
SOUTH AFRICA

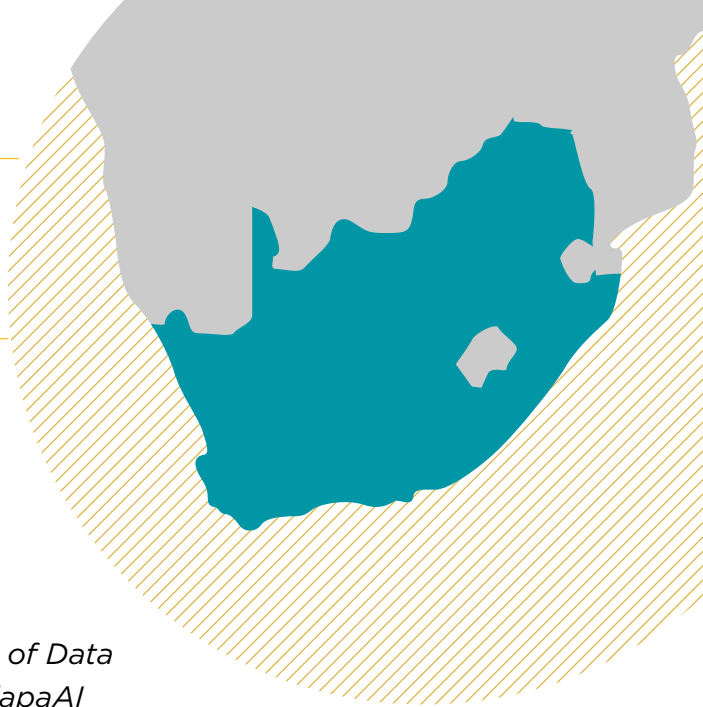
Adopting artificial intelligence for all citizens

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Key takeaways

- South Africa has embraced AI by establishing: the Presidential Commission on the Fourth Industrial Revolution; the Artificial Intelligence for Africa Blueprint and other regional frameworks; a digital and future skills training programme for 500,000 participants; the Centre for Artificial Intelligence Research, and the Artificial Intelligence Institute of South Africa; and initiatives to reduce data costs and improve internet penetration, so that all South Africans can benefit from the AI revolution.
- The Department of Science and Innovation's National Integrated Cyber Infrastructure System, together with supercomputer research into AI, means that South Africa is poised to harness big data and drive future scientific and industrial growth.
- A key challenge is the need for a comprehensive national AI strategy to guide and coordinate efforts across various sectors in South Africa.

AI is a rapidly growing technology in South Africa. Research publications in the country increased from 262 in 2000 to 4,000 in 2023 (OECD, 2024), while venture capital investments in AI grew from USD 1.5 million to USD 213 million in 2021. The economic potential of AI for South Africa is significant, with Access Partnership estimating that AI could contribute up to USD 52.2 billion in economic gains by 2030 (Access Partnership, 2023).

Government strategy

South Africa's commitment to integrating AI into its science system is rooted in its national development plan, also known as Vision 2030 (Government of South Africa, 2011). In 2019, the newly established Presidential Commission on the Fourth Industrial Revolution (PC4IR), reiterated this commitment (Presidential Commission on the 4th Industrial Revolution, 2020).

The Commission advises on strategies for skills development and research and development (R&D) programmes to advance technologies including AI. Comprising leaders from academia, business and civil society, the PC4IR has recommended that R&D and implementation

capabilities for AI must be embedded within the state. As such, the Department of Science and Innovation (DSI) promotes a whole-of-government approach to research, implemented through a decadal plan (Department of Science and Innovation, 2019).

The DSI decadal plan (Department of Science and Innovation, 2024b) prioritizes six digital domains for focused resource allocation over the next ten years: the internet of things (physical network); cloud computing; modelling and simulation; AI, robotics and cybernetics; blockchain recording and cybersecurity; and quantum computing. To support these domains, the DSI launched in 2021 a ten-year Foundational Digital Capabilities Research programme, in collaboration with the Council for Scientific and Industrial Research (CSIR).

On the international front, South Africa has actively contributed to pan-African initiatives. Most notably, during its African Union Presidency, the country was instrumental in developing the *Artificial Intelligence for Africa Blueprint* as part of the Smart Africa initiative, supported by the German Development Cooperation (GIZ) and the Smart Africa Secretariat (Smart Africa, 2021). The Blueprint assists member states in crafting policies, strategies, and plans to foster growth and prosperity within the context of the 'Fourth Industrial Revolution' (4IR). Additionally, South Africa has led efforts to develop a Southern African Development Community big data framework (Department of Communications and Digital Technologies, 2023).

To gain a global perspective, the PC4IR analysed 4IR strategies from countries including India, the UK, the USA, China, Japan, Singapore, Mexico, Malaysia, Kenya, Australia, Canada, Russia, and Tunisia, extracting critical lessons. Such insights informed the development of South Africa's decadal plan, which aligns with international approaches such as the EU's Horizon 2020 research, development and innovation programme.

Priority sectors for artificial intelligence

By focusing on the following sectors, South Africa aims to harness the transformative potential of AI to drive sustainable and inclusive growth.

- Manufacturing, agriculture and mining
- Digital and circular economies
- Health innovation
- Energy innovation
- Building of a capable state
- Social progress
- Societal grand challenges such as climate change

Opportunities and challenges

Artificial intelligence can substantially improve many sectors of the South African economy. In healthcare, it can lead to more accurate diagnoses, personalized treatment plans, and improved patient outcomes. In agriculture, it can optimize crop yields, enhance resource management, and reduce waste. In education, it can personalize learning experiences and improve outcomes. And in manufacturing, it can streamline production processes, reduce costs, and increase efficiency. Moreover, AI can act as a lever for the South African Government to improve service delivery, and consequently the quality of life of its citizens.

But alongside these numerous opportunities also lie critical challenges – such as the digital divide, which creates disparities in access to digital technologies and services, particularly in rural areas. The DSI’s *White Paper on Science, Technology and Innovation* acknowledges additional challenges, including the need for high-level skills, sufficient funding, and robust infrastructure to support AI research and applications. And the Department of Communications and Digital Technologies, in its strategic plan, highlights as critical hurdles policy uncertainty, high data costs and outdated policies on information and communication technology.

In addition, the PC4IR has noted the need for substantial investment in digital infrastructure, including data centres and broadband connectivity. It has also identified a pressing shortage of professionals skilled in AI, which hampers South Africa’s ability to fully leverage AI technologies. And it acknowledges that addressing data privacy, algorithmic transparency and ethical concerns in the deployment of AI is essential for building public trust and using AI in a responsible manner.

An overriding challenge is the lack of a comprehensive national strategy outlining goals, initiatives and investments for developing and implementing AI. The South African National Advisory Council on Innovation is therefore spearheading an initiative, led by the CSIR, to develop recommendations for a national AI strategy.

Institutional structures and initiatives

South Africa has established a robust governance structure to oversee the implementation of AI and other 4IR technologies. At the top is the biennial Presidential Science, Technology and Innovation Plenary (Department of Science and Innovation, 2023), which brings together all innovation actors, including government, academia, industry and civil society. This is complemented by an Interministerial Committee on Science, Technology and Innovation, which ensures government alignment on scientific and technological innovation; the PC4IR; and the DSI, which plays a pivotal role in steering AI-related initiatives.

Other key government institutions include the National Research Foundation, which funds and supports AI research projects (National Research Foundation, 2024a); the Technology Innovation Agency, which focuses on the development and exploitation of discoveries, inventions and innovations to improve quality of life for all South Africans (Technology Innovation Agency, 2024); and the National Intellectual Property Management Office, which ensures that intellectual property resulting from publicly financed research and development is identified, protected, utilized and commercialized (The Innovation Hub, 2024).

AI initiatives also involve the national science and research community, including the CSIR; the Centre for Artificial Intelligence Research, a network across eight universities conducting research in cybersecurity, machine learning and ethics and other aspects of AI (CAIR, 2024);

the Artificial Intelligence Institute of South Africa, established in 2022 at four universities in Tshwane, Johannesburg, and Free State and Western Cape provinces; and the Medical Research Council, which has launched a new initiative, in partnership with the Bill & Melinda Gates Foundation and Grand Challenges, using models like GPT-4 to address health challenges (SAMRC, 2023).

Public–private partnerships, based on a multi-stakeholder approach, play a key role in implementing AI in South Africa. For example, a partnership between IBM South Africa and the Department of Trade, Industry and Competition launched one of South Africa’s largest equity equivalent investment programmes (Department of Trade, Industry and Competition, 2022), which includes an IBM Research Africa lab that fosters local innovation, and creates new models for partnerships with industry, academia, government, non-profit organizations and start-ups (IBM Research, 2024).

To support AI and other emerging technologies, specific budgets and grants are allocated through various channels including the National Research Foundation and the Department of Trade, Industry and Competition, which implements the Technology and Human Resources for Industry Programme to leverage collaboration between government and industry (Department of Trade, Industry and Competition, 2024). Additionally, the South African Government offers an R&D tax incentive designed to promote private sector investment in R&D activities within the country (Department of Science and Innovation, 2024a).

Transparency and ethics

South Africa has made significant strides towards data protection and cybersecurity, which are crucial for the successful deployment of AI. This includes enacting several key laws to safeguard personal data and ensure secure digital interactions. In addition, the DSI *White Paper on Science, Technology and Innovation* highlights the importance of responsible research and innovation (RRI) – which can help South African researchers collaborate and compete with their international counterparts in an increasingly ethics-driven global research environment. The country plans to develop RRI indicators and a comprehensive monitoring, evaluation and learning framework to ensure that AI systems are transparent and ethically sound.

The DSI decadal plan further underscores the importance of open science and open data policies to ensure that AI technologies are transparent and accessible. In line with these principles, it calls for the development of a comprehensive artificial intelligence strategy and ethics framework – to address critical issues such as data privacy, algorithmic bias and the ethical use of AI technologies. By establishing clear guidelines and standards, the framework aims to mitigate risks associated with AI, and ensure that its deployment aligns with societal values and ethical norms.

Capacity building and skills development

South Africa is committed to enhancing and future-proofing human capabilities to ensure a competitive and adaptable workforce in the rapidly evolving landscape of the 4IR. To achieve this, the Department of Higher Education and Training has launched several initiatives including investment in skills forecasting and overseeing a national skills fund.

Complementing these efforts, the DSI is collaborating with the Department of Basic Education to integrate essential 4IR skills, such as robotics, coding, and using augmented reality, into the school curriculum. By introducing these skills at an early stage, South Africa aims to build a solid foundation for the digital future. The DSI is also engaging with education

and training authorities, and state-owned enterprises, to build intermediate-level R&D skills in areas aligned with its decadal plan. Alongside this, the Department of Communications and Digital Technologies aims to train 500,000 people in a new digital and future skills training programme.

The National Research Foundation plays a crucial role in advancing research and innovation through its South African Research Chairs Initiative in public universities (National Research Foundation, 2024b): two of the research chairs awarded focus on artificial intelligence. Other educational initiatives include the Machine Learning and Data Science Africa Network and the AI Africa Consortium, led by the University of the Witwatersrand (AI Africa Consortium, 2024). In addition, non-governmental organizations like Deep Learning Indaba aim to strengthen machine learning and AI in Africa.

South Africa's leading universities offer undergraduate and postgraduate specializations in AI, with the number of tertiary AI courses increasing from just two in 2017 to 54 in 2023 (OECD, 2024). For example, the African Institute for Mathematical Sciences, a partnership between universities including Cambridge, Oxford, Cape Town and Stellenbosch, now offers a Master's degree in Mathematical Science which includes an 'AI for Science' module (AIMS, 2024). And in 2019, the University of Johannesburg introduced a free, online course entitled Artificial Intelligence in the Fourth Industrial Revolution.

National Integrated Cyber Infrastructure System

South Africa's commitment to advancing scientific and industrial development is exemplified by the National Integrated Cyber Infrastructure System (NICIS). This initiative, spearheaded by the DSI and implemented by the CSIR, aims to provide a robust and integrated cyber infrastructure to support research and education communities across the country. It is designed to promote scientific and industrial growth through the provision of high-performance computing capabilities, high-speed network capacity, and a comprehensive national research data (NICIS, 2024). These components are hierarchically integrated into both globally connected and local systems, providing seamless access for researchers and educators.

One of the three pillars of NCIS is the Centre for High Performance Computing, which offers massive capabilities and services to researchers in both industry and academia, enabling them to tackle complex computational problems that require significant processing power (CHPC, 2024). The second pillar, the South African National Research Network, provides high-speed connectivity and advanced networking services, ensuring that researchers have access to adequate bandwidth and network performance in order to collaborate effectively, share real-time data, and access global research resources.

The third pillar, the Data Intensive Research Initiative of South Africa, addresses the growing need for managing very large datasets, focusing on issues such as data curation, provenance, trust, digital preservation and analytical techniques. These services are critical for ensuring that data-intensive research can be conducted effectively, and that valuable data is preserved for future use. A related initiative is South Africa's new National Big Data Strategy (Department of Science and Innovation, 2024b).

Next steps

Recognizing the need for a strategic approach to solidify its position as a global leader in AI, South Africa is working on several plans for the future. Firstly, it is developing a national AI strategy and government policy – providing the framework necessary to harness the potential of AI, promote innovation and drive economic growth. Secondly, building on the progress of the digital and future skills training programme, South Africa will further invest in creating a skilled workforce for a digital future.

Thirdly, the country will continue to enhance data infrastructure and internet connectivity, ensuring that all South Africans have access to the digital tools and resources they need. Finally, through continued support for institutions like the Centre for Artificial Intelligence Research and initiatives like Deep Learning Indaba, South Africa will advance research into AI research and foster a vibrant AI community throughout the country. Such a multi-faceted and coordinated approach is both ambitious and necessary – for paving the way towards sustainable and inclusive growth, and ensuring ethical adoption of AI that benefits all sectors of society.

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