Deloitte.



The rise of physical AI and GenAIpowered humanoid robots in construction and real estate management

Real Estate Predictions 2025

Today's rapidly evolving technologies will reshape real estate, through operational efficiencies, revolutionary onsite processes, and new data collection channels. The next frontier for AI will be the physical world, and this article explores how physical AI and humanoid robotics will transform construction and real estate management.



The emergence of humanoid robotics: bridging the digital and physical worlds

Digital AI and physical robotics are converging to deliver radically new capabilities. Today's robots typically execute repetitive tasks in controlled environments such as assembly lines. However, humanoid robots will mimic human interactions and navigate dynamic, unstructured settings. They combine cameras, sensors and generative AI (GenAI), to bring enhanced decision-making abilities, real-time adaptive learning, and a finesse that was once the preserve of skilled human labor.

Digital AI and physical robotics are converging to unlock radically new capabilities. While today's robots perform repetitive tasks in controlled environments—such as assembly lines—humanoid robots are set to mimic human interactions and navigate dynamic, unstructured settings. By integrating cameras, sensors, and generative AI, these advanced systems deliver enhanced decision-making, real-time adaptive learning, and a finesse once exclusive to skilled human labor. Industry forecasts suggest that over the next 5–10 years, cumulative investments in humanoid robotics could reach US\$15-20 billion, driven by significant R&D from major technology players. Looking ahead, market projections indicate that the value of humanoid robotics could grow to approximately US\$38 billion by 2035 with an estimated robot shipments of 1.4 million units1.

Physical robots also unlock unprecedented opportunities to collect data in the physical world. The entirety of the internet has already been thoroughly mined to power today's Large Language Models (LLMs), meaning that tomorrow's game-changing data and insights will largely come from the physical environment. This is why today's biggest technology companies, such as Nvidia, Meta, Tesla, Amazon and Google, are advancing their products into the realm of PhysicalAI. Whether on construction sites or in buildings, every interaction can be captured, analyzed, and transformed into actionable intelligence.

For example, at BMW's Spartanburg plant, Figure Al's Figure 02 robot already performs intricate assembly tasks with millimeter accuracy². Its integrated cameras and sensors simultaneously capture, analyze and feed data into a digital management of the production line . This process yields detailed insights on material usage, environmental conditions and equipment performance, and enables managers to optimize workflows and predict maintenance needs.

The successful adoption of humanoid robotics in mass manufacturing is heralding a new era in the construction sector. With growing investment from venture capital funds and tech giants mass production is scaling rapidly, and millions of humanoid robots could be in circulation by 2035.

Consumer-grade humanoid robots like Tesla's Optimus are projected to cost between \$20,000 and \$30,000— with industrial models poised to reach or exceed \$100,000 due to higher costs associated with cutting-edge sensors, actuators, and processing hardware3. This pricing range highlights the push toward mass-market affordability, equal or less than the equivalent cost of a human to perform these roles, while still accommodating advanced, specialized robotics for high-end applications.



Transforming onsite construction with humanoid robotics

Construction sites have always been complex and volatile, but humanoid robots promise to solve two big challenges: skilled labour shortages and onsite safety risks. Since as far back as 2018, industry researchers have already shown that the humanoid robot prototypes, such as HRP-5P can autonomously install drywall, by lifting boards and fastening them with screwdrivers, guided by environmental detection and object recognition capabilities4. An autonomous robot could lay bricks or pour and finish concrete precisely, but also monitor and adapt dynamically to its environment, adjusting to temperature changes, modifying material placement, and even correcting errors as they occur.

The new generation of GenAl-powered humanoid robots deployed to sites can perform and link multiple precision tasks such as quality assurance, materials handling, and safety monitoring in unpredictable, hazardous environments, to reduce human risks while delivering quality and speed.

Humanoid robotics will improve efficiency, by automating routine yet critical activities, to reduce project delays and cut costs. Nonhumanoid construction robots, such as Hadrian X and the Semi-Automated Mason (SAM), have already demonstrated productivity gains of 3– 5x, and labor cost savings of 50%5, so Gen-Alpowered robots could deliver similar or higher benefits where activities require human levels of dexterity. Furthermore, humanoid robots will play an active role in data-driven decision-making, by collecting data from the physical environment, not simply the task at hand . As they move through construction sites, robots continuously gather and transmit detailed information on material usage, project progress and environmental conditions. Critical insights from this real-time data then enable managers to fine-tune operational strategies in real-time.

Although these more sophisticated robots will deliver great benefits through both their execution and data-gathering capabilities, a critical consideration will be how they collaborate with human personnel. Upskilling the workforce to manage and integrate advanced robotics will be key to a successful transition, ensuring that human expertise complements robot precision



Enhancing real estate management through data and integration

Physical AI will also transform how real estate is managed. IoT devices and smart building systems already streamline property management, but humanoid robots will continuously gather more extensive and nuanced data in ways and areas traditional sensors cannot reach. Whether to detect construction quality or maintenance needs, enhance facility management, or contextualize energy consumption relative to space and occupancy, tomorrow's robots bring a precision of actionable data gathering that will be transformative.

Leveraging its advanced AI, a humanoid robot can bridge the gap between construction and longterm facility management. As it navigates a partially completed building, the robot compares on-site conditions against digital blueprints, alerting design teams to deviations that could affect structural integrity or energy efficiency. Once the building is operational, it transitions into a maintenance role—conducting routine inspections using thermal imaging, vibrational analysis, and other diagnostic tools. The collected data enables predictive maintenance scheduling that minimizes downtime, extends asset lifespan, and ultimately reduces lifecycle costs.

Property developers and owners will gain a strategic advantage, as richer insights drive better decisions on leasing strategies, capital investments, and asset management. By harnessing the data from physical AI, stakeholders can optimize asset performance, extend building lifecycles, and achieve greater tenant satisfaction.



Strategic predictions



Over the next 5 to 10 years, we predict that adoption of physical AI and humanoid robotics will accelerate dramatically. In the short term, we expect to see pilot projects and new benchmarks for operational efficiency and safety. Longer-term, as these technologies mature, their full-scale integration is will transform traditional business models, and prompt a shift toward data-centric, technology-first strategies.

Construction and asset management leaders can dramatically add value by adopting advanced robotics. But this transformation is not without its challenges, including regulatory hurdles, cybersecurity risks, and data collection ethics. To anticipate these complexities, industry leaders must invest in robust roadmaps that balance innovation with compliance and risk management.

Construction and asset management leaders can dramatically add value by adopting advanced robotics.

- 1. **Mitigating Skilled Labor Shortages**: robots can perform repetitive, labor-intensive tasks precisely, to keep projects on time and budget by reducing their dependence on scarce labor.
- 2. **Enhancing Safety**: robots can minimize human exposure to potential hazards in dangerous environments, reducing accidents, lowering insurance costs and improving safety
- 3. **Unlocking New Data**: comprehensive, granular and real-time data from entire construction sites can help optimize project planning, quality control and predictive maintenance.
- 4. **Real-Time "Hive Mind" Coordination**: networked robots can create a site-wide, real-time "hive mind", to coordinate tasks, streamline workflows and adjust dynamically to changing conditions.
- 5. **Increasing Precision, Repeatedly**: humanoid robots can execute precision tasks accurately and reliably, minimizing errors and reducing rework costs.
- 6. **Process Innovation and Cost Efficiency**: although initial costs might be high, robotics will deliver long-term benefits, including lower labor costs, fewer delays, and increased productivity.
- 7. **Predictive and Preventive Maintenance**: advanced robots can monitor assets continuously, detect problems early, and alert management teams to potential issues before they escalate.

Conclusion

Humanoid robotics is poised to revolutionize construction and real estate management by delivering unparalleled operational efficiency, enhanced safety, and robust, data-driven decisionmaking. As the physical world transforms into an ever more valuable source of actionable data, we anticipate a paradigm shift marked by groundbreaking innovation. In the near future, intelligent machines will not only construct and maintain our buildings but also continuously monitor and optimize them, ensuring resilient, sustainable environments for generations to come.

End notes

- 1 The global market for humanoid robots could reach \$38 billion by 2035, Goldman Sachs, February 27, 2024.
- 2 Humanoid Robots for BMW Group Plant Spartanburg, BMW Group, September 11, 2024.
- 3 How Much Does a Tesla Robot Cost? Tesla Optimus Price, Features, and Release Date, Plisio.net, January 12, 2025.
- 4 Laurie Cowin, "Japanese researchers create humanoid bot that installs drywall independently," Construction Dive, October 3, 2018.
- 5 Construction Robotics Website

Authors



Saurabh Mahajan Specialist Senior Manager saurmahajan@deloitte.ca Deloitte Canada



Marco Macagnano Senior Manager <u>mamacagnano@deloitte.ca</u> Deloitte Canada

Deloitte.

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited ("DTTL", its global network of member firms, and their related entities. DTTL (also referred to as "Deloitte Global" and each of its member firms are legally separate and independent entities. DTTL does not provide services to clients. Please see www.deloitte.nl/about to learn more.

Deloitte is a leading global provider of audit and assurance, consulting, financial advisory, risk advisory, tax and related services. Our network of member firms in more than 150 countries serves four out of five Fortune Global 500® companies. Learn how Deloitte's approximately 264,000 people make an impact that matters at www.deloitte.nl.

This communication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or their related entities (collectively, the "Deloitte network" is, by means of this communication, rendering professional advice or services. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser.

No entity in the Deloitte network shall be responsible for any loss whatsoever sustained by any person who relies on this communication.



© 2025 Deloitte The Netherlands.

Designed by CoRe Creative Services. RITM2046740