Robotics in 2026

Where is robotics going and what does it mean?

March 2026

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1. Introduction

Executive Summary

Robotics in 2026 has reached a definitive inflection point, where rapid advances in artificial intelligence and materials science are rapidly embedding the technology deep into the fabric of modern society. This evolution presents a unique challenge for the education sector, which must now prepare future generations to coexist and collaborate with intelligent machines in both classrooms and the workplace.

This white paper provides a realistic outlook on how robotics will augment human potential while also examining ethical reflections, all while maintaining a focus on human-centred values such as autonomy and justice.

Robotics is at an inflection point

The phrase 'at an inflection point' is often overused when describing emerging fields, but for the field of robotics, it may very well truly apply right now. Recent and ongoing advances in AI and materials are transforming the field and expanding the reach of robotics far beyond traditional manufacturing activities (Forbes, 2025b; RoboDK, 2026).

The term *robotics*, which has a rich history dating back to the 1921 when Karel Čapek introduced the term 'Robot' in the Czech Play "R.U.R." ("Rossum's Universal Robots"), is now advancing so quickly that the safe and efficient integration of these technologies into broader society may prove challenging (Jordan, 2019). This rapid pace of advancement raises concerns for the research and education communities, who must both develop the technologies and prepare future generations to coexist and collaborate with robots in classrooms and beyond. (Nature Humanities and Social Sciences Communications, 2025)

As the robotics landscape evolves, it brings both opportunities and risks that must be addressed alongside technological progress (Springer, 2023; Mestre et al., 2024). In this white paper, we examine the technologies driving current and emerging robotics, highlight specific use cases, and analyse their present impact on society. Our goal is to clarify where robotics started, where it is going, and where it might go next.

Structure and Approach

We examined the key factors that will influence the adaptation and integration of robotic technologies into broader society. We identified the key aspects as the influence of AI on robotics, the consideration of modern use cases as exemplars, new material developments for robotics, and a short ethical reflection on the implications of robotic technologies.

This white paper:

- **Presents** a grounded overview and outlook on the future of robotics.
- **Summarises** advances in the emergence of AI-powered robotic systems and materials for robotics.
- **Highlights** where robotics are being deployed today, and the lessons that these use cases offer for their deployment in other aspects of society.
- **Explores** the implications of robotics on the future workplace.

Special thanks

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2. Robotics in Transition:

From industrial automation to embodied intelligent systems.

"Robotics is our 2026 technology of the year." That's the first sentence of an editorial 'Robot reasons' published in *Nature Electronics* *(Nature Electronics, 2026)*. So, why does *Nature Electronics* back robotics as the field to watch in 2026?

First, the emergence of advanced artificial intelligence (AI) platforms in general is significantly enhancing the capabilities of robotic technologies (Boston Dynamics, n.d.; Forbes, 2025b). Second, these technologies are becoming increasingly integrated into everyday life; for instance, robotic vacuum cleaners and floor-washing robots are increasingly familiar in many homes (Forbes, 2025b). Third, the broader society is becoming increasingly exposed to the implications of robotics for our world (Forbes, 2025a). News reports on recent conflicts routinely mention the use of robotic drones, while highly-edited and even staged viral videos from factories and laboratories show humanoid robots assembling cars or racing through obstacle courses (Humanoid Robotics Technology, 2026a).

At the same time, popular fiction – traditionally a space for speculative portrayals of robots that implicitly promotes conjecture on the future of robots – is beginning to depict the real capabilities and limitations of current systems. For example, season one of the Apple TV+ series *Pluribus* shows drones delivering food and collecting refuse, with the latter use case highlighting the shortcomings of today's drone technologies.

Inflection point
Several academic, trade, and industrial publications have all shared the same opinion on robotic technologies. They argue that the field of robotic technologies has reached an inflection point where it will start to flourish and become more deeply embedded in modern society (Forbes, 2025b; NL Robotics, 2026; RoboDK, 2026). This change is mainly driven by improvements in AI platforms, which are propelling the widespread emergence of embodied AI systems – that is, robots or robotic devices that can accurately measure their environment and then make autonomous decisions thanks to on-board AI protocols.

Materials and length scales
New developments in robotics are driven not only by advances in AI. Inventive new materials are also enabling the production of robots of a wide range of sizes and with increasing degrees of freedom. While many people primarily associate robots with the manufacturing industry – where large steel or aluminium-based devices help produce automobiles, computers, and medicines – robotic systems can now be designed to operate inside the human body, delivering drugs with high precision or monitor physiological conditions (UMC Utrecht, n.d.; Forbes, 2024).

Humanoid robots – designed to mimic human physiology and function within environments built for humans – are also emerging as viable solutions across multiple industries (Humanoid Robotics Technology, 2026a; UBTECH, n.d.). For example, the Chinese company Engine AI is collaborating with the commercial space company Interstellar to send the humanoid robot PM01 into space (CNEVPost, 2026; Interesting Engineering, 2026). This marks a significant step forward in space robotics. Until now, most mobile robots on planetary missions have resembled remote-controlled cars in the form of rovers or have been immobile landers. Humanoid robots could instead be deployed first to confront the unknown before humans visit an uncharted location, and then to assess how these new environments affect a human's ability to live and survive.

Finally, soft and biohybrid materials are paving the way for robots that can navigate complex terrains or act as ingestible devices (Mestre et al., 2024) to deliver medicines and monitor internal bodily functions. Realising some of these systems will require the seamless integration of conventional electronics with new deformable materials.

Impressive advancements
The steep learning curve in AI is greatly expanding what is possible in robotics. The current level of learning and adaptation in humanoid robots is striking, as illustrated by recent demonstrations during the 2026 Chinese New Year celebrations of robots performing martial arts (YouTube, 2026). Although initially impressive, it should be noted that it is not clear from these demonstrations if they are truly 'autonomous'. They may be teleoperated or exposed to strict choreographed training, which, when exposed to something unexpected on stage, could deliver a very different public perception.

Nonetheless, these advances in agility and stability significantly broaden the deployment options for general-purpose robots (Boston Dynamics, 2026), including humanoid and, by extension, robots of all shapes and forms. As a result, the home and workplace will be transformed in fundamental and task-dependent ways, much like the impact the personal computer (Forbes, 2025a) had on jobs and skills in the 1980s.

Realistic outlook
In this white paper, we present the foundations of future robotic technologies and offer a realistic outlook on where these technologies are right now and how they could soon impact society.

The field of robotics – and even its very definition – is changing rapidly, driven by advances in AI, the development of new materials, and the adaptation of these technologies to operate in new workplaces and environments (Nature Electronics, 2026; Forbes, 2025b).

3. How AI is Changing Robotics

In April 2025, *Forbes* published an article heralding the rise of AI-powered robotics and its impact on the future of work. The article opens by surmising that "these intelligent machines are automating tasks, boosting efficiency, and sparking debates about their impact on jobs." (Forbes, 2025a)

In reality, robots have been automating industrial manufacturing processes and reshaping the workplace since the early 1960s. *Unimate* – the first industrial robot – transported hot die castings and welded parts onto automobile frames, sparing human workers from potential injuries associated with handling materials at such high temperatures (Forbes, 2025b).

Today, industrial robots are an evolving, integral part of manufacturing processes and work alongside human workers (RoboDK, 2026; Forbes, 2025b). With rapid advances in AI and its integration into robotics, the way robots operate in our workplaces is changing, and consequently so is our working relationship with them.

Real-time response
Traditional robots are programmed to perform specific actions. Sensors such as cameras or range finders can provide them with data which is then processed using algorithms to provide information about their surroundings, helping robots to operate correctly and safely (Fadlelseed et al., (2025). However, these robots are only as 'intelligent' as their programming allows them to be.

AI-powered robots, by contrast, can respond in real time and adapt to changes in their environment, enabling them to autonomously complete complex tasks (Boston Dynamics, n.d.; Forbes, 2025b). Coupled with ever-improving sensor technologies, AI is paving the way for robots to become central to a global manufacturing industry that is more efficient, productive, and safer for human collaborators (Forbes, 2025b; NL Robotics, 2026). These robots are an example of embodied AI, in which intelligence is embedded in a physical entity that operates in and interacts with the real world rather than being confined to a virtual setting.

Beyond industrial manufacturing
The impact of AI-powered robotics is also evident in broader society, as demonstrated in recent academic investigations. For example, researchers have developed an AI-powered robotic lifting arm, controllable via a remote joystick, to help elderly and disabled people with their shopping (Ghazl et al., 2021).

In agriculture, researchers have created an AI-powered robotic system called AgriScout that can identify and map the spread of Potato Virus Y (PVY) infections in potato crops (AgriScout, 2025). This type of system may act as a catalyst for the wider adoption of AI-powered robotics in modern farming.

AgriScout images - *Source: sciencedirect (Singh et al, 2025)*

Oversight and the changing workplace

Regardless of the degree of advancement in AI-powered robotics, human oversight of their activities is likely to remain a necessity (Hosseini et al., 2023). Although these robots are set to take over many physically demanding tasks in logistics and transportation, they will still require supervision in terms of their activities, performance, and maintenance (European Commission, n.d.).

An intermediate step may involve many of the current logistics human workforce teleoperating AI-powered robots in the short term to help train robots for future autonomous operation (S. FadleIseed et al., (2025). Companies must also support workers in transitioning to new roles within their organisations, rather than simply replacing human employees with robots (Forbes,2025a; Hosseini et al., 2023).

Ultimately, the future of AI-powered robotics across industries will depend on technological progress, the ease with which these systems can be integrated into existing work environments, and the education and training provided to the current workforce (Forbes, 2025a; NL Robotics, 2026) to enable seamless collaboration with robotic counterparts.

A sign of the concerted effort to achieve this is the partnership announced in January 2026 between Boston Dynamics and Google DeepMind, through which Google's AI systems will be integrated into a new fleet of Atlas robots (Boston Dynamics, n.d.).

The future impact of AI

Non-rigid body robots
Building on today's early soft robotic systems, future robots will increasingly use flexible, AI-optimised materials that allow them to bend, adapt, and safely work alongside humans (Mestre et al., 2024, 2024; Forbes, 2024), while still matching the precision and strength of today's rigid machines.

Embodied AI & Edge AI
While many robots currently depend on cloud computing, future systems will run much more of their intelligence locally, perhaps even supported by advancements in brain-inspired computing (Abdelrahman, 2026) and self-learning materials, where more powerful AI chips and efficient models will enable faster decision-making, stronger data security, and lower energy consumption (Forbes, 2025b; Boston Dynamics, n.d.).

Autonomous robots
As we move beyond today's partially autonomous machines, advances in AI training, simulation, and sensing will gradually remove many of the current limitations of robots (Synopsys, n.d.; Taylor & Francis, 2021). This progress will pave the way for safer, fully autonomous robots that can operate reliably in a wide range of real-world environments. However, training humanoid robots remains one of the field's core challenges. Robots require real-world, real-time data, and the scarcity of this data is currently a key bottleneck. To overcome this, innovations in simulation-based training and teleoperation will be essential (FadleIseed et al., 2025), enabling richer, more scalable data collection and ultimately moving the field forward toward robust, real-world autonomy.

4. Robots in Society

Nowadays, robotic technologies are critical to many manufacturing industries, and their ability to operate in a wide range of environments – including hazardous ones – reduces the level of risk faced by human workers (RoboDK, 2026; Forbes, 2025b). With advances in materials, robotic design, computational power, and AI, robotics are poised to disrupt many more aspects of daily life (NL Robotics, 2026; Forbes, 2025b). In this section, we highlight three use cases in modern society where robotics will play an increasingly prominent role.

Transportation

For many people, the phrase 'autonomous' or 'self-driving' vehicles brings to mind the proliferation of driverless cars. However, self-driving buses and trucks are also becoming part of our current and future public transport infrastructure. (IEEE Access, 2025; European Commission, n.d.)

In July 2025, the Netherlands' first self-driving shuttle bus began operating between the Meijersplein metro station in Rotterdam and Rotterdam The Hague Airport. (Rotterdam Style, n.d.) Despite the introduction of this service, RET continues to hire hundreds of new employees each year in light of ongoing driver shortages.

Sustainable bus – *Source: sustainablebus.com*

Truck platooning

Another industry heavily affected by driver shortages is the haulage industry. According to some estimates, by 2028, there will be a shortage of more than 745,000 truck drivers across much of Europe (European Commission, n.d.). Self-driving trucks could help address this shortfall, with the Netherlands leading developments in truck platooning, which involves a small convoy of trucks travelling in unison. In truck platooning, a lead truck sets the route and driving pattern, while the following trucks match its movements (European Commission, n.d.; Taylor & Francis, 2021).

Research has shown that a preferred platoon formation is three trucks travelling at a constant speed of 80 km/h with an inter-truck distance of 10 metres. Coordinated motion and spacing are maintained using data from radar and camera sensors on the trucks (Synopsys, n.d.).

Platooning - *Source: Shutterstock*

Platooning offers several benefits, including lower CO_2 emissions, greater fuel efficiency, and improved traffic flow, which could help reduce the frequency of major traffic jams. However, self-driving trucks are still very much in the testing phase, and several research organisations are exploring ways to accelerate their development. A key milestone for deployment is achieving Level 4 automation (Synopsys, n.d.; Taylor & Francis, 2021), in which a vehicle can operate without a human driver on board. Autonomous trucks could operate continuously without driver rest breaks, enabling significantly extended operating hours and even near 24/7 operation. Achieving this vision will require major advances in sensing technologies, AI-driven control systems, and energy infrastructure (Forbes, 2025b; NL Robotics, 2026).

Robots in Healthcare

Robotic surgery

While now quite common, robot-assisted surgery has improved markedly over the past two decades, transforming not only treatments but also logistics, procedures, the quality of care, and patient recovery times (UMC Utrecht, n.d.; Forbes, 2024). These advances have come with rising costs, which can be difficult to discuss because it effectively puts a price on saving lives.

For some, the idea of a robot performing a complex operation on the human body with sharp tools still sounds like science fiction – or even a nightmare. This perception is gradually changing, particularly as more examples emerge of robots performing reliably, and in some cases better than human surgeons, resulting in shorter recovery times, greater precision, and improved patient outcomes (UMC Utrecht, n.d.; Forbes, 2024).

Surgeons are increasingly accepting robotic technologies as a means of enhancing the care they provide to patients. This growing acceptance is helping to drive further advances in medical robotics (UMC Utrecht, n.d.). Future applications of surgical robots include accurately targeting biopsies, precisely removing cancerous tissue, and closing arteries from the artery.

Although there are still complex legal and ethical arguments to resolve, the next major steps will involve untethered interventions – in which small robots move freely inside the body under the control of external magnetic fields – and the broader deployment of AI-powered robots in surgery (Forbes, 2024). In addition, miniaturised robots will be used for high-precision drug delivery, to reduce collateral damage during procedures, and to enable treatments in hard-to-reach areas such as the brain and complex vascular networks (UMC Utrecht, n.d.).

> *"The future of surgical robotics lies in their integration with other advanced medical technologies. For instance, combining robotic systems with advanced imaging, AI-driven diagnostics and real-time data analytics could create a holistic approach to surgery."*
>
> Jelle Ruurda - gastrointestinal and oncological surgeon, professor of robot-assisted minimally invasive surgery at UMC Utrecht - (UMC Utrecht, n.d.)

Exoskeletons supporting rehabilitation

Wearable robotic systems, such as exoskeletons, are emerging as an important category of robotics, particularly in healthcare. By supporting or augmenting human physical capabilities, exoskeletons can be used as part of a rehabilitation programme in healthcare or reduce strain on human body in physically demanding jobs, such as construction (Forbes, 2025b). Over time, exoskeletons may also be deployed as performance-enhancing technologies, facilitating smoother and more efficient body movements when walking, climbing, lifting or running (Hypershell, n.d.).

Robotics in Education

Typically, a hands-on STEM *(Science, Technology, Engineering, Maths)* approach has been adopted to embed robotics in educational curricula, with the integration of programmable machines and activities targeted at developing critical 21st-century skills (Lu et al, 2025). Essentially, robots have been used as objects of learning to stimulate engineering and computational thinking and to train future engineers in the design, building, programming and maintenance of autonomous systems. However, with the recent acceleration of Generative AI, Large Language Models (LLMs), and spatial computing capabilities, robots now offer the promise of becoming active participants in education, potentially acting as tutors, assistants, service agents, and even students (Lu, et al, 2025; RIE, 2026).

Furthermore, the rise of robotics as potential actors in our future workforce means humans may also need to adapt and prepare for a future of workplace collaboration with robots. This raises many questions, such as: 'What skills are required for these future collaborations?', 'How do we work together with robots?', 'Will there be such a thing as 'Robot versus Human' politics?', 'Will humans train the robots, or will robots train the humans?', and 'Will robots train robots?'.

The robot as a student
With a future where robots are integrated in our society, a crucial question needs to be addressed:

How will robots be trained at scale without placing an enormous burden on traditional education systems?

LEARNING THROUGH ROBOTICS

A Catalyst for Innovation
Robotics acts as a driver for experiential learning, research, and complex simulations.

Future-Ready Competencies
Focuses on real-world problem-solving and interdisciplinary projects to prepare the future workforce.

LEARNING WITH ROBOTICS

Robots as Social Participants
Machines act as tutors, teaching assistants, peer learners, and institutional service agents.

Personalised and Accessible Learning
Social robots enable highly individualised and collaborative experiences for diverse learners.

LEARNING ABOUT ROBOTICS

Robotics as the Curriculum
Focuses on programming, engineering, and computational thinking as core academic content.

Technical Literacy Development
Students gain deep understanding by designing, building, and maintaining robotic systems.

Source: Generated with Notebook

NVIDIA Isaac Sim (an open-source reference framework built on NVIDIA Omniverse –a real-time 3D graphics collaboration platform) seeks to train robots at scale by providing a platform that closely mirrors key aspects of human education: guided learning, repeated practice, feedback, and the gradual development of skills in a safe environment.
In Omniverse, robots 'learn' by interacting with simulated worlds, for example, a digital twin of a kitchen or street, experimenting with tasks, and refining their behaviour based on virtual outcomes, much like students solving problems or conducting experiments in a classroom. The key difference is that robots are trained entirely in digital simulations, often at scales and speeds impossible for humans, and without consciousness or true understanding. On the other hand, human education develops cognitive, emotional, and social capacities alongside technical skills.

Social robots enhancing engagement
The SURF Social Robots in Education (2025) report examines how social robots could be integrated into tertiary education, arguing that their physical presence and AI capabilities may enhance student engagement beyond screen-based tools.

5. Material Choices in Robotics

The efficiency of any robotic system depends on two key components: software and hardware. Earlier, we examined how advances in AI software are driving the emergence of AI-controlled robotics. Here, we focus on material choices for robotic hardware – the physical foundation without which robots cannot exist in the first place (Forbes, 2025b; NL Robotics, 2026).

Rigid Material Robotics

The first mobile robot capable of visualising its environment and making its own decisions about where to move was Shakey, developed at the Stanford Research Institute (SRI) in the 1960s. It is widely recognised not only as the first mobile robot of its kind, but also as one of the earliest robots constructed from rigid materials (Jordan, 2019).

Since then, rigid materials such as steel, high-strength plastics, and carbon fibre-based composites have been used to build robots for industrial applications, for example, robotic arms for vehicle manufacturing, and for extraterrestrial missions (RoboDK, 2026; Nature Electronics, 2026), such as the Canadarm2 on the International Space Station.

The exterior of a host robotic systems must be sturdy, lightweight, and easily movable. For robots operating in extreme environments, such as space, the materials must also be able to withstand very high and low temperatures, large g-forces during operation, and elevated levels of harmful radiation (Nature Electronics, 2026).

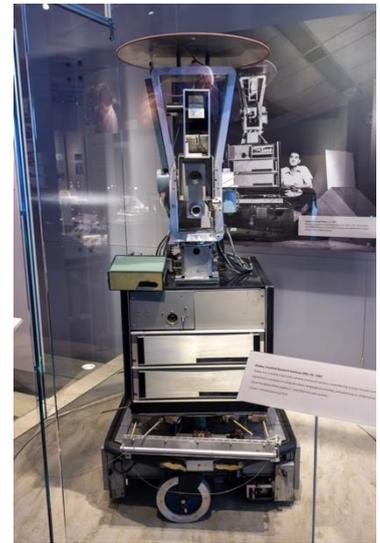Shakey the Robot in the Computer History Museum – *Source Wikipedia*

Critical internal systems within robots also require protection. Power supplies – such as those based on lithium-ion or solid-state batteries – can be encapsulated in lightweight composite materials to improve safety and durability (Forbes, 2025b).

Materials for rigid 'humanoid' robotics

For humanoid, non-stationary robots, large power supplies are often required, which increases overall mass and can reduce performance efficiency. Boston Dynamics, for example, has moved from hydraulic systems in the early iterations of its Atlas robot to highly efficient electric actuators and motors in the latest version. This transition has enabled a reduction in both the size of the power supply and the overall energy consumption.

In addition, the latest Atlas robot incorporates 3D-printed titanium and aluminium components, making it lighter and therefore more energy efficient during operation (Boston Dynamics, n.d.; Humanoid Robotics Technology, 2026a).

In late November 2025, the Chinese firm UBTECH announced it had shipped more than 1,000 units of its Walker S2 humanoid robot (Humanoid Robotics Technology, 2026b). The Walker S2 is a service robot designed for industrial manufacturing, logistics, and welcoming guests at exhibition halls. It uses a flexible, lightweight composite and an aerospace-grade aluminium alloy, and features a 3D-printed primary frame along with a 3D-knitted fibre structure (UBTECH, n.d.).

Soft Materials in Robotics

Traditional robots are typically built from rigid metal parts connected by joints, much like a human skeleton. They move using familiar technologies such as electric motors, gears, or hydraulics. As their motion occurs at specific joints, their movements are precise but relatively stiff.

Soft robots, on the other hand, are made from flexible, rubber-like materials. Instead of moving only at fixed joints, their entire bodies can bend, stretch, twist, or squeeze. Given that they are soft and highly flexible, they can adapt their shape to their surroundings (Mestre et al., 2024) – for example, gently gripping delicate objects or moving through tight spaces. Typically, soft robots are made from silicones, polyether polyurethane (PPUs), rubbers, nylons, and even textiles. The latest advancements allow soft robots to perform tasks without any electronics, as they use pneumatic analogue logic to generate motion and sense the environment. These robots are made entirely from flexible materials that increase the recyclability and sustainability of soft robots.

In simple terms, rigid robots move like machines with hinges, while soft robots move more like living organisms such as elephant trunk (precise motion, yet strong), plants (that can bend when perturbed by wind but do not break), or an octopus (can pass through tiny holes and limited only by their rigid beak).

Biohybrid Robotics

Two decades ago, the use of living cells as robotic actuators seemed like science fiction. Today, and although at an early stage, the field of biohybrid robotics – systems that integrate living tissue with engineered structures – is emerging as a vibrant, multidisciplinary research field (R. Mestre et al., 2024). These robots use living cells, most commonly skeletal and cardiac muscle, to generate motion. Early prototypes include centimetre-scale devices capable of walking, swimming, and gripping objects, and researchers are now exploring the use of neuronal cells to control muscle-powered robotic systems.

Compared with robots made solely from rigid or soft synthetic materials, biohybrid systems offer several advantages. Living cells are biodegradable, naturally compliant, capable of self-healing, and in some cases can be more energy-efficient, potentially reducing the need for large onboard power sources (Mestre et al., 2024).

Despite this promise, the field is still in its infancy, and most existing devices remain at the sub-centimetre scale. Scaling up will require advances in bio-fabrication processes, more robust interfaces between living tissue and electronics, and reliable life-support systems for living cells in the robots. (Mestre et al., 2024). While widespread applications such as humanoid robots may be far off, biohybrid muscle systems could ultimately enable technologies like artificial organs and other advanced biomedical devices.

6. Responsible Robotics - Ethics and Discussion

Robotics, advances in materials, artificial intelligence, and other emerging technologies are building on the current momentum of innovation and technological solutions. In this white paper, we have bridged various verticals, including education, healthcare, and logistics, creating points of attention where decision-makers may need to watch, prepare, or act. This discussion section reflects broadly on the topics covered here, highlighting moral connections and complex ethical concerns that call for further work on responsible robotic design and implementation.

AI, society, and materials

How AI is changing robotics, the use of robots in society, and materials for robotics; these sections of this white paper connect domains of robotics that have interesting, shared developments that require further reflection on moral concerns. This is due in large part to technologies not being neutral (Purdue University, n.d.). The impacts of technologies like robotics continue to surprise, change, and in turn shape how we perceive the future of various sectors, such as those mentioned in this white paper.

Robotics, AI and automation
Increasing industrialisation and an ever-changing workplace due to advances in how robots assist in work raise concerns between and beyond the employee, the employer, and what it means for work in the broader sense (Forbes, 2025a; Hosseini et al., 2023). The developments mentioned here demonstrate how efforts are being made on the principle of avoiding harm to everyone involved in working with robotics. Protection of people in a work environment that accommodates robotics will require change and the ability to adapt to how we work.

Greater experimental work on the combination of robotics with AI brings a commitment to change, which is an exploration that can be challenging for everyone involved. Currently, there is significant focus on the implementation of new technologies with emphasis on efficiency and cost reduction (Hosseini et al., 2023). Robotics in shared spaces with humans can require humans to be less mobile in areas around the robots for safety, creating more cramped spaces for human and robot workers in the process.

These robotic 'colleagues' will also come with new sensor technologies that can enable new surveillance opportunities for employers. This can infringe on the privacy of human employees who share the same workspaces. In addition, and perhaps of greatest concern, human employee-performance may be increasingly compared to that of their robotics 'colleagues' as we begin to reshape what is 'normal' working output or desirable capabilities.

Ethical concerns for robotics and work help remind us of the desirable futures we want to create with our robotics colleagues, where recognising what is at stake with our 'robotic-other', and what may create additional challenges for ourselves in our future workplaces.

Rethinking robots in society
It is at the societal level that we recognise the far-reaching impact of robotics. Self-driving trucks, surgeries performed with new robotic tools, and robotics in education all play a role in reshaping the societies into which they are introduced (European Commission, n.d.; Forbes, 2024; Lu et al., 2025). Each promises increased precision, expanded capacity, and a reduction in human error. These areas of social life typically demand skill development, professionalisation, and the shaping of citizens in this new context.

A shared moral concern across the examples featured in this white paper is the growing reliance on new robotic systems, which reveals new challenges that we face as we ourselves change alongside technological developments. Advancements in autonomous vehicles show that an essential skill – like operating a commercial vehicle – may no longer be considered fundamental for humans in a future that relies on the precision of robotic driving (Synopsys, n.d.; Taylor & Francis, 2021). A generation of surgeons trained primarily with robotic assistance may lose the same degree of manual dexterity that their predecessors possessed. These are not neutral additions to existing systems. Each generates parallel concerns such as the deskilling of practitioners, responsibility gaps, access inequalities, and dependence vulnerabilities (Hosseini et al., 2023). These patterns suggest that robotic transformation operates according to common logics across sectors – logics that warrant further investigation and careful refinement.

These massive transformations are neither simply good nor bad, but they demand our attention: What are we gaining? What are we losing? And who decides which trade-offs are acceptable?

Materials and choices
Combining biological and artificial elements in robotics raises important concerns. Material developments in biohybrid robotics show how living cells inside some of our future robots will come to solve or re-imagine new solutions in our daily lives (Mestre et al., 2024). These developments, however, do not come without a cost.

The work of biohybrid robotics involves high-development costs and may therefore only be accessible to the wealthiest communities, organisations, and countries worldwide. These technologies might also require the extraction of tissue and cell samples from animals, raising ethical concerns regarding non-human animal rights and the possibilities of lab-grown tissue. We risk creating robotic parts that we develop an attachment to and that are essential for our survival and our day-to-day existence, leading to a progressively complex relationship with nature and machines. By reflecting on moral considerations from various philosophical perspectives, we can find new ways to refine our reasons for developing these paradigm-shifting technologies.

7. The Wrap Up

As of 2026, robotics has entered a decisive phase, moving from isolated industrial automation to broad societal integration. Advances in embodied AI and next-generation materials are driving this shift.

The emergence of increasingly impressive humanoid form factors illustrates how lightweight manufacturing, adaptive control systems, and material advancements are redefining machine mobility and dexterity. In parallel, biohybrid robotics, integrating living cells with mechanical systems, introduces capabilities such as self-healing and ultra-low-power operation, expanding research frontiers across engineering and the life sciences.

This transformation has significant strategic implications for educational and research institutions. Robotics should be embedded across interdisciplinary curricula, including computer science, mechanical engineering, biomedical sciences, ethics, and public policy. Laboratories are evolving into collaborative human-robot environments, where students interact directly with intelligent systems as research tools, experimental platforms, and instructional assistants.

Within this landscape, research priorities should focus on safe autonomy, efficient and fair human-robot collaborations, and ethical governance. Robust frameworks for bio-containment, algorithmic transparency, and responsible deployment are essential towards maintaining public trust and meeting regulatory expectations.

Consequently, robotics is not merely a technological domain any more; it is now a foundational research pillar. Institutions that align technical innovation with ethical stewardship will be best positioned to prepare a workforce capable of advancing robotics responsibly while augmenting human capabilities. Embracing in an open, transparent, and focused manner this inflection point for robotic technologies will help our modern society to flourish into one where robotics plays a critical role in ensuring that we move in the right direction with our technological developments.

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