COMPANY UPDATE

2025. 10. 2

EV/Mobility Team

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AT A GLANCE

BUY

Target price	KRW285,000	29.5%
Current price	KRW220,000	
Market cap	KRW45.0t/USD32.1b	
Shares (float)	204,757,766 (66.2%)	
52-week high/low	KRW248,500/KRW177,500	
Avg daily trading value (60-day)	KRW145.4b/ USD103.8m	

ONE-YEAR PERFORMANCE

	1M	6M	12M
Hyundai Motor (%)	0.0	12.1	-7.2
Vs Kospi (%pts)	-10.6	-20.9	-33.0

KEY CHANGES

(KRW)	New	Old	Diff
Recommend.	BUY	BUY	
Target price	285,000	285,000	0.0%
2025E EPS	43,779	43,779	0.0%
2026E EPS	49,698	49,698	0.0%

SAMSUNG vs THE STREET

No of estimates	24
Target price	279,583
Recommendation	4.0

※ Rating: 4 < → BUY, 3 = HOLD, 2 > → SELL

Samsung Securities

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Hyundai Motor (005380)

On-site visit: Heading toward dark factories

- Over Sep 16-19, we visited Hyundai Motor Group Metaplant America and Boston Dynamics, and attended Hyundai Motor's (HMC) CEO Investor Day.
- At the Investor Day, HMC outlined plans to expand its hybrid lineup and enter the pickup truck market to improve profitability. It also emphasized its differentiated battery durability, which gives it an edge amid the rapid expansion of electrified mobility.
- On robotics, drawing on developments at Boston Dynamics and Robotics Lab, the company is progressing toward unmanned factories and expanding into service sectors. How the robotics business evolves in 2026 is expected to become a key investment theme.

WHAT'S THE STORY?

Extended version of HMGICS: Hyundai Motor Group Metaplant America features fully automated in-plant logistics. By combining cell-based production with conveyor belt systems, the facility can flexibly optimize workflows based on vehicle specifications.

- **Verification of robot operations and dynamic data accumulation:** Mass-production of humanoid robots is targeted for 2027 through collaboration with Hyundai Mobis on component lightweighting and actuator standardization.

HMC's CEO Investor Day: Hyundai Motor (HMC) aims to lift profitability through hybrid lineup expansion and entry into the pickup truck market. Robot deployment in factories should enable it to locally produce 80% of vehicles sold in the US by 2030 (up from 40% in 2025).

(Continued on the next page)

SUMMARY FINANCIAL DATA

	2024	2025E	2026E	2027E
Revenue (KRWb)	175,231	185,523	196,907	205,507
Operating profit (KRWb)	14,240	13,306	14,351	15,476
Net profit (adj) (KRWb)	13,230	12,474	13,597	14,767
EPS (adj) (KRW)	46,042	43,779	49,698	53,973
EPS (adj) growth (% y-y)	5.6	-4.9	13.5	8.6
EBITDA margin (%)	10.6	9.7	9.8	10.0
ROE (%)	12.4	10.3	10.8	10.8
P/E (adj) (x)	4.6	5.0	4.4	4.1
P/B (x)	0.5	0.5	0.4	0.4
EV/EBITDA (x)	10.5	12.0	11.5	11.0
Dividend yield (%)	5.7	5.5	5.7	5.9

Source: Company data, Samsung Securities estimates

- **Expanding hybrid sales:** The development of full-size hybrid engines enables a complete lineup.
- **Entering the North American pickup market:** The pickup segment is sized at 2.85m units annually. HMC expects its entry to bolster its market share in the US.
- **Differentiated battery technology:** HMC has strong capabilities in battery packaging, cooling, and BMS, backed by extensive data from the Ioniq—its first mass-produced EV using lithium-ion batteries. Its batteries have demonstrated durability of up to 250,000 miles.

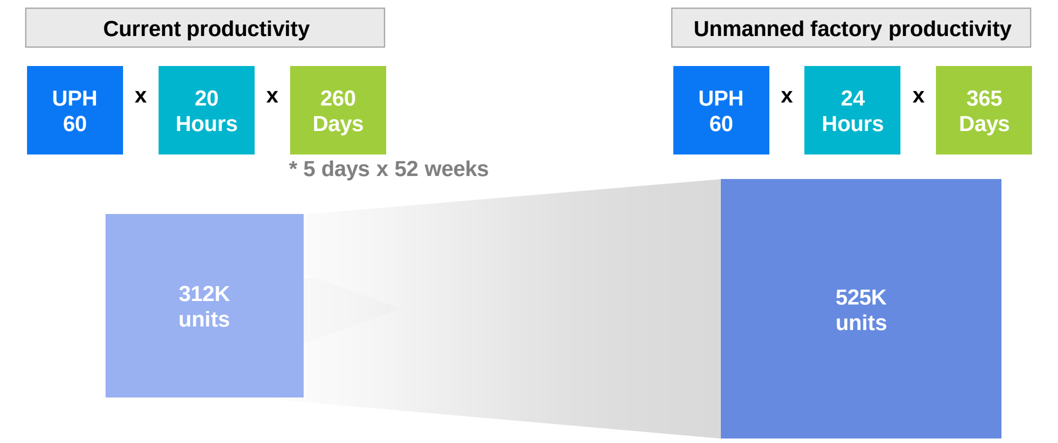
HMG's journey to dark factories: Hyundai Motor Group (HMG) is moving toward unmanned factories that integrate IoT, robotics, sensors, and smart logistics. Fully unmanned facilities can run 24/7, potentially boosting output by around 60% without increasing capacity. At this early stage of the robotics business, Hyundai Mobis's role in actuator development and the broader value chain are likely to attract attention.

HMC/Kia Metaplant summary: Where dark factory technology begins

Extended version of HMGICS: Hyundai Motor Group Metaplant America (the Metaplant) features fully automated in-plant logistics, using automated guided vehicles (AGVs) to transport components and car bodies. It combines cell-based production with conveyor belt systems.

- **Assembly lines with 40% automation:** Collaborative robots are deployed for assembling bulky components such as center panels, while industrial robots—operating separately from humans—handle heavy tasks like installing seats and mounting cockpits with infotainment systems.
- **Cell-based production mixed with conveyer belt systems:** Workflows can be optimized according to each vehicle's specifications. Cars can bypass certain production stages, allowing more efficient use of the line.
- **Potentially the first plant to deploy Boston Dynamics humanoids:** The Metaplant continuously assesses which processes can be automated as robotics technology advances, and its operations can be restructured to raise automation levels. Whether a task remains manual or is automated is decided through economic feasibility analysis. If there is a clear rationale for retaining manual work, Boston Dynamics incorporates this into the Atlas humanoid's design and engineering. Atlas units are expected to be introduced to the Metaplant for testing in late 2025, with assembly data collection from human workers beginning around that time.
- **Starting point for dark factory technology:** A dark factory is a fully automated facility that can run without human intervention—and therefore with lights out. Hyundai Motor Group (HMG) is progressing toward such unmanned plants by integrating IoT, robotics, sensors, and smart logistics. A fully automated facility can operate 24/7, potentially increasing utilization by more than 60% without expanding capacity. This implies that combined output from Hyundai Motor's (HMC) Alabama plant (380,000 units), Kia's Georgia plant (370,000 units), and the Metaplant (500,000 units) could be scaled from 1.25m units to 2m. HMG aims to locally produce over 80% of the vehicles it sells in the US by 2030 (vs 40% in 2025).

Annual production: Manned factory vs fully unmanned factory



Source: Samsung Securities

HMC/Kia Metaplant tour: Mecca of factory automation

On the first day of our HMC tour, we visited the Metaplant. HMG announced a USD7.6b investment in Georgia in May 2022 and broke ground on the site in October of the same year. The investment covers an on-site battery plant, a training center for employees and robots, and a logistics hub. After Phase 2 expansion, annual capacity will reach 500,000 vehicles. Phase 1, with 300,000 units of capacity, is already operational, producing the Ioniq 5 and Ioniq 9.

The Metaplant was originally planned as a BEV-only facility but has been redesigned to produce both BEVs and hybrids amid weak US demand for EVs. The 300,000-unit plant has two production lines, each capable of assembling four models. Production rate is 60 vehicles per hour. Monthly output has been below 10,000 units in 2025, but utilization should increase in 2026 as hybrid models are added to production.

The Metaplant is the most highly automated of HMG's factories. Stamping, welding, and painting are nearly 100% automated—similar to Ulsan. Even the assembly lines have an automation rate of 40%. In traditional car plants, more than 95% of manufacturing workers are deployed along assembly lines, as numerous components must be checked and installed individually, and work inside vehicle bodies requires human flexibility. The Metaplant uses a greater number of collaborative and industrial robots. Advances in safety technology now allow collaborative robots to work alongside humans, performing heavy, upward-facing tasks such as center panel assembly. Industrial robots, operating in separate zones, handle high-load tasks such as installing seats and mounting cockpits with infotainment systems.

The Metaplant can continually reassess which tasks can be automated and adjust automation levels as robotics technology evolves. It is expected to become the first HMG facility to deploy humanoid robots.

Hyundai Motor Group Innovation Center Singapore (HMGICS) pioneered the use of cell-based production supported by AGVs to move large components and car bodies within the factory. This approach has been adopted at the Metaplant, which integrates conveyor belt systems with cell-based production. AGVs optimize workflows based on vehicle specifications, allowing some cars to skip certain production stages. After assembly, vehicles are transported by parking robots to undergo soak testing and wheel-alignment testing.

The Metaplant employs 1,140 human workers on its assembly lines, alongside 102 industrial robots, 161 AGVs, 24 parking robots, and 37 collaborative robots. Two Boston Dynamics robot dogs, Spot, use vision systems to inspect whether parts have been correctly installed in vehicles.

During the tour, two questions were raised about automation: whether 100% automation is feasible and what role humanoid robots will play. The executive in charge of manufacturing technology explained that robots are deployed for physically demanding tasks or those workers are reluctant to perform—they cannot fully replace humans. For example, lifting and installing components weighing 15 kg or more in an upward direction requires workers to rest every two hours, and repeated performance over long periods can lead to musculoskeletal issues. Robots can handle such tasks continuously, thereby boosting productivity.

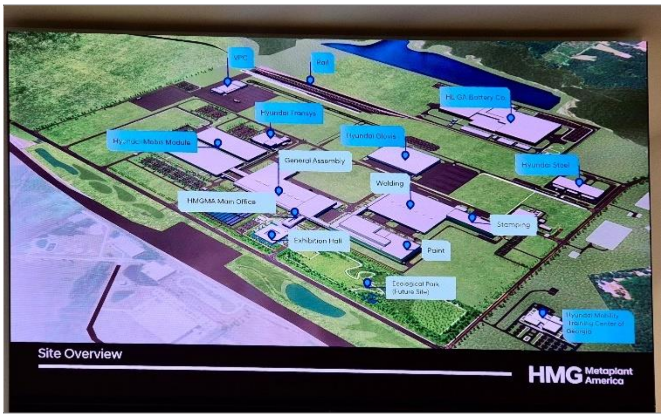
Certain tasks remain difficult for robots. These include arranging wiring harnesses to avoid tangling or inserting soft weather strips into windows, fillers, and hoods—jobs requiring human dexterity and tactile feedback. For such tasks, humans rely not only on sight but also on touch and sound; for instance, they listen for a “click” to confirm proper installation or use flexible hand movements to insert rubber strips into narrow spaces. Such actions are still challenging for humanoid robots given the current limitations of robotic hands. Boston Dynamics is developing third-generation robotic hands and believes that humanoids equipped with tactile sensors and trained using behavioral, video, and voice data will eventually be able to replace human workers.

The potential role of Boston Dynamics humanoid robots at the Metaplant is under active exploration. The initial version, E-Atlas, lacks dexterity and is expected to serve as an assistant to human workers rather than a replacement. Current development is focused on enabling E-Atlas to use vision to recognize its surroundings, classify parts, and perform basic pick-and-place tasks.

With HMC and Kia plants set to become E-Atlas’s first clients, development efforts are likely to target replacing human labor along assembly lines and enhancing plant-wide productivity. Given the clarity of these objectives, tangible progress is expected relatively quickly.

All production tasks and quality checks at the Metaplant are recorded via vision sensors and shared with Boston Dynamics. However, human workers’ motion data are not yet being captured. The plant currently employs 1,140 assembly line workers, a number expected to rise to 2,000 after Phase 2 expansion. The 30,000 robots HMG agreed to buy from Boston Dynamics by 2029 are likely to be used not only at the Metaplant but across the Alabama and Georgia plants, as well as Hyundai Mobis facilities.

Hyundai Motor: Metaplant site

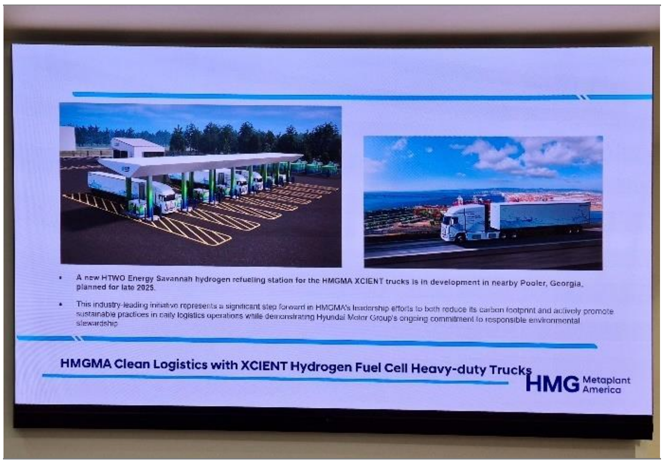


Source: Company data, Samsung Securities

Hyundai Motor: Metaplant

Source: Company data, Samsung Securities

Hyundai Motor: Metaplant



Source: Company data, Samsung Securities

Hyundai Motor: Metaplant

Source: Company data, Samsung Securities

Metaplant tour Q&A

Q1. What manufacturing processes or facilities will be added for HEV production?

Hybrid production does not require major additional facilities. Some extra processes will be introduced, and a few more robots—roughly two per assembly line—will be added.

Q2. When will the Transmission Mounted Electric Device 2 (TMED2) platform be used for hybrid production, and in which models?

Model selection is still under review, and the business plan will be determined by customer demand.

Q2-1. Has TMED1 been skipped in favor of TMED2?

No. Different vehicle types require different powertrains. Either the TMED1 or TMED2 platform will be used depending on the model. No single TMED platform has been exclusively designated for the Metaplant.

Q3. If Atlas humanoids are deployed at the Metaplant or the Singapore plant at year-end, what will be the scale?

The matter is under review, and no decision has been made on the timing of deployment. A pair of Spot robot dogs are currently being used for welding-quality inspections. Humanoids, even if deployed, will not replace all human labor at current technology levels; they are expected to assist rather than replace workers.

Q4. Which roles are the hardest to automate?

The biggest limitation of humanoid robots is hand dexterity. Precision assembly tasks still rely on human hands, which are more dexterous than robotic grippers. Humanoids are expected to be deployed first for logistics tasks such as pick-and-place. As robotic hand technology advances, their role may expand to assembly line work.

Q5. How does personnel input at the Metaplant compare to the Alabama plant for the same 300,000-unit capacity?

The Metaplant is expected to require at least 20% fewer personnel than the Alabama plant.

Q6. What are the financial benefits of higher automation at the Metaplant?

Internal and external perspectives on automation differ. Externally, automation is often viewed primarily as a labor cost reduction measure. Internally, however, the main goal is to offload 3D (difficult, dirty, dangerous) and highly complex tasks to robots.

The Metaplant's automation rate is currently around 40%, with robots deployed mainly to handle 3D and highly complex tasks rather than simply to cut labor costs.

Q6-1. Which processes have the highest automation rates?

End-of-line testing is fully automated. Highly complex tasks such as wheel alignment (ensuring the car runs straight) and battery installation are also being automated through the use of collaborative robots.

Q7. What will be the composition of 30,000 robots HMG plans to introduce by 2028?

Currently, the assembly line uses 40 collaborative robots designed to work safely alongside humans, while industrial robots work independently in isolated zones. The planned 30,000 new robots will all be humanoids capable of autonomous operation.

Q7-1. In which processes are collaborative robots mainly used?

Collaborative robots can move and work independently in the proximity to humans. Built-in safety features allow them to stop automatically upon contact with humans. They can also work in tandem with humans. For example, collaborative robots assist in headlamp alignment by positioning screwdrivers with pinpoint accuracy. They are typically deployed in narrow spaces requiring high precision, or in areas where industrial robots are restricted by safety regulations.

Q8. EVs have recently started selling at discounts. Can utilization be sustained amid slowing demand for EVs and the upcoming expiration of tax credits?

BEV demand has weakened as the sector has encountered the adoption chasm. With North American demand expected to slow further after tax credits expire at end-September, the company is discussing adjustments to incentives and production volumes while reviewing longer-term operational strategies.

Q9. What is the breakeven utilization rate?

Break-even is achieved at 300,000 units of production.

Q10. The continuing evolution of robots requires a lot of data. Are the data from collaborative robots currently operating at the Metaplant shared with Boston Dynamics to support robot evolution?

Cooperation with Boston Dynamics is ongoing, and production data are being collected and utilized through robots' vision systems. For example, welding operations are controlled within a 0.5 mm tolerance. The stamping inspection process is fully automated. Deviations or issues are captured by vision systems, stored as production data, and reflected in subsequent production stages, feeding directly into assembly operations.

Q10-1. Are workers' motions also collected as data?

No, because human movements lack consistency.

Q10-2. If humanoids are to replace humans, won't worker motion data be necessary?

Humanoid robots will focus on pick-and-place, fitting, and loading tasks. Since these activities rely on coordinates, vision-based training will form the foundation, and worker motion data will be unnecessary.

Q10-3. Are robots currently trained for specific tasks?

Yes. Robots are trained for specific tasks after assessing their suitability for each role.

Q11. Can the Metaplant's automation processes be applied to existing plants (*eg*, Ulsan)?

Assembly processes at the Metaplant and existing plants are virtually identical, with the only major difference being space. The length and number of processes are similar (6.8 meters at the Metaplant vs 6.6-6.8 meters at Ulsan). The Metaplant is simply more automated, with robots handling some tasks previously done by humans. There are no spatial constraints preventing similar automation at older plants, so if the Metaplant's automation proves efficient, it can be applied to facilities like Ulsan.

Q12. Improving utilization of the new plant is crucial amid stagnant US demand for BEVs. Will vehicles made in the US be exported to Korea?

Export decisions are made at headquarters, not at the Metaplant.

Q13. What is the current status of Boston Dynamics robot deployment, and what advantages do Spot robots offer?

Two Spot robot dogs have been deployed for quality inspections of welded vehicle bodies. They scan the rear doors and quarters of auto bodies and occupy less space than fixed scanners. These tasks were not previously performed by humans.

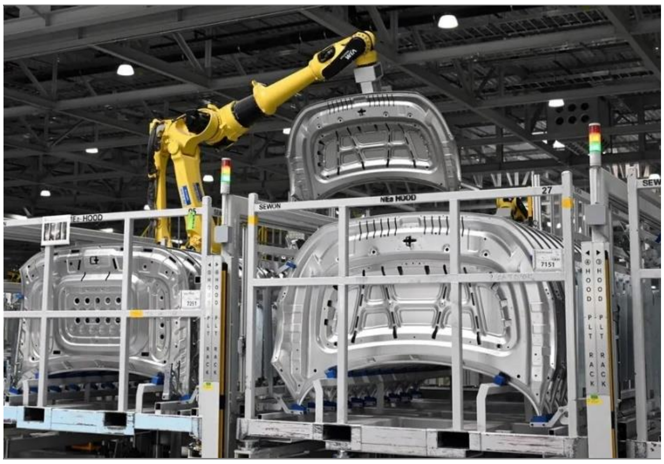
Q13-1. What is the cost difference between Spot and fixed scanners?

Spot robots, equipped with vision systems, tend to be more expensive. However, prices fluctuate significantly depending on demand, making direct cost comparisons difficult.

Q14. Industrial robots appear to handle all automatable tasks, while jobs requiring human senses remain with human workers. Will deploying humanoid robots actually improve productivity?

The primary goal of automation and robot deployment is to support, not replace, human workers. Humanoids are being considered for repetitive or heavy-load tasks. Current regulations prohibit human workers from handling objects heavier than 15 kg for more than two hours, whereas humanoids can perform such tasks continuously. This should help offset worker fatigue and dissatisfaction.

Metaplant: Industrial robot performing loading task



Source: Company data

Metaplant: Spot robots performing inspection task

Source: Company data

Metaplant: Collaborative robot working on assembly line with humans

Source: Company data

Metaplant: Ioniq 5 being transported by AGV

Source: Company data

CEO Investor Day: Longer-term growth vision intact

Maintaining 2030 sales target of 5.55m units (up 33% y-y): HMC expects to exit a global sales slump as a new-model cycle begins in 2H25.

- **Growth contribution from Korea to fall:** The Korean portion of sales is projected to decline from 17% in 2025 to 13% in 2030, while the Korean portion of production will probably fall from 43% to 32% over the same period.
- **Sales to rise in all other markets:** HMC expects sales to rise 20% in North America, 40% in Europe, and 40% in India.
- **To add 1.2m units of capacity by 2030:** the carmaker has plans to add 500,000 units of capacity in the US, 250,000 units in India, 200,000 units in Korea, and 250,000 units at CKD sites.

Mix to improve: Profitability should improve through hybrid lineup expansion and entry into the US pickup truck market. Robot deployment should support localization, with 80% of vehicles sold in the US to be produced locally by 2030 (vs 40% in 2025).

- **Rising hybrid sales:** HMC expects hybrid sales to double from 750,000 units in 2025 to 1.32m units in 2030. Full-size hybrid engine development will enable a complete lineup, with 18 hybrid models planned by 2030. Hybrids will be introduced to the Genesis brand starting in 2H26.
- **Entry into the pickup truck market:** The US pickup segment is sized at 2.85m units, accounting for 18% of the US market. HMC expects its pickup truck entry to bolster its US market share.
- **Expanding the N lineup (high-performance EVs):** HMC has set a sales target of 100,000 units for its N performance EV lineup by 2030.
- **Targeting 80% US local production by 2030:** To mitigate geopolitical risks such as tariffs, HMC plans to increase US production through higher automation. Fully unmanned facilities operating 24/7 could boost production volumes by around 60% without increasing capacity.

Differentiated battery technology: HMC's batteries have demonstrated durability of up to 250,000 miles, and the firm is developing next-generation batteries with enhanced competitiveness.

- **Favorably positioned for robotaxi operations:** Supported by extensive data collected from the Ioniq—the firm's first mass-produced EV using lithium-ion batteries—HMC boasts strong capabilities in battery packaging, cooling, and BMS technology. Validation of 500,000 Ioniq 5 vehicles shows over 90% battery life retention after 250,000 miles. This high durability makes its batteries well suited for robotaxi applications, strengthening partnership potential with Waymo.
- **Battery sourcing flexibility:** HMC is expanding into robotics and urban air mobility.

  The firm can select and apply the most appropriate battery technology for each product and segment by sourcing from not only from Korean cell makers but also from their and Chinese counterparts. Korean suppliers are strong in lithium-ion cells, while Chinese makers lead in LFP technology. Proven battery performance should provide a key differentiating edge during the EV transition and the expansion of electrified mobility.

Strengthening global partnerships: HMC is collaborating with Waymo and GM.

- Supplying robotaxis to Waymo: Ioniq 5 vehicles produced at the Metaplant will be delivered to Waymo starting in 2026 for integration with Waymo's sixth-generation driver technology.

- **Co-developing five models with GM, targeting sales of 800,000 units:** HMC and GM are working on an electric commercial van for North America, as well as a compact sedan and compact pickup for Latin America. The partnership also includes exploring joint sourcing of commodities and parts, and sharing battery technology and supply chains.

2025 guidance update: HMC has lowered its 2025 profitability guidance to reflect the impact of US tariffs but has kept its longer-term profitability targets intact by planning a better sales mix and increasing local production.

- **2025 profitability guidance lowered:** HMC has revised its 2025 guidance as follows: sales growth target up from 3-4% y-y to 5-6% y-y; operating margin target down from 7-8% to 6-7%; capex target down from KRW16.9t to KRW16.1t, and free cash flow target (ex finance division) down from KRW0.5t-2t to KRW0-1.5t.
- **Longer-term profitability target intact:** HMC continues to target an operating margin of 7-8% by 2027 and 8-9% by 2030.
- **Committed to 35% total payout ratio:** Even if the 25% US tariff remains in place, HMC is committed to repurchasing and cancelling KRW4t of shares over the next three years. Some investors had expected more immediate action in 2025 and were disappointed by the lack of any specific mention of this.

CEO Investor Day Q&A

Q1. (Risk) From management's standpoint, what is the biggest long-term concern?

The market environment is changing rapidly, but group-wide and divisional strategies remain stable. These strategies provide resilience across the company's various missions and business elements. Hyundai emphasizes rigorous execution throughout the group, working closely with partners, dealers, and employees.

Q2. (Regional strategy) How will HMC compete with Chinese automakers in key markets like Europe and Latin America? What are Boston Dynamics' medium- to long-term volume targets and profitability outlook for these markets?

Hyundai views China as an opportunity and is pursuing a localized strategy through local partners and products, strengthening collaboration with BAIC.

- **Europe:** The company is maintaining high profitability while meeting European regulatory requirements. It aims to become the number-two automaker by market share.
- **Asia-Pacific:** The strategy for Australia mirrors that for Europe. HMC plans to launch pickup trucks to expand growth in North America, Latin America, and Southeast Asia. HMGICS acts as a testbed for advanced manufacturing technologies, which are rolled out globally once proven.
- **India:** Capacity is being expanded both for domestic demand and exports, with a new plant planned in Pune. HMC was the first major automaker to go public in India, which is one of its most profitable markets.
- **Latin America & Middle East:** HMC has a strong localization strategy and expects to increase market share through its Saudi CKD plant (capacity: 50,000 units).
- **Genesis brand:** Global Genesis sales volume is expected to rise by 50%, contributing meaningfully to group profitability.

Q3. (US market) What are the growth opportunities in the US over the next 3-5 years? Please outline opportunities in each region, and the company's strategy for autonomous driving.

- **US:** The US is currently HMC's most profitable market. Historically, the company lacked large SUV and pickup truck offerings, which now presents a major growth opportunity as the lineup expands.
- **Europe:** HMC plans to enhance competitiveness by expanding the Genesis portfolio and launching sales finance operations.
- **India:** No significant market share gains are expected, but the market itself may grow, and HMC sees export opportunities and potential for launching its luxury brand.
- **Latin America, Asia-Pacific, and Southeast Asia:** HMC has a strong localized presence and is ranked number two by market share in the Middle East, where it is investing in additional capacity to support growth.
- **Autonomous driving strategy:** HMC is pursuing multiple strategies in parallel: 1) in-house development of autonomous driving technologies; 2) global partnerships with Motional (US), Waymo (US), and Momenta (China); and 3) mobility services expansion through group companies like 42dot, which are targeting new businesses such as robotaxis. Over the long term, HMC's objectives are technology standardization and improved profitability.

Q4. (Tariffs and shareholder returns) If the 25% tariff remains, can HMC defend its profit margin? Does the company have a share buyback plan this year?

Our revised guidance assumes a 25% tariff. If the tariff is reduced to 15%, our previous guidance would become achievable. While some short-term margin pressure is inevitable, HMC aims to defend margins by focusing on customers, improving its sales mix, and maximizing sales. The company remains committed to delivering a total payout ratio of at least 35% through dividends and buybacks, including KRW4t of share repurchases over the next three years.

Q5. (Pricing policy, collaboration with GM, and Russia) Will HMC hike prices in the US? How are things done when co-developing models with GM? Do you plan to return to Russia?

- **Pricing policy:** HMC puts customers front and center. The company focuses on maintaining competitive pricing by reducing costs, commonizing platforms, and maximizing plant utilization. Pricing will remain flexible, taking into account demand conditions and the competitive landscape.
- **Collaboration with GM:** HMC and GM are co-developing five models in a donor-receiver structure and pursuing multiple synergy opportunities, including collaboration with Glovis on logistics. The target scale of the partnership is currently around 100,000 vehicles.
- **Russia:** HMC has exited the Russian market, and nothing has changed in this regard. None of its current projections rely on a return to Russia.

Q6. (Robotics) What are HMC's goals and investment plans for the robotics business? What are the company's US local production targets?

Robotics is a means to boost productivity, improve quality, and reduce costs. It is used to automate high-risk tasks and drive manufacturing innovation. HMG has combined its manufacturing expertise with Boston Dynamics' leading technology. While investment allocations have not been disclosed, all projects undergo ROI assessments.

In the US, HMC has 450,000 units of capacity in Alabama and 300,000 units at the Metaplant (rising to 500,000 units after Phase 2 expansion), with plans to produce 1m vehicles this year. The company aims to manufacture more Genesis models in the US to strengthen its premium positioning.

Q7. (Localization) HMC is trying to reach 80% local production in the US. What are the company's US sales and local production targets?

US localization is not about shifting production from Korea but about supporting growth. HMC intends to produce vehicles in the US to match US sales while using Korean production for other markets. The firm currently has 400,000 units of capacity in Alabama (targeting output of 385,000 units this year) and 300,000 units at the Metaplant (to be expanded to 500,000 units). Given the strategic importance of the US market, HMC plans to increase Genesis production locally. Total US production is expected to reach around 1m vehicles this year.

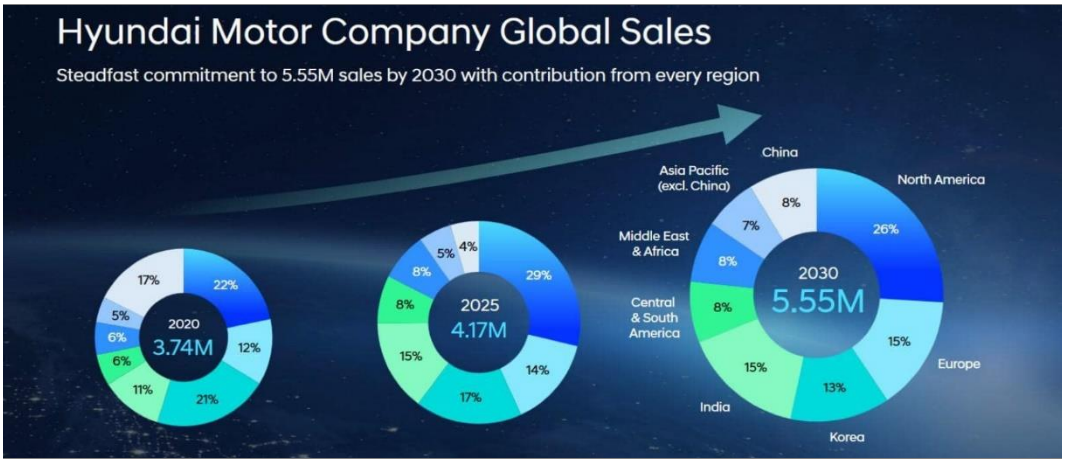
Hyundai Motor CID: Ioniq robotaxi

Source: Samsung Securities

Hyundai Motor CID: Genesis concept car

Source: Samsung Securities

Hyundai Motor: Global sales target



Source: Company data

Hyundai Motor: Electrified deployment plan

Source: Company data

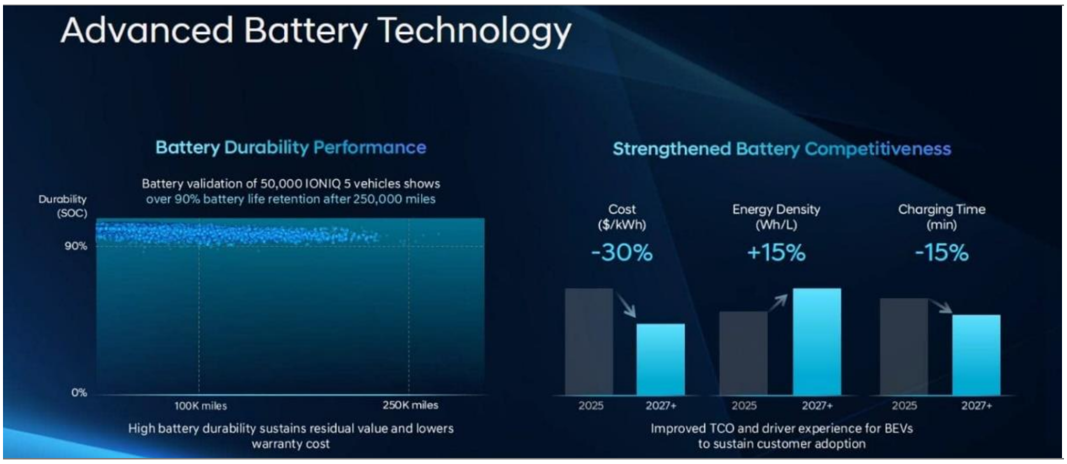
Hyundai Motor: Acceleration global production capacity

Source: Company data

Hyundai Motor: EV portfolio

Source: Company data

Hyundai Motor: Advanced battery technology



Source: Company data

Hyundai Motor-Waymo partnership: Ioniq 5 robotaxi fleet

Source: Company data

Hyundai Motor-GM strategic alliance: Vehicle co-development

Source: Company data

Hyundai Motor: 2025 annual guidance update

Source: Company data

Hyundai Motor: Future investment plan

Source: Company data

Hyundai Motor: Shareholder return policy

Source: Company data

Boston Dynamics summary: Boston Dynamics to drive HMG's rerating

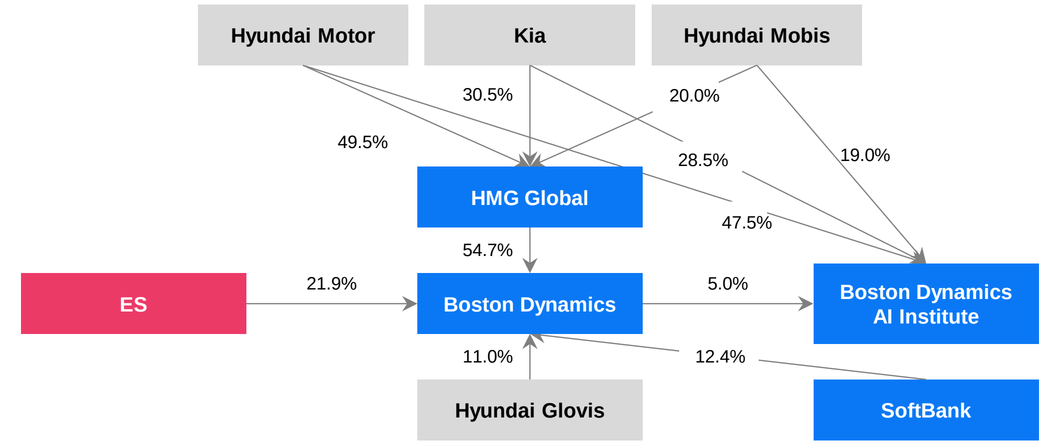
Boston Dynamics and HMC: The world's foremost robotics company is collaborating with a leading automobile manufacturer.

- **Combining robot technologies with automobile domain technologies:** Boston Dynamics, a global leader in robot motion intelligence, has commercially launched two AI robots—Spot and Stretch—and entered the humanoid robotics market through a partnership with HMG, one of the world's leading carmakers. HMG's extensive expertise in manufacturing economics and accumulated process data provides Boston Dynamics with a unique advantage: the ability to apply automation feasibility analyses directly to real-world factory environments, and in so doing, sophisticate its humanoid robot technology. Boston Dynamics plans to begin humanoid robot trials at the Metaplant—HMG's first dedicated mass-production EV plant—by end-2025. Commercialization is targeted for 2027, after the establishment of a foundation model for humanoid robot AI.
- **Humanoid robot AI architecture:** Boston Dynamics is developing a foundation model designed to enable its humanoid robots to perform over 20,000 tasks relevant to HMC/Kia assembly lines. The architecture integrates advanced technologies such as mixture of experts (MoE), large behavior models (LBMs), and vision-language models (VLMs). This approach aims to create general-purpose humanoid robots capable of learning and executing a vast range of manufacturing tasks. Finalization of the architecture is expected within 12-18 months. The model will be strengthened through data on worker behaviors captured at the Metaplant, reinforcement learning at training centers, and extensive simulations. It will leverage Nvidia's DRIVE Thor chip and cloud platforms.
- **AI talent expansion through RAI:** In Aug 2022, Boston Dynamics established the Robotics & AI Institute (RAI, formerly The AI Institute) with an initial USD400m investment to accelerate AI model development and expand engineering talent. About 40 PhD researchers from Harvard and MIT are collaborating with the institute. HMG Chairman Chung Eui-sun chairs the institute, established by Boston Dynamics' founder Marc Raibert. Despite fierce competition for robotics AI talent, recruitment has progressed smoothly thanks to Boston Dynamics' reputation, its East Coast location, and HMG's strong capital backing.
- **Advancements in gripper technology:** Boston Dynamics' Gen2 gripper features three fingers, balancing complexity and practicality. Gen3 grippers will offer higher degrees of freedom and tactile sensing, enabling complex fine motor skills.
- **E-Atlas—Fully electric humanoid robot:** Boston Dynamics is developing E-Atlas, a fully electric, commercial humanoid robot that replaces the previous hydraulic model (Atlas), following efforts to reduce costs and weight. Actuators were co-developed with Hyundai Mobis.
- **IPO expected in 2028:** Based on its development roadmap, Boston Dynamics expects its humanoid robots to be ready for real-world automotive assembly tasks by 2027. Following successful trials at the Metaplant, mass-production is expected to begin, with orders from external clients likely from 2028. An IPO is anticipated in 2028 to finance mass-production.

Boston Dynamics is well positioned for a strong listing, given: 1) its experience commercializing two robots; 2) HMG's role as both a key client and shareholder; and 3) a clear humanoid commercialization roadmap (within two years).

Figure AI raised over USD1b in Series C funding at a post-money valuation of USD39b. Boston Dynamics, with stronger commercialization credentials, sees no reason its valuation should be lower.

Boston Dynamics: Governance structure



Source: Company data, Samsung Securities

Value of stakes if Boston Dynamics goes public with a market cap of USD20b

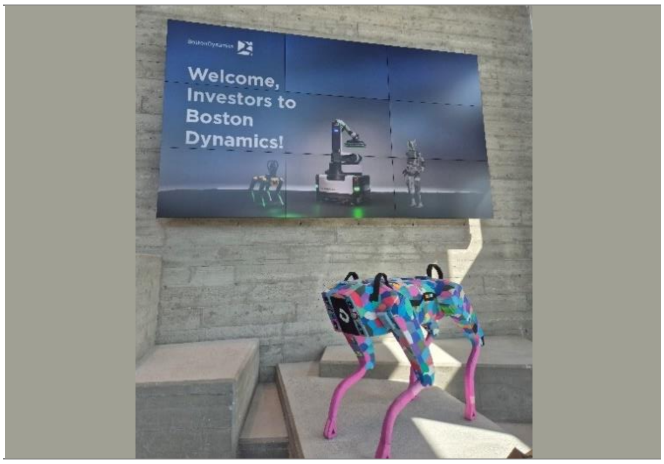
	Stake (%)	Stake value (USDm)	Stake value (KRWb)
HMC	27.1	10,569	14,797
Kia	16.7	6,513	9,118
Mobis	10.9	4,251	5,951
ES	21.9	8,541	11,957
Glovis	11.0	4,290	6,006
SoftBank	12.4	4,836	6,770
Total	**100**	**39,000**	**54,600**

Note: Assuming exchange rate of KRW 1,400/USD
Source: Samsung Securities

Boston Dynamics: Headquarters

Source: Samsung Securities

Boston Dynamics: Spot



Source: Samsung Securities

Overview of Boston Dynamics

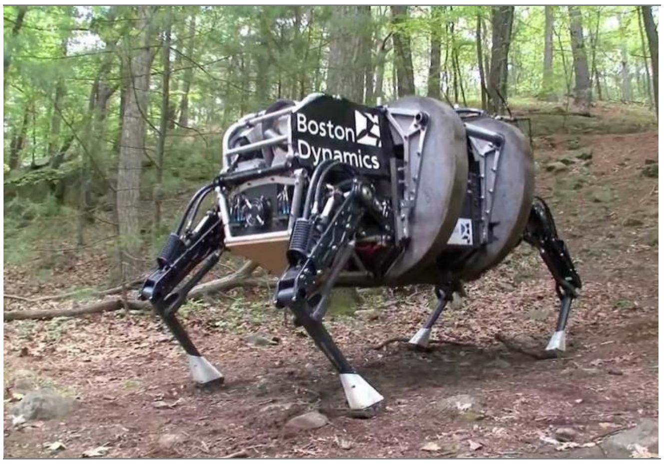
Boston Dynamics began in the 1990s as a simulation software company founded by robotics professors at MIT. Initially, it took on short-term projects (typically 9-12 months) to demonstrate the feasibility of robotic capabilities that had not yet been proven.

In the 1990s, it was unclear whether machines could maintain balance autonomously in complex environments. In 2007, Boston Dynamics answered this question with BigDog, a dynamically stable quadruped military robot platform. BigDog was large to enable it to carry heavy payloads for soldiers across rough terrain. It successfully traversed forests, hills, and rocky ground without the aid of cognitive sensors.

Recognizing that robotic mobility (for the likes of Big Dog) could be enhanced by adding cognitive sensors, Boston Dynamics shifted focus to integrating perception with locomotion. While academic and corporate rivals tested mobility in controlled lab environments, Boston Dynamics conducted field tests in rugged outdoor settings, placing itself at the forefront of dynamic walking research globally.

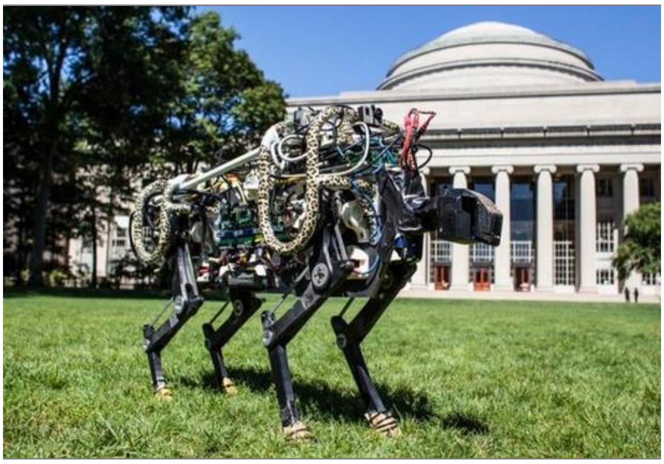
The company went on to develop a series of four-legged robots. Inspired by the cheetah, it created Cheetah, capable of sprinting at more than 20 mph and making agile banked turns. It then produced a prototype robot capable of carrying heavy payloads for the US army, following human leaders or navigating autonomously using GPS.

Boston Dynamics: Big Dog



Source: Media

Boston Dynamics: Cheetah



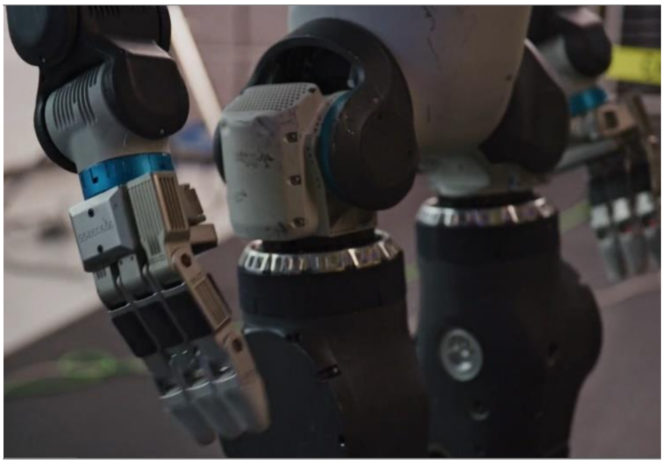
Source: Media

Google acquired Boston Dynamics in 2013. Following the acquisition, the company ended its military robotics program, recognizing that military contracts were too limited to support large-scale commercialization. Initially, it continued developing hydraulic robots but later transitioned to fully electric platforms to serve a broader range of industries.

Boston Dynamics experimented with articulated arms and grippers—most notably on its Spot robot—but finger dexterity remained a weak point during complex manipulation, forcing compromises.

Boston Dynamics has proven its dynamic motion capabilities over several decades, and it is now focused on improving precision manipulation. To that end, the company formed a dedicated R&D team focused on advancing robotic dexterity. Its latest all-electric humanoid robot, Atlas 3.0, is expected to feature significantly improved manipulation capabilities thanks to redesigned arms and grippers.

Boston Dynamics: Altas gripper



Source: Company data

Boston Dynamics: Atlas gripper, 2nd generation

Source: Company data

Boston Dynamics has successfully commercialized two autonomous robots: Spot (a quadruped inspection robot) and Stretch (a warehouse logistics robot). These successes underscored a critical strategic insight: the firm must expand only after clearly defining the value it can deliver to customers.

Spot: Four-legged walking robot

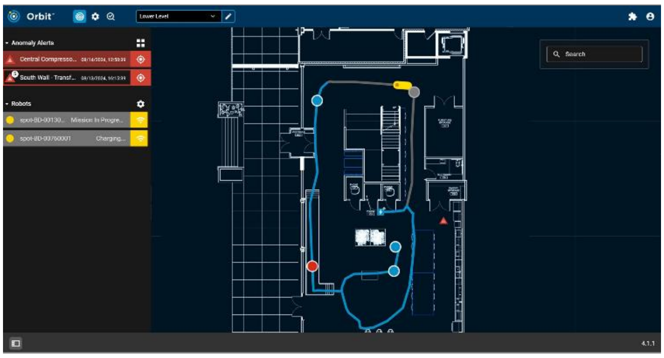
Spot is Boston Dynamics' agile, four-legged robot powered by its Orbit software platform. Around 2,000 Spot units have been sold globally across key industries including food & beverage, semiconductors, high tech, and utilities. Spot is particularly effective in older or more complex facilities, where it automates inspections of working conditions and critical equipment. Spot is a profitable product for Boston Dynamics. Its rising sales reflect growing demand among companies that cannot afford full smart factory solutions but see Spot as a cost-effective replacement for human inspectors.

Spot is priced at USD150,000-300,000, depending on the specifications (such as sensors, actuators, and service packages). For industrial applications, customers typically achieve a two-year return on investment (ROI). The robot's battery lasts 1.0-1.5 hours, with a recharge time of about one hour.

Boston Dynamics: Spot

Source: Company data

Boston Dynamics Orbit: Robot fleet management



Source: Company data

Boston Dynamics' Orbit is a fleet management platform that enables Spot to perform advanced detection and manipulation tasks in the physical world.

Orbit is built on a vision-language AI model that can compare real-time visual data to reference information, identify anomalies in equipment or on the site, and build a visual history of a site. This allows remote monitoring and virtual facility walkthroughs. Operators can issue natural language queries such as: "Is it okay for this object to be here?", "Is it appropriate for a person to be in the factory at night?", and "Is the door open?"

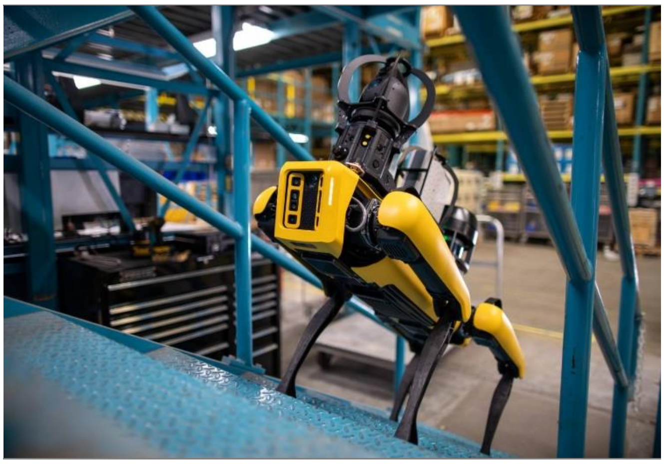
Spot operates either autonomously within a defined space or under remote control via Orbit. The data it collects are transmitted not only to Orbit but also to a client's internal systems through APIs. Client data can be fed back into Orbit, allowing the system to become increasingly sophisticated over time.

Spot is equipped with an array of cameras, sensors, and actuators, along with a Spot Arm mounted on top of its body for manipulation tasks. Key sensors include: 1) visual sensors (front)—360° stereo and thermal cameras, enabling environmental mapping and anomaly detection; 2) acoustic sensors (middle)—SPV-600, allowing sound-based anomaly detection; and 3) LiDAR sensors (rear)—providing 3D environmental mapping. Spot uses either on-board or external computing modules to conduct inference.

Boston Dynamics' dynamic motion technology—developed through decades of R&D starting with BigDog—enables Spot to navigate complex terrains such as uneven surfaces, stairs, and grassy areas.

In semiconductor fabs, Spot can collect data for automated inspections and link them to factory systems. In a manufacturing setting, it can inspect motors with cameras and flag issues when it detects thermal anomalies. With its acoustic imager, Spot can detect pinhole air leaks (that are creating noise anomalies).

Boston Dynamics: Spot



Source: Company data

Boston Dynamics: Spot sensor

Source: Company data

Stretch: Logistics robot

Boston Dynamics' Stretch robot is designed to automate the physically demanding and injury-prone task of unloading boxes in logistics environments. Unloading boxes is repetitive, strenuous work with a high risk of worker injuries, making it an attractive area for automation.

Key clients include DHL, Inditex (apparel), and GAP. Tire manufacturers are also in discussions to adopt the technology. Given labor shortages and aging populations, the client base is expected to expand significantly.

Stretch uses cognitive sensors to identify boxes before autonomously picking and stacking them onto conveyor belts. It is equipped with: 1) a vacuum gripper with 50 suction cups that allows secure handling of a wide range of box sizes and shapes; 2) 360° cameras that enable real-time box recognition, obstacle avoidance, and autonomous decision-making; and 3) a long robotic arm mounted on a pallet-sized base, giving it a much greater reach and range of motion than human workers—for instance, the arm can access the second row of boxes on a pallet, beyond what humans can typically reach, and can safely lift and handle boxes weighing up to 23 kg, ranging in size from that of a small cup to a meter square.

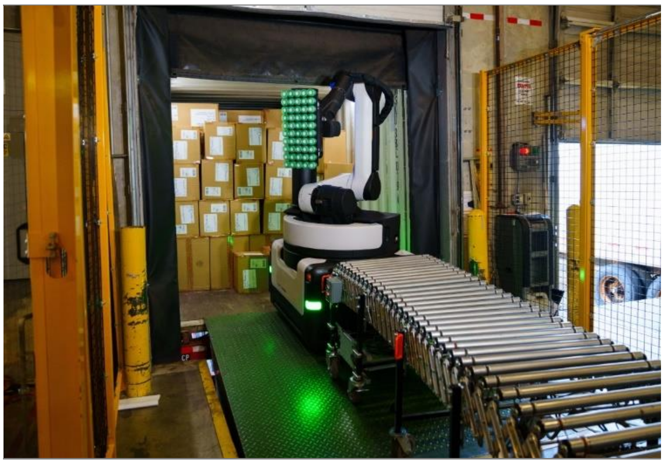
The robot's battery is housed in its base, helping maintain stability even when the arm is fully extended. The battery lasts 4-5 hours, sufficient for up to two full work shifts per charge, and can be fully recharged in about one hour.

Stretch is priced at USD400,000, which includes system integration, safety system deployment, and services. Clients typically achieve a 2- to 3-year ROI, and the robot has an expected lifespan of four years. While the upfront cost is high, automation of unloading tasks is becoming inevitable given the difficult working conditions and high injury rates. Prices are expected to fall as production scales.

Stretch has been designed as a flexible and easily scalable solution. Its applications are set to expand beyond automated truck unloading to include automated pallet building, depalletizing, and truck loading. For example, at local distribution centers, Stretch could collect household goods (*eg*, tissue, shampoo, packaged items), stack them onto pallets, and transport them automatically to exit zones for shipping.

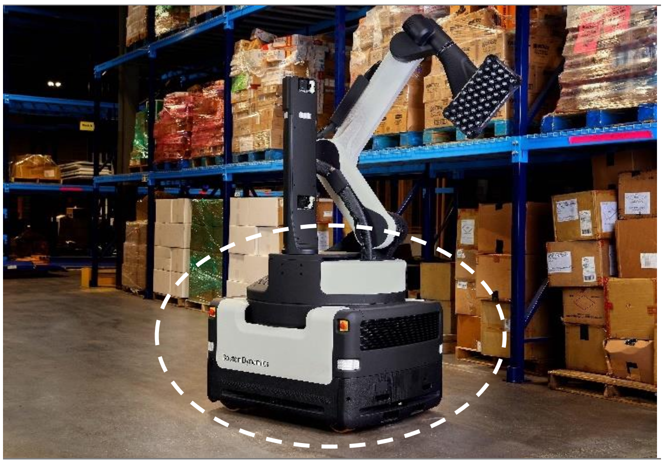
The main technical challenge lies in durability. Repetitive, heavy work can cause wear and damage to the robot's joints and structure over time. Enhancing the robot's durability remains Boston Dynamics' biggest hurdle to scaling deployment.

Boston Dynamics: Stretch



Source: Company data

Boston Dynamics: Stretch battery

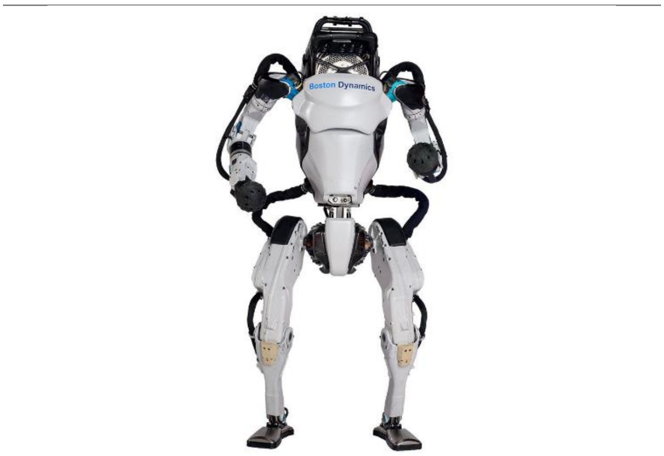


Source: Company data

E-Atlas: Second-generation humanoid robot

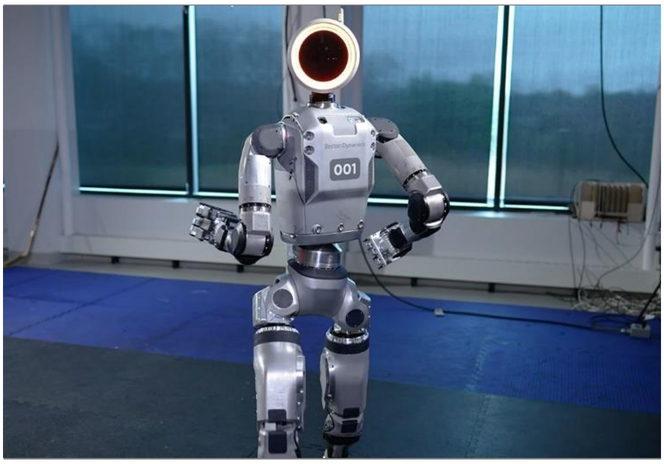
E-Atlas is Boston Dynamics' second-generation humanoid robot and the company's first all-electric model, marking a shift away from the hydraulically powered first-generation Atlas. Developed 1.5 years ago, E-Atlas has served as a test platform for machine learning and multi-task automation. A third-generation version, designed for commercialization, is expected to be unveiled soon.

Boston Dynamics: Atlas 1st generation



Source: Company data

Boston Dynamics: Atlas 2nd generation



Source: Company data

A key challenge in commercializing humanoid robots lies in defining clear use cases—a prerequisite for identifying customers and scaling the market. Spot's market only emerged once its use cases were clearly articulated, while Stretch initially struggled to secure clients despite well-defined applications, primarily due to its high early-stage pricing.

Unlike Spot or Stretch, Atlas was launched with a clear target market—Hyundai Motor Group (HMG). This gives Boston Dynamics a strong commercialization pathway. HMG is an ideal client: it knows exactly what it wants, it can provide extensive manufacturing data, and it stands to enjoy meaningful cost reductions through automation.

During Atlas's development, Boston Dynamics engineers visited global automakers and parts manufacturers to analyze real-world operations. They identified two areas in automotive manufacturing that remain heavily manual: 1) parts handling, where the vast array of components complicates automation; and 2) general assembly, where a diverse set of intricate tasks makes it difficult to fully automate.

To address these gaps, developers focused on cost-effective automation by combining general-purpose hardware platforms with general-purpose AI systems, rather than pursuing humanoid robots designed simply to mimic human appearance. The vision is to make humanoids economically viable solutions for previously manual tasks.

Current automation solutions in automotive plants are often cumbersome, leaving large opportunities for humanoid robots as technology advances.

HMC has provided Boston Dynamics with detailed data on why specific tasks remain manual. In HMC factories, a task is performed manually only if engineers have determined that this is the most cost-effective method. The company maintains extensive classification data that distinguishes manual from automated tasks. Boston Dynamics has access to these datasets, enabling developers to understand precisely why certain tasks resist automation, and design humanoid capabilities tailored to overcome those specific challenges.

E-Atlas will begin proof-of-concept (PoC) testing at HMC's Metaplant in 2026, marking the first real-world implementation of its machine learning-based behavioral system. A recently released YouTube video demonstrated the large behavior model (LBM) trained on real-world work data collected at an HMC factory. The humanoid robot team is currently gathering extensive work data from HMC plants to: 1) determine the number of data hours required for reliable model performance; and 2) verify whether the machine learning pipeline can be effectively applied to real manufacturing tasks. The commercial version of E-Atlas has been in development for 1.5 years and is now approaching completion. Once the third-generation model is launched, the second generation will be phased out.

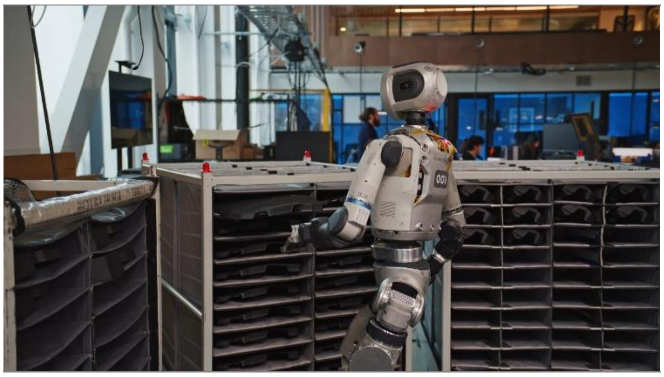
The upcoming third generation will feature a replaceable battery system, enabling three-shift operations, with battery swaps taking only 2-3 minutes.

Current second-generation robots have a human-like body shape and joint structure but exhibit superhuman strength. Atlas is slightly stronger than an elite athlete and can move freely without joint constraints. This gives it significant advantages in both speed and operational efficiency.

Boston Dynamics has fully applied its expertise in motion intelligence and physical agility to E-Atlas.

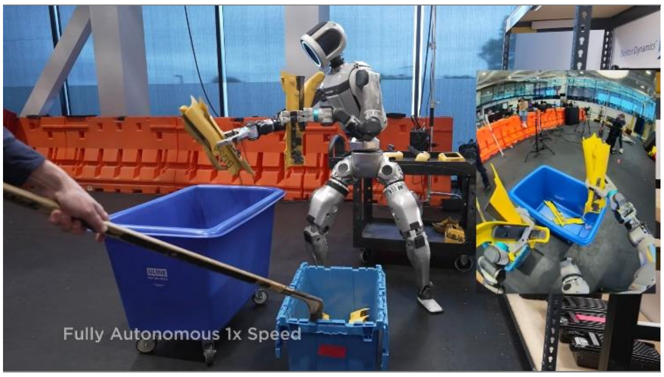
For data collection, Atlas uses a whole-body controller and a teleoperation system. Unlike most robotics companies that control upper and lower body segments separately, Boston Dynamics—drawing on decades of research—can control the entire body in a coordinated manner. Data is collected via teleoperation, and a recent demonstration video showed E-Atlas performing a "sequencing" process commonly found in automobile factories—*ie*, delivering parts to the assembly line in the precise order needed for each vehicle. In the demonstration, the robot picked up parts from a cart and placed them on a shelf, capturing motion data for training.

Boston Dynamics: E-Atlas



Source: Company data

Boston Dynamics: E-Atlas



Source: Company data

Robotics generalization, which is essential for economic viability, requires large volumes of high-quality data and sophisticated AI models. Boston Dynamics estimates that collecting 5-10 hours of demonstration data per action type is sufficient for stable autonomous execution within the current machine learning pipeline.

In the future, demonstration data for various actions will be collected from the training center. As teleoperation alone is not enough to collect data, simulation data, synthetic data, and reinforcement learning will be utilized to build a much larger humanoid operating system—human-in-the-loop (HITL)—which will be tested in real factory environments.

The company expects it will take 12-18 months to achieve robust generalization of whole-body behaviors. The underlying AI architectures are rapidly evolving, combining multiple models—such as vision-language models (VLMs), action expert models, flow matching, and diffusion models—resulting in multi-billion parameter systems.

The recently unveiled LBM, for example, has hundreds of millions of parameters in a relatively small action expert architecture. It can process vision and language simultaneously, leading to faster training and eliminating the need for massive computing clusters.

E-Atlas Q&A

Q1. How many tasks have been identified per manufacturing line in HMC's factories?

HMC has internally compiled a list of tens of thousands of tasks, supported by a clear technology roadmap for implementation. This list excludes tasks handled by parts suppliers.

Q2. How does E-Atlas's technology level compare to that of competitors?

Most products in the humanoid robotics industry remain in their early stages, and most companies are still grappling with the challenges of fitting reliable, cost-effective, and safe systems into a humanoid form factor. Tesla is a more mature player and has shown strong capability in addressing these challenges.

Boston Dynamics has invested heavily to meet safety and functionality requirements for automotive factory applications. There is no "secret formula" in humanoid robotics—most companies are developing similar core technologies—but differentiation lies in which part of the data pyramid and which applications companies target.

Technological capabilities across competitors are broadly comparable, but Boston Dynamics claims several competitive advantages: 1) extensive experience built over many years of robotics development; 2) access to unique datasets that competitors cannot currently replicate; 3) expertise in building a data engine (by teleoperation) from full-body humanoid behavioral datasets; 4) proven mass-production experience, having successfully commercialized two robot platforms—Spot and Stretch; and 5) mature sales, service, and manufacturing systems, enabling it to deliver products aligned with customers' life cycle expectations. Competitors with less mature technologies will encounter steep technical and operational challenges as they move toward commercialization.

Q3. What is the most difficult part of the commercialization process?

There are two main challenges: 1) technological reliability; and 2) business model and value communication.

- **Technological reliability:** In robotics, 90% functionality in lab settings is considered successful, and 99.9% is celebrated. However, even 99.9% reliability is insufficient for commercial deployment, as customers expect flawless performance. Achieving 100% reliability is extremely difficult, and failure to deliver this can lead to numerous service calls and persistent "long tail" issues.
- **Business model and value communication:** Engineers focus on technology development, but convincing the CFO to invest in mass-production—and customers to buy the product—requires a clear articulation of value propositions and ROI. Defining compelling sales points remains one of the most difficult commercialization hurdles.

Q4. Tesla is developing a 22-degree-of-freedom gripper hand. Does Boston Dynamics have similar plans?

Atlas currently uses a second-generation gripper with two fingers and a thumb. This simple, practical design allows it to grasp and manipulate a wide variety of heavy, large and medium-sized objects. Boston Dynamics views robotic hand design as a long-term challenge. Its strategy is to start with simpler structures and add complexity gradually to ensure smooth integration with the humanoid platform.

A third-generation gripper is under development, aimed at increasing degrees of freedom for more-delicate tasks. However, the company emphasizes avoiding unnecessary complexity, which can raise costs, reduce reliability, and slow learning.

Tesla's push for highly complex hands somewhat contradicts Elon Musk's own mantra that "the best part is no part". In contrast, Boston Dynamics bases its hand design strategy on tens of thousands of identified tasks, prioritizing practicality and cost-effectiveness over sophistication for its own sake. The company is confident this approach will deliver superior real-world performance.

Q5. What factors are needed for commercialization? Is it mainly about gathering more data?

The single most critical ingredient for humanoid robot commercialization is data. Several factors are key. First, data diversity is essential. Robots must be trained on a wide variety of situations to handle the unpredictability of real-world environments. Second, skill learning is necessary. Robots must learn the specific skills required to execute tasks effectively once deployed. Third, iterative improvement is vital. Robots must improve continuously through reinforcement learning, which is crucial for long-tail reliability by addressing rare and difficult edge cases. Significant investments are being made in this area. Fourth, hardware reliability is crucial. Initial design, testing, and verification processes must meet automotive-industry standards.

In this regard, Boston Dynamics' collaboration with Hyundai Mobis on actuators is pivotal. Co-developing Atlas actuators with Hyundai Mobis helps target 99.999% reliability while ensuring strong cost competitiveness.

Q6. What is the current estimated cost of production?

While Boston Dynamics has target numbers in mind, it is too early to disclose them publicly. Quoting figures such as USD20,000 would be premature. However, meaningful cost projections are possible by assuming long-term production volumes in the millions and a 15-year time horizon.

Q7. What is Boston Dynamics' top focus nowadays? Although Atlas has demonstrated impressive capabilities such as superhuman parkour skills, these are not relevant to factory environments.

The current focus is a simple, staged sequence of tasks within HMC factories: car part sequencing and logistics tasks; machine tending tasks; and then general assembly tasks. The upcoming commercial version of the robot will reflect a tight focus on these practical capabilities.

Q8. How is Atlas different from existing collaborative robots used in automotive general assembly?

While some collaborative robots are deployed in general assembly, final assembly remains heavily dependent on human labor, far more so than in body or paint processes. Even at HMGMA—one of the world's most automated automotive plants—the largest share of workers is concentrated in final assembly. This remains a key concern for manufacturing analysts.

Q9. Some argue that rule-based AI training limits humanoid robots' competitiveness against industrial and collaborative robots. If the robot can only do limited tasks, what advantage does it have?

Boston Dynamics' approach is learning-based, not rule-based. General assembly tasks have historically remained manual because programming each individual task is impractical and prohibitively expensive. For example, installing a stationary robot at a single workstation typically costs around USD150,000, often more than the equipment itself.

Boston Dynamics addresses this problem through generalist humanoid hardware. Unlike industrial and collaborative robots, which require extensive infrastructure and specialized programming, our robots can be deployed rapidly and flexibly.

Q10. What is the timeline for deploying robots in factories? Is 12-18 months—as the company has previously mentioned—realistic?

The 12- to 18-month timeline refers to the expected completion of the AI architecture and the development of generalized, complex behaviors for humanoid robots—not to full commercial deployment. AI development and deployment follow an evolutionary trajectory, where onboarding new tasks becomes cheaper and faster over time.

Currently, training a robot for a task requires about 10 hours of initial demonstrations from skilled operators. As more data accumulates, both the number and quality of required demonstrations decrease, improving scalability. Over time, Boston Dynamics expects robots to learn directly from natural language and gestures, without relying on teleoperation. That is the ultimate goal.

Q11. Is sequencing-related data collection useful for real-world processes like at the Metaplant? Are we in a position to do that at some point?

Yes, Boston Dynamics' robot models can ingest data from multiple sources, and direct data collection from factory workers is considered an especially important and useful source. Although this is not yet underway, Boston Dynamics has discussed it with HMC.

Currently, the team is focused on core research questions, such as using egocentric human demonstrations (*ie*, first-person recordings of workers performing tasks) to support learning. Though we have not yet scaled this approach to entire factories.

The company prefers to overdeliver rather than overpromise, only discussing initiatives once they are operational.

Q12. Boston Dynamics has mentioned exploring different AI models. Please elaborate on this.

Essentially, Vision Language Action (VLA) is the approach we have chosen. At the same time, we use our proprietary architecture, Action Expert, for scientific evaluation. Action Expert is particularly effective for quickly testing specific questions related to data collection and mixing.

VLA is a structure in which an internet-pretrained multimodal model is used as a base to ingest generalizable knowledge into a robot behavior model. This is then combined with proprietary embodiment datasets to generate operation-specific action outputs.

Q13. How about on-device computing? Does the firm need expensive custom silicon?

Boston Dynamics is currently evaluating its application models on Nvidia chips, and the models fit well within existing hardware capabilities.

The company plans to use a hybrid processing solution, splitting computation between onboard and cloud GPUs. Nvidia's Thor chip is sufficiently powerful for current needs, so no major hardware breakthroughs are required—only steady, incremental progress.

Q14. What is the difference between the design of a robot's head (intelligence) and hand? Why three fingers instead of five?

The choice of three fingers, including an opposable thumb, is driven by pragmatism and complexity reduction. Two three-fingered hands provide enough expressivity to grasp a very wide range of objects. Boston Dynamics is satisfied with the current gripper design, but the next-generation hands are expected to feature greater dexterity and complexity to handle delicate general assembly tasks.

These hands need to be strong, slim, and rugged as they need to reach into tight spaces and withstand collisions. They should have more degrees of freedom to perform assembly tasks like tool use and fastening. The company has extensive simulation environments for testing hand morphologies, providing a deep understanding of the trade-offs involved in hand design.

Q15. Can large-scale behavioral models built from HMC's factory data be applied to other carmakers?

Yes. While HMC's data is valuable and foundational, Boston Dynamics' commercialization strategy targets all OEMs, not just HMC. The company's progression strategy moves in stages: from automotive manufacturing complexity, to other manufacturing industries, to the service sector, and ultimately to consumer applications. This staged approach is viewed as essential for broad societal adoption of humanoid robotics and aligns with HMG's growth strategy.

Q16. How does Boston Dynamics cooperate with Nvidia and Toyota Research Institute?

Boston Dynamics works closely with Nvidia. Boston Dynamics was the first to receive and test an engineering sample of Nvidia's Thor chip. The companies collaborate closely on reinforcement learning, with Boston Dynamics providing early engineering feedback to help Nvidia anticipate upcoming challenges.

Boston Dynamics has collaborated with Toyota Research Institute (TRI) on large behavior model (LBM) development for Atlas for about a year. While TRI lacks humanoid robotics experience, it has strong expertise in LBM development. The collaboration involved deep knowledge sharing between TRI's LBM team and Boston Dynamics' in-house LBM group, leveraging complementary strengths.

Q17. Where does Boston Dynamics recruit its AI engineers?

Boston Dynamics' AI institute consists of around 40 PhD holders from MIT and Harvard. Overall, the company employs roughly 400 engineers out of 900 total staff. As part of efforts to commercialize Spot and Stretch, the company has significantly expanded its non-engineering workforce, including roles in product planning, service, management, and marketing.

Q18. What sensors does Atlas use?

Atlas is built on a completely new design compared to Spot. The lab-version Atlas is equipped with stereo camera pairs, relying primarily on visual images (the standard in modern machine learning techniques) rather than LiDAR point clouds. This emphasis on visual sensing aligns should continue in the production version of Atlas.

Q19. How is sensing realized in Atlas's hands? Can robots replicate the human ability to feel or hear the "clicking" that signals assembly completion?

Atlas's fingertips, which are coated in rubber, contain a grid of pressure sensors that detect both the location and magnitude of applied pressure. These pressure sensors feed into neural networks in the same way vision data does. The next-generation gripper will include sensors over larger surface areas.

Humans often rely on subtle sensory cues—such as the sound of a "click" or the feel of resistance—to confirm proper assembly. Atlas is being trained to replicate this through synthetic data and AI models. Just as Spot used sensor data to perform tasks that previously required humans, Atlas is expected to demonstrate significant advances in gripper-based assembly tasks over the next two decades.

Q20. Is Boston Dynamics considering entering the defense business?

Boston Dynamics sells Spot robots to the US government, mainly for public safety applications such as bomb disposal and surveillance. However, defense is not a core market. The company's primary focus is commercial and industrial markets, with defense, non-weapons applications, and public safety as secondary segments.

Q21. What does the company think about synthetic data production? Is 99.999% reliability achievable?

Use of synthetic data is considered essential for achieving ultra-high reliability. Atlas learns from pose- and motion-related models built using synthetic data, which has proven effective. In the future, synthetic data will be crucial for improving the performance of LBMs. Achieving 99.999% reliability would be virtually impossible without synthetic data.

Q22. Does Boston Dynamics produce synthetic data in-house, or work with partners like Nvidia?

Boston Dynamics produces synthetic data in-house. There are many bottlenecks in generating synthetic data, particularly when it comes to creating environments with sufficient diversity and the right types of assets. Nvidia does not currently provide satisfactory solutions for these challenges. Synthetic data production still involves a strong manual element.

However, Boston Dynamics expects major breakthroughs—especially in transitioning from monocular images to articulated object simulations—which should significantly accelerate synthetic data production. The company plans to leverage these advances when they become available.

Q23. What are the company's views on linear vs rotary actuators? In which direction is Boston Dynamics likely to go in the long term?

Boston Dynamics has strong internal views on this issue but chooses not to disclose them at this time, noting that it is too early to make a public statement.

Q24. Does Boston Dynamics design actuators in-house or outsource them?

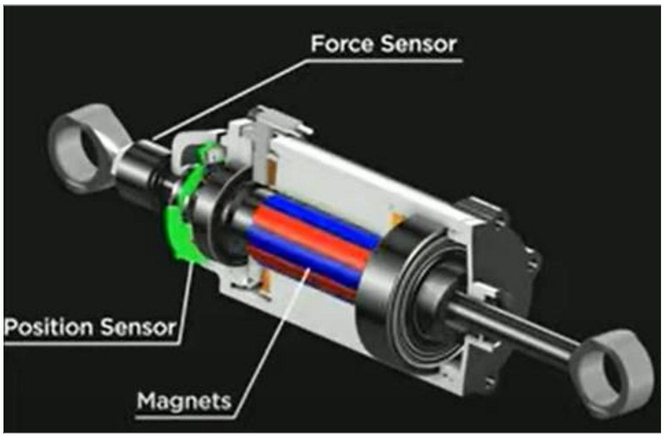
Boston Dynamics partners with Hyundai Mobis for actuator development. Robot actuators are completely different from traditional ones in volume, strength, and power density, posing substantial engineering challenges across magnetic motor design, gear materials, and coatings.

Simulation and synthetic data generation are central to the company's engineering philosophy, so actuator designs are chosen with ease of simulation in mind—the simpler, the better.

Q25. Does Boston Dynamics plan to build an independent data center, or will hyperscale cloud solutions suffice?

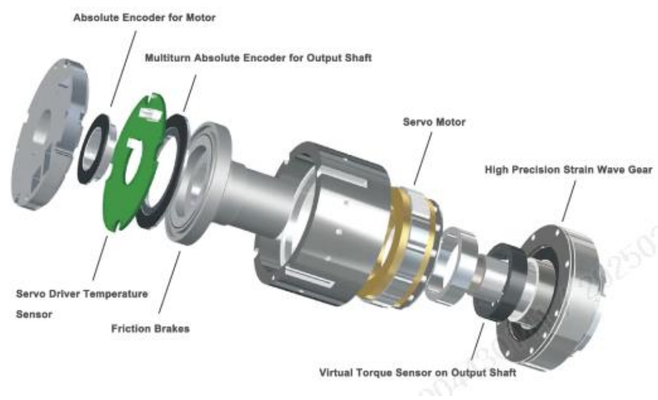
In my personal opinion, it is not reasonable to build our own data center. Like other AI companies (such as OpenAI), it uses leased GPU clusters. The company believes that efficient computing, rather than ownership of infrastructure, is what matters for robotics innovation.

Linear actuator



Source: Tesla

Rotary actuator



Source: Faradyi

Income statement

Year-end Dec 31 (KRWb)	2023	2024	2025E	2026E	2027E
Sales	**162,664**	**175,231**	**185,523**	**196,907**	**205,507**
Cost of goods sold	129,179	139,482	150,792	159,789	166,700
Gross profit	**33,484**	**35,749**	**34,732**	**37,117**	**38,808**
Gross margin (%)	20.6	20.4	18.7	18.9	18.9
SG&A expenses	18,357	21,510	21,426	22,766	23,331
Operating profit	**15,127**	**14,240**	**13,306**	**14,351**	**15,476**
Operating margin (%)	9.3	8.1	7.2	7.3	7.5
Non-operating gains (losses)	**1,750**	**3,251**	**3,332**	**3,778**	**4,213**
Financial profit	1,560	1,531	882	660	666
Financial costs	971	899	512	528	542
Equity-method gains (losses)	2,471	3,114	2,905	3,188	3,408
Other	-1,309	-496	57	458	681
Pre-tax profit	**16,877**	**17,490**	**16,638**	**18,130**	**19,689**
Taxes	4,627	4,232	4,164	4,532	4,922
Effective tax rate (%)	27.4	24.2	25.0	25.0	25.0
Profit from continuing operations	12,992	13,549	12,474	13,597	14,767
Profit from discontinued operations	-720	-319	0	0	0
Net profit	**12,272**	**13,230**	**12,474**	**13,597**	**14,767**
Net margin (%)	7.5	7.5	6.7	6.9	7.2
Net profit (controlling interests)	11,962	12,527	11,705	13,189	14,324
Net profit (non-controlling interests)	311	703	769	408	443
EBITDA	20,073	18,527	18,050	19,249	20,509
EBITDA margin (%)	12.3	10.6	9.7	9.8	10.0
EPS (parent-based) (KRW)	43,589	46,042	43,779	49,698	53,973
EPS (consolidated) (KRW)	44,721	48,626	46,655	51,235	55,642
Adjusted EPS (KRW)*	43,589	46,042	43,779	49,698	53,973

Balance sheet

Year-end Dec 31 (KRWb)	2023	2024	2025E	2026E	2027E
Current assets	**58,604**	**64,336**	**54,243**	**55,783**	**58,528**
Cash & equivalents	19,167	19,015	5,240	3,944	4,548
Accounts receivable	4,682	5,908	6,255	6,639	6,929
Inventories	17,400	19,791	21,770	23,106	24,115
Other current assets	17,355	19,622	20,978	22,093	22,936
Fixed assets	**116,172**	**147,622**	**165,055**	**177,720**	**189,765**
Investment assets	33,054	41,392	49,389	54,254	59,065
Tangible assets	38,921	44,534	48,692	50,707	51,597
Intangible assets	6,219	7,683	7,781	7,868	7,945
Other long-term assets	37,978	54,014	59,193	64,891	71,158
Total assets	**282,463**	**339,798**	**359,923**	**381,159**	**403,331**
Current liabilities	**73,362**	**79,510**	**82,370**	**87,030**	**91,546**
Accounts payable	10,952	12,550	13,287	14,102	14,718
Short-term debt	9,036	9,327	8,827	8,827	8,827
Other current liabilities	53,375	57,633	60,256	64,101	68,001
Long-term liabilities	**107,292**	**140,013**	**148,208**	**154,312**	**160,458**
Bonds & long-term debt	90,603	120,420	126,420	130,420	134,420
Other long-term liabilities	16,689	19,593	21,788	23,892	26,038
Total liabilities	**180,654**	**219,522**	**230,577**	**241,343**	**252,005**
Owners of parent equity	**92,497**	**109,103**	**117,404**	**127,467**	**138,534**
Capital stock	1,489	1,489	1,489	1,489	1,489
Capital surplus	4,378	7,656	7,656	7,656	7,656
Retained earnings	88,666	96,596	104,782	114,845	125,912
Other	-2,036	3,362	3,477	3,477	3,477
Non-controlling interests' equity	**9,312**	**11,173**	**11,942**	**12,349**	**12,792**
Total equity	**101,809**	**120,276**	**129,345**	**139,816**	**151,326**
Net debt	99,174	130,142	148,813	154,040	157,508

Cash flow statement

Year-end Dec 31 (KRWb)	2023	2024	2025E	2026E	2027E
Cash flow from operations	**-2,519**	**-5,662**	**16,789**	**19,306**	**20,841**
Net profit	12,272	13,230	12,474	13,597	14,767
Non-cash profit and expenses	21,192	23,950	4,744	5,221	5,534
Depreciation	3,284	3,398	3,842	3,985	4,110
Amortization	1,663	889	902	913	923
Other	16,246	19,663	0	324	502
Changes in A/L from operating activities	-30,365	-35,160	2,476	3,998	4,450
Cash flow from investments	**-8,649**	**-14,623**	**-28,439**	**-20,506**	**-20,190**
Change in tangible assets	-6,926	-7,890	-8,000	-6,000	-5,000
Change in financial assets	-1,131	-1,842	-1,476	-778	-539
Other	-592	-4,891	-18,964	-13,729	-14,650
Cash flow from financing	**9,393**	**19,493**	**2,271**	**1,408**	**1,270**
Change in debt	12,527	32,090	5,789	4,535	4,526
Change in equity	137	3,278	0	0	0
Dividends	-2,499	-3,913	-3,519	-3,126	-3,257
Other	-772	-11,961	0	0	0
Change in cash	-1,698	-152	-13,775	-1,296	603
Cash at beginning of year	20,865	19,167	19,015	5,240	3,944
Cash at end of year	19,167	19,015	5,240	3,944	4,548
Gross cash flow	**33,465**	**37,180**	**17,218**	**18,819**	**20,301**
Free cash flow	**-9,590**	**-13,723**	**8,789**	**13,306**	**15,841**

Note: *Excluding one-off items
**Fully diluted, excluding one-off items
***From companies subject to equity-method valuation
Source: Company data, Samsung Securities estimates

Financial ratios

Year-end Dec 31	2023	2024	2025E	2026E	2027E
Growth (%)					
Sales	14.4	7.7	5.9	6.1	4.4
Operating profit	54.0	-5.9	-6.6	7.9	7.8
Net profit	53.7	7.8	-5.7	9.0	8.6
Adjusted EPS**	63.9	5.6	-4.9	13.5	8.6
Per-share data (KRW)					
EPS (parent-based)	43,589	46,042	43,779	49,698	53,973
EPS (consolidated)	44,721	48,626	46,655	51,235	55,642
Adjusted EPS**	43,589	46,042	43,779	49,698	53,973
BVPS	351,861	413,568	451,038	489,697	532,215
DPS (common)	11,400	12,000	12,000	12,500	13,000
Valuations (x)					
P/E***	4.7	4.6	5.0	4.4	4.1
P/B***	0.6	0.5	0.5	0.4	0.4
EV/EBITDA	7.9	10.5	12.0	11.5	11.0
Ratios (%)					
ROE	13.7	12.4	10.3	10.8	10.8
ROA	4.6	4.3	3.6	3.7	3.8
ROIC	15.0	12.3	9.5	9.6	9.9
Payout ratio	19.4	19.5	20.7	19.1	18.3
Dividend yield (common)	5.6	5.7	5.5	5.7	5.9
Net debt to equity	97.4	108.2	115.1	110.2	104.1
Interest coverage (x)	27.1	31.5	26.0	27.2	28.5

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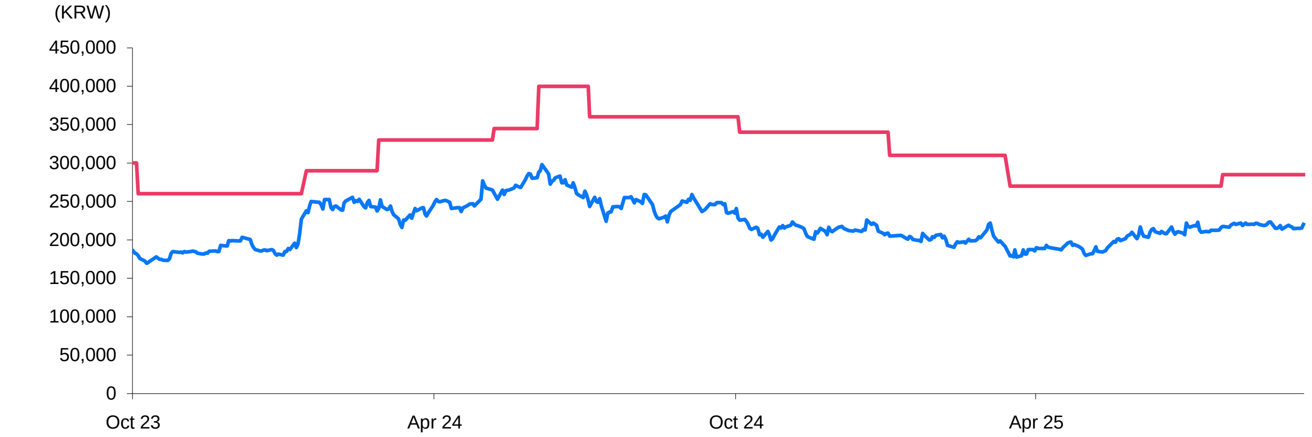
Target price changes in past two years



Rating changes over past two years (adjusted share prices)

Date	2023/4/26	10/26	2024/2/5	3/20	5/29	6/25	7/26	10/25	2025/1/24	4/7	8/14
Recommendation	BUY	BUY	BUY	BUY	BUY	BUY	BUY	BUY	BUY	BUY	BUY
Target price (KRW)	300000	260000	290000	330000	345000	400000	360000	340000	310000	270000	285000
Gap* (average)	-34.65	-28.49	-15.25	-26.19	-21.52	-31.63	-32.30	-37.27	-34.90	-26.06	
(max or min)**	-30.00	-12.69	-11.90	-16.06	-16.96	-25.50	-28.06	-33.38	-28.39	-17.41	

Note: * [(average, maximum, or minimum share price over duration of target price minus target price) / target price] x 100%
** Maximum/minimum share price if new target is higher/lower than market close on the business day prior to target price change

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Industry

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* Note: Effective Jul 27, 2023, BUY, HOLD, and SELL criteria are based on expectations of share-price moves of 15% or more within 12 months

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BUY(83.5%)·HOLD(16.5%)·SELL(0%)

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