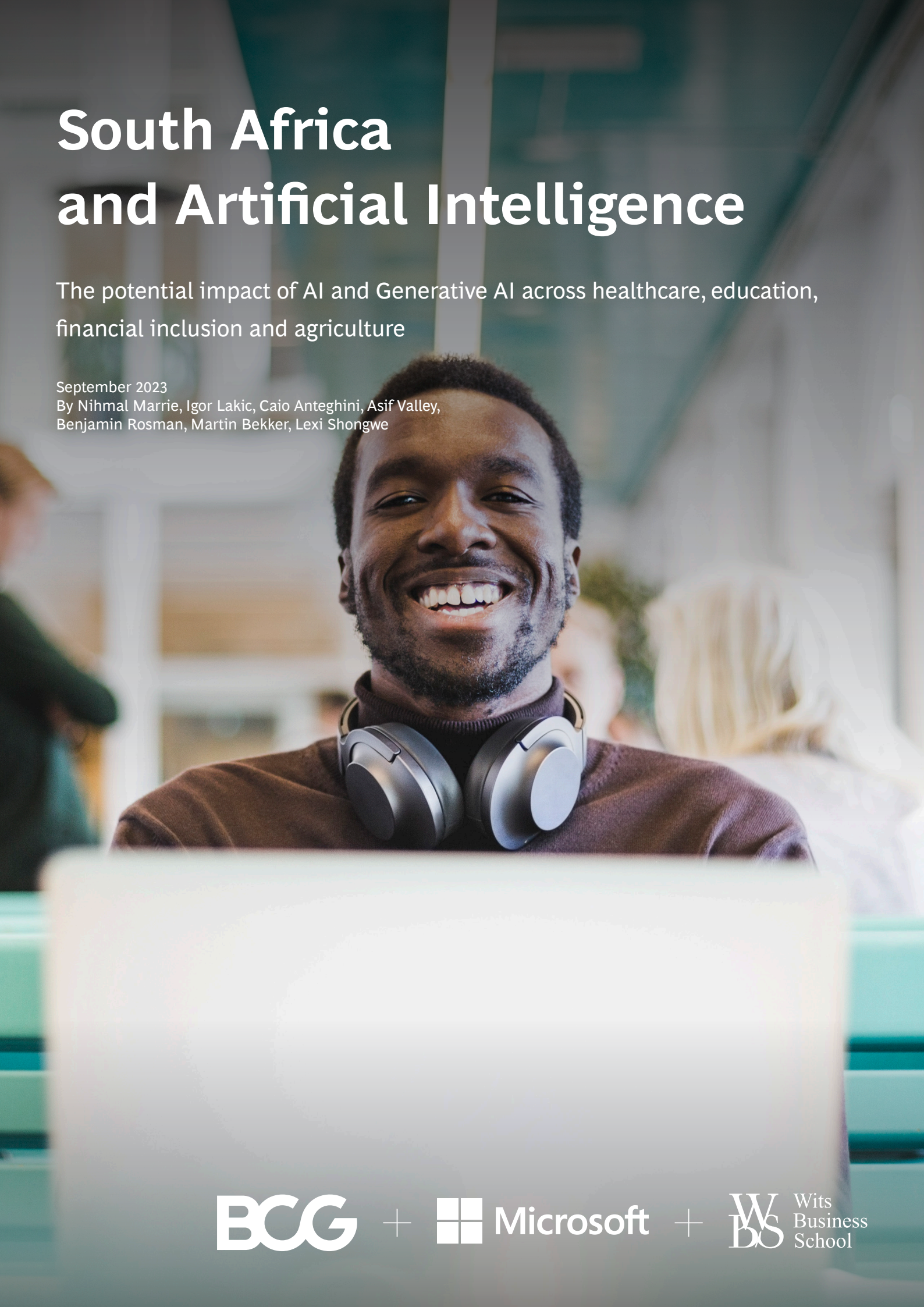
South Africa and Artificial Intelligence

The potential impact of AI and Generative AI across healthcare, education, financial inclusion and agriculture

September 2023
By Nihmal Marrie, Igor Lakic, Caio Anteghini, Asif Valley, Benjamin Rosman, Martin Bekker, Lexi Shongwe



BCG + Microsoft + Wits Business School

Boston Consulting Group partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG works closely with clients to embrace a transformational approach aimed at benefiting all stakeholders – empowering organizations to grow, build sustainable competitive advantage, and drive positive societal impact.

Our diverse global teams bring deep industry and functional expertise and a range of perspectives that question the status quo and spark change. BCG delivers solutions through leading-edge management consulting, technology and design, and corporate and digital ventures. For more information, please visit bcg.com

BCG X is the tech build and design unit of BCG. Turbocharging BCG's deep industry and functional expertise, BCG X brings together advanced tech knowledge and ambitious entrepreneurship to help organizations enable innovation at scale. With nearly 3,000 technologists, scientists, programmers, engineers, and human-centred designers located across 80+ cities, BCG X builds and designs platforms and software to address the world's most important challenges and opportunities. Teaming across our practices, and in close collaboration with our clients, our end-to-end global team unlocks new possibilities. Together, we're creating the bold and disruptive products, services, and businesses of tomorrow. For more information, please visit bcg.com/x

Wits Business School

Sculpting global leaders

Wits Business School (WBS), the graduate school of business administration of the University of the Witwatersrand, is a leading education institution in Africa. It offers postgraduate academic and executive courses, along with public seminars featuring prominent African thought leaders. WBS Executive Education specializes in tailoring in-company programmes to enhance management skills, employing generative-thinking methodologies for immersive learning. WBS is dedicated to nurturing visionary business leaders capable of shaping Africa's future and promoting ethical business practices across the continent.

Microsoft

Microsoft Corporation is an American multinational technology corporation. Microsoft's best-known software products are the Windows line of operating systems, the Microsoft 365 suite of productivity applications, and the Edge web browser. Its flagship hardware products are the Xbox video game consoles and the Microsoft Surface line-up of touchscreen personal computers. It is considered one of the Big Five American information technology companies and a leader in Artificial Intelligence. Microsoft's mission is to empower every person and organization on the planet to achieve more.

Contents

Introduction

Generative Artificial Intelligence (Generative AI), though still in its early stages, is maturing fast, and looks set to become one of the most important technologies of our time. It has already attracted strong interest and substantial investment. The launch of ChatGPT last year, with its underlying language-model AI technology, brought to public attention the power of Generative AI technology. New use cases for Generative AI are emerging daily.

Generative AI can leverage very large amounts of proprietary data and then support data-led decision-making. The commercial applications of these capabilities are very promising, and are being pursued apace. This report, however, concentrates on the societal implications: it looks at the ways in which Generative AI, together with AI more broadly, can address some of South Africa's most pressing challenges, and discusses how AI can be responsibly harnessed to transform the lives of South African citizens.

The report explores four key areas where Generative AI could play a transformative role: **healthcare, education, financial inclusion** and **agriculture.** The aim is to examine some of the possibilities in each of these areas through various use cases, and also to discuss the risks associated with AI and the ideal environment for realizing AI's potential benefits. But first, we should define Generative AI – especially in relation to AI in general – and sketch the current state of play.

> "We definitely want the benefits of this technology and we want to mitigate the unintended consequences[1].

Satya Nadella
Microsoft CEO

1. https://www.cnbc.com/2023/05/17/microsoft-ceo-talks-ai-concerns-and-its-impact-on-jobs-education-.html

Defining Generative AI and outlining its progression and adoption

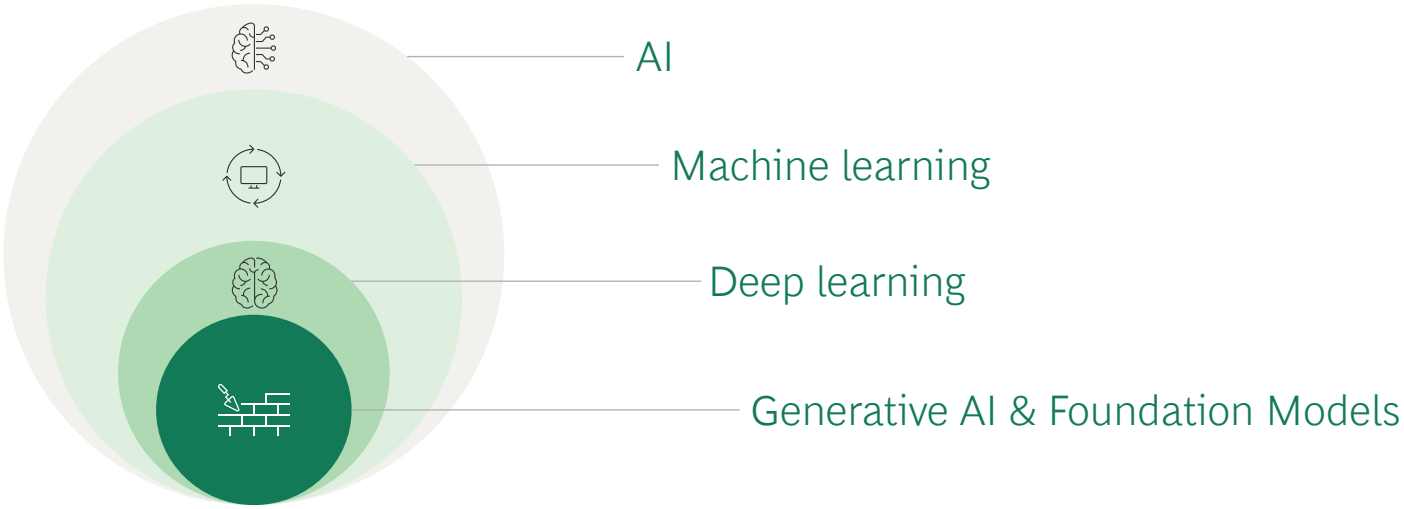
AI is the field of computer science that aims to create machines or systems able to perform tasks that normally require human intelligence – tasks involving reasoning, learning, decision-making, or creativity. AI has evolved over the decades from rule-based systems and expert systems to machine learning and deep learning, which can identify patterns and gain insights from data, and can improve over time.

As for Generative AI, it is best known through its manifestations such as ChatGPT (text-based AI) or DALL-E (text-to-image AI), but it goes well beyond these applications. Generative AI is a subset of machine-learning techniques and models that can produce original text, images, and audio (see Exhibit 1).

To put it another way, Generative AI is a "set of algorithms, capable of generating seemingly new, realistic content – such as text, images, or audio – from training data"[2].

2. BCG overview on Generative AI : https://www.bcg.com/x/artificial-intelligence/generative-ai

Exhibit 1: Where does Generative AI fit in the AI context?

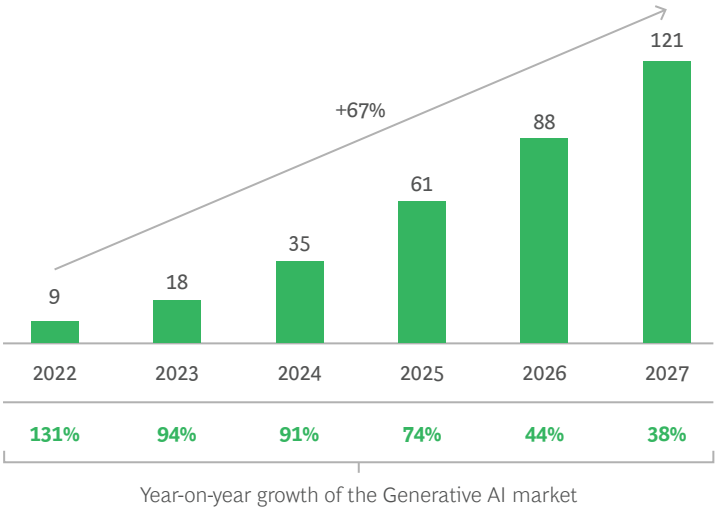


Over the past few years, the barriers to using AI have begun to fall, as the necessary tools and platforms have increasingly become accessible to ordinary citizens. In this fine new world, there is no longer the need for vast datasets or powerful computers, since much of what's necessary is now available through cloud providers. There is also no need for sophisticated technical knowledge: certainly tech-savvy users can download the code and train and refine the models if they want to,[3] but non-experts can comfortably use models trained by others.

Estimates are that Generative AI will have a market value of USD 60 billion by 2025, accounting for 30% of the total addressable market for AI in general (see Exhibit 2).

Exhibit 2: Estimated growth of Generative AI market

Generative AI TAM[1] (USD B)



By 2025, Generative AI is expected to be a **~USD 60B** global market, accounting for a…

~30%

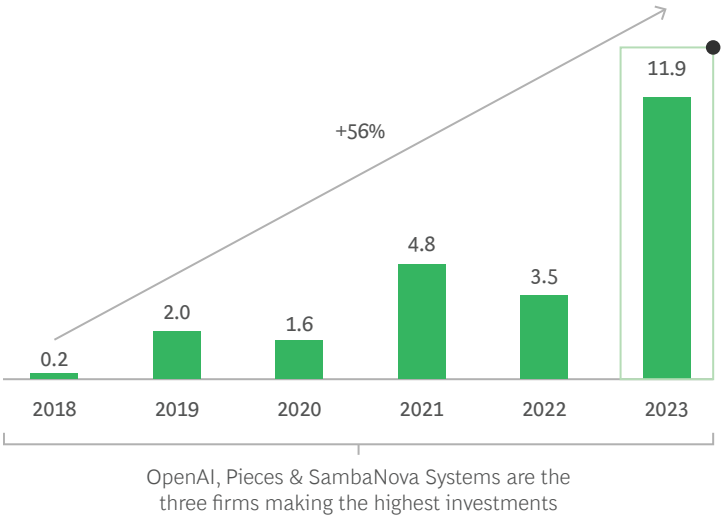
…share of the overall AI market

1. TAM: Technology Acceptance Model
Sources: AI TAM research; Expert interviews; BCG analysis

3. The "open-source AI boom" driven by Big Tech companies like Google, Meta, and Microsoft has fuelled innovation by making accessible the code behind generative models. See MIT Technology Review, "The open-source AI boom is built on Big Tech's handouts. How long will it last?", May 2023.

Exhibit 3: Generative AI start-ups received ~USD 20B in investments in the past three years, five times the amount of investment received in 2018-2020

Private investments (USD B)



50%+ growth in annual investments between 2019 and 2023

● Data for H1 for 2023

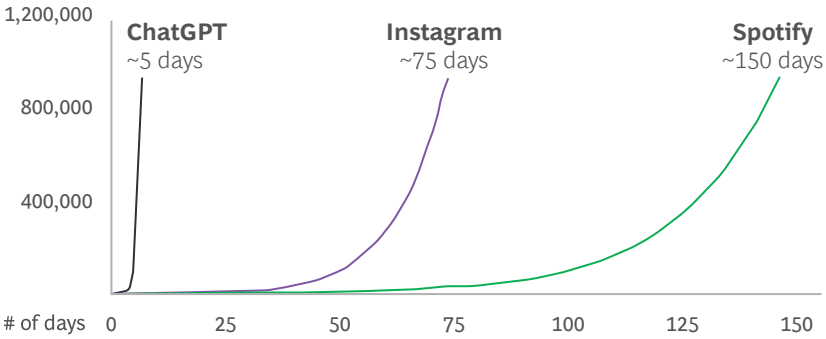
Note: ~1.7K patent families related to Generative AI domain were considered for the analysis; investment data for 2018 & 2023 are incomplete owing to date-to-date restrictions.
Source: BCG analysis; BCG Center for Growth & Innovation Analytics

Over the past three years, Generative AI start-ups have attracted soaring levels of investment, receiving USD 20 billion in funding, five times more than the total investments secured in the previous three years (see Exhibit 3).

The recent launch of various easy-to-use chatbots has led to a rapid and widespread public adoption of Generative AI, with consumers captivated by its ability to create realistic and immersive content (See Exhibit 4).

Exhibit 4: Generative AI has witnessed unprecedented levels of adoption by consumers

ChatGPT reached a million users in just five days – a fraction of the time it took previous viral hits to do so



Top companies partnered with OpenAI since GPT-3

BCG amazon ATLASSIAN salesforce Microsoft Morgan Stanley servicenow

Bard

30M
Active users recorded

1B
Expected customer base

50M
Site visits in March 2023

ChatGPT

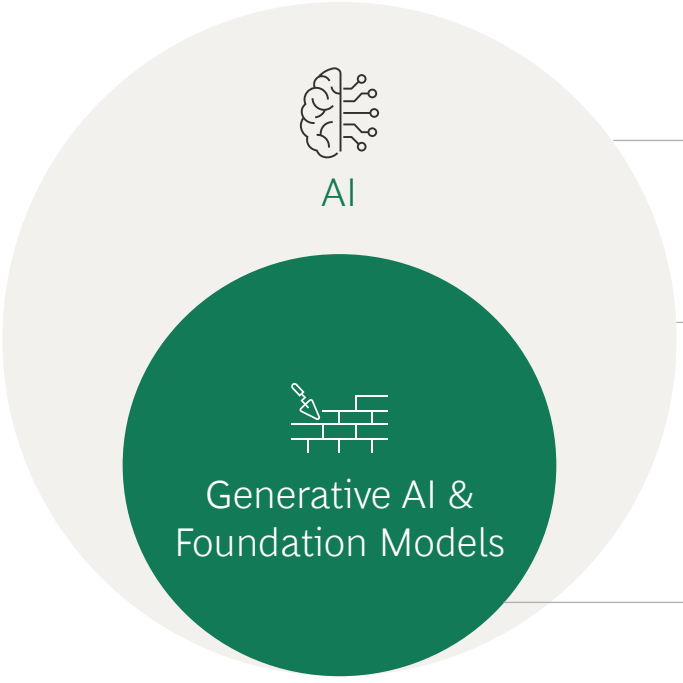
5
Days to achieve 1M users

100
Million users recorded in just 2 months

1.7B
Site visits in April 2023

(Note that some of the use cases outlined below are traditional AI use cases that are enhanced when Generative AI is applied to them (see Exhibit 5). Accordingly, the broader term *AI* will be used from now on, rather than *Generative AI*.

Exhibit 5: Generative AI will unlock new use cases and complement traditional AI in certain cases



Generative AI provides a new range of AI offerings

AI use cases will persist

Scheduling, route optimization, process optimization and control, reservoir modelling, classification, regression, recommenders, decision-making, etc.

Generative AI extends current AI use cases

Increases accuracy and speed of existing models by generating better synthetic data

Simplifies the user interface, and enables effectiveness of current processes (e.g. predictive maintenance)

Generative AI unlocks new use cases

Ability to generate content and ideas will reshape R&D, workforce productivity and customer engagement

Examining the possible uses of AI in South Africa

AI is no silver bullet, but it certainly can make a transformative contribution to easing societal difficulties, notably in four key areas: **healthcare, education, financial inclusion** and **agriculture.**

Healthcare

The healthcare system in South Africa faces several challenges. Both public and private sectors are involved in healthcare provision, with ~70% public and ~30% private[4]. The key issues facing the healthcare system include obstacles to accessing care and affordable medicines, variable quality in the care provided, inadequate funding, and insufficient staff (particularly in the public sector). By way of example, in 2019, South Africa registered a doctor-patient ratio of 0.8 doctors per 1,000 people. To put that into context, compare the ratios of Brazil (2.3), China (2.2), France (3.3) and the United Kingdom (3.0).[5] In rural public hospitals and clinics, where the ratio is likely to be lower still, it is even more difficult for people to get the medical care that they need. AI can address these healthcare issues in several ways:

- **AI can function as an assistant, transcribing and summarizing each consultation, and automatically**

4. Statistics South Africa General Household Survey 2021
5. World Bank Database for Physicians per 1,000 people, accessed 19 June 2023

keeping patient records regularly updated. That will enable doctors and nurses to spend less time on administrative tasks and more time on patients.

DeepScribe provides AI scribing services to practitioners in the United States. It was trained on data from ~2 million patient encounters. It can filter out small talk, identify key medical information, and generate complete EHR-ready notes.[6]

Impact – the tool claims to enable healthcare providers to achieve a 75% reduction in documentation time, and to see two extra patients per day[7].

- **AI can also support personalized diagnosis and treatment recommendations for patients, by using AI-driven analyses of data and taking account of available inventory in hospital pharmacies.** This support for diagnosis and treatment, and the alignment on available drugs, will again free up time for doctors to spend with patients, and will improve patient care and experience. The increase in doctor productivity will improve the efficiency of South Africa's over-stretched public-health system. Doctors will, however, need to maintain a reasonable mistrust, to protect against AI hallucinations and data bias.

- **AI can serve as a 24/7 health-education resource, disseminating Health Department alerts and advice regularly, and in various languages.** Using analyses of individuals' data (such as race and age), AI can provide tailored content – in the appropriate language, and in personalized wording, for maximum impact – on healthier lifestyle choices, managing chronic conditions, and even prevention guidelines in the event of a pandemic. Again, appropriate disclaimers are needed: for any higher-risk matter, and AI advice given to patients should add a warning for them to check with a doctor.

- **AI can also generate efficiencies, both for R&D and for the delivery of supplies.** AI can assist with conducting virtual compound screening and prediction modelling, and thereby reduce reliance on costly physical experiments. In addition, by generating synthetic data for training models, AI can enhance the efficiency of R&D efforts. AI can also refine supply-chain management and distribution strategies by forecasting demand trends, suggesting ways to reduce waste, and optimizing the timing of medication deliveries to the market. Some of the cost-savings could well be passed on to the patient.

Education

Education in South Africa is characterized by severe disparities between private and public schools. Public schooling in general suffers from teacher shortages and under-funding (especially in rural areas). And among public schools themselves, there are marked differences according to their location, students' backgrounds, class sizes, and the like. Teachers often lack appropriate resources, including internet access; and many students face hunger and a lack of parental support.

A recent report, based on a survey of 320 schools in South Africa, found that:

81% of Grade 4 learners (typically aged 9-11) are still unable to read for meaning[8].

Without proper access to high-quality education, deprived children will struggle to escape the cycle of poverty and inequality.

If access to the internet, computers, and digitization of materials were improved appropriately, AI could contribute to several positive shifts in the education sector:

- **AI can help with policy, curricula, and content creation.** By analyzing vast amounts of data, AI can inform policy decisions and syllabus design, and create learning materials. The new content can be tailored to various grade levels and to individual students, and can be presented in the student's preferred language.

  NolejAI in France has made its instructional content generator publicly available for users. It was beta-tested on more than 2,500 educators across primary, high-school and higher education. It enables educators to upload text, video, or audio, and creates interactive lessons.

  Impact – reportedly, educators generated content 50x faster and 20x more cheaply than when using traditional methods[9].

- **AI can help teachers to plan daily classes and can suggest ways of explaining complex ideas.** In schools lacking adequate resources and materials, teachers cannot teach their classes as effectively as they might. With the help of AI, however, they will be able to produce stimulating visual aids and easy-to-understand explanations in their daily classes. In that way, they can bring abstract topics to life, and sharpen their students' critical thinking. AI should also eventually fine-tune lesson plans for the teachers, and produce tailored materials.

6. EHR: Electronic Health Record
7. Company website: https://www.deepscribe.ai/
8. 2023 Background Report for the 2030 Reading Panel
9. Company website: https://nolej.io/nolej-ai

- **AI can be used to create a "conversational tutor", which would enhance student interactions, and also enable better access to resources.** Through natural-language processing, AI-powered conversational tutors can make sense of students' questions and navigate intricate knowledge repositories to retrieve relevant information. It can then generate responses that provide detailed and contextually accurate explanations. This dynamic interaction, in which students engage in seamless and intuitive conversations with the tutor, fosters deeper comprehension.

- **AI can develop personalized lesson plans based on students' strengths/weaknesses.** In the medium term, using analyses of data on student performance and learning patterns, AI will be able to generate engaging lesson plans for each individual student. By adapting the curriculum to a student's individual strengths and weaknesses, AI will ensure better learning outcomes.

Financial inclusion

Recent efforts to expand financial inclusion in South Africa have met with some success, but far more remains to be done to improve people's financial literacy, money management, and access to economic opportunities. Currently, ~20% of adults lack even a basic bank account (or ~30% if you exclude social-grant beneficiaries),[10] with a disproportionate number being women, people living in rural areas, and people from lower-income households. In addition to this unbanked population, there is the under-banked population: an estimated 47% of people that have a bank account fail to make full use of it.[11]

Many other factors complicate the banking landscape in South Africa; for example:

1. Given the constraints on Internet access, only ~5% of people with bank accounts engage in internet banking, and ~18% do basic transactions via their mobile phones.

2. Banks struggle to assess creditworthiness for many customers who cannot provide the traditional metrics.

Although these problems will not be easily or quickly be resolved, AI can offer some assistance to foster financial inclusion:

- **AI can make financial services more accessible to customers.** By deploying AI-powered chatbots to handle routine client queries and provide timely responses, banks will be able to:
  - Spare customers the inconvenience of going to branches and waiting for a banking consultant to be available
  - Increase transparency on products and services, and increase trust from clients, given that chatbots consistently provide accurate responses
  - Communicate in the client's home language
  - Reduce the costs of serving clients, and thereby reduce prices for clients

Ushur is an engagement platform used by financial institutions that leverages conversational AI to build streamlined digital interactions for customers, and provides analytics to know customers better.

Impact – as much as a ten-fold reduction in customer response time, enabling rapid processing[12].

- **AI can help provide personalized recommendations, and improve financial literacy.** AI can assist the under-banked both through education and through financial advice. Via chatbots, AI can engage with users in natural language, fine-tuning their guidance to cater for individual needs. They could also produce personalized recommendations, such as budgeting strategies and investment options, to enable the under-banked to make informed financial decisions and gain access to essential financial services that were previously out of reach.

- **AI can expedite the drafting of legal documents, and assist in explaining, in plain language, pertinent terms to customers.** By extracting and analyzing data from client discussions, AI can swiftly produce legal documents in plain language, or even in home languages, reducing the time and costs associated with traditional drafting of contracts. A further benefit might be to increase access to banking facilities: customers will more easily understand legal agreements, and so will feel more comfortable in signing them.

Agriculture

South Africa has a rich farming history. Agricultural production plays a pivotal role in the country's economy, contributing ~2.5% to GDP[13] and ~10% to exports.[14] But the sector faces several challenges, including under-productivity and climate change. Droughts and variable weather patterns disrupt crop yields. Among the other issues that farmers face, especially in remoter areas of the country, are access to loans, land tenure, and markets. The sector could strug-

10. 2022 Financial Sector Outlook Study, Financial Sector Conduct Authority (FSCA)
11. 2021 Finscope South Africa Consumer Survey, Finmark Trust
12. https://ushur.com/solutions/industries/banking-and-financial-services/
13. World Bank Database for Agriculture, Forestry & Fishing Value Added (as % of GDP), accessed 16 August 2023
14. International Trade Administration, South Africa – Country Commercial Guide (Agricultural Sector)

gle increasingly to achieve the crucial balance between sustainable practices and ensuring food availability and affordability for the population.

There are several ways in which AI can engage with these industry challenges:

- **AI can analyze data to help farmers optimize the efficiency and sustainability of their farming practices.** Farmers can use sensors, drones, and satellites to gather real-time data on their crops, including details on soil health, water usage, crop growth, and the presence of pests. This data can then be analyzed by AI algorithms, and the results will guide farmers on how best to use resources and how to maximize crop yields. Farmers will be able to:

  - Determine optimal planting times, and decide how frequently to irrigate or apply pesticides.

  - Identify variability within a crop field and apply resources at variable rates where most needed.

Jiva is an integrated platform for smallholder farmers. It provides a set of services, including an advisory engine, enriched by machine learning, that provides personalized advice on sustainable farming. It makes use of climate data, remote sensing, and computer vision to help farmers decide on what actions to take next.

Impact – reportedly, most farmers using Jiva have increased crop yields by up to 40%.[15]

- **AI can enhance crop-health monitoring through disease detection.** AI algorithms, based on images of crops from drones and satellites, can also help to identify anomalies and early signs of disease or pest infestations in crops. Farmers can then monitor developments in real time, and intervene as appropriate, thereby minimizing yield losses and achieving food security.

- **AI can – via refined credit scoring – expand financial access for smallholder farmers.** By integrating field data obtained from satellites, weather stations, and IoT devices[16] (sensors and gadgets placed in fields, on equipment, or on animals), AI can develop algorithms that analyze factors such as crop health, soil quality, and weather patterns in real time. The consequent insights, combined with traditional financial data and predictive analytics, help to create a comprehensive credit profile for farmers lacking a conventional credit history. That could enable financial institutions to make more informed lending decisions. It also supports financial inclusion, empowering farmers to invest in their operations, adopt modern agricultural practices, and improve their livelihoods.

15. In 2020 BCG X partnered with Olam to launch Jiva, https://www.bcg.com/x/mark-your-moment/profit-for-purpose-business-building

16. IoT: Internet of Things

Adopting AI in South Africa – broader risks and considerations

While AI opens up a new class of opportunities, it also introduces a new class of risks.

Many of the risks implicit in AI have been widely publicized, and some of them will prove difficult to mitigate, let alone eradicate. Moreover, given that AI is still maturing, some new and unforeseen risks will emerge. Constant vigilance and evaluation of risks are therefore crucial as the technology progresses. (A comprehensive exploration of the risks is beyond the scope of this report.)

For AI to achieve scalable and affordable adoption in South Africa, and to realize its full potential, several indispensable elements will need to be in place.

Appropriate laws and regulation

AI development should take place within an appropriate legal and regulatory framework, to define standards, priorities, and ethical boundaries, and also to support the growth of AI adoption and to mitigate AI risks. A technical working group of experts from relevant industries, including academia, should work with government agencies to develop and continually review all existing and proposed regulations, in an effort to enable an optimal and accountable environment for all.

If the use of AI tools is not explicitly regulated, and the personal information of data subjects is processed without their knowledge or consent, that could place an organization or business in breach of its obligations under the Protection of Personal Information Act (POPIA). The issues raised and the possible consequences would then need to be addressed by appropriate policymakers.

People and workface enablement

South Africa already has an unemployment rate of 33% at the second quarter of 2023,[17] and AI will very likely lead to further job displacement. In South Africa, as in other countries, that downside can be offset by the new work opportunities that AI could open up. To mitigate against the risk of job losses, employers could be incentivized to retain workers and/or retrain or upskill employees to transition into roles associated with AI capabilities. They should also champion AI-focused businesses, especially start-ups, as new spaces for employment, and should introduce supportive legislation for them.

Collaboration

Through Public Private Partnerships (PPPs), the public and private sectors can join forces and pool resources to roll out AI. Collaboration through PPPs would help to prove concepts, and it would reduce the cost and increase the speed of a major AI scale-up. It could also ensure that AI solutions are accessible and beneficial to all South Africans, not just an elite few. One option in that regard would be to provide localized AI tech free of charge to everyone as a public service. Of course, it would not really be free, because it would be founded by taxpayers' contributions, but it might be preferable to the alternatives: becoming reliant on foreign-based private industry to provide crucial AI tech, or having no AI tech at all.

Financial underpinning

Other crucial participants in South Africa's AI roll-out will be Development Finance Institutions (DFIs) and private-sector venture capitalists. They will provide relevant financial support and investment opportunities to local businesses, new or old, and to research institutes. They will also facilitate partnerships between international tech companies and local organizations, promoting knowledge exchange and capacity-building. This support will foster an ecosystem in which South African AI innovators can thrive.

Technological infrastructure

PPPs and DFIs can jointly embed one further foundation stone of South Africa's AI development – tech infrastructure. At the top level, data-sharing platforms are needed for building the large and diverse datasets on which AI models are trained. At a local level, stable and high-bandwidth connectivity needs to be available full-time. Only through a major infrastructure upgrade, especially in remote and under-served areas of the country, will AI's benefits be fairly distributed regionally and socially.

Once all these underpinning components are in place, AI will be positioned – with minimized risk and maximum equitability – to play a transformative beneficial role across key aspects of South African society.

Reassuringly, South Africa's AI start-up landscape is far from empty. The country already boasts a variety of start-ups offering helpful AI-enabled services and solutions. Here are four diverse examples:

Aerobotics

Aerobotics provides AI-enabled pest detection, disease detection, drone imagery services, orchard management, and yield management.

envisionit DEEP AI

Envisionit Deep AI utilizes AI to streamline and improve medical imaging diagnosis for radiologists.

foondamate

FoondaMate's free AI-powered chatbot provides students with instant access to educational resources such as exam papers, study guides, and explanations for difficult words – in more than 10 different languages.

JUMO

Jumo – an online marketplace– connects banks with traditionally inaccessible customers to provide loans, savings, and insurance services.

17. Statistics South Africa, Quarterly Labour Force Survey Q2:2023

Conclusion: Call to action

For AI and Generative AI to fulfil their potential in easing or resolving South Africa's most pressing societal issues, the country's citizens will have to play their part, collectively and individually. Public and private sectors will need to engage in constant open dialogue, concerted action, and cross-functional collaboration.

As shown above in the use-case profiles, many remarkable benefits have already emerged, and countless more opportunities lie in wait. The risks, known and unknown, will have to be navigated and managed. To that end, the correct legislative framework needs to be put in place – and speedily – to match the speedy development of AI itself.

Stakeholders should persevere in exploiting and refining existing technologies, seeking new beneficial applications, and pursuing needs-informed research. Throughout, they should remain mindful of the risks, notably job losses, and push for stronger regulation and mitigating measures as appropriate. If all goes well, AI will live up to its transformative promise, and transform South African society for the better.

> "By leveraging AI, there are unique opportunities for South Africa to address key areas of historic inequity. Collaborative action is needed now to unlock these opportunities while also calibrating potential risks

Nihmal Marrie

Managing Director and Partner,
BCG South Africa

About the Authors

Nihmal Marrie is a Managing Director and Partner in BCG's Johannesburg office.
You can reach him at Marrie.Nihmal@bcg.com.

Igor Lakic is a Managing Director and Partner in BCG's Johannesburg office.
You can reach him at Lakic.Igor@bcg.com.

Caio Anteghini is a Partner in BCG's Johannesburg office.
You can reach him at Anteghini.Caio@bcg.com.

Asif Valley is the National Technology Officer at Microsoft South Africa.
You can reach him at asif.valley@microsoft.com

Benjamin Rosman is Professor in the School of Computer Science and Applied Mathematics at the University of the Witwatersrand.
You can reach him at benjamin.rosman1@wits.ac.za

Martin Bekker is a Lecturer in the School of Electrical and Information Engineering at the University of the Witwatersrand.
You can reach him at martin.bekker@wits.ac.za

Hlulekisile (Lexi) Shongwe is a Consultant in BCG's Johannesburg office.
You can reach her at Shongwe.Hlulekisile@bcg.com.

For more information

To learn more about our work on AI, please visit our dedicated BCG X website at https://www.bcg.com/x and our dedicated technology and digital advantage practice area website at https://www.bcg.com/capabilities/digital-technology-data/overview

Acknowledgments

This publication synthesizes invaluable insights from discussions with experts. The project team wishes to thank them all for their time, dedication, and guidance.


BCG
Microsoft
Wits
Business
School