

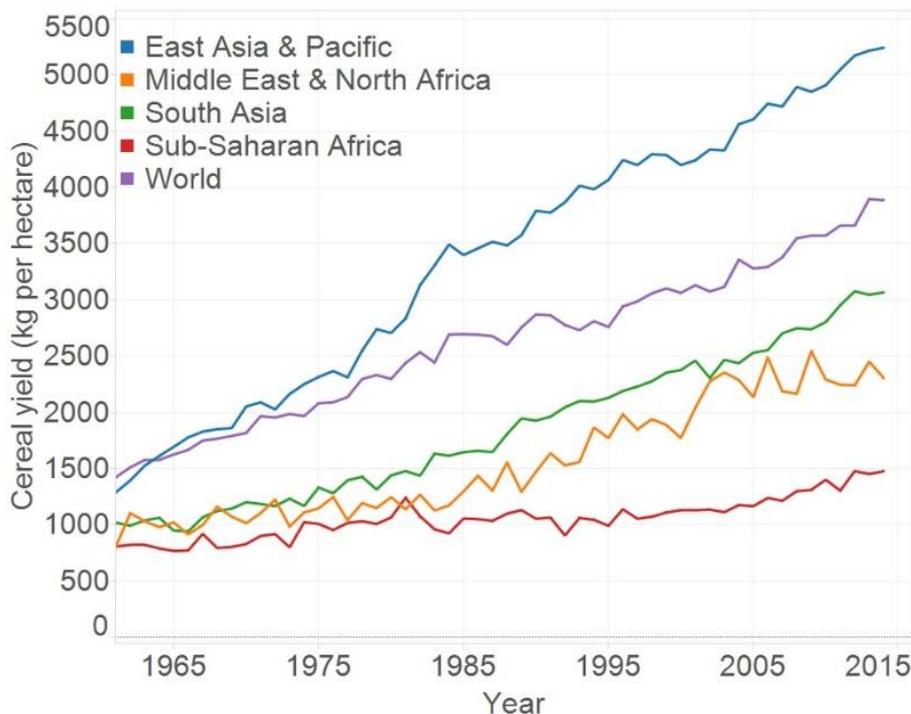
AFRICAN HOME-GROWN INNOVATIONS TAKE OFF

Over the last decade African advances in technology, especially in the home-grown mobile banking sector, have shown how innovation can contribute to economic development across the continent. By understanding how the application of changes in technologies take hold globally—from initial discovery to new commercial products, processes, or services—private firms in Africa can better deploy investment into successful innovations to propel the continent’s productivity and growth.

The term ‘technology’ means different things to different segments of society, and its usage has changed with time. Today the term is often associated with electronic or digital products and services, but older and more basic tools and processes qualify as technology too. At its core, technology is the practical application

of knowledge to a particular objective, often with the effect of increasing economic productivity. Nails, for example, are a technology for holding wood together, and in turn they led to the development of other technologies, from basic hammers to pressurized nail guns.

Cereal yields by region and year show the potential to increase the productivity of Africa’s agricultural sector,



Source: World Development Indicators 2016

Business-led advances in technology have played a key role in emerging-market growth, especially in Africa. While the advent of mobile banking in Kenya in the last decade is among the best known new technologies, a number of other firm-led advances outside of the high-tech arena have helped raise economic productivity and standards of living for hundreds of millions of Africans. For example, fertilizer is an example of a low-tech method that has boosted commercial and social returns on investment.

AFRICAN SUCCESS STORIES

A few examples provide insights about technology development in Africa across the innovation continuum from inventions to technology adoption and adaption. These success stories provide a partial picture of how public policy can influence business growth. Many developments in technology stemmed from inventions initially designed for Africa.

Mobile Phone Solar Charging

With unreliable or often absent electrical grids, charging devices—and especially mobile phones—can be difficult in many African countries. Fenix International, a venture-backed private company founded in 2009, makes a “ReadySet” kit that is a portable solar-powered mobile phone charger designed for the African market. The company, with offices in East Africa and Silicon Valley, struck an agreement with MTN, the South Africa-based telecom company, to sell the kits at cost initially in Uganda and then Rwanda through MTN’s distribution network.

ReadySet kits directly increased revenue for MTN by keeping subscribers’ phones charged. That meant that subscribers used more mobile services, from mobile banking to remotely checking crop prices in distant markets to time harvesting activities.

But the technology also unexpectedly spawned a cottage industry of individual ReadySet kit owners charging others’ phones in return for a fee. In addition to creating additional revenue sources, the new industry helped workers save time by keeping them from having to travel to a kiosk or a phone store and wait while their phones charged. The ReadySet kit also incorporates an LED light that allows users to reduce reliance on dangerous kerosene lighting.

Crop Storage

Agriculture is a vital industry for all emerging-market countries, and for Sub-Saharan Africa in particular. The United States Agency for International Development, the United Kingdom’s Department for International Development, and the Gates Foundation funded a project involving West and Central African farmers and agricultural researchers from Purdue University. Together they developed a triple-layered plastic bag for seed and crop storage that has generated greater income for African farmers while enhancing food security for the population.¹

The air- and water-tight bags provide extreme protection from moisture, pests, and high temperatures for a variety of crops, including peas, maize, sorghum, wheat, rice, nuts, and beans. Referred to as Purdue Improved Crop Storage, the bags also have been tested to assess which seeds can be safely stored for prolonged periods without succumbing to mold.

The retail price of a PICS bag, which varies from \$2 to \$4 depending on the country, is

about three times that of a conventional storage sack. However, because of their durability the useful life of a PICS bag is on average three years, and sometimes longer.

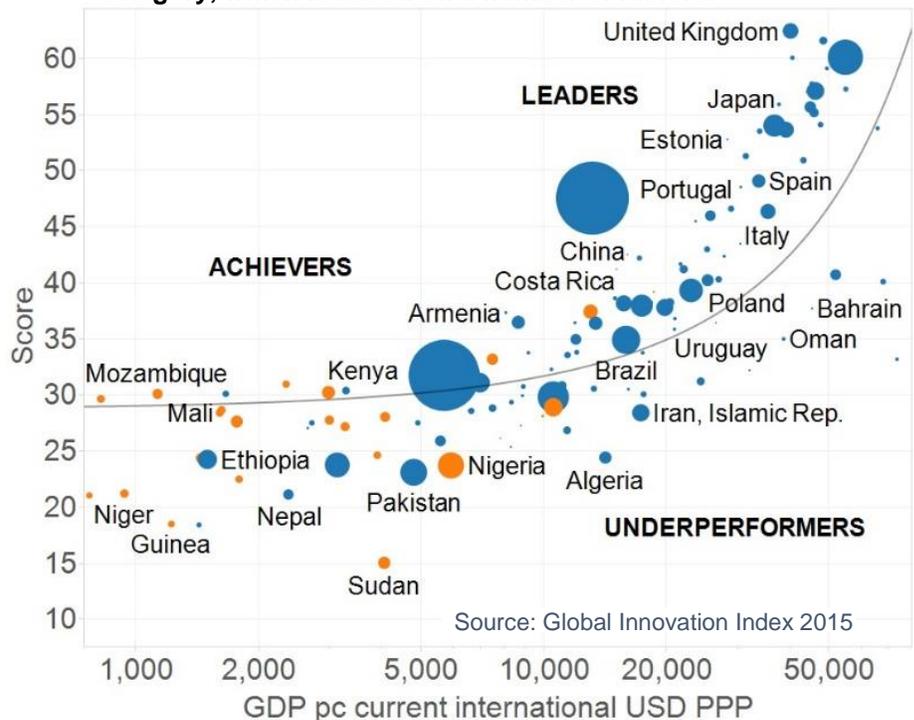
The benefits of PICS bags are considerably greater than their price. Farmers can time their plantings to favorable weather conditions and bring harvested crops to market at a time when prices are higher. As a result, PICS bags have boosted incomes of African farmers by almost 50 percent, according an assessment by the Food and Agricultural Organization of the United Nations.² In addition, the bags help farmers reduce reliance on pesticides, making agricultural communities healthier overall. Finally, PICS bags are manufactured and distributed locally, creating a new labor-intensive industry in Zambia and Tanzania.

Educational Tablets

East Africa, particularly Kenya, is a magnet for high-tech incubators. While retail companies have been the most successful start-ups, educational tablet software firms such as BRCK, eLimu, and Kytabu, are also growing. These start-ups, often the result of collaborations between venture capitalists and nongovernmental organizations, provide or sell pay-per-view tablets to students at a cost less than that of a traditional textbook or laptop.

These tablets allow teachers to customize courses, pulling information from different textbooks and other reading material in an economical way. Customized and changeable course

Some African countries fall into the innovation achiever category, which is based on a number of factors.



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materials help teachers in emerging markets overcome deficits in the educational infrastructure, and they prompted the current government of Kenya to announce that it would ensure access to tablets to students in every public primary school over the course of the next few years.³

Agriculture Insurance

Smallholder farms of less than 2.5 acres make up more than two-thirds of Sub-Saharan Africa's agricultural sector, which employs the majority of adult workers on the continent. Africa's agricultural output has risen almost as fast as that of Asia and Latin America over the last half century, but this is because of the portion of arable land devoted to farming has been growing, not because of productivity gains.

While there are numerous reasons for the lack of productivity gains—ranging from the inadequate use of fertilizer, lack of cost-effective infrastructure, and even foreign tariffs that discriminate against imports of African food products—a fundamental problem is the lack of instruments to mitigate the risks of poor weather patterns, such as drought, storms, flood, and erratic rains.

Newly developed insurance mechanisms, coupled with advances in mobile data and banking services, have begun to make a difference in mitigating these risks in African agriculture. Agriculture and Climate Risk Enterprise Africa (ACRE), for example, was established in 2010 by Kenyans and other East Africans, with support from the Swiss chemical giant Syngenta and the Global Index Insurance Facility. It is a private insurance intermediary that links crop and dairy farmers to micro-insurance products based on fluctuations in measured weather indexes.

One of ACRE Africa's principal products remotely monitors rainfall levels and changes in other weather-related variables in a specific location and compares that data with base-case historical data for that location. If current measurements reveal a rainfall deficit compared to the historical norm, the farmer automatically receives compensation through the mobile banking network without the need to file a claim or present evidence of damaged crops. Because of the model's simplicity and its nominal transaction costs, the insurer is able to charge significantly lower premiums, making insurance affordable to small farmers.

As of 2015 more than 800,000 smallholder farmers in Kenya, Tanzania, and Rwanda purchased \$646 million in crop insurance through ACRE Africa, covering maize, sorghum, coffee, sunflower, wheat, and potatoes.⁴ Dairy farmers can also buy indemnity insurance to protect against illness or death of livestock.

Some technology developments stemmed from adoption.

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Relocating Power Plants

Founded in 2014, Astra Innovations facilitates the relocation of mothballed power plants from Europe to Sub-Saharan Africa, Southeast Asia, and Latin America. Because the company is able to buy and relocate cheap and energy efficient assets, power plants are erected in new markets more quickly and less expensively than it takes to build a new plant. Consumers benefit from lower rates and the projects create jobs in emerging markets.

As of 2016 Astra had a pipeline of 40 projects—and totaling 3,000 megawatts—in Botswana, Ghana, Kenya, Nigeria, and Tanzania, and it is launching a 35 megawatt plant in Rwanda.⁵ Private equity funds most of the projects.

Anglophone and Francophone Call Centers

Africa is a comparative latecomer among emerging markets to the outsourced call center industry—another example of almost pure technology adoption. While such call centers emerged in India about three decades ago, Africa is developing a new competitive advantage in the sector with huge potential. The continent has a large population of English and French speakers, lower labor costs, and it matches European time zones. It is a sector that could quickly foster economic growth across the continent and integrate African countries into the global marketplace.

Some technologies have been adapted to African contexts and markets.

'Pay-As-You-Go' Solar Panel Companies

Africa's lack of infrastructure has created new opportunities for high-technology products and services such as mobile banking. Distributed energy service companies, or DECSOs, are now providing 'pay-as-you-go' photovoltaic services giving Africans access to reliable power. DESCOS have brought competition to an industry largely dominated by monopoly players. Their 'pay as you go' services make energy affordable for large numbers of Africans who can't afford a small photovoltaic system. DESCOS also sometimes use a 'rent to own' plan, in which customers pay small amounts toward the eventual purchase of the system.

In either case, customers make an up-front, one-time payment partly to cover installment costs, and then make regular payments. If customers don't renew the credits, DESCOS automatically block the functioning of the equipment through remote control. The equipment cannot be used again until more credit has been purchased. Under the 'rent to own' plan, after the customer cumulatively pays the DESCOS the total contracted amount, the equipment unlocks and ownership of the system transfers to the customer.

Despite the capital requirements, competition in the sector is thriving because of the decentralized nature of solar panel technology. There are at least nine participants in the market, many of whom compete against one another in the same geographies, proving that de-regulation is a policy that countries can pursue to foster new technologies.

Cargo and Health Care Service Delivery by Drones

In advanced economies, drones are not yet in widespread use for product delivery. In Africa, however, they're already being used to overcome poor transportation networks, especially in the healthcare industry. In May 2016 the United Parcel Service established a joint venture with robotics maker Zipline to begin making up to 150 deliveries a day of transfusion blood to 21 rural clinics in western Rwanda.⁶ Drones are also being tested in Malawi to deliver blood samples of rural area infants for highly specialized HIV testing in the capital city's major hospital.⁷

Outside of the healthcare area, the Afrotech project, led by the Swiss National Center of Competence for Research in Robotics and École Polytechnique Fédérale de Lausanne, is researching long distance unmanned drone cargo shipments in Kenya. The project group is planning a commercial robotic cargo drone test flight in 2017, and Afrotech plans to establish a drone port in Rwanda.⁸ The goal is to operate the first cargo drones by 2020.

Multinational Corporations

In April 2016 Johnson & Johnson launched its global public health strategy, aimed at harnessing the company's resources to find solutions for public health issues across emerging markets. As part of this strategy the company is establishing a new research and training facility in Cape Town, which will focus on HIV, tuberculosis, and maternal and newborn health.

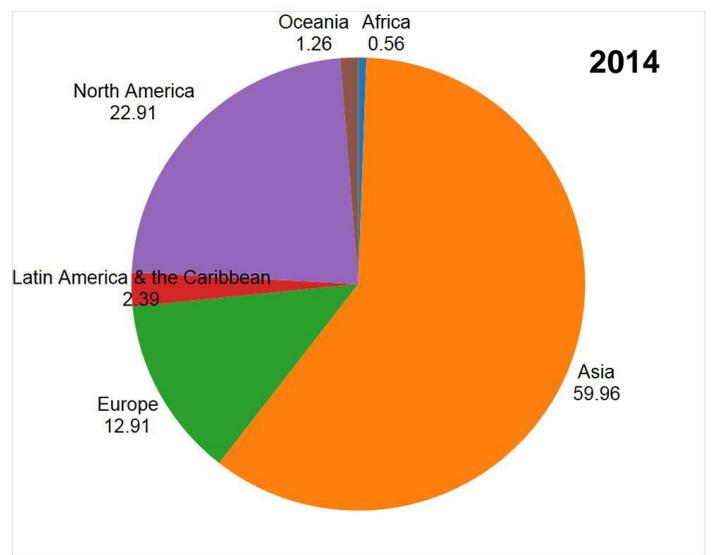
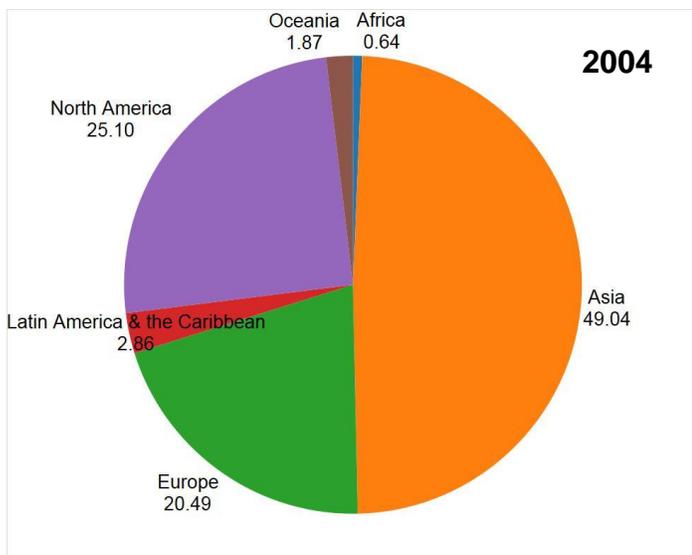
J&J's commitment to Africa reflects the opportunities it sees on the continent. The company's initiatives will tap into South African health researchers' skills and institutional capacity, provide new incubators for South African health sector entrepreneurs, and team up with local clinics across the country to bolster health care delivery in low-income communities.

OBSTACLES AND OPPORTUNITIES

Despite the many successes, private sector-led innovation in Africa still faces several obstacles. By overcoming these, however, policy makers can drive technology advances that lead to economic growth and productivity.

Many countries in Africa must contend with skilled worker shortages at all levels, creating challenges for businesses looking to implement new and existing technologies. Because improvements at one level are unlikely to succeed without improvements at other levels, a multi-pronged, flexible approach to enhancing higher education is required.

Africa's global share of patent applications decreased from 2004 to 2014.



Source: World Intellectual Property Organization 2016

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At the same time, Africa has an abundance of unskilled workers, creating a threat to overall economic security, social stability, and, in an increasing number of cases, national security. To combat this threat, policy makers must increase overall employment opportunities by utilizing technological advances to boost the productivity and standard of living of workers.

Low-level technologies—especially in infrastructure—for African businesses and households are in short supply or even absent across many sectors and geographies. As a result, Africa is one of a very few regions where technological leap-frogging is a real possibility, as long as skilled workers can be found. With the right policies, countries on the continent can apply higher-level technologies to overcome deficits in low-level ones. Mobile banking, for example, has provided financial services to people who live prohibitively far from city centers where banks are often located.

The African continent also has a large number of small, land-locked countries. Trade integration, investment policies, product and service standards, as well as regulatory regimes governing transport, logistics, and related infrastructure activities must be far more effective and durable if these countries are to attain the benefits of economies of scale and scope.

The absence among a number of contiguous, neighboring African countries of uniform, standard gauge rails for freight and passenger trains, for example, means moving a 40-foot container overland from Bujumbura, Burundi, to Mombasa, Kenya, takes 40 days and costs \$7,000. Meanwhile moving that same container from the port in Shanghai to Mombasa takes 28 days and costs less than \$1,000.⁹ Even if political obstacles to the implementation and enforcement of better standards are overcome, significant capital investments will be needed to close Africa’s infrastructure gap.

The consumer class is rapidly growing in Africa and African consumers are becoming more sophisticated, learning to make tradeoffs between price and quality. Still the bulk of the population of African countries have low incomes. As a result, innovations that produce low-cost products and services are more likely to capitalize on mass market sales, which would in turn create economic growth, job creation, and higher disposable incomes.

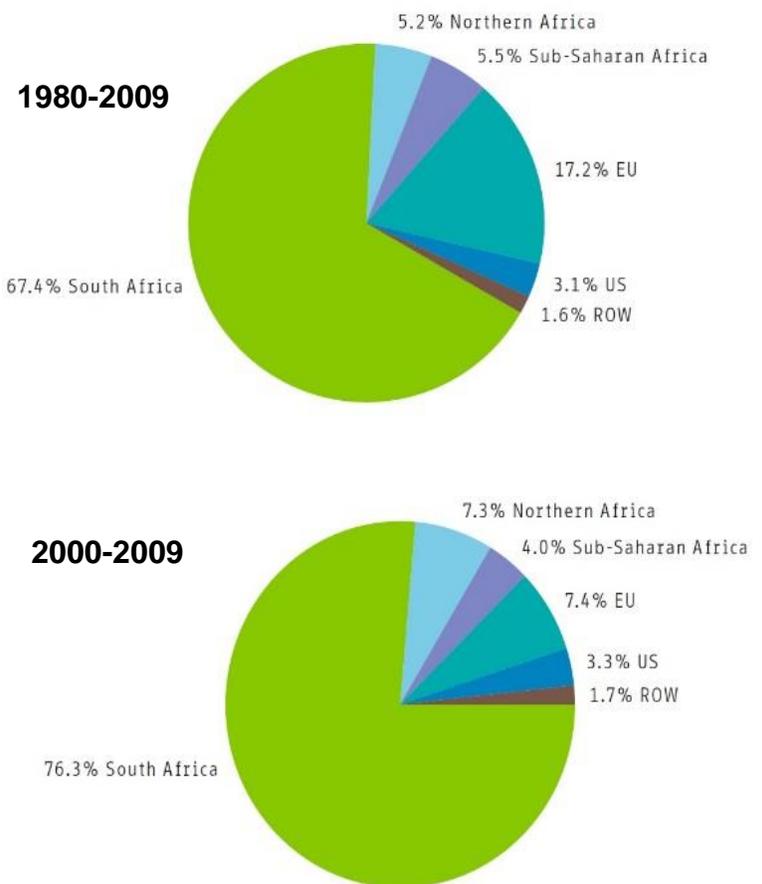
The health of Africa’s population is also a significant constraint on both labor force participation and business productivity. In spite of advances in the quality and efficiency of health care services in parts of the continent, the health of Africans remains

generally poor. Greater investments in healthcare would boost participation rates and productivity, further increasing growth.

Africa possesses huge endowments of underdeveloped or poorly developed natural resources, including arable land, minerals, oil, natural gas, rivers, and forests. The efficient and environmentally safe development, production, and consumption of such resources requires innovation. Businesses will need to help the region shift from reliance on raw material exports toward exports of higher value-added processing.

Finally, African businesses have been slow to form clusters that spur innovation and growth. The businesses that have started to locate near each other are high-tech start-ups in the services sectors, in addition to light manufacturing companies. Such

The share of alternative energy patents registered by domestic companies in Africa grew in recent decades.



Source: United Nations Environment Programme 2013

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clustering, in which separately owned businesses come together under one corporate roof, can lead to major efficiency gains.

Moreover, many of these clusters serve as incubators where professionals exchange ideas, connect to funders, and share office space. Information and communication technology sector clusters tend to be located in Kigali, Lagos, and Nairobi. Clusters in healthcare, pharmaceuticals and other medicines have formed in Cape Town, Johannesburg, Lagos, and Nairobi.

These interconnected obstacles, including a lack of skilled workers, an abundance of unskilled workers, infrastructure deficits, poor worker health, underdeveloped natural resources, and a lack of business clusters define areas where policy makers can take steps to boost innovation and economic growth. Establishing research centers, for example, can increase the number of skilled workers and lead to a cluster of businesses across a variety of sectors connected to the center. In some cases, the most robust gains—whether commercially or socially—will come from the application of technology that actually enhances cross-sectoral leveraging.

¹ United States Agency for International Development.

² "Food and Agriculture Association of United Nations," <http://www.fao.org/nr/sustainability/food-loss-and-waste/database/projects-detail/en/c/233143/>

³ Eric Wainaina, "Kenya Government to Issue 1.2 Million Tablets to Primary School Pupils," *Techweez*, June 22, 2015.

⁴ Agriculture and Climate Risk Enterprise Ltd.

⁵ Knowledge@Wharton, "Power Shift: An Innovative Solution for the African Energy Market," April, 13, 2016.

CONCLUSION

Technology has helped businesses around the world increase productivity and seize new opportunities. In Africa, however, businesses face many obstacles in developing and applying the technologies needed to grow and prosper. But government can play a major role in promoting private investment in new technologies. Several examples show how governments in Africa are supporting private firms in finding new solutions to existing challenges. With business-led innovation, countries across the continent can develop their own economies and increase productivity, ultimately lifting many residents out of poverty. ■

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⁶ "United Parcel Service,"

<https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1462760058735-442>

⁷ "The United Nation Children's Fund," <https://blogs.unicef.org/blog/flying-high-to-save-children-from-hiv-in-malawi/>

⁸ "Rwanda chosen for world's first 'drone-port' to deliver medical supplies," *The Guardian*, September 20, 2015.

⁹ African Development Bank Group, Independent Development Evaluation, "Evaluation Matters: The Transport Issues," June 2014.