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Foreword by ITU

We are living through defining times for humanity's relationship with technology.

Artificial intelligence is advancing faster and faster, reshaping how we learn, work, deliver healthcare, manage natural resources, and respond to global challenges. While increasingly powerful and autonomous technologies create a wealth of opportunity to drive global prosperity, they also continue introducing new and complex risks.

The findings of this year's AI for Good Impact Report show these dynamics becoming even more pronounced.

Generative AI has entered the mainstream and emerging agentic AI systems are poised to transform entire industries. Research into artificial general intelligence and quantum technologies point to future capabilities that could profoundly affect societies, economies, and governance systems worldwide.

AI is already helping to deliver meaningful benefits in areas from personalized learning and skills development to better healthcare diagnostics, early warning systems, and climate adaptation tools. The real-world applications outlined by this report demonstrate that, when guided by shared values, AI can be a powerful force for good.

The challenges, however, are growing in scale and urgency. Autonomous systems raise new questions around accountability and human oversight. Bias and misinformation remain key risks. Changing labour markets call for investment in new skills. And the energy and resource demands of AI infrastructure keep rising.

Governments around the world are taking diverse regulatory and governance approaches, from comprehensive risk-based frameworks to flexible, innovation-oriented models. The United Nations system, supported by ITU's AI for Good initiative, is working to strengthen international cooperation on AI development anchored in human rights and the public interest.

This AI for Good Impact Report shares the latest insights on emerging technologies, governance trends, and AI use cases across education, healthcare, environmental sustainability, infrastructure, and agriculture. It highlights how ethical, inclusive AI can help accelerate progress toward the future we want, while identifying actions needed to manage risks and close digital divides.

It can help guide informed decision-making and collective action to ensure that responsible AI governance and AI innovation remain mutually reinforcing goals.

Doreen Bogdan-Martin
Secretary-General, International Telecommunication Union

Foreword by Deloitte

Organizations today are discovering how they can use AI to drive innovation and improve productivity, but the potential of AI is measured not only in business value. More significantly, AI can contribute to the benefit, wellbeing, and betterment of communities around the world.

With AI, we can imagine a world where AI enables high-quality educational instruction regardless of geography or income. A world where communities enjoy confidence in their access to basic necessities, like food and water, as AI tools change how we address food security and resource management. We can imagine healthier communities, aided by applications and medical research that provide health services and breakthrough treatments, irrespective of means or economic status. And powerful approaches to improving environmental sustainability, positively impacting livelihoods on a grand scale can be imagined.

This report explores the trajectory of AI across industries and sectors. It also considers the significant impact AI has on workforces and the importance of helping people acquire the skills and knowledge to thrive in an AI-fuelled world. Indeed, if AI is a boon to humanity, the needs and concerns of people across many walks of life should be reflected in the tools and systems transforming the world around them.

The guiding light for the path ahead is a philosophy of human centricity. People should be at the heart of how we approach this world-changing technology. The public sector is a valuable collaborator as society moves to bolster its collective development and advancement through leveraging AI.

This is a pivotal moment. The brightest future will likely result when AI is inherently collaborative, wherein the public, private, and civil sectors work together to mitigate challenges while amplifying the good AI can enable. With a focus on people, trust, and value to society, we can shape a future with AI that meets and even exceeds our greatest ambitions.

Beena Ammanath
Executive Director
Global Deloitte AI Institute

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Executive summary

Artificial Intelligence (AI) is transforming the global landscape, influencing how societies learn, work, deliver health care, manage resources, and address environmental challenges. The AI for Good Impact Report 2025 provides an overview of AI's current state, potential future trajectory, regulatory environment, and its application across key sectors. This summary distils the report's key insights, aiming to offer readers a clear understanding of AI's opportunities, risks, and considerations.

Current AI landscape and emerging technologies

The adoption of AI continues to accelerate, driven notably by Generative AI (GenAI), which has revolutionized a wide variety of technologies from content creation to automation. The evolution from GenAI to Agentic AI marks a significant shift: Agentic AI systems can act autonomously, making decisions and learning without human intervention. Looking ahead, increasingly capable AI agents are expected to operate not only individually but also in coordinated networks, forming ecosystems for resource sharing, information exchange, and even dedicated marketplaces. These intelligent agents are reshaping workflows across industries ranging from health care and finance to manufacturing and utilities, demonstrating enhanced efficiency but also raising ethical and workforce concerns.

Artificial General Intelligence (AGI), representing AI with human-like cognitive abilities, remains a theoretical goal but is being pursued by leading technology firms. Its potential emergence within the next decade could profoundly impact society, necessitating early policy and strategic preparation.

Sovereign AI initiatives reflect a growing global emphasis on technological autonomy. Some countries are investing in domestic AI infrastructure and capabilities to help reduce dependence on foreign technologies, safeguard national security, and tailor AI applications to local contexts.

Quantum AI, though still in research phases, may lead to transformative advances by leveraging quantum computing to solve complex problems beyond classical capabilities. International efforts, such as the UN's International Year of Quantum Science and Technology 2025, highlight the importance of responsible and inclusive development in this frontier.

Regulatory developments and governance

The proliferation of AI has increased the need for governance frameworks that balance innovation with risk mitigation. The European Union's AI Act, effective since August 2024, currently stands as the most comprehensive regulation, establishing risk-based classifications, transparency requirements, and prohibitions on harmful AI practices.

Globally, diverse regulatory approaches are emerging. Japan has adopted a soft law model prioritizing innovation, while South Korea and China have implemented foundational AI laws and standards; South Korea emphasizes industry promotion alongside establishing a trustworthy and security foundation, and China focuses on trustworthiness and security. In Africa, progress is made by the adoption of frameworks and policies by various countries and through its Continental AI Strategy, the Africa Union aims to guide member states toward inclusive, ethical

AI development, though regulatory maturity varies. In the United States, federal efforts seek to emphasize innovation through voluntary standards, while some states are introducing more prescriptive measures focused on transparency and safety. Overall, the Americas and Middle East show a mix of voluntary frameworks and targeted legislation, reflecting regional priorities.

Internationally, the United Nations has established new mechanisms, including a High-Level Advisory Body on AI and an Independent International Scientific Panel, to foster global cooperation and develop inclusive governance aligned with human rights and sustainable development goals. The Global Digital Compact aims to create a universal framework promoting an open, secure, and human-centric digital future.

Addressing AI's challenges

Ethical and trustworthy AI is paramount to maintaining public confidence and helping ensure inclusive benefits. Key concerns include bias, misinformation, loss of human control, and emergent behaviours in autonomous systems. Robust design principles, human-in-the-loop oversight, adversarial testing, and adherence to established and emerging standards are important to mitigating risks.

AI's inclusivity challenges stem from data bias, unequal access to infrastructure, and digital divides that disproportionately affect underrepresented communities and developing regions. Efforts to bridge these gaps include promoting diverse datasets, fostering AI literacy, and expanding connectivity and computing resources globally.

Privacy protection is increasingly complex as AI systems process vast sensitive datasets. Techniques like differential privacy, federated learning, and privacy-by-design principles are important to safeguard personal data. Regulatory frameworks such as the EU's GDPR in addition to other existing and emerging national laws provide legal foundations for data governance.

AI is reshaping labour markets by evolving job roles and skill requirements. The World Economic Forum projects job transitions and new opportunities by 2030, with a growing demand for AI literacy and technical skills. Governments and organizations worldwide are investing in upskilling and reskilling initiatives, targeting groups and promoting inclusive access to AI education.

AI's energy demands, particularly from data centres, can pose sustainability challenges. Data centres currently consume significant global electricity, with projections indicating a doubling of demand by 2030. Regional disparities in energy and water use, especially in water-stressed regions, highlight the need for tailored solutions.

Sustainable data centres powered by renewable energy, energy-efficient algorithms, and innovative infrastructure models such as offshore floating data centres are emerging to help address these concerns. International collaborations and initiatives like the International Telecommunication Union's Green Digital Action promote transparency and sustainable AI deployment.

AI applications tackling global challenges

Education: AI can enable personalized learning, intelligent tutoring systems, and enhanced assessment analytics, improving access and outcomes, particularly in underserved regions. Initiatives like the ITU's AI Skills Coalition focus on closing the global AI skills gap inclusively.

Health care: AI supports diagnostics, early detection, drug discovery, and virtual health assistants, improving care quality and accessibility. Examples include AI tools reducing stroke treatment times in the UK and AI-powered platforms addressing maternal health in Africa.

Environment: AI aids environmental action through emissions reduction, disaster preparedness, biodiversity monitoring, and energy optimization. It supports vulnerable regions by enhancing early warning systems and enabling data-driven adaptation strategies.

Infrastructure and smart cities: AI-driven digital twins, traffic optimization, and disaster resilience tools enhance urban management, safety, and sustainability. Cities worldwide are increasingly adopting AI to improve quality of life and operational efficiency.

Food security and agriculture: AI advances precision farming, livestock management, and supply chain transparency, addressing food insecurity and promoting sustainable practices. Digital public goods and open data platforms democratize access to agricultural intelligence.

AI holds transformative potential to help address pressing global challenges across multiple sectors. Realizing these benefits requires coordinated efforts to foster ethical, inclusive, and sustainable AI development. Public and private sectors and civil society should collaborate to bridge digital divides, protect privacy, and invest in workforce readiness. By aligning innovation with human rights and environmental stewardship, AI can become a powerful catalyst for equity for all and resilient development worldwide.

Introduction

Artificial Intelligence (AI) is one of the most powerful technologies shaping our world today. It is changing how people learn, work, receive health care, grow food, and can help protect the environment. This report aims to provide a balanced understanding of how AI can be used to address global challenges. The focus is on real-world applications, opportunities, and risks, with an emphasis on responsible and inclusive use of AI.

This report does not go into technical details. Instead, it provides an overview of current AI trends, examples of how AI is being applied in different regions and industries, and insights into what the future might hold. It highlights both opportunities and challenges, including economic, ethical, and environmental considerations. By covering education, the environment, health care, infrastructure, and agriculture, the report shows how AI can be applied across important areas of development and public policy.

This report is intended for a varied audience involved in shaping and responding to the development of AI. It serves as a guide to understanding the current state of AI and its likely developments over the coming years. It provides an overview of some of the key opportunities and risks associated with AI across different sectors. Additionally, it offers a framework to help shape policies and strategies and includes a non-exhaustive glossary with commonly used terms. Designed to be practical and easy to read, it delivers quick takeaways for decisionmakers as well as more detailed examples for those seeking deeper insights.

The present state and potential future trajectory of AI

From Generative AI to autonomous agents

In 2025, the adoption of AI continues to gain momentum as organizations build the necessary structures and processes to extract meaningful value from its tools and technologies. Although this new era is only just beginning, its impact is already evident: startups and forward-thinking companies are working to adopt AI-focused business models, redefining conventional practices, and swiftly gaining market presence.[1]

A survey by the Data & AI Leadership Exchange in partnership with DataIQ highlights that we are experiencing a transformational moment comparable to the internet's emergence in the 1990s. Although most organizations (76.2%) have been using earlier AI forms such as machine learning for more than three years, it is the arrival of Generative AI (GenAI) that has accelerated AI adoption and use dramatically. Corporate investments in AI and data are also rising sharply, with 98.4% of organizations reporting increased investments in 2024, up from 82.2% the previous year.[2]

Over the past year, organizations have gained valuable experience with GenAI, leading to a deeper awareness of both the opportunities and challenges involved in scaling the technology. This has prompted many to revise their strategies and recalibrate their expectations. With investment in AI continuing to increase, the importance of a disciplined, methodical approach has also grown. While technical capabilities have strengthened, uncertainties around regulation and risk management have increased. Implications for workforce and talent continue to matter as AI drives a shift in skill requirements. Throughout this period, one priority has remained unchanged: the ongoing focus on improving data management, even among organizations that are already highly data-centric.[3]

As AI reshapes organizational needs, larger companies report greater hiring activity for AI-related roles, particularly AI data scientists, machine learning engineers, and data engineers, positions that remain challenging to fill.[4] Reflecting this shift, responsible AI, which includes ethics, governance, and risk mitigation, is becoming a top priority, with organizations focusing on establishing safeguards to help ensure ethical AI use.[5] Correspondingly, an increasing number of organizations are appointing Chief AI Officers as leadership roles evolve to oversee AI and data strategies.[6] To help organizations minimize risks and maximize the potential of GenAI in a safe and secure manner, Deloitte US has developed its Trustworthy AI™ framework. Through the application of controls, guardrails, and training, organizations can be equipped to implement new technology in a secure, compliant, and responsible way.[7]

GenAI has changed how organizations create and automate content, driving unprecedented efficiency and innovation. However, the transition from GenAI to Agentic AI, which will be discussed in the next section, represents a significant leap.

Agentic AI

Since 2024, AI intelligence has seen significant advancements, particularly with the emergence of Agentic AI. Unlike traditional GenAI tools that mainly answer questions, Agentic AI can perform actions and transform business processes by working alongside human employees as digital workers. Although still developing, this capability can reshape workflows across industries.

The rise of multimodal AI models, for instance Google's Gemini suite, can generate and understand images, audio, video, handling multiple types of input and output.[8] This progress is helping to move AI closer to human-like perception and interaction.

Traditionally, business software digitalized existing tasks without altering underlying roles. Agentic AI disrupts this model by proactively suggesting directions, filling gaps, and adapting to context without waiting for explicit instructions.[9]

One application of Agentic AI is autonomous drones capable of navigating complex, dynamic environments independently. These drones can identify relevant information and relay it to rescue teams in disaster zones, monitor crop health and detect pest or drought-affected areas in agriculture, and enhance logistics by delivering packages safely and efficiently through the air.[10] Another development is real-time, contextual multimodal AI assistants wearable as smart glasses.[11]

Similarly, Agentic AI is driving digital transformation in health care. Diagnostic agents analyze vast amounts of medical and patient data to predict diseases more accurately while optimizing the use of medical resources.[12] In business, AI agents are increasingly deployed across sectors such as finance, banking, supply chain, and public sector to autonomously perform high-value tasks.[13]

These examples show that Agentic AI is already reshaping labour markets and societal structures, with impacts seen across industries such as automotive, health care, and robotics. As part of the Fourth Industrial Revolution, it enables machines to replicate human behaviours and tackle complex challenges by integrating AI, robotics, and data. This transformation may show significant benefits and improved work efficiency but also raises ethical, workforce, and security concerns.[14]

Despite its growing importance, the impact of Agentic AI on employment, social structures, and ethics often receive insufficient attention. These considerations are important as Agentic AI continues to evolve and integrate into society.[15] Gartner forecasts a dramatic shift in enterprise software, predicting that by 2028, 33% of applications will incorporate Agentic AI, a sharp rise from less than 1% in 2024. This evolution could enable 15% of routine work decisions to be made autonomously, signalling a move toward systems that not only assist but act independently within business environments.[16]

Looking ahead, we can expect major leaps in automation and innovation driven by increasingly capable AI agents operating both individually and in coordinated networks. These agents will become more precise, intelligent, and widely available, potentially forming their own ecosystems for collaboration, resource sharing, and information exchange, including dedicated marketplaces and communication protocols.[17] In payments and e-commerce, this means AI agents can research products, initiate purchases, optimize checkout flows, and even manage virtual spending through tools like Stripe's agent-ready checkout and virtual card systems. Companies like PayPal and eBay are already piloting Agentic AI to enhance user experience and automate consumer interactions, while Klarna and Remitly have demonstrated measurable gains in customer service efficiency using GenAI.[18]

Public perception of AI has grown more cautious. Concerns focus on the environmental impact of AI, especially the high energy consumption of data centres, which could drive up energy costs for consumers and strain resources. There are also worries about the impact of automation and the fast pace of AI development, which may challenge society's ability to adapt and reskill the labour market. Similarly, scepticism remains about whether AI's benefits will be shared fairly. Despite these concerns, AI holds potential to expand access to services such as education and financial advice and to encourage investment in sustainable energy.

The next sections will examine how AI has the potential to evolve over the next three to five years, highlighting areas for stakeholders to consider.

Artificial general intelligence (AGI)

AGI is a theoretical area of AI research focused on creating software that exhibits human-like intelligence and the capacity for self-directed learning. Unlike current AI technologies, which operate within predefined parameters, such as image recognition models that cannot perform unrelated tasks like website building, AGI aims to develop systems capable of autonomous self-control, self-awareness, and the ability to acquire new skills independently. This would enable AGI to solve complex problems in unfamiliar contexts without prior training. However, AGI with human-level abilities remains a theoretical concept and an ongoing research goal.[19]

Leading technology companies are investing billions and actively advancing AI capabilities with the ambition of achieving AGI or even superintelligence.[20] Some experts propose a narrower definition of AGI as achieving human-level performance across most economically relevant digital tasks, suggesting this milestone could be reached within five years. Others view AGI as a moving target, with the race toward its development likely to continue for many years.[21]

The exact timing of AGI's arrival remains uncertain, with predictions placing its arrival within five to ten years. Nonetheless, its eventual emergence is expected to impact each facet of life, business, and society. Corporate executives and policymakers are encouraged to begin understanding the trajectory toward machines attaining human-level intelligence and to prepare for the transition to a more automated world.[22] As definitions of AGI evolve alongside its capabilities, the emergence of superintelligence could bring profound changes to security, privacy, and societal norms.

Sovereign AI

Countries are increasingly recognizing the complex nature of GenAI, acknowledging both its potential and inherent risks, as well as its implications for economic growth and national security. In response, some nations are actively developing their own AI infrastructure, capabilities, and industries to enhance competitiveness and safeguard their futures. This effort is often framed as building 'Sovereign AI'.[23]

Sovereign AI aims to reduce dependence on foreign AI technologies by developing domestic capabilities and securing access to critical data, technologies, knowledge, and infrastructure within national borders. This approach helps protect countries from potential supply chain disruptions and strengthens their national sovereignty. Consequently, states seeking technological autonomy may increasingly view sovereign AI as a strategic path forward.[24] [25] By aligning AI systems with national digital public infrastructure (DPI), such as digital ID, payments, and data exchanges, countries can help ensure that AI serves public interest, enhances service

delivery, and reflects local values. This integration can allow AI models to be trained on locally relevant, high-quality datasets, such as multilingual corpora, or the same text in more than one language, and sector-specific data like crop yields or weather patterns, supporting context-aware applications. In India, for example, farmers receive AI-powered advisories on crop insurance and government programmes via voice-based interfaces in local languages, while in Bangladesh, AI tools translate court judgments to improve public access to legal information. Behind the scenes, AI strengthens fraud detection in digital finance and enables biometric verification in national ID systems, reinforcing trust and efficiency within public infrastructure.[26]

In Switzerland, the 2025 launch of Apertus marks a significant step toward publicly governed AI infrastructure, offering open models and compute access tailored to multilingual needs such as Swiss German, Romansh, and others.[27] The United States advances sovereign AI through expanded public infrastructure like the National AI Research Resource (NAIRR), aiming to secure domestic innovation and strategic autonomy across critical sectors.[28] Meanwhile, the United Arab Emirates (UAE) has developed initiatives like Falcon LLM, an open-source language model developed at the Technology Innovation Institute (TII),[29] and the AI Campus in Abu Dhabi. The country is also forging strategic international collaboration, most notably a 2025 agreement with the United States to establish the "US-UAE AI Acceleration Partnership" based on a set of joint commitments.[30]

India is making a concerted effort to overcome challenges such as linguistic diversity and underinvestment in AI research. Despite being a global technology hub, India has lagged other countries in homegrown AI innovation due to limited research and development (R&D) funding, fragmented data, and a services-oriented tech ecosystem.[31] The more recent launch of generative pre-trained transformer (GPT) models acted as a catalyst, prompting India's Ministry of Electronics and Information Technology (MeitY) to mobilize resources rapidly, including access to nearly 34,000 graphics processing unit (GPUs) and to solicit proposals for foundation models tailored to Indian languages and needs.[32] Initiatives like Sarvam AI's large-scale multilingual models and innovative tokenization techniques address India's linguistic complexities, aiming to reduce the 'language tax' and develop AI that serves its varied population. Supported by the US$1.25 billion IndiaAI Mission, this sovereign AI push combines public funding, private sector engagement, and emerging research programmes to build AI infrastructure, foster innovation, and extend AI benefits to sectors such as education, agriculture, and healthcare.[33]

UK's Sovereign AI Unit

The UK's Department for Science, Innovation and Technology (DSIT) has established the Sovereign AI Unit to develop and leverage the nation's AI capabilities, aiming to drive economic growth and strengthen national security. The unit collaborates closely with the Prime Minister's Adviser on AI to deliver its mandate.

Announced in the AI Opportunities Action Plan prepared by Matt Clifford, the Sovereign AI Unit is backed by up to £500 million in funding. Its objectives include investing in UK companies to support the growth of AI national champions. Working alongside Innovate UK and the British Business Bank, the unit aims to help high-potential startups launch and scale within the UK.

Additionally, the unit focuses on creating and enhancing UK AI assets and enablers, such as data infrastructure, computing resources, and talent development. It also seeks to position the UK as the preferred collaborator for frontier AI companies, ensuring that both public and private sectors have reliable access to, and influence over, cutting-edge technologies. This approach is designed to ensure that the benefits of transformative AI reach communities across the country.[34]

The broader global and economic context will likely influence AI's impact and shape how societies benefit from, or are challenged by, AI. A new form of digital competition, a so-called 'space race' for sovereign AI, is underway.[35]

Quantum AI

Though still years from practical deployment, quantum artificial intelligence (quantum AI) represents a long-term frontier with transformative potential. Quantum AI involves using quantum technologies to run AI systems. Given that AI models demand significant computational power and infrastructure to operate efficiently, quantum AI seeks to replace traditional AI infrastructure with quantum computing resources, enabling faster and more cost-effective data processing.[36]

What is quantum technology?

Quantum technology derives from the principles of quantum mechanics, which govern the behaviour of subatomic particles. These principles were established in the 1920s through the contributions of physicists such as Niels Bohr, Werner Heisenberg, and Erwin Schrödinger. Although the term may seem modern, quantum technology has been around for some time. It played a key role in the creation of nuclear power and remains essential to the semiconductors used in mobile phones and numerous other electronic devices.[37]

A key advantage of quantum AI lies in its ability to solve problems that are exponentially difficult or nearly impossible for classical computers. This includes optimization challenges important to fields such as logistics, finance, and materials science. Additionally, quantum AI holds promise for simulating complex systems like chemical reactions and protein structures, areas where AI has already made significant strides, as seen in the 2024 Nobel Prize for protein structure prediction.[38] Other potential applications encompass quantum machine learning, quantum simulations, and the development of new materials. Although significant technical hurdles remain, specialists are optimistic that advancements in hardware and software could enable solutions to problems currently deemed unsolvable.[39]

Despite these exciting prospects, quantum AI remains largely in the research phase, with most AI workloads still relying on conventional computing resources for operation.[40] While quantum technologies offer transformative potential across medicine, environment, trade, and more, they also introduce risks, particularly in cybersecurity.[41]

Quantum for Good

Quantum technology is poised to transform our world, but its development should be inclusive, ethical, and sustainable. The initiative Quantum for Good is spearheading responsible innovation, fostering global collaboration, and promoting the creation of inclusive standards to ensure that quantum technology delivers tangible benefits.[42]

Recognizing the significance of quantum science and to raise awareness of its historical and future impact, numerous national scientific societies have united to support the marking of 100 years since the discovery of quantum mechanics with a United Nations-declared international year.

On 7 June 2024, the United Nations officially proclaimed 2025 as the International Year of Quantum Science and Technology (IYQ). As part of this, the ITU and its collaborators are working to harness quantum's potential to accelerate progress in critical areas such as the environment, healthcare, cybersecurity, and digital inclusion.[43]

In response to these rapid developments, the next section will examine key regulatory changes over the past 12 months, highlighting how governments worldwide are adapting legal frameworks to help manage AI's risks and opportunities.

2025 AI regulatory landscape

This chapter explores the evolving international regulatory landscape, highlighting initiatives including the UN's High-Level Advisory Body on AI and the Global Digital Compact. These developments were reinforced during the UN General Assembly's high-level meetings in September 2025, where Member States and global leaders debated the ethical use of AI in military contexts, the governance of autonomous systems, and the urgent need to safeguard information integrity.[44]

Alongside this, the chapter discusses the European Union's AI Act. It further examines national regulatory developments across key jurisdictions, illustrating varied approaches to AI oversight.

Recent developments in global AI governance

AI systems present a range of societal and ethical risks including concerns around bias in algorithmic decision-making, the need for trustworthy and ethical AI aligned with human rights, and challenges in data privacy and consent.

In response to these challenges, the United Nations has launched two new global bodies to strengthen AI governance: the Global Dialogue on AI Governance and the Independent International Scientific Panel on AI. Announced during a high-level UN General Assembly (UNGA) meeting in September 2025, these initiatives aim to foster international cooperation, align regulatory approaches, and provide evidence-based guidance on AI's societal impacts. The Global Dialogue serves as a platform for governments, industry, and civil society to share good practices, while the Scientific Panel functions as an early-warning system, offering insights into emerging risks and opportunities.[45] This initiative builds on the Global Digital Compact adopted in September 2024, a global framework for digital cooperation and AI governance.[46]

At the UN's high-level meetings held in September 2025 discussions addressed concerns such as disinformation, autonomous weapons, and algorithmic manipulation, with UN Secretary-General António Guterres outlining four global priorities: ensuring human control over AI in conflicts, establishing coherent international regulation, safeguarding information integrity, and closing the global AI capacity gap. Member States and regional blocs reaffirmed their commitment to human-centric AI. Proposals such as a Global Fund for Capacity Development were introduced to support fair access and mitigate the concentration of AI benefits, reinforcing the UN's role in shaping a responsible and collaborative global AI ecosystem.[47]

Global Digital Compact

The Global Digital Compact (GDC) aims to create a broad and inclusive international framework that supports the collaborative efforts of multiple stakeholders to bridge gaps in digital access, data, and innovation. It seeks to establish guiding principles, goals, and actions that promote a digital future that is open, free, secure, and centred on human rights, while also advancing the achievement of the Sustainable Development Goals.

Global Digital Compact (continued)

This Compact was first proposed in the UN Secretary-General's report, "Our Common Agenda", as a response to the Member States' Declaration commemorating the United Nations' seventy-fifth anniversary (A/RES/75/1). The report recommended that the Global Digital Compact be finalized at the Summit of the Future in September 2024, with participation from relevant stakeholders. To support this process, the Secretary-General released a policy brief outlining the Compact's objectives and guiding the preparations and negotiations ahead of the Summit, where the Compact will be a central topic.

The General Assembly, through decision 77/568, has committed to conducting open, transparent, and inclusive intergovernmental consultations on the Compact. Should the Compact be agreed upon through these negotiations, it will become a key outcome of the Summit of the Future and will be appended to the Pact for the Future. The intergovernmental negotiations are being co-facilitated by Sweden and Zambia.[48]

Regulations can play a role in mitigating AI-related risks by setting standards for transparency, accountability, and safety. For example, the EU AI Act requires conformity assessments for high-risk systems, while other jurisdictions focus on data governance, fairness audits, and environmental reporting. Described in more detail in the following sections, these regulations and frameworks aim to help ensure AI serves the public good, protects individual rights, and fosters trust across various contexts.

The EU AI Act

On a regional level, the European Union (EU) AI Act entered into force on 1 August 2024 and applies across the 27 EU member states, with significant extra-territorial reach for AI providers offering products or services on the EU market.

To support effective implementation, the European Commission has issued non-binding guidelines on the definition of AI systems. These guidelines clarify how to determine whether a software system qualifies as an 'AI system' under the Act and will evolve over time based on practical experience and emerging use cases. They were published alongside guidance on prohibited AI practices. Examples of systems not considered AI under the Act include basic data processing tools such as spreadsheets or dashboards that execute pre-defined instructions without learning, as well as classical heuristic systems like rule-based chess programmes that do not adapt through data. Prohibited systems include, inter alia, subliminal or manipulative AI that distorts human behaviour beyond conscious awareness and AI exploiting vulnerabilities of individuals due to age, disability, or social or economic status.

The European AI Office has also released interpretative guidelines for general-purpose AI (GPAI) models, applicable since 2 August 2025. These include a practical guide and a template for documenting training data, and they serve to complement the voluntary EU GPAI Code of Practice. While not legally binding, they provide insight into the Commission's enforcement approach.

The implementation is phased. Provisions on prohibited practices and AI literacy took effect in February 2025, while obligations for GPAI models, governance structures, and penalties began in August 2025. Full application of high-risk AI requirements will continue through 2026 and beyond.

As timelines for further standards for high-risk AI systems are delayed, the European Commission proposed a simplification package for the AI Act in November 2025. The proposal introduces a deferral of high-risk application obligations by up to 16 months. Further, with the competitiveness of EU businesses in mind, the proposal aims to reduce compliance burdens through streamlined documentation and reporting requirements, particularly for SMEs and small mid-cap companies. These measures aim to maintain the Act's core objectives while ensuring proportionality and legal certainty, enabling European firms to focus resources on innovation and growth. The proposal will now be discussed by European Parliament and EU Member States with an expected conclusion until summer 2026.

While product safety and consumer protection remain central, AI may now be seen as a strategic tool to boost competitiveness and autonomy. The EU aims to reduce dependency on non-EU technologies and strengthen its position in the global AI race. The AI Continent Action Plan, part of the 'AI Made in Europe' strategy, includes the InvestAI initiative to mobilize €200 billion for AI development. This plan focuses on building AI factories and gigafactories for large-scale model training using Europe's supercomputing network, expanding data infrastructure, and investing in talent. The EU's approach combines risk-based regulation with massive investment, signalling that the EU intends not only to regulate AI but also to compete globally on innovation and infrastructure.

The European Union AI Act in a nutshell

The development of the EU AI Act has been a carefully orchestrated process, beginning with the formation of a 'High-Level Expert Group on AI' by the European Commission. This group was tasked with drafting policy recommendations focused on advancing trustworthy AI. Following these initial efforts, the European Commission released its European approach to AI in February 2020 and subsequently presented the first proposal for the EU AI Act in April 2021. The AI Act represents the result of a five-year political process aimed at balancing innovation with the need for secure and reliable AI systems. Its primary objective is to enhance the functioning of the single market concerning AI products and services, while also promoting a human-centric approach to AI development and deployment, putting the protection of EU citizens at the forefront of this regulation. The Act applies to a broad range of stakeholders, including providers, deployers, importers, and distributors of AI systems within the EU, as well as non-EU entities whose AI systems are used within the EU. This approach reflects the regulatory framework seen in the General Data Protection Regulation (GDPR), emphasizing the importance of safety and innovation in equal measure.

The European Union AI Act in a nutshell (continued)

The EU AI Act establishes a framework for regulating the deployment and use of AI within the EU, creating a standardized process for the market entry and operational activation of AI systems. This framework drives a harmonized approach across EU Member States. Serving as a product safety regulation, the Act employs a risk-based classification system, categorizing AI systems based on their use cases and assigning compliance requirements according to the level of risk they pose to users. This includes prohibiting certain AI applications deemed unethical or harmful, as well as imposing stringent requirements on high-risk AI applications to effectively manage potential threats. Additionally, the Act sets out transparency obligations for AI technologies associated with various risks, helping to ensure that the regulation remains adaptable to future developments in AI technology.

Given the widespread adoption of general-purpose AI technologies, the Act distinguishes between single-purpose AI, designed for specific tasks, and general-purpose AI, which can perform a wide range of functions. Regardless of the risk associated with specific use cases, the AI Act establishes rules governing the market entry, oversight, and enforcement of general-purpose AI models, to help establish public trust and the integrity of AI innovations.

To support the implementation of the AI Act, a new governance structure has been established at both the EU and Member State levels. At the EU level, the European Commission created the European AI Office in February 2023 to oversee the Act's implementation. The AI Office is responsible for enforcing obligations related to general-purpose AI models and has issued interpretative guidelines for GPAI providers, effective since August 2025. These guidelines, while non-binding, include practical tools such as documentation templates and complement the voluntary EU GPAI Code of Practice.

At the national level, Member States are required to designate supervisory authorities to enforce the AI Act's obligations concerning AI systems. These supervisory authorities will help ensure that AI systems comply with the established standards and regulations. For instance, they will oversee the accuracy of conformity assessments conducted by providers of high-risk AI systems to ensure these systems meet specific standards, regulations, or requirements. During investigations, market surveillance authorities will have the authority to access necessary documentation, including training, validation, and testing datasets used in the development of high-risk AI systems, as well as the source code of such systems. Providers of high-risk AI are obligated to cooperate fully with these authorities, helping to ensure that AI technologies adhere to the rigorous standards set forth by the EU AI Act.

AI regulatory developments at national level (Note)

Note – The following overview of AI development at a national level includes only a selection of countries and regions and is not intended to be exhaustive.

Europe

While the EU AI Act provides a unified framework across member states, many European countries have launched national initiatives to address local priorities.

In **France**, the French data protection authority (CNIL) released updated recommendations to help AI stakeholders assess whether their models fall within the scope of the General Data Protection Regulation (GDPR). With the aim to align innovation with privacy protections, the guidance emphasizes the need for systematic analysis and documentation of data processing risks as well as practical safeguards to prevent personal data exposure, including effective filtering mechanisms embedded within system architectures.[49]

With its economic stimulus and 'package for the future', the federal government in **Germany** committed to increase the planned expenditure of €3 billion for the promotion of AI by €2 billion, resulting in a total of €5 billion by 2025.[50] In addition, in autumn 2025, the German federal government launched its so-called 'Hightech Agenda,' a strategic investment programme aiming to strengthen technological sovereignty and competitiveness. A central pillar is an AI programme aimed at making 10% of Germany's economic output AI-driven by 2030, supported by GenAI, and sector-specific applications, as well as the establishment of AI gigafactories and expanded computing infrastructure.[51] In the **Netherlands**, growing resistance to the EU AI Act has led to a parliamentary motion calling for its postponement or simplification. The Dutch government plans to finalize its supervisory structure by Q3 2025, favouring a decentralized model where sector-specific regulators oversee high-risk AI applications. [52]

Spain is using a supervised regulatory AI Sandbox to help companies, especially small and medium-sized enterprises (SMEs), translate the EU AI Act's high-risk system requirements into day-to-day practice, by road-testing compliance mechanisms before market deployment. Lessons learned are channelled to the Spanish AI Supervisor, AESIA, and coordinated with other market surveillance authorities, such as the data-protection authorities, helping knit together privacy law and AI safety obligations during its 2025 rollout.[53] **Switzerland**, though outside the EU, is aligning with the AI Act's principles through its Digital Switzerland Strategy 2025 and plans to implement the Council of Europe's AI Convention via tailored sectoral laws, avoiding a standalone Swiss AI Act.[54]

Asia-Pacific (APAC)

Japan

On 4 June 2025, Japan publicized the new AI Act (Act on the Promotion of Research, Development, and Utilization of Artificial Intelligence-Related Technologies), which aims to advance the research, development, and use of AI.[55] For example, the EU AI Act mandates providers to have high levels of accountability for high-risk AI, such as disclosing algorithmic information. In contrast, Japan's AI Act only obliges those who develop or provide products or services using AI-related technologies, or otherwise utilize such technologies in their business activities ('Utilization Business Operators') to actively promote the efficient and advanced use of AI technologies, contribute to the creation of new industries in accordance with the fundamental

principles, and cooperate with national and local government policies under Article 7, while requiring other business stakeholders to comply with existing domestic laws related to human rights, data privacy and inclusion.[56] The Act emphasizes the protection of privacy, security, verifiability, transparency and accountability, while encouraging active collaboration with society, promotion of AI education and literacy, support for fair competition, and fostering innovation to drive sustainable economic growth and ensure that the benefits of AI are shared by all members of society.[57]

Australia

The Digital Transformation Agency (DTA) has created an AI technical standard to promote the safe and responsible use of AI within the Australian Government. This standard offers practical guidance for technical specialists and business leaders integrating AI into government systems, supporting confident experimentation and development of AI applications. It defines leading practices for the life cycle of AI systems and upholds the Government's AI Ethics Principles. By establishing a core technical foundation, the standard enhances related policies and frameworks, enabling government agencies to innovate with AI while maintaining public trust and improving outcomes for Australians.[58]

South Korea

South Korea's National Assembly passed the Basic Act on the Development of Artificial Intelligence and the Establishment of Foundation for Trustworthiness (AI Basic Act) on 26 December 2024, with the law scheduled to take effect in January 2026. This legislation aims to enhance the country's AI competitiveness and establish a trustworthy infrastructure for AI use. The Act establishes a governance framework whereby the Minister of Science and ICT will coordinate an AI Master Plan every three years, subject to the deliberation and resolution of the National AI Strategy Committee chaired by the President (formerly the National AI Committee). It also provides for the creation of the AI Safety Institute, a specialized body tasked with mitigating potential risks associated with AI to protect citizens' lives, bodies, and property.[59]

China

Since 1 September 2025, new 'Labeling Rules' require AI-generated content to carry implicit labels embedded in the file's metadata, with explicit labels clearly visible to users. This is mandatory for text, audio, images, videos, and virtual scenes where applicable. Additionally, on 25 April 2025, China's State Administration for Market Regulation and the Standardization Administration jointly issued three national standards to improve the security and governance of GenAI which will come into force on 1 November 2025.[60]

Philippines

The National AI Strategy for the Philippines (NAIS-PH) was approved in May 2025, emphasizing the need to harness AI's benefits while managing its risks. The Department of Science and Technology (DOST) led the strategy's development with input from specialists, the government, the private sector, and academia. NAIS-PH focuses on infrastructure, workforce, innovation, data governance, and AI deployment, aiming for AI to drive inclusive innovation and strengthen industries by 2028.[61]

Vietnam

Vietnam's new digital technology law, effective January 2026, aims to boost national digital transformation and support domestic tech growth. It encourages local production, technology transfer from foreign firms, and startup development with financial incentives and global market support. The law targets 150,000 businesses by 2035, offering infrastructure aid, workforce training, and tax benefits. It mandates human oversight of AI, classifying systems by risk level with strict controls on high-risk AI. The law also establishes a legal framework for digital assets to ensure transparency and compliance with international standards.[62]

Africa and the African Union AI Continental Strategy

Building an effective AI strategy has become a national priority for African countries seeking to create favourable ecosystems for innovation. This urgency underpins initiatives such as the Continental Artificial Intelligence Strategy released in 2024, which calls on member states to frame AI development around an Africa-centric, development focused approach.[63] Over the past two years, several African countries have released their own national AI strategies or vision. Across the continent, however, progress remains uneven, with countries at different stages of adoption.

Egypt

Egypt launched its National AI Strategy in 2020. This broad roadmap provides a framework for responsibly deploying AI across sectors such as health, education, agriculture, and finance. Egypt aims to position itself as a regional hub for innovation and investment. With the implementation of the strategy, it is aiming to increase the contribution of the ICT sector to Egypt's GDP by 7.7%. With the emergence of GenAI, Egypt updated its AI strategy in 2025 by releasing a second edition.[64]

Nigeria

In 2024, Nigeria launched its inaugural National Artificial Intelligence Strategy, positioning itself to harness AI's transformative power to tackle socio-economic challenges, drive innovation, and boost national productivity. Building on the establishment of the National Centre for AI and Robotics (NCAIR) and several AI-focused government programmes, the strategy provides a broad roadmap for sustainable development and research-driven growth.[65]

Côte d'Ivoire

Côte d'Ivoire published its National AI Strategy in 2024, presenting a framework designed to harness AI for inclusive, ethical, and sustainable development by 2030. As part of its implementation, the strategy proposes concrete actions such as the establishment of a National AI Agency as well as a roadmap and change management plan.[66]

Kenya

Kenya has also advanced from relying on existing ICT and data governance frameworks to launching its dedicated National Strategy on Artificial Intelligence in 2025. This ambitious roadmap aims to harness the transformative potential of AI to drive socioeconomic development and position Kenya as a continental leader in the field.[67]

South Africa

South Africa established a Presidential Commission on the Fourth Industrial Revolution (4IR) in 2019 to shape its national vision for emerging technologies, including AI.[68] Building on this foundation, the government released the National Artificial Intelligence Policy Framework in 2024, marking a pivotal step toward a broad AI strategy.[69]

Americas

Canada

As of 2025, Canada's AI regulatory landscape is in flux following the halting of Bill C-27, which included the proposed Artificial Intelligence and Data Act (AIDA). The bill was paused in January 2025 due to Parliament's prorogation after Prime Minister Trudeau's resignation.[70] In its absence, Canada has leaned on voluntary frameworks and provincial initiatives. Ontario introduced a bill requiring job postings to disclose AI use in hiring as of January 2026, while Québec enforces strict privacy rules under Law 25.[71] Federally, the government launched the Safe and Secure Artificial Intelligence Advisory Group and refreshed its AI Advisory Council, alongside publishing a guide to help organizations implement the Voluntary Code of Conduct for generative AI systems.[72]

United States of America

AI regulation in the United States reflects a combination of federal deregulation and state-level safety mandates. The Executive Order for Removing Barriers to American Leadership in AI (January 2025)[73] and America's AI Action Plan (July 2025)[74] emphasize voluntary standards and reduced oversight aimed at accelerating innovation.

Latin America

Across Latin America, regulatory efforts surrounding artificial intelligence are gaining momentum. Some countries have introduced preliminary frameworks, while others are still in early policy discussions.[75] While implementation remains uneven and largely in its early stages, there is growing interest in regulatory sandboxes and regional cooperation aimed at harmonizing standards.[76] [77] [78] [79]

Chile is updating its National AI Strategy and considering legislation modelled on the EU AI Act, with a particular focus on algorithmic transparency and the protection of fundamental rights.[80] [81] [82]

Mexico is making progress in developing a broad and inclusive AI governance framework led by the National Alliance on Artificial Intelligence (ANIA) and the new Digital Transformation and Telecommunications Agency (ATDT). The National AI Agenda proposal and the pending General Law on AI aim to balance innovation with human rights, national security, and technological sovereignty. By embracing diverse perspectives and prioritising public interest, education, and international cooperation, Mexico is progressing towards embedding a responsible and cross-sector AI framework.[83]

Argentina is progressing towards AI regulation with up to nine initiatives pending in Congress. While the projects vary in content and the extent to which lawmakers want to regulate AI, the trend is pointing towards a less regulated technological environment to foster innovation and

investment. Consequentially, OpenAI announced the plan to build the construction of a $25 billion mega data centre in the Patagonia region.[84] [85] [86]

Uruguay, though lacking a dedicated AI law, contributes to regional dialogue and has published ethical guidelines and best practices.[87] [88] [89] The country has also developed a National Artificial Intelligence Strategy, promoting the safe and responsible use of AI to benefit society and serving as the cornerstone for the implementation of a public AI policy.[90]

Colombia is working towards the development of an AI law that encompasses several initiatives. The initiative submitted by the Federal Government seeks to provide a legal framework that fosters ethical and responsible use of AI, while allowing for innovation, aiming to adhere to UNESCO and OECD´s guiding principles regarding transparency, human control and scrutiny, respect for human rights and data protection.[91]

Peru was the first country in Latin America to pass a general law regulating AI. On 5 July 2023, Law No. 31814 was enacted to promote the use of artificial intelligence for the country's economic and social development. The law aims to encourage AI adoption within the national transformation process, prioritising respect for human rights and ethical considerations.[92]

El Salvador also passed a national AI law in February 2025 providing legal protections for open-source AI development, including sandbox provisions and safeguards against third-party misuse. It establishes an AI Lab focused on research and government applications such as traffic management, water quality monitoring, and geothermal optimisation.[93] Additionally, the National Assembly passed a national law on technology and robotics in July, which aims to regulate physical AI.[94]

Middle East

United Arabic Emirates

The United Arab Emirates (UAE) has taken steps to position itself as a global AI leader through a mix of regulatory innovation and strategic talent attraction. In April 2025, the government announced plans to use AI to help draft legislation, overseen by a new Regulatory Intelligence Office, aiming to accelerate lawmaking by up to 70%.[95] Regulatory safeguards are tightening too: the UAE Media Council now bans AI-generated depictions of public figures or national symbols without prior approval, citing risks of misinformation and defamation.[96] These efforts build on the UAE's National AI Strategy 2031 and its Ministry of Artificial Intelligence, reinforcing a governance model that blends ambition with ethical oversight.[97]

Saudi Arabia

In April 2025, Saudi Arabia's Communications, Space and Technology Commission (CST) released a draft Global AI Hub Law that redefines digital jurisdiction by proposing three types of AI hubs – private, extended, and virtual – each offering varying degrees of foreign legal governance and operational models. Central to the law is the concept of 'data embassies,' allowing foreign entities to host data and services in Saudi-based hubs under their own national laws. This infrastructure-first approach aims to attract global tech firms by offering secure, scalable, and legally flexible data hosting options, while leveraging Saudi Arabia's strategic location to bridge digital divides and enhance cross-border AI deployment.[98]

Navigating AI's challenges

As AI increasingly shapes solutions to global challenges, it brings complex concerns for careful consideration. Ethical concerns and bias may risk undermining fairness, while inclusivity should be balanced to reduce further exacerbating the digital divide. Security and resilience are important to safeguarding AI systems against threats and failures. Additionally, the rapid evolution of AI can highlight gaps in skills and raise questions about its environmental footprint. This chapter delves into these multifaceted challenges, exploring how governments and industries are responding and what stakeholders should consider to implement AI responsibly and sustainably.

Building ethical and trustworthy AI

Ethical considerations are fundamental to the development and deployment of AI systems that are fair, transparent, accountable, and safe. As AI grows more advanced and autonomous, building trustworthy AI is important to maintain public confidence and meet regulatory expectations. This chapter examines the key principles, design practices, and governance frameworks that help mitigate risks such as bias, misinformation, and loss of human control, while promoting responsible and beneficial AI use. It also highlights emerging standards and regulatory efforts that guide organizations in embedding ethics throughout the AI life cycle.

Ethical considerations are central to AI development and deployment

As AI systems grow increasingly advanced and autonomous, the ethical considerations involved in their creation and use have become more important. Trustworthy AI is characterized by fairness, transparency, accountability, and safety. It forms the foundation for public trust, regulatory acceptance, and the enduring success of AI advancements.

The risks posed by untrustworthy AI are becoming more apparent. The growing use of AI as a substitute for human interaction, including as therapists or advisors, is raising concerns.[99] Other examples such as biased hiring algorithms and biases in digital advertising reveal how AI can perpetuate discrimination and compromise privacy.[100] Discussions regarding the adoption of practices such as mandatory labelling of AI-generated content, the creation of National Digital Security Centres, and regional cooperation in cybersecurity have emerged due to the surge in cyberattacks and disinformation in electoral processes in Latin America. Some countries have expanded their regulatory framework considering the protection of critical infrastructure and risk management in AI. Nonetheless, challenges in data protection and cybersecurity remain as regulatory maturity around AI is reached.[101] [102] [103] [104]

Some AI specialists warn that advanced AI models are beginning to develop behaviours that could escape human control.[105] Similarly, a growing body of research is revealing troubling emergent behaviours in advanced AI systems, particularly large language models (LLMs) configured as autonomous agents. In the absence of robust guardrails and oversight mechanisms integrated into AI design, AI systems may agree with users rather than challenge or provide alternative perspectives, which can lead to unintended consequences. A 2025 study identifies a phenomenon termed 'agentic misalignment', where AI systems may pursue goals in ways that conflict with human intent or ethical boundaries.[106] AI can also be exploited to spread mis-, dis-, and mal-information at scale, undermining societal trust and political stability. In African regions like the Sahel, low literacy levels, fragile institutions, and rising social media use create fertile

ground for harmful narratives amplified by AI-generated content. These dynamics threaten democratic processes, public safety, and social cohesion, demonstrating how malicious use of AI compounds existing vulnerabilities and governance challenges.[107]

These findings underscore the urgency of embedding ethical constraints and robust oversight mechanisms into AI design, especially as models gain greater autonomy and decision-making capacity. This is reflected in the results of a recent survey by Deloitte US, where 35% of participants identified the potential for AI-driven errors with real-world impact as the most significant barrier to adopting GenAI in the coming two years. Additionally, 29% expressed concerns that bias, hallucinations, and inaccuracies could erode trust and hinder broader implementation.[108]

However, trustworthiness goes beyond merely avoiding harm; it also involves fostering positive and beneficial outcomes. Trustworthy AI frameworks provide organizations with guidance for developing, adopting, and assessing AI technologies. Numerous governments and intergovernmental bodies have created such frameworks. Moreover, businesses can adopt various strategies and tools, such as continuous monitoring, thorough documentation, and robust AI governance, to enhance the trustworthiness of their AI systems and reduce associated risks.[109]

Design principles and ethical safeguards

Responsible AI governance involves rethinking approaches to incorporate practical steps for designing, deploying, and managing AI throughout its life cycle. In an organizational context, it is important to clearly define roles, responsibilities, and decision-making by developing clear approaches for effective oversight as well as ensuring alignment with organizational goals and ethical standards.[110]

The growing emphasis on oversight raises important questions about how to evaluate AI system performance, particularly in terms of accuracy. AI hallucination, misinformation generated by AI systems, has become a growing concern among scholars, especially as AI tools like ChatGPT gain traction across industries. Researchers argue that hallucination is an inherent trait of models like GPT, making complete elimination nearly impossible without sacrificing performance.[111] Experts suggest that eliminating hallucinations entirely may be unrealistic, not only because humans themselves misremember or invent details, but also because such errors mirror deeper aspects of human cognition that AI inevitably emulates.[112]

However, unlike human errors which often stem from cognitive limitations or misjudgment, AI hallucinations arise from the model's lack of epistemic awareness: it does not 'know' facts but generates outputs based on statistical patterns. This distinction complicates traditional notions of accuracy and calls for new frameworks to interpret and manage AI outputs. Robust guardrails, such as retrieval-augmented generation (RAG), adversarial testing, and human-in-the-loop oversight, as well as feedback loops that allow users and developers to monitor, report, and correct inaccuracies over time are essential.[113] Key takeaways from recent implementation guidance reinforce the need to treat hallucinations as a predictable and measurable feature of AI systems, not an occasional anomaly. Developers are thus encouraged to build domain-specific evaluation sets and apply precision and recall metrics to quantify factual reliability.[114]

Human-in-the-loop systems remain a cornerstone of ethical AI. The EU AI Act mandates that high-risk AI systems include effective human oversight to minimize risks to health, safety, and fundamental rights. Oversight must be proportional to the system's risk and autonomy, enabling

humans to understand, monitor, interpret, override, and safely stop AI operations. For certain systems, decisions require verification by two qualified individuals, except in specific law enforcement or border control cases.[115]

Operational guidance on insuring transparency and explainability has matured in parallel, acknowledging that opaque AI systems can undermine trust and accountability. National Institute of Standards and Technology's (NIST) AI Risk Management Framework (AI RMF 1.0) translates trustworthiness characteristics into the functions of govern, map, measure and manage across design, development, deployment and monitoring.[116] [117]

AI systems should be resistant to failure, manipulation, and misuse. Continuous monitoring and red-teaming are increasingly used to identify vulnerabilities before deployment.[118] In September 2025, the Federal Trade Commission (FTC) adopted a resolution to investigate GenAI 'companions' for safety lapses, including harmful dialogue with minors and medical misinformation.[119] These cases illustrate the need for proactive safety testing and internal governance, especially when monetization incentives may conflict with user protection.

There is a responsibility for organizations and society to use AI responsibly and ethically, with attention paid to emerging risks. As a response, some organizations are adopting structured risk management frameworks to assess and mitigate ethical risks. ISO/IEC 23894 (2025), developed by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), provides process guidance for AI risk management,[120] while ISO/IEC 42001 outlines requirements for AI management systems.[121] These standards help translate abstract principles into repeatable governance processes, helping to enable auditability and assurance.

Responses from policymakers, governments and industry

Ethical frameworks for AI are converging on a rights-based and risk-proportionate approach coupled with life cycle governance. Intergovernmental instruments now provide a coherent baseline: the OECD Council Recommendation on AI (2019, updated 2023/2024) articulates values-based principles and implementation guidance;[122] [123] UNESCO's 2021 recommendation sets a global standard centred on human rights, inclusion, transparency and human oversight;[124] and the Council of Europe's Framework Convention on Artificial Intelligence, opened for signature on 5 September 2024, establishes the first legally binding international treaty aligning AI activities with human rights, democracy and the rule of law.[125] Complementing these, the G7 Hiroshima Process issues international guiding principles and a voluntary code of conduct for organizations developing advanced AI systems, including foundation and generative models.[126] [127] Together, these instruments define the 'what' of responsible AI: safeguard fundamental rights, ensure transparency and contestability, and embed governance across the AI life cycle.

The ITU's AI Standards: From Governance to Impact report[128] highlights a broad and practical spectrum of international AI standards that can enable innovation across sectors. These include mechanisms for tracking the authenticity of digital media (e.g., watermarking and provenance standards), metrics for testing and evaluating AI models, and energy efficiency benchmarks for AI infrastructure. Standards also support interoperability for multi-agent systems, edge AI hardware integration, and automation in industrial processes, such as robotics in manufacturing and supply chains.[129]

AI Standards Exchange Database

The AI Standards Exchange Database, launched at the 2025 AI for Good Global Summit, is a collaborative platform designed to support global coordination and transparency in AI standards development. It is developed by the World Standards Cooperation and currently includes over 700 standards and technical publications. The database categorizes standards by industry verticals and human-AI activity areas, helping users understand their practical applications. The initiative emphasizes inclusive participation, coherence across standards bodies, and alignment with the Global Digital Compact. Standards organizations are invited to contribute via an online submission form.[130]

Alongside formal international standards, the G7 Hiroshima Process introduced international guiding principles[131] and a voluntary code of conduct for developers of advanced AI systems, encouraging comparable disclosures on capabilities, limitations, safeguards and incident handling, reinforcing market accountability beyond statutory requirements.[132]

Enterprises can translate these norms into governance and engineering practice through recognized frameworks. The Deloitte Trustworthy AI™ framework organizes controls across six dimensions (fair & impartial; transparent & explainable; robust & reliable; safe & secure; respectful of privacy; responsible & accountable) and is designed to integrate with public guidance such as the NIST AI RMF.[133] [134] In combination, these approaches help organizations move from principles to repeatable governance and assurance, aligned with emerging international norms.[135]

Shaping an inclusive AI economy

This chapter explores how AI can be harnessed to help foster an inclusive economy that drives growth and societal progress for all. It highlights the persistent challenges of lack of access to AI technologies and data, which risk deepening existing digital divides and negatively affect some communities. By examining sources of bias, connectivity gaps, and the need for fair access to AI resources, this chapter underscores the importance of coordinated efforts and ethical governance to help ensure AI's benefits are widely shared across populations and regions.

Understanding sources of bias and implementing responsible mitigation strategies

As AI systems become more widespread across various fields, addressing bias and ethical considerations is increasingly important. Bias can occur in various phases of the AI life cycle and can have significant real-world consequences especially when reinforcing discrimination or social inequality.[136] Addressing bias in AI systems is therefore important and this requires identifying the sources of bias as the initial step.[137]

Data bias in AI stems from the complexities and imperfections inherent in the data used to train models. Often, historical datasets carry embedded societal norms that can inadvertently influence AI outcomes. Additionally, when datasets fail to accurately represent the target population, due to limitations in data availability or sampling methods, certain groups may be underrepresented, leading to skewed results.[138] AI systems are often trained on datasets

dominated by users from the Global North, where infrastructure and digital access are more advanced. This creates algorithms that may fail to capture linguistic, cultural, and socioeconomic diversity of some regions. For example, in most African countries, the absence of standardized data policies and formal data collection bodies means the primary source of available data comes from internet and mobile users.[139] However, in regions such as sub-Saharan Africa only 37% of the population is online,[140] and among the world's top 34 languages used on the internet, not one is African.[141] This leaves limited text to be used to train large models, excluding certain populations and reinforcing the data divide.[142]

Measurement challenges also arise when proxy variables oversimplify real-world phenomena or when data collection methods vary across different populations. Furthermore, analyzing aggregated data without considering subgroup differences can mask important patterns, potentially resulting in misleading conclusions. Recognizing and addressing these multifaceted sources of bias is essential to ensuring AI systems operate fairly and effectively.[143]

In many low- and middle-income countries, structured electronic data collection remains limited. Some African innovators are taking significant steps to address bias and data limitations in AI systems. Ghanaian company Bace Group developed a facial recognition solution specifically designed to represent black African faces, reducing the algorithmic bias often present in Western-developed tools.[144]

Algorithm design itself can also be a source of bias. Errors in programming, such as an AI developer assigning disproportionate importance to certain factors during decision-making, can inadvertently become embedded within the system. While weighting is commonly used to reduce bias by adjusting data to more accurately represent the real population, it often relies on assumptions made by designers, which can introduce inaccuracies and bias. Additionally, developers may incorporate subjective rules into the algorithm that reflect their own conscious or unconscious biases.[145]

The evaluation of AI systems relies on various metrics, such as accuracy and fairness, typically measured against a benchmark or test dataset. Evaluation bias can occur at this stage because the benchmark itself may introduce bias. AI systems might perform exceptionally well on a specific test dataset, but this success may not translate to real-world scenarios due to 'overfitting' to that dataset. This matter is particularly pronounced if the test dataset contains historical, representation, or measurement biases. For example, a dataset collected in the United States may not accurately represent the population in Germany, or data gathered during the COVID-19 pandemic in 2020 might not be applicable in a medical context outside of that period. Consequently, even if bias is addressed during training, it can still emerge during the evaluation phase.[146]

To address biases in AI, systems should be designed to minimize bias and strive for inclusive representation. Since AI can interact with sensitive personal data and is created by humans who are naturally prone to bias, it is important for responsible teams to actively work on reducing algorithmic bias through continuous research and by using data that reflects diverse populations. AI data, however, can reflect societal biases, raising complex questions about acceptable standards and how to surface and remediate bias. Guardrails for AI have limitations due to the nature of AI learning from vast datasets, including problematic content.

Key actions include conducting real-time analysis to detect both intentional and unintentional biases, investigating their origins, and finding ways to mitigate them. Development should

avoid intentional biases, with regular team reviews to identify and prevent unintentional biases such as stereotyping or confirmation bias. Additionally, implementing feedback mechanisms or encouraging open dialogue with users helps raise awareness of any biases or concerns identified by those interacting with the AI.[147]

Methodologically, organizations should also identify and mitigate bias using approaches recognized by standards bodies. Guidance by the NIST characterizes socio-technical sources of bias (systemic, human and computational) and recommends combining participatory design and qualitative review with quantitative techniques (fairness metrics, disaggregated/subgroup evaluation and stress testing).[148] [149] ISO/IEC TR 24027 further details measurement techniques and mitigation practices across each life cycle phase, from data collection and model development to deployment and monitoring.[150]

Bridging the AI divide by ensuring connectivity and fair access to AI resources

A key factor for inclusive participation is connectivity. According to ITU's Facts and Figures 2024, about 5.5 billion people, roughly 68 percent of the global population, are online, leaving around 2.6 billion people without internet access. This highlights ongoing divides based on income and geography.[151] [152] [153] AI is deepening this global digital divide, separating nations with the computing infrastructure to build advanced AI systems from those without. This imbalance is reshaping global politics and economics, as countries scramble to avoid exclusion from a transformative technology race. The United States, China, and the EU dominate, hosting over half of the world's most powerful data centres, while more than 150 countries, especially in Africa and South America, lack any such facilities. These massive, costly hubs are essential for cutting-edge AI development, but their concentration among a few tech giants is reinforcing global inequalities and dependencies. This imbalance could widen economic and technological disparities, limiting the ability of lower-income nations to participate meaningfully in AI development and deployment.[154]

The growing AI divide

The UN's *Mind the AI Divide* report emphasizes that without deliberate action, AI could deepen existing inequalities across education, employment, and governance. It calls for international cooperation to help ensure access to AI infrastructure, data, and skills. The report highlights the need for public investment in AI literacy, ethical frameworks, and inclusive innovation ecosystems, particularly in low- and middle-income countries. Together, these insights underscore that building foundational AI literacy is essential not only for participation in the digital economy but also for safeguarding human rights and equal opportunity for all in an AI-driven future.[155]

Public finance and development cooperation can catalyze diffusion beyond major urban centres by supporting inclusive digital strategies, public-service transformation and regional ecosystems, as illustrated by the World Bank's Digital Economy Initiative for Africa (DE4A) programme in Africa.[156] [157] DE4A-supported operations and analytics have underpinned large-scale connectivity and digital-economy projects across multiple countries, laying the groundwork for AI-enabled services.[158]

Access also depends on fair and open availability of essential resources across the AI value chain, particularly high-quality data and computing power. This can ensure that innovators beyond the largest companies can compete effectively.[159] Recent OECD research points to potential competition challenges and highlights the need for authorities to develop policies that promote fair access to data and computing resources, alongside ongoing monitoring.[160] [161]

Responses from policymakers, governments and industry

Establishing effective ethical guardrails is fundamental to fostering societal trust and helping to ensure AI systems respect diverse global and local values. AI models predominantly trained on Western-centric data risk perpetuating cultural biases when deployed worldwide, raising complex ethical challenges. Initiatives such as the OECD's International Standards and the African Union's Continental AI Strategy strive to incorporate diverse perspectives, yet the absence of universally accepted ethical frameworks complicates consistent implementation. Recent commitments by global tech companies to align with UNESCO's Recommendation on the Ethics of AI underscore the growing emphasis on cultural sensitivity. Regional efforts in Australia, Canada, New Zealand, the Council of Europe, and Singapore further reflect tailored approaches to governance.

However, the UN's 2024 report 'Governing AI for Humanity' highlights a critical gap: many voices from the Global South remain excluded from international AI governance dialogues, risking a homogenized ethics landscape dominated by Global North perspectives. Addressing this requires inclusive, wide-ranging approaches that embrace cultural diversity.[162]

Latin America struggles to bridge the digital and talent gap, however, there are initiatives to provide AI access to a wider range of users, such as through multi-stakeholder consortia (public-private-academic) and large-scale training programmes. Both AI Atlas for Latin America and the Caribbean, and the Latin American AI Index have shown improvements in infrastructure, talent and governance, with Brazil, Chile and Uruguay ranking highest in the region.[163] Mexico is also strengthening the development of digital infrastructure hubs with high-level performance data centres which aim to be the foundation for AI initiatives, and other countries are motivating the inclusion of rural communities and vulnerable groups in AI projects.[164] [165]

Inclusive adoption of AI should be guided by the OECD AI Principles, which emphasize "inclusive growth, sustainable development and well-being." These principles aim to ensure that the benefits of AI reach a broad range of people, sectors, and regions, rather than being concentrated in a few centres of innovation.[166] They serve as a shared direction for governments and businesses striving to create opportunities while safeguarding rights and maintaining fair competition.[167]

To support inclusive AI deployment, many countries are adopting digital public infrastructure (DPI), such as interoperable digital identity systems, payment platforms, and data-exchange networks. These tools can help reduce the cost of delivering inclusive digital and AI services.[168] The 50-in-5 coalition, led by countries themselves, aims to assist 50 nations in designing and scaling at least one core DPI component by the end of 2028. This initiative seeks to create foundational systems that AI-enabled services can build upon safely and inclusively.[169]

Numerous national strategies stress the importance of collaboration across the economy. For example, the World Economic Forum's Blueprint for Intelligent Economies (2025) recommends coordinated investments in computing and data infrastructure, human capital development, and interoperable standards to foster inclusive and competitive AI ecosystems.[170] [171] Organizations like the OECD and national observatories can support these efforts by tracking policies and sharing leading practices, helping to spread AI benefits beyond leading firms and regions.[172]

As Europe seeks inclusive AI that reflects its linguistic diversity, Spain is investing in public, open resources to reduce reliance on proprietary systems. ALIA translates this ambition into shared infrastructure, aligning open science, compute access, and governance for researchers, public services, and SMEs.[173]

ALIA provides a public infrastructure of open, transparent AI resources, starting with foundation models in Spanish and co-official languages, to reduce language barriers and foster reproducible research. Early 2025 releases made initial models available for public use, with pilots in public services and research collaborations. It also promotes trustworthy AI by releasing model cards and licensing that can enable safe reuse and auditing, while coordinating compute access through EuroHPC and national research clouds. By combining open models, tooling, and governance, ALIA helps diffuse capabilities beyond big tech, increasing innovation and inclusion.[174]

AI can widen or close gaps for people with disabilities. **Spain** has reserved dedicated funding to steer innovation toward inclusion. In June 2025, it announced a €5 million call to fund AI projects that help improve quality of life for people with disabilities from assistive technologies and accessible interfaces to inclusive entrepreneurship. Administered via Red.es under the Ministry for Digital Transformation and the Civil Service, the programme signals that equal opportunity for all is a priority within the national AI portfolio. By elevating accessibility and inclusion alongside innovation, the call helps ensure AI benefits extend beyond early adopters and large enterprises, aligning with the country's broader digital-inclusion agenda and the EU's social objectives.[175]

At the same time, technological advancements are projected to remain driven by the private sector. As such, it will become increasingly important for innovative AI solutions to be more inclusive of their expanding global user base.[176]

Safeguarding privacy in the age of AI

The rise of AI has intensified the imperative to protect personal and sensitive data, making privacy a central concern in AI development and deployment. AI systems can rely on vast datasets, including highly sensitive information such as health records and biometric data, raising complex ethical, legal, and technical challenges. Allowing individuals to maintain control over their data while preventing misuse, unauthorized access, and re-identification requires effective data governance frameworks and advanced privacy-preserving technologies. This chapter explores the multifaceted privacy risks associated with AI, highlights emerging technical safeguards like differential privacy and federated learning, and reviews evolving regulatory

responses worldwide aimed at embedding privacy-by-design principles into trustworthy AI systems.

The need for privacy protection and effective data governance

AI privacy focuses on safeguarding personal and sensitive information collected, used, shared, or stored by AI systems. Closely linked to broader data privacy principles, it emphasises individuals' control over their personal data – how it is gathered, stored, and utilized. While data privacy concerns have evolved over time, the rise of AI has intensified these concerns, as AI systems can rely on vast amounts of data, including sensitive information such as health records, biometric data, and personal finance details.[177]

Privacy risks in AI are especially acute in healthcare, where the sensitivity of patient data and the complexity of clinical systems can amplify the stakes. AI models trained on clinical data can inadvertently expose identifiable patient information, especially when large public repositories are involved. This risk is compounded by the challenge of ensuring true anonymization, as advanced algorithms may re-identify individuals from seemingly de-identified datasets.

AI privacy risks can stem from multiple factors, including the collection of sensitive data without proper consent, use of data beyond agreed purposes, unchecked surveillance, and inherent biases in AI models. For example, data may be gathered without individuals' knowledge or repurposed for AI training without explicit permission, raising ethical and legal concerns. Surveillance technologies powered by AI can exacerbate privacy violations and perpetuate biases, sometimes leading to harmful outcomes. Additionally, AI systems may face threats from data exfiltration, where attackers manipulate AI inputs to extract confidential information, and data leakage, which involves accidental exposure of sensitive data. High-profile incidents have demonstrated vulnerabilities in AI models, highlighting the urgent need for effective data governance and security measures.[178]

Technical safeguards and privacy-preserving AI

As AI systems grow more powerful and pervasive, the technical challenge of protecting privacy has become central to responsible innovation. Unlike traditional software, AI models, especially those trained on large-scale datasets, can inadvertently memorize and reproduce sensitive information, even when such data was not explicitly intended for retention. To address these matters, specialists advocate for effective safeguards such as data anonymization, encryption, and privacy-preserving techniques like federated learning and differential privacy.[179]

By removing or obfuscating identifiable information, anonymization can help reduce the risk of data breaches, re-identification, and unauthorized profiling, especially in sensitive domains like healthcare and finance. Modern anonymization techniques can even be tailored to preserve data utility while meeting legal and ethical standards. This balance allows researchers and developers to train models on real-world data while remaining compliant with privacy regulations such as the GDPR.[180]

Differential privacy is another powerful technique that protects individual data privacy while allowing meaningful analysis. By introducing controlled noise into algorithm outputs, it can ensure that the inclusion or exclusion of any single individual has minimal impact on the results, providing quantifiable privacy. This approach is versatile, applicable across various data types and use cases, including image classification, web and app activity, and medical records. It also

enhances applications like search engine optimization and voice query processing by leveraging semantically related terms and natural language.[181]

Similarly, **Federated Learning (FL)** offers an innovative machine learning approach that can enable multiple data sources, such as devices or organizations, to collaboratively train a shared model without centralizing raw data. By keeping data local, FL reduces privacy risks and complies with regulatory constraints, making it especially valuable in sensitive contexts. Its applications are wide-ranging, including personalized recommendations, healthcare analytics, data ecosystems, and autonomous transportation, where privacy and data security are critical.[182]

Good practice in privacy protection and data governance for AI begins with privacy-by-design anchored in internationally recognized norms, notably the OECD Council Recommendation on AI, which embeds respect for human rights, including privacy, as a foundation for trustworthy AI.[183] [184] The UN's *Governing AI for Humanity* report (2024) stresses that privacy must be treated as a foundational design principle, not a retroactive fix. This includes limiting model capacity to memorize data, auditing training sets for sensitive content, and implementing real-time monitoring of outputs for potential privacy violations.[185]

Responses from policymakers, governments and industry

Policymakers have been working to safeguard individual privacy from technological advances since at least the 1970s. However, the expansion of commercial data collection and the rise of AI have intensified the need for broad data privacy legislation.[186]

A notable example is the General Data Protection Regulation (GDPR), an EU law effective since May 2018, that regulates how organizations worldwide handle the personal data of EU residents. It sets legal standards for data transfer and processing, mandates protection of data both at rest and in transit, and grants individuals rights over their personal information. GDPR defines personal data broadly, covering both direct identifiers like names and credit card numbers, and indirect identifiers such as physical traits or birth dates. The law applies globally to any entity processing the personal data of EU citizens, regardless of where the organization is based.[187]

Several African countries have adopted the European GDPR as a benchmark for developing their own data protection frameworks. In Ghana, for instance, the Data Protection Commission (DPC) is actively enforcing compliance by publicly naming non-compliant entities and collaborating with regulators across the continent to harmonize and standardize data protection laws.[188] In Nigeria, the Data Protection Act 2023 introduces safeguards that promote ethical AI practices. These directives help to ensure lawful, fair, and transparent data processing, grant individuals rights over their personal data, and protect them from certain automated decisions.[189]

China's Interim Measures for the Administration of Generative AI Services, effective from August 2023, set out rules for public-facing GenAI tools, emphasizing alignment with socialist values, user protection, and national security. The measures require providers to conduct security assessments, ensure transparency and accuracy, and implement content filters to prevent harmful outputs. While encouraging innovation and international cooperation, the framework mandates algorithmic filing and compliance with broader digital governance laws, marking a shift toward guided regulation over strict enforcement.[190]

Building an AI-ready workforce

AI is reshaping the nature of work by transforming job roles, skill requirements, and industry dynamics. AI is driving a reconfiguration of the global labour market, fostering the emergence of new opportunities and augmenting human capabilities across sectors. As advanced systems such as agentic AI accelerate workplace change, the emphasis is shifting toward adaptation: equipping individuals with the skills and literacy needed to collaborate effectively with intelligent technologies. This chapter explores how AI is influencing employment patterns, skill development, and policy responses, underscoring the importance of proactive strategies to help ensure inclusive and sustainable workforce transformation.

AI's impact on jobs and skills requires navigating workforce evolution

According to the World Economic Forum's Future of Jobs Report 2025, AI is expected to reshape the global job landscape by 2030, with 92 million roles evolving or transitioning, and 170 million new opportunities emerging.[191] Agentic AI, with its advanced capabilities, is accelerating workplace transformation faster than many anticipated.[192]

Employers anticipate that 39% of key job market skills will change by 2030. The growing emphasis on continuous learning, upskilling, and reskilling programmes is helping companies better prepare for evolving skill demands. Technological skills, especially in AI, big data, networks, cybersecurity, and technological literacy, are projected to grow in importance more rapidly than other skill sets over the next five years.[193]

The impact of AI transformation also varies significantly across sectors. Software development faces substantial disruption. Code generating platforms provide vast datasets that AI tools use to autonomously write code. Currently, three-quarters of developers employ AI assistants in their workflows. Similarly, customer support is highly susceptible to AI automation due to the abundance of data; IBM reports that AI-driven systems analyzing calls, emails, and tickets can reduce costs by 23.5%.[194]

Industries like marketing consulting, graphic design, office administration, and call centres have experienced employment growth below trend, attributed to AI-driven efficiency gains.[195] Sectors such as healthcare, construction, and education lag in AI adoption, primarily due to limited public construction data availability and stringent privacy regulations concerning patient and student information.[196]

Goldman Sachs research suggests that widespread AI adoption could lead to significant shifts in the US labour market, affecting 6–7% of current roles. However, this transition is expected to be temporary, as new job opportunities, driven directly by technological innovation and indirectly by increased economic output and demand, are likely to offset these changes. Notably, around 60% of US workers today are employed in occupations that did not exist in 1940, underscoring that more than 85% of employment growth over the past decades has been fuelled by technological progress.[197] Nonetheless, a transitional period of labour market adjustment may occur as workers navigate shifts in job roles and seek new opportunities aligned with emerging technologies.[198]

AI complements human labour by enhancing efficiency and creating new opportunities

Studies indicate that AI often complements human labour by enhancing and supporting job tasks. This conclusion is drawn from worker perceptions and the growing use of AI tools in roles that augment human skills. Additionally, AI integration can foster sustainable practices and entrepreneurial opportunities, driving business innovation and environmental efficiency. Workers increasingly perceive AI as a value-added component of their jobs, especially in sectors focused on sustainable development.[199]

Several studies suggest that AI often augments rather than replaces workers, challenging the common perception that it can lead to widespread job losses.[200] Nevertheless, with approximately one in three job vacancies in OECD economies exposed to AI, a portion of the workforce is influenced by AI's rise.[201] This trend is increasing demand for both specialized AI professionals and workers with a general understanding of AI.[202]

Importantly, most workers exposed to AI do not require specialized skills. Instead, they need general AI literacy to effectively use and interact with AI systems. Training programmes should therefore focus not only on advanced AI skills but also on building foundational AI knowledge. AI literacy can enable workers to communicate and collaborate effectively with AI technologies, understand AI ethics, recognize potential risks, and critically evaluate AI tools as they use them.[203]

Responses from policymakers, governments and industry

With the recent surge in AI adoption, many countries have made significant progress in offering publicly funded training programmes focused on AI skills development.[204]

Singapore's SkillsFuture for Digital Workplace 2.0 initiative targets adults in roles likely to be impacted by AI, particularly those with lower skill levels. The programme covers four key areas: automation, cybersecurity risk, data analytics, and in-demand digital tools. It offers two-day courses subsidized through the SkillsFuture Credit scheme, which provides SG$500 in training credits to Singaporeans aged 25 and above, helping to offset training costs.[205]

The **United Arab Emirates (UAE)** has launched the ambitious '1 Million AI Talents in the UAE' programme in collaboration with Microsoft. Aiming to equip government teams with future-ready AI skills by 2027, the initiative offers four tracks, 'AI for Everyone,' 'AI Academy,' 'AI for Champions,' and 'AI for Leaders,' available both in-person and virtually. This reflects the UAE's commitment to building a highly skilled national workforce, accelerating AI adoption across key sectors, and enhancing its global competitiveness in AI.[206]

Africa-based initiatives, such as Alliance4AI, the African AI Foundation and ALX aim to bridge the AI skills gap in the region. Alliance4AI goes beyond traditional learning by offering a self-learning toolkit for learners at all levels.[207]

Countries like **Egypt**, **Senegal**, **Morocco**, and **Tunisia** are also advancing in STEM and AI education reform. In Egypt, for example, the government is collaborating with universities and tech companies to modernize degree programmes and introduce AI awareness initiatives for younger students, focusing on topics like machine learning, data ethics, and AI applications.[208]

Nigeria is also implementing measures to expand access to AI education through government-led programmes like the 3 Million Technical Talent (3MTT) initiative and the introduction of Digital Technologies as a core subject in secondary schools by the Ministry of Education, alongside a US$1 million partnership with Microsoft to train one million Nigerians in AI and digital skills.[209] [210]

As **Spain** readies the operational rollout of EU AI rules and pursues administrative modernization, the civil service faces rising demands for digital capability. INAP (Spain's National Institute of Public Administration) positions skills as the enabling lever, framing a multi-year approach to embed AI literacy, governance, and safe adoption across government.

Building on this framework, INAP is scaling AI training under its 2025-2028 Learning Strategy, complemented by recurring calls for courses in the second half of 2025. The programme blends online and in-person delivery, emphasizes lawful and ethical AI, and targets administrative roles where automation can streamline routine work. By upskilling civil servants and guiding safe adoption inside government, the initiative reduces disruption risks for public employees while improving service productivity.[211]

Environmental sustainability in AI

The increasing use of AI is driving demand for energy, particularly in data centres that power AI model training and deployment. These facilities consume vast amounts of electricity, and their energy needs are projected to more than double by 2030,[212] raising concerns about sustainability and resource management. This chapter examines the environmental impact of AI-related energy consumption, highlighting regional disparities in electricity and water use, especially in water-stressed areas. It explores emerging solutions such as sustainable data centres powered by renewable energy, innovative energy-efficient algorithms, and novel infrastructure models including offshore floating data centres. The chapter also reviews international initiatives and government policies aimed at balancing AI's transformative potential with responsible energy stewardship to support a sustainable digital future.

AI and energy: Navigating the increase in data centre electricity consumption

Affordable, reliable, and sustainable electricity supply is an important factor for AI development. Countries capable of delivering the necessary energy at scale and speed will be best positioned to benefit. Training and deploying AI models requires large, power-intensive data centres. A typical AI-focused data centre consumes as much electricity as 100,000 households, with the largest currently under construction expected to consume 20 times that amount.[213]

In 2024, data centres accounted for approximately 1.5% of global electricity consumption, or 415 terawatt-hours (TWh). While AI represents only one of many workloads handled by data centres, the growing demand for AI-related services is driving rapid investment and expansion in this sector. Global investment in data centres nearly doubled since 2022, reaching half a trillion US dollars in 2024, highlighting the escalating electricity demand.[214]

The United States leads in data centre electricity consumption, accounting for 45% of the global total, followed by China at 25% and Europe at 15%. Since 2017, data centre electricity use has grown by about 12% annually, more than four times faster than overall electricity consumption. Projections indicate that by 2030, data centre electricity demand will more than double to around 945 TWh, exceeding Japan's current total electricity consumption. AI is the primary driver of this growth, alongside increasing demand for other digital services. The United States is expected to contribute the largest share of this increase, with China following closely. In the United States, data centres are projected to account for nearly half of the country's electricity demand growth through 2030.[215] [216]

Renewable energy and natural gas are leading sources for meeting expanded data centre electricity needs, with renewables expected to supply half of the global growth in demand. This expansion is supported by energy storage solutions and the broader electricity grid, with renewable generation projected to increase by over 450 TWh by 2035 to accommodate data centre requirements.[217]

The adoption of AI across private, public, and consumer sectors has heightened concerns about its environmental impact. Although high-performance AI systems can deliver significant economic and operational benefits, they can also contribute substantial digital emissions due to energy-intensive training processes, continuous inference workloads, and a hardware supply chain reliant on resource-intensive extraction.[218]

Advancing sustainable AI infrastructure through sustainable data centres

In response to the growing energy demands and environmental concerns associated with AI and data centres, the development of sustainable data centres has become an industry focus.[219] Sustainable data centre design now incorporates innovative solutions aimed at reducing environmental impact while ensuring the high-performance computing required for AI applications.

An advancement in this area is the increased adoption of renewable energy sources. Some organizations are investing in solar, wind, and hydroelectric power to decrease reliance on non-renewable energy sources and lower carbon emissions. For instance, Google has pledged to operate entirely on carbon-free energy by 2030. Similarly, Microsoft has pioneered underwater data centres powered by offshore wind energy.[220]

Research institutions are contributing to this evolution by developing novel energy-efficient algorithms and machine learning techniques. Their work focuses on optimizing resource use at multiple levels, including data acquisition through methods like compressed sensing and event-based sampling; algorithm execution by leveraging edge, fog, and cloud architectures to distribute machine learning efficiently; and data transmission by processing information as close to its source as possible, thereby reducing communication to essential features and results.[221]

ITU Green Digital Action (GDA)

Digital technologies enhance efficiency, reduce waste, and lower carbon footprints across sectors. However, the global digital industry must also address its own environmental impact. To this end, the ITU and over 50 global organisations launched the Green Digital Action initiative to promote sustainability through digital innovation.[222] Under the GDA's Green Computing pillar, the sub-working group on Sustainable AI is tasked with identifying gaps in measuring and testing different AI workloads to improve our understanding of this technology's environmental footprint.[223]

By establishing standardised metrics, the GDA initiative aims to provide clear, reliable data that supports strategic decision-making in both public and private sectors. This will help optimise AI operations for sustainability, challenge misconceptions about AI's environmental effects, and encourage collaboration among organisations committed to greener AI practices. Ultimately, the initiative seeks to align AI development with environmental stewardship, contributing to a more sustainable technological future.[224]

Responses from policymakers, governments and industry

A global conference on energy and AI held in December 2024 included a high-level roundtable to develop strategic insights into the intersection between energy and AI, alongside a technical forum for specialists. Canada announced plans to develop a formal approach to AI and energy matters, to be established in 2025 during its G7 Presidency. South Korea, which hosted the 2025 APEC Energy Ministerial as well as the Clean Energy and Mission Innovation Ministerials, also pledged to advance key discussions on energy and AI.[225]

As AI scale drives up energy and hardware demands, **Spain** is pairing industrial policy with sustainability goals, backing compute-efficient techniques that shrink models, reduce power use, and enable deployment beyond hyperscale data centres. In June 2025, Spain authorized a €59.2 million, public investment, via the state-owned Sociedad Española para la Transformación Tecnológica (SETT), into Multiverse Computing, a Spanish quantum-inspired software company. The operation, executed under the Next Tech co-investment fund, targets a technology that compresses large language models (LLMs) by up to 97%, reducing energy and cost while enabling AI to run on resource-constrained devices (from smartphones to satellites). The government frames the move as strategic autonomy plus sustainability: fewer parameters and lighter inference lower electricity needs, ease cooling pressure, and broaden access to efficient AI capacity across sectors such as finance, energy, logistics, space, health and defence. The press dossier cites more than 140 patents, performance gains, and a jobs plan of more than 300 direct and 1,000 indirect roles centred in San Sebastián. By tying public capital to measurable efficiency, Spain signals that sustainable performance is part of the licence to scale.[226]

One strategy to attract investments in sustainable data centres and AI projects for **Latin America** countries is to use the influence of their renewable energy matrix. For these countries, responsible resource use and mitigation of environmental impact are being considered when integrating sustainability criteria into their AI policies.[227] [228] [229]

Teraco, a digital realty company, begun construction of a 120 MW solar photovoltaic (PV) power plant in **South Africa**'s Free State province in 2024. This is an important milestone for data centre operators, as the aim is for Teraco to own the plant and wheel renewable energy directly to its data centres in municipalities like Ekurhuleni and Cape Town. The initiative aims to sustainably power cloud and AI computing applications, assisting to address South Africa's energy constraints and supporting digital transformation across Africa. The plant, expected to be operational by late 2026, is projected to generate over 354,000 MWh annually. This project is part of Teraco's broader renewable energy strategy and sets a precedent for municipal energy distribution in South Africa.[230]

How AI is being used to tackle global challenges

Education and skills development

AI is transforming education and skills development by helping to enable personalized learning, enhancing assessment, and addressing digital skills gaps worldwide. It offers innovative solutions to improve access, tailor instruction to individual needs, and support educators in delivering more effective teaching. However, the rapid integration of AI in education also raises important ethical, fairness and equal opportunity for all concerns, including data privacy, digital divides, and the risk of exacerbating existing inequalities. This chapter explores how AI-driven tools and initiatives are reshaping pedagogies and labour markets, while emphasizing the need for inclusive policies and infrastructure to ensure that the benefits of AI-powered education reach all learners.

Bridging educational opportunities and labour market shifts through AI

AI presents an opportunity to address some of the challenges in education today, driving innovation in teaching and learning practices and accelerating progress.[231] As AI becomes increasingly embedded in education systems, it is reshaping pedagogies, curricula, and governance structures. However, this rapid integration also raises concerns around fairness, ethics, and human agency, encouraging education systems to carefully navigate concerns such as digital surveillance, systemic biases, and the potential erosion of human accountability in decision-making.[232]

The accelerating capabilities of AI, which is beginning to outperform humans in areas like reading, mathematics, and scientific reasoning, compel a reassessment of educational priorities. Educators and policymakers must determine which skills to emphasize, which to phase out, and how teaching methods should evolve to prepare learners for an AI-influenced world. This evolution also prompts deeper reflection on the overarching goals of education as AI's cognitive, physical, and social capacities continue to advance.[233]

These shifts in education intersect with broader labour market dynamics. In some OECD regions, employment growth has led to labour shortages, particularly in densely populated urban centres and areas experiencing demographic decline. GenAI offers potential to alleviate these shortages and enhance productivity, yet its impact can be unevenly distributed. For instance, 45% of workers in certain urban regions face significant exposure to AI, compared to only 13% in some rural areas, risking the exacerbation of existing urban-rural divides.[234] This uneven exposure reflects a broader pattern where digital technologies have historically widened inequalities within and between countries, including in education access and outcomes.[235]

On the other hand, AI could boost productivity for certain segments of the workforce, especially those in high-skilled, high-paying professions. This dual effect underscores the urgency of equipping learners with important future skills, such as collaborative problem-solving, which could contribute an estimated US$2.54 trillion in global productivity gains. Notably, the greatest relative benefits from such investments are expected in regions like sub-Saharan Africa and Latin America and the Caribbean, highlighting the importance of inclusive education strategies that bridge digital divides and foster growth.[236] [237]

In summary, while AI can offer opportunities to transform education and labour markets, realizing its potential may require deliberate efforts to address ethical concerns, ensure access, and recalibrate educational goals and practices to prepare learners for a rapidly changing world.

AI Skills Coalition

The AI Skills Coalition, launched by the International Telecommunication Union (ITU) under the AI for Good Impact Initiative, is a global platform aimed at closing the AI skills gap through inclusive and accessible education. It responds to the UN's call for a global AI capacity-building framework and is supported by the Global Digital Compact and WTSA-24 Resolution COM4/AI.

The coalition brings together over 25 organizations, including governments, academia, industry, and civil society, to help equip professionals across sectors with AI knowledge. It prioritizes learners from developing and LCDs. Key goals include fostering AI literacy, promoting ethical and sustainable AI use, and enabling countries to leverage AI for development and governance.[238]

AI-driven personalized learning through intelligent tutoring systems and adaptive learning platforms

Many education systems face challenges in addressing the growing digital skills gap, which is important for students' future employability and responsible use of technology. Bridging this gap is important for preparing an AI-ready workforce capable of meeting evolving job demands.[239]

AI can offer a pathway to enhance digital literacy, critical thinking, problem-solving, and creativity among learners. Whether integrated through traditional classroom methods or innovative approaches, AI plays a key role in shaping the workforce of tomorrow.[240] This potential is particularly important given that approximately 250 million children worldwide are currently out of school, meaning they are not enrolled in primary or secondary school. AI-powered tutors could help generate personalized learning materials tailored to individual needs and capabilities, making education more accessible regardless of location.[241]

Research shows that individual tutoring significantly improves learning outcomes, with tutored students outperforming 98% of their peers in conventional classroom settings. However, providing personalized tutoring at scale can present economic challenges. AI helps to address this hurdle by enabling customized learning experiences that adapt to each student's pace and style, thereby enhancing academic performance and catering to varied learning needs. Customizable interfaces are especially valuable for neurodiverse students and those with varying physical abilities.[242]

Despite these advantages, Intelligent Tutoring Systems (ITS) can face limitations, including high development costs, limited emotional intelligence, and the risk of diminishing essential face-to-face interactions. They can be less effective for complex or creative subjects, underscoring the need to balance AI-driven tutoring with traditional teaching methods to help ensure a broad education. Nonetheless, ITS can provide numerous benefits: they personalize content by adjusting lesson difficulty and pace, offer immediate feedback to help students correct mistakes

promptly, and scale personalized learning to reach many students simultaneously. Additionally, ITS uses performance data to inform curriculum improvements, enhancing instructional quality and accessibility.[243]

AI-powered assessment and analytics

The integration of AI in education offers the potential to transform assessment and analytics. AI-enabled assessments can provide educators with valuable insights, from identifying learning trends to supporting the evaluation of non-standardized tests. By harnessing AI's capabilities, educators can accelerate the assessment process, delivering timely feedback to students and enabling more focussed and effective engagement. Real-time analysis allows teachers to pinpoint individual strengths and weaknesses, facilitating targeted instructional strategies that better address learners' needs.[244]

Delivering high-quality math education requires frequent, detailed feedback that helps students understand not only what they got wrong but also why. In public education settings, where one teacher often manages many students, providing this level of personalized feedback consistently can be a challenge. Consequently, such tailored support has traditionally been limited to costly private tutoring, making it inaccessible to many learners.[245]

Connectivity as a foundation for digital inclusion and access to education

AI is changing how people learn, teach, and understand the world, but this transformation may be occurring unevenly. Approximately one-third of the global population remains offline, limiting access to the most advanced learning models to those with subscriptions, adequate infrastructure, and linguistic advantages. These disparities not only restrict who can benefit from AI but also influence which knowledge, values, and languages dominate educational systems increasingly shaped by AI.[246]

Connectivity can offer vast possibilities in an increasingly digital world. Although mobile network coverage reaches 92% of the world,[247] over 2.6 billion people[248] still lack internet access. While the absence of internet does not entirely prevent children from receiving an education, it can significantly limit the learning opportunities that connectivity enables.[249]

Research indicates that improving internet access and digital tools in schools, alongside complementary measures such as device availability, relevant content, and support for teachers and students, can help equalize educational opportunities from an early age. These benefits extend beyond individual learners to society. Internet connectivity helps to enhance the quality of education by providing students and teachers with access to vast learning resources and materials, unrestricted by geography and available to those who are connected.[250]

Giga

Problem: Today, nearly half of the world's six million schools remain offline; leaving millions of children without access to digital learning and opportunity. This lack of connectivity means that many children have fewer opportunities to learn and fulfil their potential. Closing this digital divide requires global cooperation, leadership and innovation in finance and technology.

Solution: Giga, a joint initiative by ITU and UNICEF, helps governments close this digital divide by mapping school connectivity in real time and identifying infrastructure gaps at scale, using AI and open geospatial data. Using schools as anchor points, Giga extends connectivity to surrounding communities, driving digital inclusion, economic growth, and sustainable development.

Impact: Since its launch in 2019, Giga has successfully mapped the locations of 2.2 million schools across 143 countries. In April 2025, over 95,000 schools across 29 countries reported real-time connectivity. More than 11 million students have benefitted from increased access to connectivity, thanks to Giga's technical support and open-source connectivity solutions.[251]

Beyond internet connectivity, AI systems need a powerful, reliable energy supply that is greater than other commercial digital technologies. While access to electricity in Sub-Saharan Africa has grown substantially over the last two decades[252], only half of the population has access today and approximately 71% of firms experience electrical outages.[253]

Key considerations for stakeholders

OECD Secretary-General highlighted the urgent need for policies that enhance digital infrastructure, improve digital literacy, and support SMEs to ensure that the benefits of AI are inclusive and effectively address local skills shortages.[254]

Given AI's potential to promote educational opportunities for all, it is important that AI-enabled educational innovations prioritize fairness in their design. This involves tackling disparities between public and private schools and among children with differing abilities and learning styles. Additionally, removing language and access barriers is important to help ensure that AI-driven education is accessible to learner.[255]

Health and health care

As the world approaches 2030, overall progress toward health-related goals and global targets remains insufficient. Although declines have been observed in mortality rates for key indicators including maternal mortality, child and neonatal mortality, premature non-communicable disease (NCD) mortality, injury mortality, and deaths linked to unsafe water, sanitation, hygiene (WASH), and air pollution these improvements are either too slow or have stalled. Consequently, current trends indicate that the global targets for these health indicators are off track and unlikely to be met without accelerated efforts.[256]

AI is transforming health and healthcare, offering solutions that extend from prevention and early detection to treatment optimization and health system efficiency. The global market for AI in healthcare, valued at US$29 billion in 2024, is projected to reach US$504 billion by 2032.[257]

Over the past decade, AI has evolved from experimental research in medical imaging and diagnostics to real-world applications that help support clinicians, patients, and health systems. Early uses focused on pattern recognition in radiology, pathology, and ophthalmology, where AI could process vast datasets to detect anomalies more quickly and accurately than human specialists. Now, AI is increasingly embedded into electronic health records (EHRs), conversational agents, drug discovery pipelines, and public health surveillance. Today, 94% of healthcare organizations consider AI central to their operations, and 86% are already using AI extensively.[258] [259]

This chapter explores the evolving role of AI in healthcare, highlighting real-world applications, ethical considerations, and the collaborative efforts required to help ensure effective, and trustworthy AI-enabled health systems worldwide.

Diagnostics and early detection

Traditional diagnostic methods often depend on the subjective interpretation of medical professionals, which can lead to variability in outcomes. AI helps reduce this variability by delivering consistent, data-driven insights, resulting in more reliable diagnoses.[260]

Early diagnosis is important for improved treatment outcomes. For instance, breast cancer detected at stage one has a five-year survival rate exceeding 90%. In contrast, colorectal cancer diagnosed at later stages has a five-year survival rate of only 14%, which improves dramatically to around 90% with early detection.[261] AI-assisted diagnostic tools are achieving impressive accuracy, with ultrasounds detecting breast cancer at a 97% success rate and other AI diagnostic systems performing between 90% and 95% accuracy in specific cases.[262] [263]

India's healthcare system faces challenges including high disease prevalence, limited rural access, and a shortage of skilled healthcare workers. AI is emerging as a valuable tool to address these matters by enhancing early disease detection, predicting health risks, and supporting treatment decisions. Studies demonstrate that AI-powered tools can accurately diagnose conditions such as malaria, diabetes, kidney disease, and tuberculosis, helping to enable earlier intervention and better management of chronic illnesses. These technologies are particularly beneficial in underserved communities with scarce resources. However, successful AI implementation requires addressing challenges related to data privacy, algorithmic bias, and infrastructure gaps. With appropriate policies and ongoing development, AI can improve healthcare accessibility and effectiveness across India.[264]

Beyond diagnostics, AI is improving operational efficiency. In the United States, Cedars-Sinai has launched Cedars-Sinai Connect, a virtual AI care platform that has served over 42,000 patients. Based on patient feedback, 77% of AI-generated recommendations were rated as optimal, outperforming physicians' recommendations, which received a 67% optimal rating.[265]

NHS

Problem: Strokes are a leading cause of serious disability in England[266], with rapid diagnosis and treatment critical to improving outcomes. However, interpreting brain scans to determine the type and severity of a stroke is complex and requires specialist doctors, potentially causing delays in treatment. These delays can reduce the chances of recovery and increase the risk of long-term disabilities such as paralysis and memory loss.[267]

Solution: The NHS has equipped all 107 stroke centres in England with a revolutionary AI scanning system that analyzes brain CT scans within a minute. This AI tool quickly identifies stroke type and severity, helping doctors to make faster treatment decisions, including whether emergency surgery or drugs are needed. The system reduces the average time to treatment from 140 minutes to 79 minutes, significantly speeding up intervention.[268]

Impact: The AI technology has tripled the proportion of stroke patients recovering with no or only slight disability, from 16% to 48%, in NHS pilot programmes. With all stroke centres now using the tool, it is expected to improve care for around 80,000 stroke patients annually in England, helping half of them recover and likely avoid serious disability. This represents a major advancement in stroke care and patient outcomes.[269]

Drug discovery and development

The development of new medicines is a complex, resource-intensive process with a high failure rate. Approximately 90% of drug candidates fail during preclinical or clinical trials, and it can take over a decade to assess their effectiveness. The vast scale and complexity of scientific data involved in drug discovery can present significant challenges. While computational methods have improved data collection and analysis, they have historically fallen short of addressing the full magnitude of these challenges, leaving room for further advancements to accelerate drug development and improve success rates.[270]

Traditionally, drug development has relied on specialist experience and trial-and-error approaches, making it a lengthy and intricate process. The emergence of AI, particularly LLMs and GenAI, is beginning to revolutionize this field. AI-driven techniques are enhancing speed and success across the entire drug development cycle, from identifying disease targets and discovering new compounds to conducting preclinical and clinical trials and monitoring drugs post-market.[271]

In medicinal chemistry, AI significantly improves the prediction of drug efficacy and toxicity, areas traditionally dependent on slow, costly, and variable experimental methods. Machine learning algorithms analyze extensive datasets to detect patterns that may elude human researchers, enabling faster and more accurate identification of bioactive compounds with reduced side effects. For example, deep learning models trained on known drug compounds can accurately predict the biological activity of novel compounds. AI can also aid in toxicity prevention by learning from large databases of toxic and non-toxic substances.[272]

Moreover, AI plays an important role in identifying drug – drug interactions, which occur when multiple medications are taken simultaneously and may cause adverse effects. Machine learning models can predict these interactions by analyzing vast datasets, supporting the development of safer combination therapies. This capability is especially important in personalized medicine, where treatments are tailored to individual genetic profiles to minimize risks.[273] Meanwhile, AI-driven analysis of data from continuous glucose monitors in wearable devices is revolutionising diabetes management by providing real-time insights that optimize treatment and lifestyle adjustments.[274]

C2itech

Problem: Traditional methods for testing drugs against respiratory viruses can be slow and expensive, causing delays in delivering treatment during outbreaks. Current tools may also lack the ability to accurately predict high-risk viral variants, limiting proactive vaccine development. These challenges are especially acute in developing regions, where access to affordable, personalized treatments for respiratory diseases is limited, exacerbating healthcare disparities.

Solution: The AI-Enhanced Organoid Platform seeks to transform pandemic preparedness and personalized medicine by combining advanced AI technologies with 3D organoid models. This platform uses deep learning algorithms trained on 3D organoid data to simulate human respiratory tract responses to pathogens such as COVID-19 and influenza. Additionally, GenAI can analyze viral genome sequences to predict high-risk mutations, enabling pre-emptive vaccine design. This integration optimizes drug discovery processes and enhances the accuracy and speed of viral mutation forecasting.

Impact: The platform could lead to significant global health benefits by accelerating drug discovery and enabling personalized treatments for respiratory diseases, which are leading causes of mortality worldwide. It can reduce drug screening times by up to 50% and achieve 90% accuracy in predicting viral mutations, thereby lowering outbreak risks. By offering low-cost, AI-driven diagnostics and treatment plans, particularly for underserved regions, it can improve access to personalized medicine. The initiative also supports the development of future researchers through open-access AI tools and certification programmes in organoid technology. By integrating biotechnology and AI, the platform contributes to pharmaceutical innovation and new standards in drug development and healthcare delivery. Collaborations with organizations such as the WHO, Institut Pasteur, and ASEAN health agencies facilitate global knowledge sharing and access to these advanced healthcare solutions.[275]

Conversational AI and virtual health assistants

In healthcare, timely access and personalized care are important factors that can influence patient outcomes.[276] A recent study in the United States found that one in four consumers cannot obtain the care they need when they need it.[277] Globally, the situation is even more concerning: progress in health service coverage has stalled since 2015, while the proportion of people facing high out-of-pocket health expenses has steadily increased since 2000.[278]

Conversational AI and virtual health assistants offer solutions to improve healthcare access by providing affordable, on-demand medical guidance. These technologies can reduce the need for costly in-person visits, alleviate financial burdens, and enhance access to care.[279]

Conversational AI enables machines to communicate naturally with humans. Early AI customer service tools relied on basic chatbots with scripted responses, but modern conversational AI includes advanced chatbots and virtual assistants trained on extensive human dialogue datasets, allowing them to handle complex interactions beyond simple queries.[280]

Patient-facing conversational AI agents perform a variety of tasks, including symptom self-diagnosis, treatment recommendations, medication management, appointment scheduling, and medication reminders. These agents operate through multiple modalities such as text-based chatbots, voice assistants, and wearable devices.[281] However, challenges remain, including concerns about data security, accuracy, and the risk of responses that fail to address the needs of underrepresented communities.[282]

In many regions, traditional mobile health apps and online content fail to reach those most in need. Organizations like Ele-vate AI Africa are addressing this gap by fostering inclusive AI and robotics ecosystems led by women and youth across East, West, Central, and Southern Africa. Partnering with institutions such as the African Union Development Agency (AUDA-NEPAD) and the African Union High-Level Panel on Emerging Technologies, Ele-vate AI Africa aims to empower communities to develop their own solutions.[283]

MamaMate

Problem: Each year, over 30 million women in Africa give birth, many with limited or no access to postnatal education and support. Approximately one in five new mothers' experiences postnatal depression, and the absence of early guidance often results in long-term developmental challenges for their children.

Solution: MamaMate is an AI-powered device designed specifically for first-time mothers in rural and underserved regions. Recognizing the challenges of unreliable internet access and low digital literacy, MamaMate operates offline, powered by solar or USB energy, and communicates directly with mothers in their native languages. The device assists with tracking baby care routines, provides culturally relevant health advice, monitors mental well-being through voice prompts, and offers anonymous emotional support from other mothers.

Impact: By delivering accessible, voice-enabled support in local languages, MamaMate helps empower mothers to feel informed, confident, and connected. The initiative prioritizes women and youth, groups often excluded from high-tech solutions. After winning the AI for Good Innovation Factory Pitching competition in July 2025, the team plans to expand MamaMate's reach across Africa, beginning with enhanced deployments in Tanzania and South Africa.[284]

Key considerations for stakeholders

The ethical and effective deployment of AI in healthcare hinges on several interconnected considerations. Providing access across all populations, thereby lessening existing health disparities. At the same time, safeguarding sensitive health data through effective privacy and security frameworks is essential to maintain patient trust and comply with regulatory standards.

AI systems should undergo rigorous clinical validation and adhere to clear regulatory pathways to help ensure their safety and efficacy. However, AI is not intended to replace clinicians but to augment their capabilities, supporting decision-making while preserving the essential human element of care. For AI solutions to be sustainable and scalable, stakeholders should carefully evaluate factors such as cost, interoperability, and infrastructure readiness.

Achieving these goals could benefit from close collaboration among AI engineers, data scientists, and healthcare domain specialists to develop solutions that are both impactful and ethical.[285] A first step for organizations is to assess their data and technology readiness before investing resources. In healthcare, this often involves integrating fragmented data from diverse sources such as electronic health records, claims data, marketing information, and call centre systems across multiple platforms and formats.

By addressing these challenges holistically, healthcare providers can harness AI's potential to improve diagnostics, enhance patient outcomes, and deliver care to populations.[286]

Environmental sustainability

Facing environmental challenges, AI offers tools to enhance climate adaptation and resilience by improving data analysis, early warning systems, and resource optimization. Realizing this potential can demand coordinated investment in digital infrastructure, inclusive governance, and access, especially in vulnerable and emerging regions. Collaboration among public and private sectors and civil society can help ensure AI supports sustainable development. This chapter discusses AI's applications in disaster preparedness, biodiversity conservation, and energy optimization, as well as the policy frameworks and capacity-building efforts needed to maximize AI's positive impact. Thoughtful AI integration can help accelerate emissions reductions, strengthen disaster preparedness, and protect biodiversity, fostering a more resilient future.

AI as a tool for climate adaptation and sustainable development

The global economy is facing environmental changes, including extreme weather, biodiversity loss, and pollution, which call for systemic transformation supported by an increase in sustainable and nature-related investments. To meet these challenges, it is estimated that at least US$4 trillion in annual investments will be needed globally by 2030. A significant portion of this could be directed toward less technically advanced countries, giving them the opportunity to bypass traditional stages of technological development and move directly to adopting innovation solutions.[287]

AI stands out as a powerful tool in this transition, offering the potential to reduce greenhouse gas emissions through various means. For example, AI can help minimize energy waste, optimize energy consumption and distribution, and identify emission hotspots within industrial processes, thereby enabling more efficient and targeted sustainability initiatives.[288] AI has also been used

to optimize waste management,[289] and enables the rapid and automated analysis of satellite and sensor datasets, offering high-resolution insights into environmental changes such as deforestation, water stress, urban expansion, and biodiversity loss.[290] Earth observation (EO) technologies could contribute US$3.8 trillion to global GDP between 2023 and 2030, with annual value-added reaching US$703 billion by 2030. EO data collected via satellites, sensors, and in-situ devices can help eliminate up to two gigatonnes of greenhouse gas emissions annually by informing climate mitigation strategies, monitoring environmental impacts, and optimizing resource use. AI is a key enabler, capable of making EO data more accessible to non-specialists and accelerating adoption across sectors.[291] However, realizing the potential of AI, particularly in developing countries, is not without challenges. Additionally, without proper safeguards, AI could worsen environmental pressures, including through unintended impacts like increased emissions from AI-powered technologies.[292]

Many EMDEs face significant barriers to adopting AI-driven climate solutions, primarily due to limited digital infrastructure.[293] Concerns such as unreliable internet connectivity, inadequate computing power, and shortages in technical experience can hinder the effective deployment of AI systems. Furthermore, these countries often lack access to high-quality, detailed climate data, which is necessary for training AI models and supporting, data-driven decision-making. Without reliable data-sharing frameworks and strong cybersecurity measures, the outputs generated by AI risk being inaccurate or vulnerable to misuse, undermining their effectiveness in climate mitigation efforts.[294]

By addressing infrastructure gaps and improving data accessibility, developing countries can harness AI technologies to accelerate their energy transitions. This approach not only supports environmental sustainability but also helps drive inclusive economic growth, demonstrating how AI can be a catalyst for both sustainable growth and development.[295] [296]

AI for biodiversity monitoring and conservation

As of 2025, approximately one million species face the risk of extinction, while 75 percent of land ecosystems and two-thirds of marine environments have been significantly altered by human activity.[297] These include land-use change, pollution, extreme weather, resource exploitation, and invasive species. Rather than causing uniform biotic homogenization, these pressures often lead to distinct shifts in species composition at local scales, with broader-scale homogenization emerging in some contexts. Pollution and habitat change are identified as the most disruptive forces, driving significant declines in local species diversity.[298] This rapid escalation in human-induced pressures is causing damage to the planet's ecosystems, underscoring the need for innovative solutions to preserve biodiversity and counteract ecological threats.[299]

AI offers potential tools to help address these biodiversity challenges by identifying effective conservation strategies. For instance, AI can be employed for species recognition to uncover 'dark diversity,' species that are present but undetected, as well as to develop multimodal models that improve predictions of biodiversity loss. Additionally, AI supports monitoring of the wildlife trade and helps manage human–wildlife conflicts. [300] For example, in India's Kanha-Pench Corridor, AI-powered camera traps alert rangers to predator activity in real time, and apps like iNaturalist have led to the discovery of new species and contributed data to thousands of scientific studies.[301]

Building on these capabilities, AI is also evolving into a broader enabler of inclusive and community-driven conservation. Its applications now extend beyond species tracking to

analyzing acoustic data, satellite imagery, and even environmental DNA, offering insights into ecosystem health. Importantly, AI is helping democratize access to conservation data, allowing local communities and non-specialists to engage meaningfully in biodiversity protection. When deployed ethically, AI can support biocultural heritage, helping to ensure that conservation efforts are not only technologically advanced but also socially inclusive. As the field progresses, collaborative and transparent development of AI tools will be important to maximize their impact on biodiversity and climate resilience.[302]

The **UK Centre for Ecology & Hydrology (UKCEH)**, in collaboration with global alliances, is developing automated biodiversity monitoring stations. These stations are being tested in regions across Europe, North America, and the tropics, areas known for their rich biodiversity but where species reporting remains limited.

Powered by solar energy, these stations can function independently for extended periods. They are equipped with high-resolution cameras to capture images of insects and acoustic devices to record the vocalizations of birds and bats. Scientists then apply AI technology, training computer systems to identify species from the collected images and audio recordings.[303]

A practical example of AI's application is in wildlife monitoring and anti-poaching efforts. Algorithms analyze real-time video and image feeds to aid ecosystem-based disaster risk reduction (Eco-DRR), detect and identify wildlife including endangered species, and trigger alerts for potential poaching activities. This capability can enable law enforcement agencies to respond swiftly and effectively to threats.[304]

Significant advancements are also being made in using AI to construct phylogenetic trees and species distribution models. Nonetheless, AI's potential remains largely untapped in helping to address complex ecological questions that require integrating diverse and inherently complex data types such as images, video, text, audio, and DNA.[305]

Looking ahead, several critical areas within conservation are expected to benefit from AI-driven developments. For example, AI could enhance the analysis and understanding of large volumes of diverse data sources, including research papers, reports, and conservation-related social media discussions. This could empower conservationists to extract valuable insights, detect emerging concerns, and better understand public perceptions and sentiments concerning conservation topics.[306]

AI-driven innovation for a sustainable and efficient energy future

The energy system is complex and evolving, becoming increasingly electrified, digitalized, connected, and decentralized, while facing rising cost pressures. These factors have driven energy companies to adopt AI-powered applications aimed at optimizing systems, enhancing production, reducing costs, boosting efficiency, improving uptime, cutting emissions, and increasing safety.[307] Similarly, electricity access planners in Africa are using AI and geospatial mapping to quickly and accurately estimate energy demand and identify underserved communities, replacing slow, costly surveys.[308] AI-based systems have also been used to forecast

power demand and reduce energy consumption in a commercial building on Jeju Island, South Korea.[309]

AI-enabled energy management systems contribute to improved grid efficiency by forecasting power demand and optimizing the integration of renewable energy sources.[310] Moreover, AI enhances the efficiency of renewable energy systems by improving grid management and increasing the load factor of solar photovoltaics and wind power by up to 20%.[311] Moreover, the impact of AI on renewable energy can be significant, with an estimated reduction in emissions of approximately 1.8 gigatonnes of CO_2 equivalent annually.[312] A recent study has shown that AI applications in just three sectors, power, food, and mobility, could reduce global emissions by 3.2 to 5.4 gigatonnes of CO_2 equivalent annually by 2035, outweighing the projected emissions from AI-related data centre energy use.[313]

To realize AI's potential in the energy sector, several initiatives are underway to stimulate growth. For example, the Global Cleantech Innovation Programme, supported by the United Nations Industrial Development Organization in partnership with the Global Environment Facility, supports early-stage small and medium enterprises in Morocco and Nigeria through business acceleration services focused on energy efficiency and renewable energy solutions.[314] In a different vein, the Danish Environmental Protection Agency (EPA) transformed its environmental permitting process by implementing a digital and AI-assisted system. The Danish model, structured around describing, digitizing, and training, offers a scalable blueprint for other governments seeking to optimize regulatory procedures and advance sustainable growth through digital innovation.[315]

Given the complexity of electricity supply, transmission, and demand, AI has diverse applications across electricity systems. In scenarios of widespread adoption, AI-driven improvements in power plant operations and maintenance could generate cost savings of up to US$110 billion annually by 2035 through fuel savings and reduced operational costs. Additionally, AI can facilitate greater integration of renewable electricity into the grid by unlocking up to 175 gigawatts of additional transmission capacity within existing infrastructure.[316]

Despite these prospects, data on patents and start-ups indicate that AI-first innovation approaches remain underrepresented in the energy sector. Only about 1% of energy-related patents reference AI, a proportion consistent across both non-renewable energy sources and clean energy technologies. Furthermore, just 2.3% of energy start-ups have an AI-related value proposition, which is lower than the shares seen in life sciences (7%) and agriculture (4.3%).[317]

Enhancing climate resilience through AI

AI can enhance resilience to environmental impacts by supporting improved long-term adaptation strategies. For example, AI-powered drought forecasting combined with assessments of canopy water content can identify regions most vulnerable to water stress. These insights may help governments and communities to allocate resources more effectively and manage risk mitigation efforts, thereby promoting greater stability and security.[318]

AI has significant potential to strengthen early warning systems for extreme weather events such as hurricanes, floods, and droughts. By enabling more accurate predictions, AI can facilitate proactive disaster risk management and preparedness.[319] As environmental-related disasters increase in frequency and severity, the capacity to forecast hazards and adapt to evolving conditions becomes ever more important. AI is being used in early warning systems for floods

and wildfires, allowing governments and communities to take timely action that reduces damage, saves lives, and lowers economic costs.[320]

Early warnings for all

One out of three people, mainly in least developed countries (LDCs) and small island developing states (SIDS), lack access to adequate multi-hazard early warning systems. According to the UN, there is a need to expand early warning systems as more frequent and intense extreme weather events are leading to widespread adverse impacts and related losses and damages.

Launched in 2022 by United Nations Secretary-General, António Guterres, Early Warnings for All is an initiative to help ensure that people on Earth are protected from hazardous weather, water, or extreme weather events through life-saving early warning systems by the end of 2027.

The UN initiative highlights that Early Warnings for All could play an important role in accelerating investment to address countries' vulnerability to environmental impacts by improving early warning systems and enhancing resilience.[321]

Building on this momentum, the UN launched the Global Initiative on Resilience to Natural Hazards through AI Solutions in August 2024. Led by ITU, the UN Environment Programme (UNEP), the UN Framework Convention on Climate Change (UNFCCC), the Universal Postal Union (UPU), and the World Meteorological Organization (WMO), the initiative uses AI to help strengthen early warning systems, hazard mapping, and emergency communications, advancing the goals of Early Warnings for All through innovation and coordinated standards development.[322]

Beyond immediate disaster response, AI can contribute to environmental modelling and planning by analyzing data and predicting impacts such as sea-level rise and deforestation. These advanced models assist governments and organizations in crafting more tailored and efficient adaptation strategies, improving disaster preparedness, and integrating resilience into infrastructure development. Furthermore, AI may improve the forecasting of long-term environmental trends and help identify areas most at risk, supporting data-driven decisions that bolster resilience.[323]

Importantly, AI applications are increasingly being deployed in developing countries, including LDCs and SIDS. In these regions, AI supports detailed analysis of weather patterns and delivers more accurate forecasts for hurricanes, floods, and droughts. This supports timely alerts and preparedness measures that help mitigate the impacts of extreme weather events on vulnerable communities.[324]

AI simulator for climate risk decision-making in the Dominican Republic

Problem: The Dominican Republic is increasingly exposed to extreme weather events such as hurricanes, floods, and droughts. Decision-makers may lack localized, data-driven tools to anticipate and manage these risks effectively. Existing models often fail to reflect the country's unique geographic and socio-economic conditions, limiting their utility in real-time planning and disaster response.

Solution: The Coalition for Disaster Resilient Infrastructure (CDRI) is developing a customized AI-powered simulator that integrates climate data, infrastructure vulnerabilities, and economic indicators specific to the Dominican Republic. The simulator models severe weather scenarios and can provide predictive insights to support evidence-based decision-making. It is designed for accessibility and explainability, enabling both policymakers and communities to engage with the tool effectively.

Impact: The simulator may enhance national resilience by enabling proactive climate risk management. It can empower stakeholders to make timely, evidence-based decisions, may help reduce vulnerability, and potentially support long-term adaptation strategies. By fostering collaboration and capacity-building, the initiative contributes to sustainable development and disaster preparedness across sectors.[325]

Key considerations for stakeholders

UNDP's Digital Strategy 2022–2025 encourages stakeholders to embed digital tools like AI into sustainability initiatives by default. It emphasizes inclusive, rights-based approaches that help ensure underrepresented groups benefit from digital transformation.[326] To realize the benefits of AI for sustainable growth, business leaders may need to help address organizational silos that often separate sustainability teams from technology teams, as these divisions can limit overall effectiveness.[327] Market forces alone are unlikely to steer AI development toward sustainable growth; therefore, public and private sectors are considered important in supporting AI deployment that is intentional, inclusive, and sustainable.[328]

A coordinated effort is seen as important to foster enabling conditions for AI deployment, particularly in emerging economies. This includes investing in digital infrastructure and building AI-related skills to strengthen the capacity of local specialists and institutions.[329] [330] The broader the adoption of AI in environmental-related sectors, the greater the potential cumulative benefits, ranging from emissions reductions to improved resilience and economic gains. Incentivizing investments in AI applications that deliver social and environmental returns is equally important, alongside regulating AI to minimize risks such as increased energy consumption. Promoting renewable-powered data centres and energy-efficient algorithms could be considered as part of this regulatory framework.[331]

Public and private sectors are encouraged to act as stewards of inclusion to help ensure that the Global South benefits from AI's transformative potential. To unlock AI's potential in developing countries, especially LDCs and SIDS, a set of priority actions is recommended. These include addressing the digital divide through investments in infrastructure and AI capacity-building

programmes, enhancing environmental data availability via improved collection and open-data initiatives, and strengthening AI governance.[332]

Additionally, designing AI systems with inclusive approaches can help ensure environmental benefits. Managing AI's resource consumption by encouraging energy- and water-efficient AI systems may help support sustainability. Finally, fostering global collaboration can be considered important for sharing knowledge, aligning standards, and addressing regulatory gaps.[333]

> As stakeholders consider how to accelerate progress toward global biodiversity goals, the strategic use of AI is emerging as a key enabler. A report by the United Nations Development Program (UNDP) highlights how AI, when applied through a human-centred and risk-aware lens, can democratize access to advanced analytics and potentially enable broader participation by a range of actors in biodiversity planning. Through initiatives like the Early Action Support (EAS) Project, AI has helped over 50 countries assess the alignment of national policies with the Kunming-Montreal Global Biodiversity Framework. These AI-driven assessments offer tailored insights that support inclusive stakeholder engagement, identify policy gaps, and strengthen coordination across sectors.[334]

Implementing these recommendations may help developing countries to harness AI as a strategic tool for advancing environmental action at scale. Strengthening digital infrastructure, closing data gaps, and adopting effective governance frameworks can help build local capacity and may also stimulate innovation and collaboration. This approach helps ensure that countries, particularly those most vulnerable to extreme weather, can participate in global environmental changes while helping to address their distinct challenges.[335]

Infrastructure and smart cities

Cities worldwide are adopting AI to help improve urban efficiency, resilience, and sustainability across infrastructure, mobility, and environmental management. This chapter explores key AI applications such as digital twins, traffic optimization, and disaster preparedness, highlighting real-world examples and policy considerations. It also addresses challenges like data quality, ethics, and access, offering insights on how cities can responsibly harness AI to build smarter, safer, and more sustainable urban environments.

The role of AI in shaping future cities

Cities around the world are adopting AI technologies, recognizing them as key drivers of efficiency, productivity, economic growth, and competitiveness. More than half (56%) of the cities surveyed in a recent study actively use AI, either selectively or extensively, while an additional 35% are piloting or planning to implement AI solutions.[336]

This trend is expected to accelerate over the next three years. The proportion of cities widely using AI is projected to nearly triple, rising from 18% today to 48%. Cities in the Asia-Pacific (APAC) region are anticipated to lead this expansion, with nearly 60% expecting to widely use AI within three years, four times the current share. European and North American cities are also set to make progress, with over half planning widespread AI adoption. Meanwhile, cities

in emerging regions such as Africa and Latin America are poised to advance as they seek to revitalize their economies through AI.[337]

Global Infrastructure Risk Model & Resilience Index (GIRI)

Developed by the Coalition for Disaster Resilient Infrastructure (CDRI), GIRI is the world's first fully probabilistic global risk assessment tool for infrastructure. It evaluates exposure to geological and climate-related hazards, such as earthquakes, floods, cyclones, and droughts, across sectors like energy, transport, water, telecommunications, health, and education. GIRI provides country-level risk profiles and financial metrics to support resilience planning. Its data has informed fiscal risk assessments in countries including Fiji, India, Mauritius, and Nepal. Integrated into major platforms, GIRI enables data-driven decisions for infrastructure governance and long-term climate adaptation.[338]

AI technologies, supported by accurate open data, are enhancing the quality of life in urban environments. For instance, the EU-funded AMIGOS project employs AI-driven smart cameras and sensors to monitor public spaces in Las Rozas, Madrid, delivering real-time data that assists city planners in making informed decisions. Similarly, the ELABORATOR initiative in Issy-les-Moulineaux, a district near Paris, uses AI to automatically manage traffic intersections. This system creates additional space for cyclists and alerts drivers to their presence based on traffic conditions and user activity, thereby improving safety and traffic flow.[339]

AI-powered cities of the future study

To learn how AI will reshape cities, ServiceNow, Deloitte, NVIDIA, and ThoughtLab joined forces to conduct a pioneering study on the AI plans, investments, and practices of 250 cities around the world. The study examined how these cities harness all varieties of AI, from machine learning and robotic process automation to GenAI and now Agentic AI.

To provide actionable insights, AI use cases and best practices across six urban domains were analyzed:

1) Government management and operations;
2) Safety, security, and resilience;
3) Living, health, and trust;
4) Mobility and transportation;
5) Urban infrastructure; and
6) Environment and sustainability.

In addition to quantitative analysis, ThoughtLab conducted interviews with city leaders and AI specialists from business and academia. This report is the result of this research, and it is designed to serve as a roadmap to becoming an AI-powered city of the future.[340]

Transforming urban planning through AI-enabled digital twins

AI has increasingly been applied to address complex challenges related to urban population growth and socioeconomic demands.[341] One particularly transformative innovation is the use of digital twins, which are virtual replicas of physical systems that integrate real-time data, AI, and simulation technologies. These digital twins can enable real-time infrastructure monitoring, predictive analytics, and stress-testing, offering powerful tools for urban planners and authorities to better understand and manage city systems.[342]

Recognizing their potential, the European Commission has highlighted digital twins as 'powerful tools for planners and authorities' and has made them eligible for funding under the European Green Deal. This initiative aims to achieve net-zero greenhouse gas emissions by 2050 by promoting innovative technologies such as digital twins.[343] [344]

Despite these advancements, AI adoption in urban governance remains concentrated primarily in Europe, North America, and Asia, with notable gaps in regions such as Africa and Central America. The limited adoption of AI in public administration and urban studies has raised concerns regarding fairness and transparency in how algorithms make decisions.[345]

Digital twin for Indian municipality

Problem: Solid waste can become a major sanitary concern if not collected in time.

Solution: Deloitte India developed a digital twin for an Indian municipality, helping forecast solid waste collection needs and optimizing collection routes. Through an AI-based simulation and optimization platform, the project led to a better overall understanding of the resilience of the waste collection service.

Impact: This solution helped mitigate sanitary risks by helping to ensure quick collection of solid waste, resulting in more than 20% cost savings on fuel consumption and 36 tCO_2 emission reduction annually by optimizing the waste collection route.[346]

Optimizing urban mobility with AI technologies

Urbanization is accelerating worldwide, with over half of the global population now residing in urban areas, a proportion expected to rise to nearly 70% by 2050. This rapid growth may intensify challenges related to urban mobility, including traffic congestion, environmental pollution, and inefficiencies within transportation systems. Traditional approaches, such as expanding infrastructure or implementing policies like congestion pricing, have often fallen short or introduced additional complexities. As cities aim to become more liveable and sustainable, there is a need for innovative, forward-looking solutions that use a combination of modern technologies.[347]

In response, AI technologies have emerged as tools to help transform urban mobility, particularly within the framework of smart city development. AI-powered systems are increasingly integrated across various transportation domains, including autonomous vehicles, traffic management, and urban planning.[348]

A practical example of AI's application in transportation is found in Yizhuang, a suburb of Beijing, which has made significant advances in autonomous driving. Yizhuang is developing a vehicle-road-cloud fusion system that combines data from vehicles, road infrastructure, and cloud platforms to create a safer and more efficient transport network. This system supports autonomous taxis, buses, freight trucks, and unmanned delivery vehicles, with the potential to fundamentally change how mobility is managed in the city.[349]

Traffic Management in Raleigh, North Carolina, USA

Problem: The Triangle region in North Carolina faced worsening traffic congestion as population growth and car reliance increase. With 2.4 million residents, the area is among the fastest-growing in the United States, particularly in its suburbs. Existing traffic signal systems struggled to keep pace. Traffic lights need to manage complex factors such as vehicle flow, timing, acceleration and deceleration, and variable light durations, yet are always not fully optimized for shifting traffic patterns, which resulted in inefficiencies and delays.[350]

Solution: The city of Raleigh partnered with NVIDIA to study traffic patterns at multiple intersections. Live video from cameras is processed through computer vision models that can detect vehicles. The initiative supports the city's Vision Zero commitment to reduce or eliminate traffic fatalities.

Impact: Raleigh has installed more than 100 cameras at intersections, helping to enable real-time observation of traffic activity. The city has advanced its AI-enabled traffic management by training models to detect near misses between vehicles and pedestrians, generating insights to inform future improvements in intersection safety.[351]

Infrastructure resilience for increased public safety and security

Natural disasters alone are projected to cause approximately US$460 billion in average annual losses to infrastructure globally by 2050. For comparison, natural disasters have resulted in more than US$200 billion of average annual damages worldwide over the last 15 years. Natural hazards are expected to become more frequent and intense in the future due to environmental impacts, significantly increasing associated losses.[352]

Infrastructure resilience unfolds across three stages, planning (prevention), response (detection and reaction), and recovery, and AI can provide tools at each step. During the planning phase, machine learning can analyze risk data and simulate scenarios to identify measures for prevention and preparedness, such as improving flood resilience or using fire-resistant materials. During an event, AI-driven early-warning systems and real-time monitoring can accelerate detection and guide emergency responses. In the recovery phase, AI helps prioritize repairs through predictive damage assessments and optimized resource allocation. By integrating data-driven insights into planning, response, and recovery, AI can strengthen traditional resilience measures, reduce vulnerabilities, and help infrastructure adapt more effectively to evolving risks.[353]

AI-powered sensors are transforming disaster preparedness through automated response systems, real-time data, and predictive analytics. These innovations can reduce the impact of natural and man-made disasters, optimize emergency response efforts, and strengthen early

warning systems. Incorporating AI sensors into urban infrastructure helps enable communities to identify threats such as floods, wildfires, and earthquakes more quickly and accurately. This proactive approach can enhance urban resilience and protect lives.[354]

Overstory is developing a data-driven approach to vegetation management around power lines to minimise wildfire risk. By analysing satellite imagery, it gathers detailed information on the health, height, and species of trees and shrubs. The platform then produces risk assessments to identify vegetation that could ignite fires, suggesting pruning or removal as preventive measures.[355]

Integrating AI-powered solutions for hazard mitigation and vulnerability reduction alone could yield approximately US$70 billion globally in annual savings in direct disaster costs by 2050, equivalent to 15% of projected average losses, complementing other resilience options. With improved AI capabilities, these savings could exceed US$110 billion annually.[356]

DeepINDRA: Leveraging AI and Citizen Science for Flood Resilience in India

Problem: India is vulnerable to flooding, with over 40 million hectares of its geographical area at risk.[357] India's annual economic losses from flooding exceeds US$28.1 billion, and 72% of Indian districts are exposed to extreme flooding events.[358]

Solution: DeepINDRA integrates AI with citizen science to create a participatory flood resilience framework. It uses satellite imagery and hydrological data to model flood scenarios, while also collecting community-sourced information through mobile platforms to validate and refine predictions. The initiative includes interactive dashboards that allow local governments and residents to visualize flood risks and coordinate response strategies. This hybrid approach helps to ensure that both technical precision and local knowledge inform flood preparedness.

Impact: The impact of DeepINDRA is multifaceted. It enhances early warning systems, improves coordination between citizens and authorities, and empowers communities to actively participate in resilience planning. By targeting urban flood hotspots and offering scalable solutions, DeepINDRA contributes to more inclusive, data-driven, and adaptive flood management across the region.[359]

Key considerations for stakeholders

To use AI effectively in urban planning and design, several key priorities are viewed as important to address. These include enhancing data quality, consistency, and integration across systems to support more reliable inputs. AI can be harnessed to improve creative efficiency within planning processes, which may enable more innovative and effective solutions. It is also considered important to build safeguards that aim to prevent and mitigate biases in AI applications, while preparing proactively for the ethical challenges that may arise from AI deployment. Long-term and systemic planning can be seen as helpful in maximizing the sustainable benefits of AI. Additionally, exploring opportunities to enhance community engagement through AI-enabled tools can help ensure that urban development is inclusive and responsive to citizens' needs.[360]

Food security and agriculture

AI is helping to transform food security and agricultural productivity with precision farming, enhanced resource efficiency, and improved supply chain transparency. As global challenges such as population growth, environmental impacts, and resource scarcity intensify, AI-driven innovations offer scalable solutions to help increase yields, reduce waste, and support sustainable practices. This chapter explores AI applications in crop and livestock management, digital public goods, and climate-resilient agriculture, highlighting real-world case studies and policy considerations. It also addresses critical concerns such as data interoperability, fair access, and the role of multi-stakeholder collaboration in helping to ensure AI benefits reach farmers and communities worldwide.

The emergence of AI as a transformative technology in enhancing food security and agricultural productivity

Food security faces challenges as the global population grows, environmental impacts intensify, and natural resources become scarcer. In 2024, 28% of the world's population, approximately 2.3 billion people, were moderately or severely food insecure. Although this marks a slight decline from a peak of 28.9% in 2021, it represents a 6.6% increase in global food insecurity compared to a decade earlier. Additionally, around 14% of the world's food, valued at US$400 billion annually, continues to be wasted. With the global population expected to approach 10 billion by 2050, ensuring food security may require agricultural systems capable of producing larger quantities of more nutritious food sustainably.[361] [362] [363]

Technological advancements are becoming central to the solutions needed for a sustainable, food-secure future.[364] Modern AI systems can detect early signs of crop stress, disease, or pest infestations long before they become visible to the naked eye. They can identify problem areas, analyze weather patterns, and suggest targeted recommendations on the optimal timing and location for interventions. These systems can continuously learn and improve their performance across different seasons and regions.[365]

For these technologies to function across varied agrifood ecosystems, interoperability driven by standardization is important. Standardization can allow seamless integration, enhance agricultural production processes, and support scalability by enabling solutions to be adapted across different regions and farming types. It also plays an important role in maintaining data security and privacy, thereby fostering trust among users.[366]

The **Global Initiative on AI for Food Systems**, launched at the AI for Good Global Summit 2025, aims to harness artificial intelligence to enhance productivity, resilience, and food security worldwide. Led by the International Telecommunication Union (ITU), the Food and Agriculture Organization of the United Nations (FAO), the World Food Programme (WFP), and the International Fund for Agricultural Development (IFAD), the initiative promotes shared digital infrastructure, pilot projects, and standards to support inclusive innovation, especially for smallholder farmers. It builds on previous work by the ITU-FAO Focus Group and invites global stakeholders to contribute to shaping AI-driven solutions for sustainable agriculture.[367]

AI for precision agriculture and resource efficiency

Plant pests and diseases are responsible for destroying nearly 40 percent of global crops annually, according to the Food and Agriculture Organization (FAO) estimates. This loss reduces the availability of nutritious food, especially affecting vulnerable populations already facing food insecurity due. Healthy plants form the foundation of a nutritious diet, providing essential vitamins, minerals, and fibres vital for human health. A decline in plant health can lead to poorer food quality, increasing the risk of malnutrition and related health concerns.[368]

Precision agriculture stands out as a key application of AI in the sector. By gathering and analyzing large datasets including satellite imagery, weather data, and soil conditions, AI systems can provide farmers with valuable insights. This enables informed decision-making regarding optimal planting times, nutrient application, irrigation scheduling, and pest and disease management. Such targeted interventions have been proven to enhance crop yields while minimising input waste.[369]

Advances in AI-enabled agritech including robotics, sensor networks, computer vision, and advanced analytics are helping to revolutionize crop cultivation and management. Connected devices and IoT sensors provide continuous, real-time monitoring of soil health, nutrient levels, crop development, and local weather conditions. Machine learning models analyze these diverse datasets to offer highly specific recommendations on irrigation scheduling, fertilizer and pesticide application, and pest or disease control. This targeted approach may replace broad, seasonal protocols with interventions tailored to precise zones within individual fields.[370] [371]

These innovations can yield a dual benefit: increasing crop yields and farm profitability while reducing inputs, waste, and greenhouse gas emissions. By automating key monitoring and decision-support functions, AI also helps to address acute labour shortages and empowers farmers, both large-scale and smallholders, to make evidence-based decisions amid uncertainty.

Moreover, precision agriculture supports the shift towards regenerative and climate-smart farming practices. AI-driven tools can detect early signs of crop stress, forecast pest outbreaks, and model optimal planting or harvesting windows based on dynamic weather forecasts. This adaptability can enhance the resilience of farming systems, helping to enable producers to better cope with extreme weather events and changing growing seasons. The continuous feedback from digital tools fosters ongoing learning and improvement, benefiting large agribusinesses as well as smallholders and cooperatives striving to maximize limited resources.

AI-driven solutions for livestock health and productivity

The livestock sector is a fundamental component of the global food system, playing an important role in poverty reduction, food security, and agricultural development. According to the FAO, livestock accounts for 40% of the global value of agricultural output and supports the livelihoods and nutritional security of nearly 1.3 billion people. Despite its importance, there remains potential to improve livestock practices to make them more sustainable.[372]

The adoption of AI in livestock management has grown rapidly in recent years. By efficiently processing data and integrating various technologies, farmers can predict disease outbreaks, optimize feeding routines, and automate monitoring of animal welfare. These innovations can empower farmers to enhance the health, well-being, and reproductive performance of

their livestock through informed decision-making, accurate forecasting, and early anomaly detection.[373]

AI integration helps enable a more personalized approach to livestock care. For example, facial recognition technology allows monitoring of individual animals' behaviour, providing farmers with detailed insights into each member of the herd. When combined with precision livestock farming (PLF) techniques, AI can support farming systems that prioritize sustainability, efficiency, and animal welfare. Real-time monitoring of feeding behaviour, which tracks and analyzes individual animals, facilitates swift intervention when necessary. Accurate feed consumption monitoring is important for maintaining optimal health and nutrition, with early detection of feed refusal or empty feeders helping to prevent disease outbreaks and ensure adequate nutrient intake.[374]

FAO's LEAP Navigator: AI for Sustainable Livestock Systems

Problem: In many low- and middle-income countries, livestock productivity is low despite rising demand for animal protein, while GHG emissions intensity is increasing. Productivity could be improved and emissions reduced by adopting proven good practices and appropriate technologies. However, many LMICs lack the advisory and extension services needed to support producers in applying these measures, leading to stagnant productivity growth and persistently high emissions.[375]

Solution: The FAO LEAP Navigator uses AI to integrate environmental, production, and health data, converting leading practice guidelines into actionable, real-time targets for farms and governments. Designed to align with One Health and Sustainable Development Goal frameworks, the tool enables users to benchmark emissions, optimize pasture management, and implement early warning systems for animal health concerns and environment-related shocks.

Impact: Since its global pilot launch in 2024, the LEAP Navigator has supported a wide range of livestock producers, particularly in emerging economies, in monitoring sustainability indicators, decreasing disease-related losses, and advancing national environmental commitments consistent with the Paris Agreement.[376]

Transformative innovations shaping sustainable agrifood systems

Advancements outlined in FAO's Harvesting Change foresight report highlight transformative technologies on the horizon, including AI-driven digital twins – virtual models that dynamically mirror physical assets – rapid progress in personalized nutrition, and even the future possibility of artificial general intelligence, which could perform any intellectual task humans or animals can, potentially surpassing human intelligence in many areas. These innovations are no longer confined to science fiction but are becoming tangible prospects.[377]

Globally, 84% of the 540 million farms are smallholders who have traditionally relied on intimate knowledge of their land and natural cycles. Today, some are adopting AI to help manage the complexities of modern agriculture. Central to AI's value is its ability to analyze varied data streams from IoT sensors, drones, and computer vision technologies in real time. This can enable precision farming practices that dynamically adjust water usage, fertilizer application,

and pest control based on environmental conditions and crop requirements. The outcome could be increased efficiency, higher yields, reduced waste, and the ability to produce more with fewer resources.[378]

The UN emphasizes that building a fairer world calls for a shared global effort to supporting and investing in digital public goods, such as open-source software, data, AI models, standards, and content, provided these resources respect privacy laws, standards, and best practices and are designed to avoid causing harm.[379] An example in the agriculture space is the Food and Agriculture Organization's AgriTech Observatory. This initiative for Europe and Central Asia has been recognised as a Digital Public Good by the Digital Public Goods Alliance, a UN-endorsed effort promoting open-source technologies. The Observatory is a virtual open knowledge hub offering a resource for exploring, analyzing, and monitoring digital initiatives that support the transformation of agrifood systems in Europe and Central Asia.[380]

FAO Hand-in-Hand geospatial platform

The FAO's open-access Hand in Hand (HIH) Geospatial Platform offers advanced information, including food security indicators and agricultural statistics, to support more targeted agricultural interventions. This platform unlocks millions of data layers from diverse domains and sources, serving as a vital tool for FAO's HiH Initiative and catering to digital agriculture experts, economists, government and non-government organisations, and other stakeholders in the food and agriculture sector. The data is sourced from FAO alongside leading public providers within the UN, NGOs, academia, the private sector, and space agencies. It includes key FAO flagship databases such as FAOSTAT, which provides food and agriculture data for over 245 countries and territories from 1961 to the most recent available year.

Since its launch in 2020, the platform has engaged over 65 countries and institutions through workshops focused on how data and technology can drive digital agriculture transformation and support rural development.[381]

Key considerations for stakeholders

For AI-based food security solutions to be effective, it is important that they are co-designed with farmers, integrated into public systems, and supported by sustainable financing. This approach can ensure that such solutions can reach and benefit populations in remote and underserved areas.[382]

A study by the European Parliamentary Research Service highlights several challenges that require targeted policies to support fair access to AI benefits in agriculture for European stakeholders. These challenges include clearly defining the rights and responsibilities of farmers, technology providers, and the public; regulating database governance within Europe; managing risks and liabilities; protecting farm workers amid increasing automation; transparency and quality in AI models; addressing digital literacy gaps and the digital divide; preventing farmer dependency on corporate digital platforms; limiting the market dominance of early technology entrants; affordable and accessible data infrastructure; and supporting investments by farmers and small-to-medium enterprises to benefit from AI's advantages.

In the agri-food sector, farmers and small-to-medium enterprises are predominantly small, independent operators, whereas technology providers and retailers wield significant economic power, potentially enabling them to influence rules imposed on suppliers and, to some extent, clients. Legislators have a vital role in establishing guidelines and regulations that balance interactions among these stakeholders, fostering a fair and sustainable ecosystem.[383]

Conclusion

We have the opportunity to shape the future of artificial intelligence to serve the public good. As AI technologies evolve and permeate each sector of society, it is important to adopt a strategic, inclusive, and responsible approach that balances innovation with ethical safeguards and fair access. AI is already reshaping our world, demonstrating significant potential to address pressing global challenges. However, work remains to harness its capabilities for societal benefit.

Achieving this will likely require collaboration between the public and private sectors, and civil society. Investment in digital infrastructure, workforce development, and AI literacy, and innovation from both public and private sectors can help accelerate progress and scale solutions. Addressing challenges such as data privacy, bias, sustainability, and fair access to AI resources can benefit from such cross-sector cooperation.

Existing frameworks and standards continue to evolve alongside the technology, helping to ensure that AI is developed and deployed responsibly. By embracing a forward-looking approach focused on creating fair and transparent systems, we can work toward maximizing societal benefits, mitigating risks, and supporting sustainable development. The AI journey is underway, and ongoing efforts and collaboration across sectors will help to determine its success.

Glossary

AI governance: The policies, rules, and frameworks that guide the responsible development and use of AI.

Agentic AI: Advanced AI systems that can act autonomously, make decisions, and learn from their environment without human intervention.

AI literacy: The knowledge and skills needed to understand, use, and critically evaluate AI technologies.

AI life cycle: The stages through which an AI system passes, from design and development to deployment, monitoring, and retirement.

Algorithm: A set of step-by-step instructions or rules that a computer follows to solve a problem or perform a task.

Alignment: The process of making sure AI systems act according to human values, safety requirements, and societal goals.

Artificial General Intelligence (AGI): A theoretical form of AI that can understand, learn, and apply knowledge across a wide range of tasks at a level comparable to humans.

Artificial Intelligence (AI): The ability of machines or software to perform tasks that normally require human intelligence, such as understanding language, recognising images, making decisions, or solving problems.

Autonomous agent: An AI system that can perform tasks and make decisions independently, often interacting with its environment.

Bias (in AI): When an AI system produces unfair or prejudiced results because of biased or unrepresentative training data or design.

Compute: Shorthand for the computing power (chips, processors, energy) needed to train and run large AI systems.

Conformity assessment: The process of checking whether an AI system meets required standards and regulations before it is used.

Constitutional AI: A training method where AI models are guided by a written 'constitution' of rules and principles, rather than relying only on human feedback.

Content authenticity: Technologies and standards (like watermarking or metadata) that show whether digital content (text, images, video) was generated by AI and who created it.

Data privacy: Protecting personal and sensitive information from being accessed or used without permission.

Deep learning: A subset of machine learning that uses large, layered networks called neural networks to model complex patterns in data, similar to how the human brain works.

Deepfake: AI-generated fake media, images, audio, or video, that convincingly mimic real people or events.

Differential privacy: A technique that adds 'noise' to data or results to prevent identification of individuals while still allowing useful analysis.

Digital public infrastructure (DPI): Shared digital systems like online identity verification, payment platforms, or data exchanges that support public services and innovation.

Digital twin: A virtual model of a physical object or system that uses real-time data to simulate and analyse its behaviour.

Emergent capabilities: Unexpected skills that AI systems show when they become very large and complex, such as solving puzzles or writing code without being explicitly trained to.

Ethical AI: AI designed and used in ways that respect human rights, fairness, transparency, and accountability.

Explainability: The ability to understand and explain how an AI system makes its decisions or predictions.

Federated learning: A method where AI models are trained across many devices or servers without sharing raw data, helping to protect privacy.

Foundation model: A large AI system trained on broad data that can then be adapted for many different tasks.

Generative AI (GenAI): AI systems that can create new content such as text, images, music, or videos based on patterns learned from existing data.

GPU (Graphics Processing Unit): A specialized computer chip designed to handle many calculations simultaneously, used for training and running AI models quickly and efficiently.

Guardrails: Built-in safety measures that limit or shape an AI system's behaviour, such as refusing to answer harmful questions or flagging sensitive requests.

Hallucination: When an AI system generates incorrect or made-up information, often confidently, even though it is not true.

Human-in-the-Loop: An approach where humans oversee, guide, or intervene in AI decision-making to help ensure safety and fairness.

Interoperability: The ability of different systems, software applications, or devices to communicate, work together and exchange information seamlessly, without compatibility concerns, even if they were developed by different organizations or for different purposes.

Large language models (LLMs): A type of AI trained on a large amount of text data designed to understand and generate human-like text.

Machine learning (ML): A type of AI where computers learn from data to improve their performance on tasks without being explicitly programmed for each task.

Model: The result of training an AI system on data; it is the 'brain' that makes predictions or decisions based on new input.

Multimodal AI: AI systems that can process and generate multiple types of data, such as text, images, audio, and video, simultaneously.

Natural Language Processing (NLP): Programming that allows computers to understand, interpret, and generate human language.

Neural network: A computing system inspired by the human brain's network of neurons, used in deep learning to recognise patterns and make decisions.

Open-weight models: AI models where the underlying parameters ('weights') are publicly released, letting researchers and companies adapt or improve them.

Quantum AI: AI that uses quantum computing technology to perform calculations much faster than traditional computers, potentially solving complex problems more efficiently.

RAG (Retrieval-Augmented generation): A technique where AI tools fetch facts from trusted databases or documents before answering, making them more accurate and less prone to hallucination.

Red teaming: Stress-testing an AI model by intentionally probing it for dangerous, biased, or unsafe behaviour.

Responsible AI: The practice of designing, building, and using AI in a way that is ethical, safe, transparent, and inclusive.

Sandbox: A controlled environment where companies can test new AI technologies under supervision before market release.

Sovereign AI: AI infrastructure, datasets, and models developed and controlled within a country (or region) to reduce dependence on foreign providers.

Symbolic AI: An approach to artificial intelligence that uses symbols or concepts, rather than numerical data to represent knowledge and logical rules to manipulate these symbols for reasoning and problem-solving.

Synthetic data: Data created by AI rather than collected from the real world. Useful for training models when real data is scarce, sensitive, or biased.

Training data: The information or examples used to teach an AI system how to perform a task.

Transformer: The underlying architecture powering most modern AI models (including GPT). It processes information in parallel, making it efficient at handling language and other data.

Watermarking: Invisible signals embedded in AI-generated content that mark it as synthetic, helping people and platforms detect and verify its origin.

Weak AI (Narrow AI): AI designed to perform a specific task (translation, chat, playing games).

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About the report

This report provides a detailed overview of the current state and future trajectory of Artificial Intelligence (AI), examining its rapid adoption, emerging technologies, and transformative impact across key sectors such as education, healthcare, environment, infrastructure, and agriculture. It explores the evolving regulatory landscape globally, highlighting varied governance approaches aimed at balancing innovation with risk mitigation. The report addresses critical challenges including ethical considerations, inclusivity, privacy protection, labour market shifts, and sustainability concerns related to AI. By presenting insights into AI's opportunities and risks, the report underscores the importance of coordinated efforts among the public and private sectors and to foster responsible, inclusive, and sustainable AI development that aligns with human rights and global development goals.

About ITU

The International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs), driving innovation in ICTs together with 193 Member States and a membership of over 1,000 companies, universities, and international and regional organizations. Established in 1865, it is the intergovernmental body responsible for coordinating the shared global use of the radio spectrum, promoting international cooperation in assigning satellite orbits, improving communication infrastructure in the developing world, and establishing the worldwide standards that foster seamless interconnection of a vast range of communications systems. From broadband networks to cutting-edge wireless technologies, aeronautical and maritime navigation, radio astronomy, oceanographic and satellite-based earth monitoring as well as converging fixed-mobile phone, Internet and broadcasting technologies, ITU is committed to connecting the world. Learn more: www.itu.int

About The Deloitte AI Institute™

The Deloitte AI Institute™ helps organizations connect all the different dimensions of the robust, highly dynamic and rapidly evolving AI ecosystem. The AI Institute leads conversations on applied AI innovation across industries, using cutting-edge insights to promote human-machine collaboration in the Age of With™. The Deloitte AI Institute aims to promote dialogue about and development of artificial intelligence, stimulate innovation, and examine challenges to AI implementation and ways to address them. The AI Institute collaborates with an ecosystem composed of academic research groups, startups, entrepreneurs, innovators, mature AI product leaders and AI visionaries to explore key areas of artificial intelligence including risks, policies, ethics, future of work and talent, and applied AI use cases. Combined with Deloitte's deep knowledge and experience in artificial intelligence applications, the institute helps make sense of this complex ecosystem and, as a result, delivers impactful perspectives to help organizations succeed by making informed AI decisions.

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