# CAPTURING THE FOURTH INDUSTRIAL REVOLUTION

A regional and national agenda

# The Fourth Industrial Revolution and digitization will transform Africa into a global powerhouse

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The Fourth Industrial Revolution (4IR)—characterized by the fusion of the digital, biological, and physical worlds, as well as the growing utilization of new technologies such as artificial intelligence, cloud computing, robotics, 3D printing, the Internet of Things, and advanced wireless technologies, among others—has ushered in a new era of economic disruption with uncertain socio-economic consequences for Africa.[1] However, Africa has been left behind during the past industrial revolutions. Will this time be different?

So far, it does not appear that Africa has yet claimed the 21st century,[2] as it still lags behind in several indicators essential for a successful digital revolution (see Figure 5.1).[3]

Improvements in Africa's ICT sector have been largely driven by expanding mobile digital financial services: The region had nearly half of global mobile money accounts in 2018 and will see the fastest growth in mobile money through 2025.

But artificial intelligence (AI) and blockchain are also attracting interest in Africa, as they have the potential to successfully address social and economic challenges there. And there are so many other areas in which 4IR technology can be transformational.

**Table 5.1**

## The four waves of industrial revolution

| Wave | Period | Transition Period | Energy resource | Main technical achievement | Main developed industries | Transport means |
|---|---|---|---|---|---|---|
| I | 1760 - 1900 | 1860 - 1900 | Coal | Steam engine | Texile, steel | Train |
| II | 1900 - 1960 | 1940 - 1960 | Oil, electricity | Internal combustion engine | Metallurgy, auto, machine building | Train, car |
| III | 1960 - 2000 | 1980 - 2000 | Nuclear energy, natural gas | Computers, robots | Auto, chemistry | Car, plane |
| IV | 2000 - present | 2000 - 2010 | Green energies | Internet of Things, 3D printer, genetic engineering | High tech industries | Electric car, ultra fast train |

Source: Petre Prisecaru, "Challenges of the Fourth Industrial Revolution," Knowledge Horizons - Economics 8, no. 1 (2016): 57-62.

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1 Landry Signé. Africa's Role in the Fourth Industrial Revolution: Riding the World's Biggest Wave of Disruptive Innovation. Forthcoming. See the summary online: landrysigne.com.
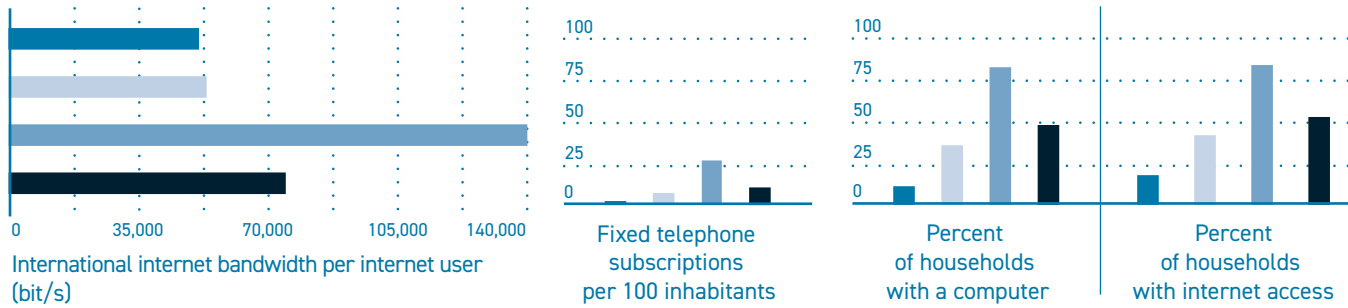2 World Bank, *Can Africa Claim the 21st Century?* (Washington, D.C.: World Bank, 2000).
3 See the International Telecommunications Union's Information and Communication Technology Development Index (IDI Index) conceptual framework and methodology: https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017/methodology.aspx
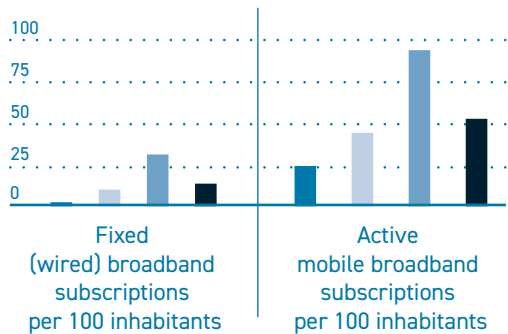
**Figure 5.1**

## Africa's ICT development indicators

Africa still lags behind both developed and other developing countries in several indicators essential for the Fourth Industrial Revolution, especially in infrastructure, technology access, and education.
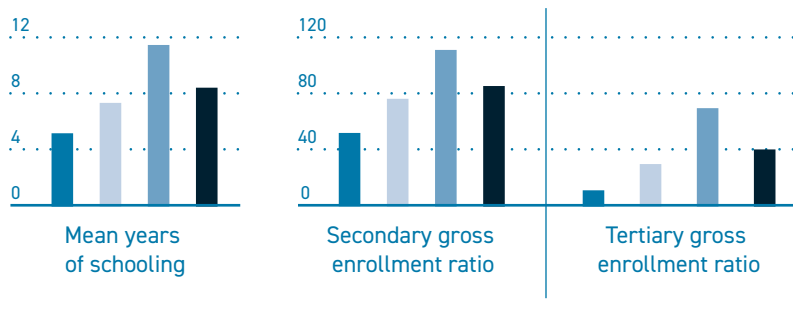
### Technology access



International internet bandwidth per internet user (bit/s)

Fixed telephone subscriptions per 100 inhabitants

Percent of households with a computer

Percent of households with internet access

### Technology use



Fixed (wired) broadband subscriptions per 100 inhabitants

Active mobile broadband subscriptions per 100 inhabitants

### Technology preparedness

Mean years of schooling

Secondary gross enrollment ratio

Tertiary gross enrollment ratio

■ Africa   ■ All developing countries   ■ Developed countries   ■ World

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Sources: Hebatallah Adam, "The Digital Revolution in Africa: Opportunities and Hurdles," Proceedings of the 10th International Conference on Digital Strategies for Organizational Success (2019) and International Telecommunication Union, Measuring the Information Society Report: Volume 1 (Geneva: International Telecommunication Union, 2018).

### The transformative potential of 4IR in Africa is substantial

***Encouraging economic growth and structural transformation:*** In recent years, the ICT sector in Africa has continued to grow, a trend that is likely to continue. Of late, mobile technologies and services have generated 1.7 million direct jobs (both formal and informal), contributed to $144 billion of economic value (8.5 percent of the GDP of sub-Saharan Africa), and contributed $15.6 billion to the public sector through taxation.[4] Digitization has also resolved information asymmetry problems in the financial system and labor market, thus increasing efficiency, certainty, and security in an environment where information flow is critical for economic growth and job creation.

Failure to recognize and capitalize on 4IR opportunities, conversely, will impose considerable risks on African stakeholders: Without attempts to move beyond existing models of innovation, entrepreneurship, and digital growth on the continent, African businesses risk falling further behind,

4 GSM Association, *The Mobile Economy: Sub-Saharan Africa 2019* (London: GSM Association, 2019).

exacerbating the global "digital divide" and lowering their global competitiveness.[5] Going beyond the existing models requires discipline in governance to allow an endogenous innovative environment. At the same time, institutions must protect the market through consumer protection laws and regulations that encourage competition.

***Fighting poverty and inequality:*** The spread of digital technologies can empower the poor with access to information, job opportunities, and services that improve their standard of living. AI, the Internet of Things (IoT), and blockchain can enhance opportunities for data gathering and analysis for more targeted and effective poverty reduction strategies. Already, we have witnessed the transformational power of formal financial services through mobile phones, such as M-Pesa, reaching the underserved, including women, who are important drivers for sustainable poverty eradication. These financial services allow households to save in secure instruments to enlarge their asset base and escape cycles of poverty.

***Reinventing labor, skills, and production:*** By 2030, Africa's potential workforce will be among the world's largest,[6] and so, paired with the needed infrastructure and skills for innovation and technology use, the 4IR represents a massive opportunity for growth. Indeed, the 4IR is dramatically changing global systems of labor and production, requiring that job seekers cultivate the skills and capabilities necessary for adapting rapidly to the needs of African firms and automation more broadly. Already, Africa's working population

is becoming better educated and prepared to seize the opportunities provided by the 4IR: For example, the share of workers with at least a secondary education is set to increase from 36 percent in 2010 to 52 percent in 2030.[7]

***Increasing financial services and investment:*** Digitization has impacted economic growth through inclusive finance, enabling the unbanked to enter formality through retail electronic payments platforms and virtual savings and credit supply technological platforms.[8] More broadly, digitization is enabling entrepreneurs and businesses to rethink business models that are more impactful, sustainable, and connected to other sectors of the economy. For example, with fintech, digitization has gone beyond the financial sector to affect the real sector and households, transforming product designs and business models across market segments.[9] Businesses are able to design products and trade online, and individuals are able to operate financial services and payments for shopping and investments. The government is also migrating to online platforms to conveniently provide public services.

Other 4IR technologies are also having impact. For example, in West Africa and Kenya, blockchain has enabled efficient verification of property records and transactions, and expanded access to credit in some previously informal sectors of the economy.[10] Since blockchains are immutable, fraud—and thus the cost of risk—is reduced. There are also immense opportunities for job creation in Africa.[11] Given the informal sector is estimated to constitute 55 percent of sub-Saharan Africa's

5 Rosanna Chan, "Rethinking African growth and service delivery: Technology as a catalyst," in *Foresight Africa: Top priorities for the continent in 2018* (Washington, D.C.: Brookings Institution, 2018), 88-9.

6 Jean Phibert Nsengimana, "How Africa Wins the 4th Industrial Revolution," *Forbes*, October 10, 2018.

7 World Economic Forum, *The Global Human Capital Report 2017* (Geneva: World Economic Forum, 2017).

8 Virtual savings products and short-term credit platforms include M-Shwari, KCB M-Pesa, and Equitel in Kenya; M-Pawa in Tanzania; and Mokash in Uganda and Rwanda, which has been extended to Côte d'Ivoire as MoMoKash.

9 Njuguna Ndung'u, "Next steps for the digital revolution in Africa: Inclusive growth and job creation lessons from Kenya," *Brookings Institution Working Paper* 20 (2018).

10 Samuel Gebre, "Blockchain Opens Up Kenya's $20 Billion Informal Economy," *Bloomberg,* June 13, 2018.

11 Mobile technologies and services generated 8.6 percent of GDP in sub-Saharan Africa and supported almost 3.5 million jobs in 2018. The GSM Association projects that by 2023, mobile's contribution will reach almost $185 billion, 9.1 percent of GDP. See: GSM Association, *The Mobile Economy: Sub-Saharan Africa 2019* (London: GSM Association, 2019).

GDP[12] (with significant heterogeneity across countries), these tools can be transformational. Their consequences can cascade: Increased financial inclusion contributes to greater capital accumulation and investment, hence potential for employment creation.[13]

***Modernizing agriculture and agro-industries:***
Africa has yet to harness the full potential of its agricultural sector, and 4IR technologies provide an opportunity to do so. Farming alone accounts for 60 percent of total employment in sub-Saharan Africa, and the food system is projected to add more jobs than the rest of the economy between 2010 and 2025.[14] Farm labor and income is especially important in sub-Saharan Africa, where on-farm activities represent almost 50 percent of all rural income in countries like Ethiopia, Malawi, Nigeria, and Tanzania.[15] Information on competitive pricing, monitored crop information, disease prevention tips, and disaster mitigation support has the potential to transform the agriculture sector to improve income, production, and demand throughout the continent. Furthermore, as incomes rise across the continent, growing consumer demand for food and beverages will coincide with business-to-business growth in agro-processing.

Ghana-based companies Farmerline and Agrocenta offer farmers mobile and web technology for agricultural advice, weather information, and financial tips. Zenvus, a Nigerian startup, measures and analyzes soil data to help farmers apply the right fertilizer and optimally irrigate farms.[16] The "Sparky Dryer," a dehydration machine invented by a Ugandan engineer, uses biofuel to dehydrate produce and reduce food waste.[17] African entrepreneurs and startups are also using the Internet of Things to help farmers optimize productivity and reduce waste through data-driven "precision farming" techniques.

***Improving health care and human capital:***
African countries face numerous health challenges exacerbated by climate change, limited physical infrastructure, and a lack of qualified professionals. 4IR technology can help mitigate these threats and build sustainable health care systems, especially in fragile states.

Mobile technology has become a platform for improving medical data and service delivery: About 27,000 public health workers in Uganda use a mobile system called mTrac to report medicine stocks. The SMS for Life program, a public-private partnership, reduces medicine shortages in primary health care facilities by using mobile phones to track and manage stocks levels of malaria treatments and other essential drugs.[18] Rwanda became the first country to incorporate drones into its health care system, using autonomous air vehicles to deliver blood transfusions to remote regions. Technology has also improved disaster response: During the West African Ebola outbreak in 2014, WhatsApp became an easy method of dispersing information, checking symptoms, and communicating under quarantine.[19]

Illness detection and pharmaceutical production have most immediately benefited from digitization. AI is being slowly implemented in Ethiopia to help medical professionals correctly diagnose cervical cancer and other

12 United Nations Economic Commission for Africa, *Contribution to the 2015 United Nations Economic and Social Council Integration Segment* (Addis Ababa: United Nations Economic Commission for Africa, 2015).

13 It is estimated that one additional technology job creates five new jobs in the local non-tradable sectors.

14 Simeon Ehui, "Why technology will disrupt and transform Africa's agriculture sector in a good way," in *Foresight Africa: Top Priorities for the Continent in 2018* (Washington, D.C.: Brookings Institution, 2018), 96-8.

15 Food and Agriculture Organization of the United Nations, *The State of Food and Agriculture: Leveraging Food Items for Inclusive Rural Transformation* (Rome: Food and Agriculture Organization of the United Nations, 2017).

16 Ehui, "Why technology"

17 Harriet Kariuki, "Innovation is Key to Curbing Post-Harvest Losses in Africa," *Medium*, August 19, 2018.

18 Access to Medicine Foundation, *Access to Medicine Index 2016* (Amsterdam: Access to Medicine Foundation, 2016).

19 Milicent Atieno, "How technology can improve healthcare in sub-Saharan Africa," *Innov8tiv*, 2017.

abnormalities.[20] IBM Research Africa is also using AI to determine the optimal methods for eradicating malaria in specific locations and using game theory and deep learning data analytics to diagnose pathological diseases and birth asphyxia.[21] (For more on the promise of artificial intelligence in Africa, see the viewpoint on page 69).

**Strategies for overcoming key challenges facing Africa during the 4IR**

Clearly, the 4IR presents significant opportunities as well as challenges for Africa. The key issue for policymakers is how to position their economies to benefit from the 4IR while managing the challenges that it presents. Below are three strategies that leaders should prioritize.

*Fixing the labor-skills mismatch*

Since creating jobs for the burgeoning youth population is a priority in most African countries, many governments are reluctant to support technologies that threaten existing jobs. Some of the current technologies tend to replace low-skilled workers—of which Africa has an abundance—with higher-skilled workers, constraining participation in the 4IR to economies with relevant skills.[22] African governments must invest in education and reskilling programs to ensure that technology supplements, instead of replaces, labor.

*Enhancing agile governance for secure, effective management of the 4IR and integration into global value chains*

As innovation is at the heart of the 4IR, reinforcing state and institutional capacity to drive and support innovation and create an enabling business environment is essential for success.

A major regulatory challenge involves increasing cybersecurity. Most African countries lack a comprehensive legal framework and institutional capacity to address cybercrime. Instead, efforts to prevent cybercrime are appearing at the more local level or are implemented by private sector actors themselves. For example, between 2015 and 2016, there was a 73 percent increase in Information Security Management System-certified companies, from 129 in 2015 to 224 in 2016, with the majority in South Africa, Nigeria, and Morocco.[23] Adopting widely accepted and appropriate norms and regulations, such as these, is a first step to increasing cybersecurity. At the same time, companies should invest in their employees to develop cybersecurity skills and integrate cyber risk protection in their decision making process.

The African Continental Free Trade Agreement offers a unique opportunity to enhance governance around the 4IR. With aligned policies and procedures, the continent can adapt to the rapid changes of the 4IR and leverage it to accelerate participation in global value chains.

More broadly, the 4IR can actually empower service delivery, through, for example, national identification and a new generation of biometrics that can centralize data for a variety of uses and users.

*Developing physical and digital infrastructure*

Access to advanced technology in Africa is constrained by infrastructure parameters such as lack of electricity and low teledensity,

20 Cary Champlin, David Bell, and Celina Schocken, "AI Medicine Comes to Africa's Rural Clinics," *IEEE Spectrum*, April 27, 2017.
21 Victor Akinwande, "AI in health care: Where does Africa lie?" *Techpoint Africa*, March 26, 2018.
22 Wim Naudé, "Entrepreneurship, Education and the Fourth Industrial Revolution in Africa," *IZA Institute of Labor Economics Discussion Paper* 10855 (2017).
23 International Organization for Standardization, *ISO Survey of Management System Standard Certifications* (Geneva: International Organization for Standardization, 2018).

internet density, and broadband penetration.[24] As a result, mobile phone and internet use remains low (Figure 5.2). (For more on strategies for upgrading Africa's ICT infrastructure, see the viewpoint on page 71). Other technological bottlenecks include a lack of standardized application programming interfaces and common data languages for the increased integration of largely self-sufficient systems as well as exposure to the dangers of cyberattacks. Accelerating the physical connectivity of fiber-optic networks as well as the interoperability of virtual platforms is critical not only for upgrading technology on the continent, but also for reaching and lowering unit costs for the underserved.

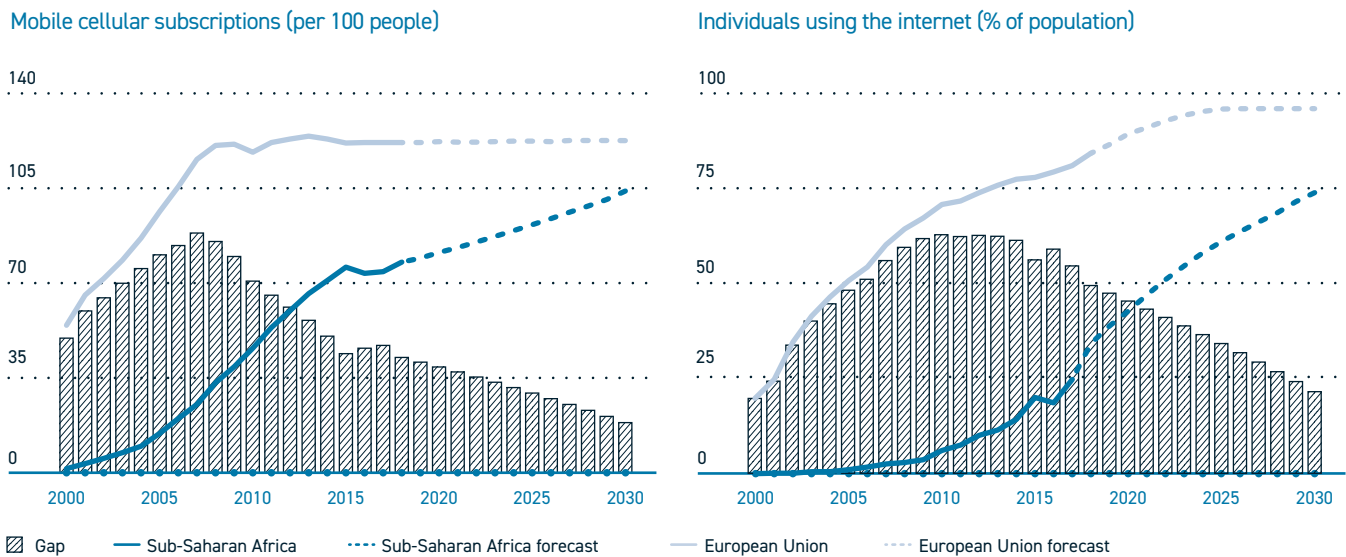More broadly, adequate infrastructure development will drive and sustain economic transformation in Africa. With lower transport and communication costs, countries with suitable agro-ecological conditions can produce high-value products. Closing the internet connectivity and access gap with advanced economies will enable more African countries to enter service export markets. Small-scale manufacturers in Africa may also become more competitive with access to digital platforms for research, sales, and distribution.

To make the most of the 4IR, African governments and entrepreneurs need to recognize new niches for industry and leverage them to achieve sustainable, inclusive growth, and take decisive steps to close the gaps in digital skills, infrastructure, and research and development.

**Figure 5.2**

## Closing the gap in mobile phone and internet access

In recent years, Africa has begun to close the gap in mobile phone and internet access. In 2018, compared to the European Union, the average gap in mobile phone access was only 44.6 mobile cell phone subscriptions per 100 people, down from a high of 92.8 in 2007. For internet access, the gap is also lessening, although at a slower rate: The access gap in 2017 was 55.4 percentage points, down from a high of 63.8 in 2010. By 2030, given current trends, these gaps are projected to decrease to 19.4 and 21.8 for mobile phone and internet access, respectively.

Mobile cellular subscriptions (per 100 people)

Individuals using the internet (% of population)



Gap ▨  Sub-Saharan Africa ——  Sub-Saharan Africa forecast ·····  European Union ——  European Union forecast ·····

Source: Brookings Africa Growth Initiative, using data from "World Development Indicators," World Bank, accessed November 2019.

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24 International Telecommunications Union, *Measuring the Information Society Report 2018*, *Volume 1* (Geneva: International Telecommunications Union, 2018).

# Viewpoint

# Shooting for the moon: An agenda to bridge Africa's digital divide

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Africa needs a digital transformation for faster economic growth and job creation. The World Bank estimates that reaching the African Union's goal of universal and affordable internet coverage will increase GDP growth in Africa by 2 percentage points per year.[1] Also, the probability of employment—regardless of education level—increases by 6.9 to 13.2 percent when fast internet becomes available, as it facilitates firm entry and boosts productivity and exports.[2] As such, digital technologies offer a unique opportunity for African countries to significantly transform various sectors of their economies. However, this potential cannot be fulfilled unless Africa addresses its sizeable deficits in digital infrastructure.

Africa is seriously lagging on the digital front. For example, internet penetration, quality, and affordability are very low compared to the rest of the world: Internet penetration in 2019 averaged 39.6 percent in Africa compared to 62.7 percent in the rest of the world, though there is immense variation among countries, ranging from 89.8 percent in Kenya to 5.3 percent in Burundi. Furthermore, in 2017, Africa used only 1 percent of the world's total international internet bandwidth. The median mobile broadband download speed in Africa is 2.7 megabits per second (Mbits/s), roughly half the global median of 5.2 Mbits/s, and the monthly cost of a fixed broadband connection is 36.6 percent of gross national income, compared with 14.5 percent globally.

African countries spend about 1.1 percent of GDP on digital investment, while advanced economies spend an average of 3.2 percent. Thus, business-as-usual is not an option, as it will continue to widen the digital divide and drive further marginalization of Africa.

On the bright side, the region has shown a readiness to embrace full digitization: It has seen the highest rate of increase in internet use and connectivity in the world over the last two decades and is home to a young and dynamic population. Over the same time period, the number of internet users in Africa has increased more than 116-fold, from 4.5 million to 523 million, while that in the rest of the world did not even double. Young Africans in particular are capitalizing on new technologies to launch startups and to find solutions to the continent's problems. Successful

1 Cesar Calderon et al., *Africa's Pulse, No. 19, April 2019: An Analysis of Issues Shaping Africa's Economic Future* (Washington, D.C.: World Bank, 2019).
2 Jonas Hjort and Jonas Poulsen, "The Arrival of Fast Internet and Employment in Africa," *American Economic Review* 109, no. 3 (2019): 1032-1079.

technological innovations, ranging from mobile banking services in Kenya to delivery of life-saving medications by drones in Rwanda, are widespread. Those successes need to be scaled up to the continental level.

Unsurprisingly, African youth, aiming to fully integrate into the 21st century economy, are demanding better digital services. In response, the African Union, supported by the World Bank, is pursuing an initiative for digital transformation, accelerating the rate of internet use to catch up and even surpass the rest of the world in a decade or less.

This Digital Moonshot initiative has five key elements. The first element is investing in digital infrastructure to improve access and quality, which includes investing in connectivity (e.g., high-speed internet, internet exchange points), the Internet of Things (e.g., mobile devices, computers) and data repositories (e.g., data centers, clouds). These upgrades will require some public investments, but most investment will need to come from the private sector, hence the need for legal and regulatory reforms to encourage private investment.

## With its large numbers of imaginative and creative youth, Africa should become the startup continent.

The second element is investing in a digitally savvy workforce to build robust digital economies and competitive markets. Third is investment in digital platforms that offer products and services through digital channels. Most platforms are developed by the private sector, but some (e.g., digital ID systems) are public sector-led. Fourth is the development of digital financial services to enhance financial inclusion; M-Pesa in Kenya is the best example of such a system. The development of digital financial systems requires reforms of monetary and financial regulations and supervision systems to allow mobile phone operators to provide financial services. The fifth element is to create an ecosystem to encourage digital entrepreneurship and innovation. With its large numbers of imaginative and creative youth, Africa should become the startup continent.

Finally, I must highlight two additional points. First, the goal of digitally transforming Africa is achievable. The total cost of this initiative is estimated at between $80 billion and $100 billion over 10 years, with more than half of the investment coming from the private sector. The challenge is not just to mobilize public resources; rather, the biggest challenge is to put in place policies and institutions that encourage the private sector to invest. Second, the needs of the digital economy should not distract from work to deal with Africa's other needs, especially investment in human capital, energy, and transport.

**Viewpoint**

# The future is intelligent: Harnessing the potential of artificial intelligence in Africa

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The future is intelligent: By 2030, artificial intelligence (AI) will add $15.7 trillion to the global GDP, with $6.6 trillion projected to be from increased productivity and $9.1 trillion from consumption effects.[1] Furthermore, augmentation, which allows people and AI to work together to enhance performance, "will create $2.9 trillion of business value and 6.2 billion hours of worker productivity globally."[2] In a world that is increasingly characterized by enhanced connectivity and where data is as pervasive as it is valuable, Africa has a unique opportunity to leverage new digital technologies to drive large-scale transformation and competitiveness. Africa cannot and should not be left behind.

> In a world that is increasingly characterized by enhanced connectivity and where data is as pervasive as it is valuable, Africa has a unique opportunity to leverage new digital technologies to drive large-scale transformation and competitiveness. Africa cannot and should not be left behind.

There are 10 key enabling technologies that will drive Africa's digital economy,[3] including cybersecurity, cloud computing, big data analytics, blockchain, the Internet of Things, 3D printing, biotechnology, robotics, energy storage, and AI. AI in particular presents countless avenues for both the public and private sectors to optimize solutions to the most crucial problems facing the continent today, especially for struggling industries. For example, in **health care**, AI solutions can help scarce personnel and facilities do more with less by speeding initial processing, triage, diagnosis, and post-care follow up.[4] Furthermore, AI-based pharmacogenomics applications, which focus on the likely response of an individual to therapeutic drugs based on certain genetic markers, can be used to tailor treatments.

1 PwC, *Sizing The Prize: What's The Real Value of AI for Your Business and How Can You Capitalize?* (London: PwC, 2018).
2 Gil Press, "Artificial Intelligence (AI) Stats News: AI Augmentation To Create $2.9 Trillion Of Business Value," *Forbes*, August 12, 2019.
3 Youssef Travaly, Nathalie Munyampenda, and Esther Kunda, *Moving from goodwill to action: A call for a Coordinated Vision for Africa's Digital Economy* (Kigali: Next Einstein Forum, 2019).
4 Access Partnership and University of Pretoria, *Artificial Intelligence for Africa: An Opportunity for Growth, Development, and Democratization* (Pretoria: Access Partnership and University of Pretoria, 2018).

Considering the genetic diversity found on the African continent, it is highly likely that the application of these technologies in Africa will result in considerable advancement in medical treatment on a global level.

In **agriculture**, Abdoulaye Baniré Diallo, co-founder and chief scientific officer of the AI startup My Intelligent Machines, is working with advanced algorithms and machine learning methods to leverage genomic precision in livestock production models.[5] With genomic precision, it is possible to build intelligent breeding programs that minimize the ecological footprint, address changing consumer demands, and contribute to the well-being of people and animals alike through the selection of good genetic characteristics at an early stage of the livestock production process.[6] These are just a few examples that illustrate the transformative potential of AI technology in Africa.

However, a number of structural challenges undermine rapid adoption and implementation of AI on the continent. Inadequate basic and digital infrastructure seriously erodes efforts to activate AI-powered solutions as it reduces crucial connectivity. (For more on strategies to improve Africa's digital infrastructure, see the viewpoint on page 67). A lack of flexible and dynamic regulatory systems also frustrates the growth of a digital ecosystem that favors AI technology, especially as tech leaders want to scale across borders. Furthermore, lack of relevant technical skills, particularly for young people, is a growing threat. This skills gap means that those who would have otherwise been at the forefront of building AI are left out, preventing the continent from harnessing the full potential of transformative technologies and industries.

Similarly, the lack of adequate investments in research and development is an important obstacle. Africa must develop innovative financial instruments and public-private partnerships to fund human capital development, including a focus on industrial research and innovation hubs that bridge the gap between higher education institutions and the private sector to ensure the transition of AI products from lab to market.

At the same time, we must be careful that priority sectors drive the AI strategy in Africa with accompanying products—not the other way around. We believe the health care industry presents by far the most urgent need and promising market opportunity, and, as such, should be put at the top of the list for the continent's decisionmakers. A large portion of the African population is still unable to access proper health care, with a low patient ratio of one physician per 5,000 patients, and there is almost no country with a fully integrated health management platform.[7] AI could intervene directly to improve personalized health care and product development. Importantly, the health management platform precedes the leveraging of AI, so we must equally invest in cybersecurity, Big Data, cloud computing, and blockchain.

### What does this mean for Africa?

Artificial intelligence for Africa presents opportunities to put the continent at the forefront of the Fourth Industrial Revolution. Before Africa can lead this transformation, though, there are important steps that must be undertaken. First, the region needs to formulate a comprehensive continental

5 "Speakers at the 2019 Indaba: Keynote Speakers," *Deep Learning Indaba*, 2019.
6 Martien Groenen, "Animal Genomics," *Wageningen University & Research*, accessed November 19, 2019.
7 Kingsley Ighobor, "Diagnosing Africa's medical brain drain," *African Renewal*, December 2016 – March 2017.

blueprint to guide its AI strategy by involving key Pan-African institutions, academia, and the private and public sectors in its conception.

In addition, these stakeholders must also invest in creating a digital identity platform for all Africans with reliable data banks for AI to be a viable economic option. For this, it is imperative to leverage readily available local talent as a means to promote and democratize AI technology continent-wide. Finally, we must harmonize regulatory policies that encourage ethically built AI systems so as to guarantee a more inclusive economic development for Africa. With these important steps, the next decade for Africa will be intelligent.

**Figure 5.3**

## Firms' preparedness for the Fourth Industrial Revolution

The majority of African firms report moderate to very low levels of business preparedness for five key 4IR technologies. Notably, firms are least prepared for artificial intelligence/robotics and blockchain technologies. Experts say that the low levels of preparedness stem from the inability of firm leadership to develop effective digital strategies, as well as low levels of education and skills of employees.



Source: Kapil Kapoor et al., "Fourth Industrial Revolution, Jobs, and Skills," in Creating Decent Jobs: Strategies, Policies, and Instruments, eds. Celestin Monga, Abebe Shimeles, and Andinet Woldemichael (Abidjan: African Development Bank, 2019), 297-334.

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**Viewpoint**

# A national strategy for harnessing the Fourth Industrial Revolution: The case of South Africa

**Cyril Ramaphosa,** President of the Republic of South Africa @CyrilRamaphosa

The Fourth Industrial Revolution (4IR) represents the great tectonic shift of our time. It is creating new possibilities for improving people's lives. Disruptive technologies like machine learning, artificial intelligence, and big data are changing the way we live, the way we work and do business, and the way we govern.

As a continent that continues to be impacted by historically low levels of development, Africa can and must take advantage of technological advances to industrialize, pursue inclusive growth, and attract investment. It must also be at the forefront of driving new solutions to our developmental challenges, like access to health care and education.

South Africa is preparing itself to take the great quantum leap into the future, and in doing so to ensure that technological advances benefit all, and not a select few.

By 2030, we aim to be a nation that has fully harnessed the potential of technological innovation to grow our economy and to uplift our people. To this end, we have established a Presidential Commission on the Fourth Industrial Revolution to develop an integrated national response strategy. The commission is composed of representatives of tech startups, academia, cybersecurity specialists, researchers, social scientists, trade unionists, and other representatives from key economic sectors. This commission, which is due to report in early 2020, has various workstreams on issues such as infrastructure and resources, research, technology and innovation, human capital, industrialization, and policy and legislation.

Our focus is threefold. First, we need to respond with agility and purpose. Like the self-learning artificial intelligence we have today that was unthinkable a decade ago, we must be adaptive and responsive to the pace of change.

> We want to be a country where our people are digital citizens, our workforce is skilled and empowered, and our youth enjoy the transformative benefits of employment in a new world of work.

Second, we are determined to take advantage of the opportunities technological change presents to enhance our global competitiveness, with a focus on key sectors with high growth potential such as agriculture, mining, manufacturing, information and communications technologies, and electronics. That is why we have prioritized attracting investment in ICT infrastructure, especially fiber optics. We also are in the process of licensing high-demand broadband spectrum as part of our economic reform package. Next generation super-fast 5G is already being rolled out in parts of South Africa.

South Africa is also developing capabilities to further our scientific and technological understanding. Projects like the MeerKat radio telescope are pushing the envelope of space observations. Our Council for Scientific and Industrial Research is recognized as a continental leader in research into complex contemporary challenges from climate change early warning systems, to water security, to biotech and nuclear research.

Third, we aim to ensure that our citizens are prepared, and, where necessary, to shield them from any adverse consequences of technological change. Just about every industry will be impacted by automation. Reskilling will therefore be critical, as will investing heavily in curriculum innovation to prepare our people for the jobs of the future.

By 2030 we want to be fully integrated into the economy of the future—an economy that uses technological innovation to revolutionize manufacturing and industrial processes and energy provision and distribution. We want to demonstrate how science, technology, and innovation have been used to enhance our food and water security and to build smart human settlements.

We want to be a country where our people are digital citizens, our workforce is skilled and empowered, and our youth enjoy the transformative benefits of employment in a new world of work. Africa is a continent of entrepreneurs, and we want to use the advance of technology to catalyze entrepreneurial activity. Economic growth will be driven by the leaner and more adaptable small- and medium-sized businesses of the future. Industry 4.0 will enable us to "leapfrog" outdated processes and technologies in favor of newer, more sustainable ones. Digital business models such as mobile money have taken root in large continental markets and are expanding.

> We want to be a country where our people are digital citizens, our workforce is skilled and empowered, and our youth enjoy the transformative benefits of employment in a new world of work.

Although the resource sector will continue its substantial contribution to GDP, Africa's long-term growth lies in scaled-up investment in disruptive technologies, especially with the rapid growth of the consumer class, more people entering the workforce, improved levels of education, and mass urbanization.

Our ability to harness the 4IR rests on forging collaborative partnerships between government and the private sector, with policymakers and industry experts, and with our fellow nations on the African continent. Our success rests on the political will of governments, on being prepared to take risks, and on striking a balance between innovation and regulation.

South Africa, together with the other nations of the world, shares a desire to be part of this new age of disruption, and, in doing so, ensures that we move beyond mere connectivity towards sustainable growth, tangible job creation, and an inclusive future.

**Figure 5.4**

## Digitization, automation, and jobs in South Africa

Digitization and automation will both displace workers and generate jobs as productivity increases, technology-responsive policy is enacted, and new occupations are created. As a result of these processes, South Africa could gain up to 1.2 million jobs by 2030.

Jobs gained and jobs lost by 2030 as result of automation, millions, mid-point scenario
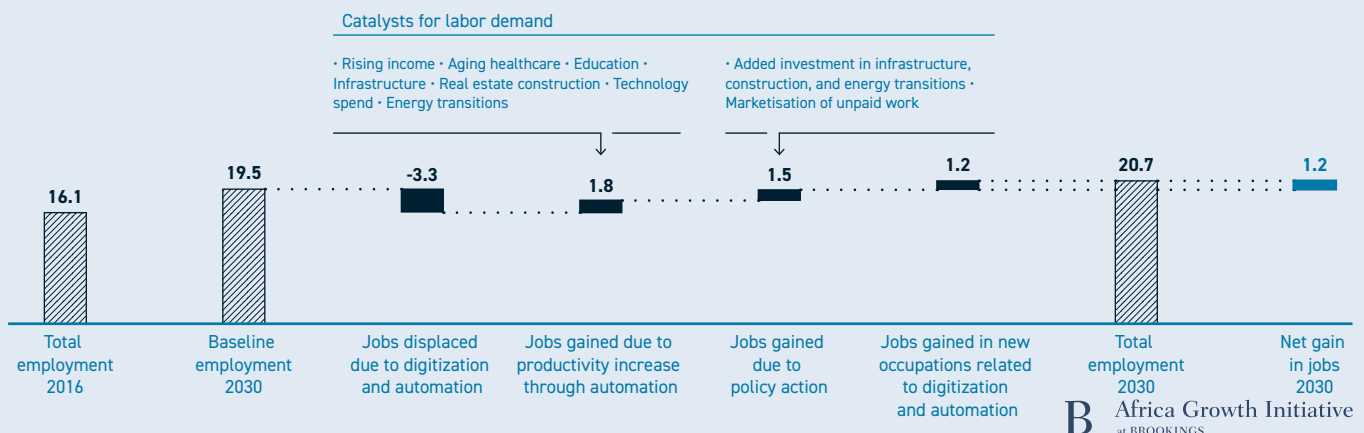


Source: Nomfanelo Magwentshu et al., *The Future of Work in South Africa: Digitization, Productivity, and Job Creation* (Johannesburg: McKinsey & Company, 2019).