

# The future is now for humanoid robotics

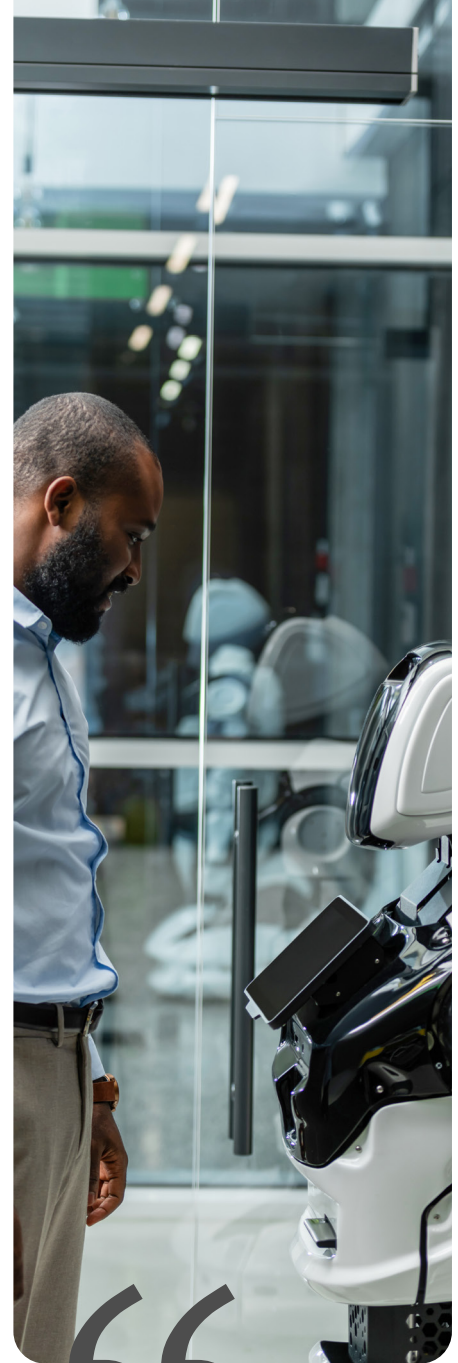
**In the near future there could be humanoid robots, machines powered by artificial intelligence (AI) with interfaces that can emulate human conversation. Economies that are able to develop such humanoid robots first can steal a march on their competitors. GCC countries, which are developing their technology sectors, can seize the potential of the humanoid robotics industry by defining a vision, investing in research and development (R&D), developing the regulatory landscape, and supporting the robotics ecosystem.**

The global market size of humanoid robotics is estimated at roughly US\$3 billion and expected to grow in double digits annually, **according to Technavio**. Although no manufacturer has yet produced a true general-purpose platform, the industry is building advanced hardware platforms and developing advanced prototypes that use artificial general intelligence, which solves problems rather than just performs specific tasks as AI does. Already, these machines can perform tasks in different industries. We estimate that such robots could eventually replace approximately 35% of existing occupations. Applied to the U.S. labor market, for example, that would mean **55 million jobs**.

Humanoid robots possess four attributes: perception, locomotion, manipulation, and autonomy. Perception uses sensors and cameras to facilitate spatial awareness. Locomotion, via wheels or bipedal movement, enables navigation. Manipulation through dexterous “hands” enables interaction. Autonomy is the capacity to operate independently, utilizing machine learning for continuous improvement.

The combination of these attributes means humanoid robots could revolutionize industries. Repetitive tasks, particularly in customer-facing roles, are prime candidates in the short term. In healthcare, for example, robots could perform routine tasks and basic patient care, such as measuring vital signs. They could eventually transform hazardous industries—working in mines, oil rigs, and nuclear power plants. As space travel advances, humanoid robots could maintain equipment and operate in inhospitable environments.

Humanoid robots are resilient. The average person works 240 eight-hour days annually. Humanoid robots can operate up to 20 hours daily for over 350 days annually, requiring downtime only for maintenance and charging. That means around four times the labor productivity of humans. Moreover, robots are more accurate and unaffected by fatigue or distractions.



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They also reduce labor costs. **Goldman Sachs** reports that prices already have fallen as production increases—to around \$150,000 per unit in 2023 from \$250,000 per unit in 2022. **Tesla** even has a target cost of \$20,000 per robot. Considering a conservative life span of three years, we estimate that the ownership cost would be \$5/hour, significantly lower than average wages for U.S. low-skill workers—without the cost of benefits and extensive HR and training processes.

Still, humanoid robots raise potential risks and ethical concerns. These systems collect and store vast data sets, including personal information and behavioral patterns, without necessarily receiving permission from the humans they interact with. Programming bias, already emerging in generative artificial intelligence models as a result of training data, could drive prejudicial behaviors. Similarly, robots could be programmed to manipulate user decisions, eroding trust. Malfunctioning machines could pose physical threats to human safety given their size, strength, and speed.

The many possibilities of humanoid robots present numerous opportunities for GCC countries, which have ambitious technology development plans.

R&D should align with national objectives. Countries can establish R&D centers in partnership with academia, fostering local talent; likewise, they can attract private-sector R&D with research grants. Sweden's VINNOVA, a governmental innovation agency, funds **Robotdalen**, a leading robotics center, and offers grants to private companies to develop technologies aligned with the national interest. China's 14th **Five-Year Plan** for the development of the robotics industry aims to position the country as a global robotics innovation hub.

GCC countries should develop regulations and policies for humanoid robots. Although existing laws such as data privacy protections and autonomy apply, humanoid robots require novel regulations. Academic institutions and private-sector companies currently engaged in R&D can advise governments. The European Commission, for example, partners with private companies under the Strategic Research, Innovation, and Deployment Agenda agreement, which includes provisions for consultations on regulations and standards for robotics technology.

GCC countries should strengthen their robotics ecosystem. That means government support through investments, subsidies, and agreements with domestic and international companies. For instance, the Canadian government has invested \$30 million in **Sanctuary AI**, which develops humanoid robots. Dedicated robotics development zones would encourage collaboration among companies, institutes, and academic centers, further bolstering national capabilities.

Our collective imagination—inspired by a literary and cinematic cast of robot characters ranging from the quirky to the malevolent—swirls with possibilities both wondrous and terrifying. Such speculation aside, humanoid robots present transformative potential for businesses, offering increased productivity, precision, and cost-effectiveness. GCC countries have the opportunity to invest now in this rapidly developing industry.

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**Camil Tahan**

Partner

[camil.tahan@strategyand.pwc.com](mailto:camil.tahan@strategyand.pwc.com)

[www.strategyand.pwc.com/me](http://www.strategyand.pwc.com/me)