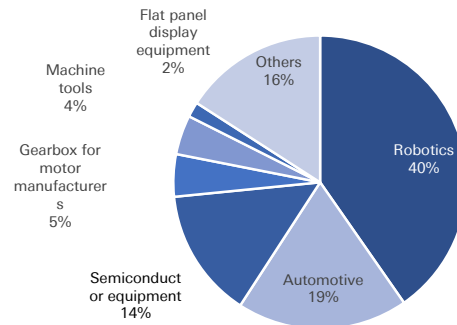
Investment thesis:

- Tesla could potentially increase the number of rotary actuators for its Optimus humanoid robot from 14 per robot to over 20, based on our channel checks. This is favourable for HDS as a global key strain wave reducer supplier. We forecast humanoid robot revenue of ¥2.5bn for FY3/26E (4% of group revenue), expecting this to increase to over ¥4bn/6% of group in FY3/27E and to over ¥10bn/15% of group in FY3/28E.
- For the fundamental business, orders grew healthily by +13% in FY3Q and we expect the recovery to accelerate in FY3/27E driven by traditional robots (robot orders for both FANUC and Yaskawa trending higher), automotive (HDS' key client Nissan is bottoming out) and semiconductor (WFE commentary very positive from leading semicap names).

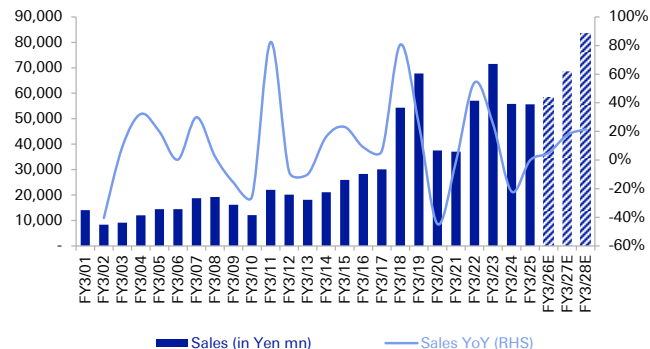
SOTP valuation for HDS

	FY3/27E (Yen mn)			Multiples			Valuation			
	Sales	% of total	Net profit	NPM	P/S	P/E	In Yen mn	Per share (Yen)	% of total	In RMB mn
Scenario: Base case										
Underlying business	64,452	94%	3,200	5.0%	4.0x	80.0x	256,031	2,696	56%	11,379
Humanoid robot business	4,200	6%	209	5.0%	48.5x	203,452.7x	203,661	2,144	44%	9,052
HDS group	68,652	100%	3,409	5.0%			459,692	4,840	100%	20,431
Scenario: Bull case										
Underlying business							256,031	2,696	29%	11,379
Humanoid robot business							632,029	6,654	71%	28,090
HDS group							888,060	9,350	100%	39,469
Scenario: Bear case										
Underlying business							256,031	2,696	79%	11,379
Humanoid robot business							67,887	715	21%	3,017
HDS group							323,918	3,410	100%	14,396

Split of non-consolidated sales of HDS in FY3/25



we forecast revenue and net profit for HDS to improve meaningfully in the coming years



APAC Industrials: Shuanghuan Driveline (002472.SZ): BUY, TP RMB52



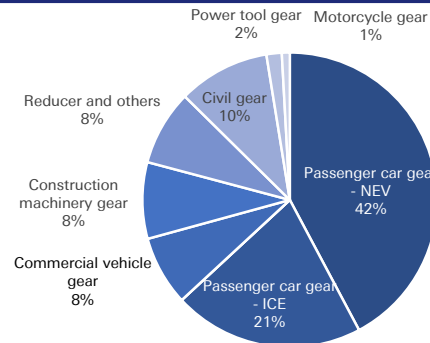
Investment thesis:

- For humanoid robot, Tesla is exploring the use of cycloidal reducers for higher payload rotary actuators for waist and hip, with 2-8 units per robot. Shuanghuan has been conducting R&D with Tesla on robots for over three years, presenting an opportunity for Shuanghuan to penetrate Tesla's supply chain.
- The phasing out of vehicle subsidies in China in 2026 is expected to exert pressure on Shuanghuan especially in 1Q26. However, we still foresee growth prospects from new business segments, including reducers for traditional robots and industrial equipment, as well as smart actuators for robot vacuum cleaners, drones, and eBikes.
- The company demonstrates overseas expansion potential, evidenced by positive reception from European and Japanese customers (Schaeffler, Valeo, Toyota, Stellantis, BMW, and Audi) and the establishment of a new factory in Hungary.

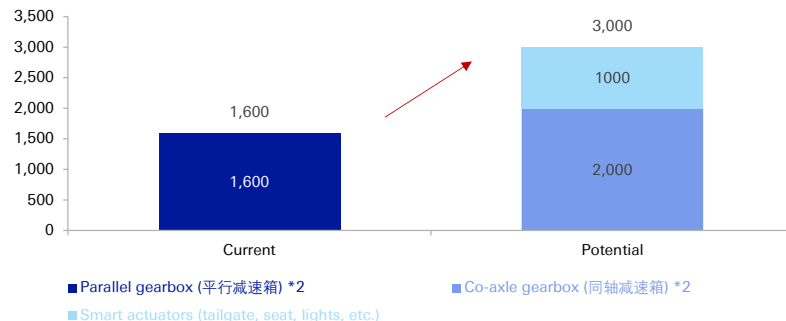
SOTP valuation for Shuanghuan

	2026E (RMB mn)				Multiples		Valuation		
	Sales	% of total	Net profit	NPM	P/S	P/E	In RMB mn	Per share (RMB)	% of total
Scenario: Base case									
Underlying business	10,754	100%	1,450	13.5%	3.8x	28.5x	41,329	49	95%
Humanoid robot business	0	0%	0	13.5%			2,400	3	5%
Shuanghuan group	10,754	100%	1,450	13.5%			43,729	52	100%
Scenario: Bull case									
Underlying business	10,754	100%	1,450	13.5%	3.8x	28.5x	41,329	49	90%
Humanoid robot business	0	0%	0	13.5%			4,800	6	10%
Shuanghuan group	10,754	100%	1,450	13.5%			46,129	55	100%
Scenario: Bear case									
Underlying business	10,754	100%	1,450	13.5%	2.7x	20.0x	29,003	35	100%
Humanoid robot business	0	0%	0	13.5%			0	0	0%
Shuanghuan group	10,754	100%	1,450	13.5%			29,003	35	100%

Revenue breakdown by end-market for Shuanghuan (1H25)



ASP growth per vehicle remains a long-term theme



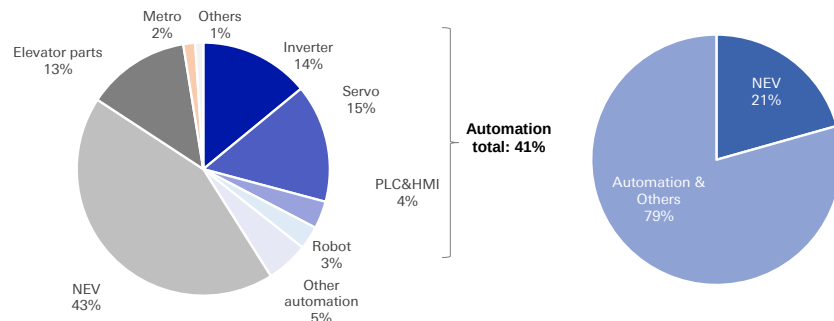
APAC Industrials: Inovance Technology (300124.SZ): BUY, TP RMB83.9

Link to latest company report: [Inovance: Upgrade to BUY; Opportunities in humanoid robots, energy and digital – 23 Nov 2025](#)

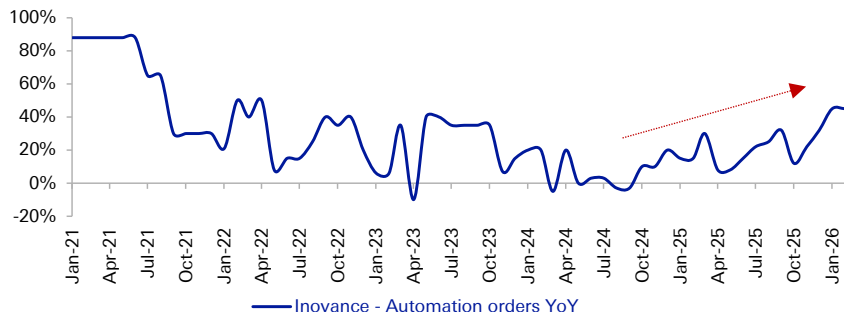
Investment thesis:

- Inovance has launched humanoid robot components in Sep 2025 and is setting up a dedicated "Intelligent Robot" business unit comprising traditional industrial robot + humanoid robot + machine vision. As China's largest automation component manufacturer and China's top four industrial robot maker, we think Inovance is well-positioned to become a prominent supplier for humanoid and AI robots over time.
- We expect the China automation market to stay healthy in 2026E driven by strong growth from battery and electronics and healthy trend from traditional end-markets.
- The NEV business could come under pressure in 2026E, especially in 1Q26. We expect the healthy growth from automation to help mitigate.
- Other growth opportunities include energy storage and digital platforms.

Breakdown (2024) – revenue (Left) and net profit (right)



Automation order YoY growth for Inovance – 40-50% in 2M26



SOTP valuation suggests the non-automotive business is trading on ~26x 2026E P/E, lower than Inovance's long-term average of 34x

	Sales	%	2026E (RMB mn)		NPM	P/S	P/E	Valuation Standalone	% held by Inovance Tech	For Inovance Tech
Automation and others	28,162	51%	5,126	83%	18.2%	4.8x	26.4x	135,163	100%	135,163
Inovance Automotive (联合动力)	26,547	49%	1,293	21%	4.9%	2.2x	45.5x	58,797	83%	48,901
Inovance Technology (Group)	54,709	100%	6,201	100%	11.3%	3.4x	29.7x	184,064	100%	184,064

Note: Valuation and Inovance group and Inovance Automotive is based on price as of close of 4 March 2026. We then back-calculate the implied valuation for the "Automation and others" business of Inovance.

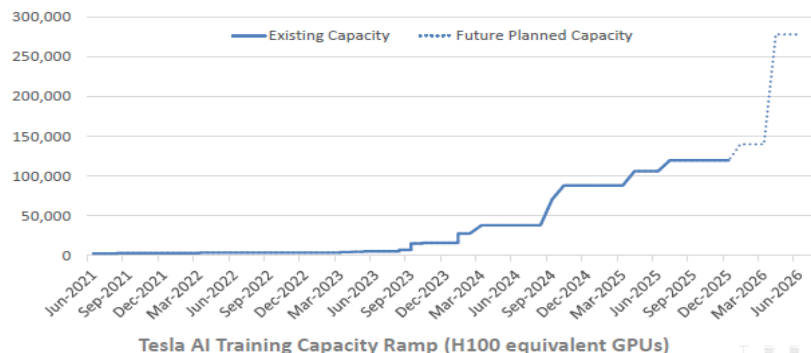
US Autos & Mobility: Tesla (TSLA.US): Buy, TP \$480



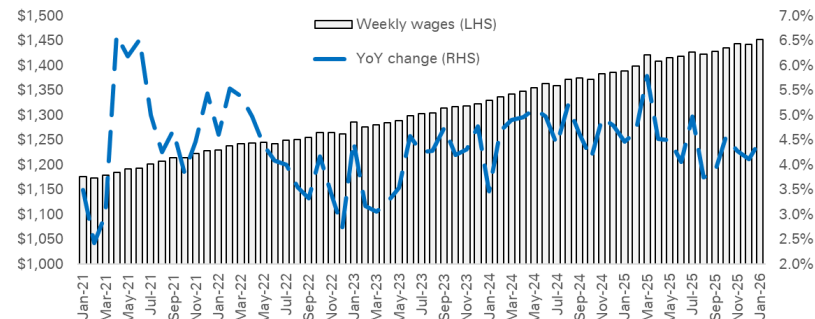
Investment thesis:

- We view Tesla as a technology platform setting the foundation for Physical AI, deserving of a unique type of valuation. Tesla structurally possesses a lead in consumer autonomy globally with FSD while Robotaxi launched last year, poised to scale up service and deliver economics which will be difficult to match (at least ex-China).
- In respect to humanoids (Optimus), this will naturally target the most lucrative TAM in our coverage: human labor. Tesla plans to replace existing vehicle lines with a humanoid line in California and then start production later this year. The ramp-up will not be linear and we don't expect high volumes until 2027 at the earliest. However, we believe the foundational pieces are in place such as a high performance custom design using tendon drive system and large AI compute infrastructure to support model training.

Model training leverages existing AI infrastructure

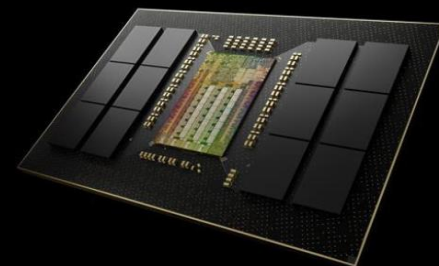
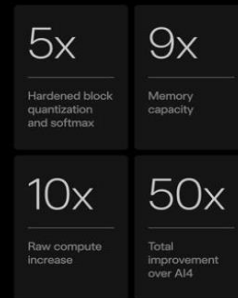


High wages in US manufacturing suggest large savings potential



Next-gen chip increasingly optimized for humanoid

Optimizing Tesla silicon



Appendix

Policy – China: Policies on robots and embodied AI (Beijing)



Date	Policy
Beijing	
Aug-25	Beijing Economic-Technological Development Area: "Several Measures to Promote the Innovative Development of Embodied Intelligent Robots" (北京经济技术开发区关于推动具身智能机器人创新发展的若干措施). Supports enterprises in tackling key technologies such as the "brain," "cerebellum," universal robot bodies, and critical components, providing up to RMB5mn based on project investment. By the end of 2027, E-Town will establish a mass production capacity for humanoid robots, reaching 10k units .
Feb-25	Beijing: "Embodied AI Technology Innovation and Industry Cultivation Action Plan (2025-2027)" (北京具身智能科技创新与产业培育行动计划 (2025–2027 年)) 2027 goal: Achieving 100+ key technological breakthroughs, focusing on "brain" and "cerebellum" models, embodied AI chips, and full-body motion control ; developing 10+ world-leading software and hardware products, and largely localizing the upstream and downstream supply chains of embodied AI; nurturing 50+ core enterprises, realizing 100+ large-scale industrial applications across scientific research and education, manufacturing and retail, tailored services, with mass production capacity >10k units and industry scale >RMB100bn .
Aug-23	Beijing: "Measures for Promoting the Innovative Development of the Robotics Industry" (北京市促进机器人产业创新发展的若干措施) Providing subsidies for robot-related technological breakthroughs , project construction, scenario applications, enterprise financing, etc.
Jun-23	Beijing: "Robotics Industry Innovation and Development Action Plan (2023-2025)" (北京市机器人产业创新发展行动方案 (2023-2025年)) Benchmarking world's leading product level to step up the layout of humanoid robots . Targeting typical application scenarios such as 3C electronics manufacturing and NEV production , breaking through technical bottlenecks in complex motion control, positioning and navigation, visual processing, and fine manipulation , to promote the engineering and industrialization of humanoid robots. 2025 goal: Greatly enhancing robot innovation ability; cultivating 100 types of high-tech and high value-added robot products, and 100 application scenarios with nationwide generalized value. The robot density reaches world-leading level, and the city's core robot industry revenue reaches RMB30bn .
Dec-24	Beijing E-Town: "Building a World-Class Demonstration City for Embodied AI Robots Industry Action Plan (2024-2026)" (北京经济技术开发区建设全球一流具身智能机器人产业新城行动计划 (2024-2026年))
Oct-24	Shijingshan District: "Humanoid Robot Development Action Plan (2024-2025)" (石景山区人形机器人产业发展行动计划 (2024–2025年))
Jun-24	Haidian District: "Action Plan (2024-2026) for Building a National Embodied AI Innovation Hub" (海淀区关于打造全国具身智能创新高地的三年行动方案 (2024–2026年))

Policy – China: Policies on robots and embodied AI (Shanghai)



Date	Policy
	Shanghai
Oct-25	Shanghai: "Action Plan for High-Quality Development of the Smart Terminal Industry (2026-2027)" (智能终端产业高质量发展行动方案(2026—2027年)) Further supports the mass production of humanoid robots and the industrialization of core components such as edge-side chips and dexterous hands.
Aug-25	Shanghai: "Embodied AI Industry Development Implementation Plan" (上海市具身智能产业发展实施方案) 2027 goal: Achieving 20+ core algorithm and other technology breakthroughs in embodied models and datasets ; clustering 100 industry leading companies, launching 100 innovative application scenarios, and promoting 100 globally competitive products. Overall to grow the embodied AI industry's core output beyond RMB50bn .
Dec-24	Shanghai: "Implementation Plan for AI 'Molding Shanghai'" (关于人工智能“模型申城”的实施方案) Organizing technological R&D efforts to develop embodied AI algorithmic models, including end-to-end, multi-modal, and spatial intelligence . Focusing on open-source robot bodies and datasets , as well as open-source autonomous simulation platforms, to build an open-source technology foundation. Conducting embodied AI data collection and releasing action datasets. Piloting the large-scale application with 100+ robots.
Oct-23	Shanghai: "Action Plan for Promoting High-quality Innovation and Development of Smart Robots Industry (2023-2025)" (上海市促进智能机器人产业高质量创新发展行动方案 (2023-2025年)) 2025 goal: Building three public service platforms, smart robot detection and pilot verification innovation center, humanoid robot manufacturing innovation center, general robot industry research institute, etc.
Sep-23	Shanghai: "Action Plan for Further Promoting the Construction of New Infrastructure (2023-2026)" (上海市进一步推进新型基础设施建设行动方案 (2023-2026年))
May-23	Shanghai: "Three-Year Action Plan for Promoting the High-quality Development of Manufacturing (2023-2025)" (上海市推动制造业高质量发展三年行动计划 (2023-2025年)) Targeting the forefront of AI technology, to build general large models and to develop industrial ecosystems for vertical domains; establishing international algorithm innovation base, and accelerating the innovative development of humanoid robots .
Sep-22	Shanghai: "Regulations on Promoting the Development of the Artificial Intelligence Sector" (上海市促进人工智能产业发展条例) The city promotes the standardization and modularization of smart robot software and hardware systems, supports the cultivation of smart robot system integrators , and encourages relevant enterprises, product users, and financial institutions to adopt methods such as product leasing and service procurement to expand smart robot application scenarios.

Policy – China: Policies on robots and embodied AI (Guangdong)



Date	Policy
Guangdong	
Mar-25	Guangdong: "Several Policy Measures to Promote the Innovative Development of the AI and Robotics Industry" (广东省推动人工智能与机器人产业创新发展若干政策措施). Explicitly grants national-level manufacturing innovation centers up to RMB50mn . It also encourages enterprises to jointly tackle key components like servo motors and sensors , guides social capital towards "hard technology" fields by establishing industrial funds, and provides a maximum subsidy of RMB500k to enterprises leading the formulation of international standards.
Feb-25	Guangdong: "2025 Action Plan for Building a Modern Industrial System" (广东省建设现代化产业体系2025年行动计划). Vigorously developing humanoid robots and other embodied AI robots , and accelerating breakthroughs in robot "brains", "limbs", "bodies", and key core components . Actively promoting innovation in smart robot application scenarios. Building a provincial embodied AI robot innovation center to high standards, and attracting/cultivating 3-5 unicorn and technology-leading enterprises.
Jan-24	Guangdong: "Action Plan for Cultivating Strategic Emerging Industrial Clusters of Smart Robots (2023-2025)" (广东省培育智能机器人战略性新兴产业集群行动计划 (2023–2025年)). 2025 goal: The operating revenue of the smart robot industry will reach RMB80bn , of which the service robot industry will reach RMB20bn, and the uncrewed vessel industry RMB50bn. The annual output of industrial robots will exceed 180,000 units . The self-sufficiency in core technologies and key components of smart robots should be significantly enhanced.
Mar-25	Shenzhen: "Action Plan for Technology Innovation and Industrial Development of Embodied AI Robots (2025-2027)" (深圳市具身智能机器人技术创新与产业发展行动计划 (2025-2027年)). 2027 goal: Breakthroughs are anticipated in key areas such as robot core components, AI chips, AI-robotics integration, multi-modal perception technologies, high-precision motion control, and dexterous manipulation technologies . The plan also aims to newly cultivate 10+ enterprises valued at RMB10bn and 20+ enterprises with revenues surpassing RMB1bn . It will see the implementation of 50+ application scenarios, each generating RMB1bn in value, with the scale of associated industries reaching over RMB100bn . The number of enterprises in the embodied AI robot industry cluster is expected to exceed 1,200.
Mar-25	Shenzhen: "Action Plan for Accelerating the Development of a Pioneer City in AI (2025-2026)" (深圳市加快打造人工智能先锋城市行动计划 (2025–2026年)). 2026 goal: The city is projected to have 3k+ AI enterprises, incl. 10+ unicorns, and the industry to achieve a CAGR of 20%+ . The city will also launch over 10 innovation incubators for AI and embodied AI robots , demonstrating significant industrial clustering effects.
Aug-25	Guangzhou: "Measures for Promoting the Innovation and Development of Embodied AI Robots Industry (Draft for Comments)" (广州市促进具身智能机器人产业创新发展若干政策措施 (征求意见稿))
May-25	Zhuhai: "Measures for Promoting High-Quality Development of the AI and Robotics Industry" (珠海市推动人工智能与机器人产业高质量发展若干措施)
Apr-25	Dongguan: "Action Plan for Accelerating the Innovative Development of Smart Robots Industry (2025-2027)" (东莞市加快智能机器人产业创新发展行动计划 (2025–2027年))
Apr-25	Foshan: "Action Plan for Accelerating the Development of Smart Robots Industry (2025-2030)" (佛山市加快智能机器人产业发展行动方案 (2025-2030年))
Nov-23	Foshan: "Development Plan for Robotics and Related Industries (2023-2030)" (佛山市机器人及相关产业发展规划 (2023-2030年))

Policy – China: Policies on robots and embodied AI (Zhejiang)



Date	Policy
	Zhejiang
Dec-25	Hangzhou: "Regulations on Promoting the Development of the Embodied Intelligent Robot Industry." (杭州市促进具身智能机器人产业发展条例) The first local regulation in China specifically targeting embodied intelligent robot, supporting the R&D and application of embodied intelligent models, motion control systems, core components, and independent technology chips . Encourages administrative agencies and public institutions to open up application scenarios , supporting the deployment of embodied intelligent robots in various fields such as emergency rescue, industrial manufacturing, healthcare and elderly care, and urban management.
Sep-24	Zhejiang: "Humanoid Robot Industry Innovation and Development Implementation Plan (2024-2027)" (浙江省人形机器人产业创新发展实施方案 (2024—2027年)) 2027 goal: The annual output of humanoid robots will reach 20k units ; the core industry scale will reach RMB20bn , and the related industry scale will reach RMB50bn .
Feb-23	Zhejiang: "Guiding Opinions on Fostering the Development of Future Industries" (浙江省人民政府办公厅关于培育发展未来产业的指导意见) Prioritizing the development of nine fast-growing future industries, incl. bionic robots and flexible electronics .
Dec-24	Hangzhou: "Measures to Promote Innovation and Development of Humanoid Robot Industry" (杭州市促进人形机器人产业创新发展若干政策措施的通知) Including humanoid robot's complete machine, software algorithms and key components in the scope of support for key scientific research projects to promote key technological breakthrough on humanoid robots such as "brain, cerebellum and limbs". Including general AI models for humanoid robots in the key vertical models for support, and including the relevant open-source algorithm platform into municipal AI open-source demonstration platform.
Dec-24	Hangzhou: "Humanoid Robot Development Plan (2024-2029)" (杭州市人形机器人产业发展规划 (2024—2029年)) Focusing on the " best body + strongest brain " to accelerate the construction of an integrated innovation system and a full industry chain ecosystem for R&D, design, manufacturing and application of humanoid robots. By 2027 , the industrial innovation system will be initially established, and the infrastructure supporting the development of humanoid robots will be basically sound; by 2029 , the industrial scale will achieve leaping growth, and the entire industry chain ecosystem and industrial clusters will be basically formed.
Jun-25	Ningbo: "Measures for Promoting the Innovative Development of Humanoid Robot Industry" (宁波市促进人形机器人产业创新发展若干政策措施)

Humanoid robot is a new addition to the robot industry (2)



Type	Industrial robot		Service robot	Humanoid robot
	Traditional industrial robot	Collaborative robot (Cobot)		
Definition	Industrial robots are heavy-duty machines designed to automate the manufacturing process	Cobots are intended for direct human-robot interaction within a shared space, or where humans and robots are in close proximity		Humanoid robots are robots designed to resemble humans in appearance and behaviour
Capability	- Material handling - Assembly - Welding - Painting & Coating - Quality inspection - Picking, sorting and packing	- Assembly (part selection, dispensing of adhesive, fastening of screws, etc.) - Machine tending - Material handling - Quality inspection - Welding	Service robots are robots in personal use or professional use that performs useful tasks for humans or equipment. Service robots include consumer service robots (domestic cleaning robots, automated wheelchairs, and social interaction robots), and professional service robots (cleaning robots for public places, delivery robots, fire-fighting robots, rehabilitation robots and surgery robots in hospitals, as well as autonomous mobile robots (AMR))	- Moving / walking - Interact with humans
Features	- Do work in place of human beings; - Can handle heavier and larger materials than cobots; - Moves at a faster speed than cobots; - Engineers need to re-write codes for any changes; - Often needs safety cages to keep humans out of the workspace	- Do work alongside human beings; - More easily programmable than industrial robots; - Not designed for heavy manufacturing; - Usually cheaper than industrial robots		- Could perform complex actions that require human-like dexterity, such as picking up objects, walking and climbing stairs; - Able to behave like humans and interact with humans
User case	- Manufacturing factory - Warehouse	- Manufacturing factory - Agriculture - Medical - Pharma	- Transportation & logistics - Hospitality - Medical robotics - Professional cleaning - Agriculture	- Manufacturing factory - Warehouse - Entertainment - Education - Home assistance - Elderly care
Example				

Appendix 1

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*Other information available upon request



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