

FUTURES OF TECHNOLOGY IN AFRICA



About STT

STT Netherlands
Study Centre for
Technology Trends



STT explores new trends and develops inspiring foresights on technology and society. For that purpose STT facilitates a free space in which enthusiastic stakeholders meet and construct creative views on the future. The results serve as starting points for new initiatives, such as applied research programmes or public-private cooperation. Project participants are the most important ambassadors of the results, which are also distributed through the media, lectures and workshops.

The STT Netherlands Study Centre for Technology Trends was established in 1968 by The Netherlands Royal Institute of Engineers (KIVI). STT is a non-profit organization funded by the Dutch government and business contributions. STT's advisory board consists of almost 30 members who are selected among contributors and scientific institutions, all appointed on personal title. In addition, STT hosts two academic chairs on futures studies and research. While most regular updates on our activities are in Dutch, many of our reports are in English. Do take a look at current and past foresight projects and our recent publications on our website.

Address:

P.O. Box 30424
2500 GK The Hague
the Netherlands

Telephone: +31 70 302 98 30

E-mail: info@stt.nl

Imprint

Lead author: Jasper Grosskurth, STT, the Hague

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FUTURES OF TECHNOLOGY IN AFRICA

Jasper Grosskurth

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PREFACE

The STT Netherlands Study Centre for Technology Trends (STT) explores futures at the crossroads of technology and society. In 2007, STT decided to initiate a foresight on 'Technology in Developing Countries'. Since the founding of STT in 1968, this was going to be the first project with an explicit focus on development. The underlying question was how new technology would affect the poorest societies rather than the richest, those with least access to technology rather than those surrounded by the latest inventions. The most important reason for focusing the project on Africa was the perception that Africa might be close to a tipping point in its development and growth, with technology as an important factor. Since then, the evidence has strengthened that this is indeed the case. And this forms the backbone of this book.

Since 2007, it has become evident to the world that Africa is changing fundamentally. Economically, most African countries have outgrown the world economy for the last decade. Politically, the number of conflicts is decreasing, while the number of democratic changes of government is on the rise. Institutionally, issues standing in the way of development, such as contested land rights, customs inefficiencies and red tape, are more and more being addressed. Technologically, Africa has surprised even the most optimistic market experts with the rise of the mobile phone. The more than 450 million units in use today might well be a prelude to a fundamental ICT revolution in Africa. Culturally, the continent is discovering its own capacities and diversity in a globalizing world.

The rest of the world is beginning to notice the change. Businesses from all continents are discovering the economic potential of Africa, ranging from serving consumers at the base of the pyramid to executing pan-African infrastructure projects, from growing grains, fruits and vegetables to securing access to minerals. In an increasingly interconnected world, the geo-political role of Africa is getting increased attention. In the words of US President

Barack Obama during his visit to Ghana in 2009: "The 21st century will be shaped by what happens not just in Rome or Moscow or Washington, but by what happens in Accra, as well." This is not only because the tools of knowledge economies and the gadgets of consumer societies crucially rely on the continent's rare metals.

Despite the change and the attention, many of Africa's problems are persistent and much of the continent's potential is still unused. Too many go hungry, too many are displaced or killed in conflicts, too many get too little education, too many die from easily preventable or curable diseases, too many are corrupt. The wealth of natural resources could secure livelihoods for the long term, if put to productive use. The land and the farmers could feed Africa and more, given appropriate farming techniques and governance. The young population could make Africa an economic powerhouse, given the opportunity and skills. International and intercontinental trade could prosper, given the right infrastructure.

Technology holds many promises as a driver of positive changes, as a tool to address the problems and as an enabler to fulfil the potential. Economic development requires modern technology and technology plays an important role in most strategies for alleviating hunger and poverty. Technology can reduce transaction costs, save lives, facilitate education, strengthen entrepreneurship, provide access to markets and help to deliver basic services, ranging from water and sanitation to public administration. However, the same technology can also be destructive and a cause of problems. Some technological developments can be facilitated or managed, others happen and require an adequate response.

It is this manifold interrelation of technology with its environment that makes exploring the future of technology so interesting and valuable. There is a need to explore how technology in Africa will or might evolve; to discuss the drivers and the obstacles, the issues technology might resolve and the problems it might cause; to identify how technology changes society and how African societies might

change global technology. These are big and complex questions and the STT foresight project, which ends with this publication, is a contribution to this discussion that is still in its infancy with respect to Africa.

This book is only one result of the STT foresight on technology in Africa. Other tangible results include the 1st Business Summit Netherlands–Africa in November 2010 and the Discover the Lion workshop series on technology-intensive industries in Africa, both to be continued in the future by the Netherlands–African Business Council (NABC). Dozens of organizations, including NGOs such as IICD, the 1% Club and AMREF Flying Doctors, businesses, including TNO and several NABC members, academic projects, such as the 3TU initiative on ethics, technology and development, and governmental organizations, such as the Scientific Council for Government Policy (WRR), the Social and Economic Council (SER) of the Netherlands and the Advisory Council for Science and Technology Policy (AWT), have consulted the project to improve their own activities and projects.

Many other results are intangible. Several of the interviewees on location now incorporate long-term thinking in their professional lives; business partners met during project activities and initiated common projects; local programmers were motivated by seeing their own activities placed in the bigger context of an African technology revolution; arts students at the Royal Academy of Arts in the Hague were inspired to explore how shifts in perception and paradigms, such as the West's rediscovery of Africa, can be captured with digital media; entrepreneurs questioned their own assumptions and found new sources of information; journalists actively went to look for the Africa beyond the problems.

This STT foresight project has also changed our own perception of Africa. We have been surprised by the speed and diversity of change. We have been disappointed by how little of the potential is being used. We are inspired by the opportunities. Most of all, we can't wait to see Africa's future evolve and to positively contribute where we can. We

invite you to join us in our renewed curiosity, of which this book is a reflection.



Dr Tini Hooymans

Chair of 'The Future of Technology in Developing Countries' Steering Committee



Ir Wiebe Draijer

Chair of the STT Netherlands Study Centre for Technology Trends

INTRODUCTION

Every successful economic catch-up in the past 140 years has involved the appropriation of international technology, and technology plays an important role in most strategies to alleviate hunger and poverty, including the UN's Millennium Development Goals. In addition to the ethical imperatives of fighting poverty and hunger, a number of global issues, including demographic shifts, climate change and geo-political stability, require the application of technology in developing countries. Beyond these considerations, businesses in developed and developing countries alike have discovered the significant buying power of the poor and their desire for affordable consumer products, as well as the potential to reduce costs through production in less developed countries. Consumption and production in poor regions are now strong drivers of global technology innovation and diffusion.

The set of opportunities and constraints guiding technological dynamics in developing countries differs from that of developed countries in some important respects. For example, developed countries are subject to strong technological lock-ins, such as communication through copper wires, internet access with desktop computers, car-intensive transport infrastructures and centralized systems of energy production. Many less and least developed countries are not subject to these limitations, offering them the opportunity for so-called leapfrogging. Landline telephones, still widespread in developed countries, are skipped in the evolution of telecoms sectors in less developed countries. For many applications, desktop will be skipped as smart phones and similar gadgets provide internet access. In many rural areas, decentralized energy solutions will roll out more quickly than the centralized ones that still form the backbone of energy systems in developed countries.

However, while the possibility of installing the latest generation of technology from scratch offers

opportunities, the path of resource-intensive technology that the Western countries have followed is largely closed to developing countries, be it for reasons of prohibitive costs of resources, relative lack of capital or global sustainability. This mostly concerns the use of fossil fuels, rare materials and fertilizers. An obstacle in the path of becoming a source of global technology is the fact that the global technological knowledge economy is highly concentrated in a very few places. This process of concentration is self-reinforcing. Geographical centres of technological excellence and innovation attract innovators, capital and expertise, making it particularly difficult for others to catch up. Experts and professionals tend to move towards these centres, and a brain drain takes place.

STT's interest in exploring the future of technology in developing countries is driven by the opportunities to address urgent problems, by questions about past and foreseeable failures, by the possibility of improving development strategies and by a wish to gain a better understanding of the world's emerging markets. The most important driver, however, is the awareness that technology will affect the future of the world's poor, that the poor will influence the future of technology, and that very little is known about this interaction. How will technology evolve in developing countries, how will global technology evolve as poor countries become emerging countries and emerging countries become developed countries, which sectors will be most affected, which will have the biggest impact, which will change soonest, and what lessons can we learn today from the answers to these questions? This is the quest of the STT foresight on 'The Future of Technology in Developing Countries'.

Scope and choices

Exploring all aspects of futures of technology in developing countries with a time horizon of two decades in a meaningful manner is beyond the scope of most organizations, including STT. There are two possible escape routes from this impossibility. The first is limiting the focus to a specific region, industrial sector or type of technology, at the cost of comprehensiveness. The second is to apply broad brush strokes, providing an overview

at the cost of precision and depth. The choices we made in combining the two strategies are based on four months of literature research and several dozen conversations with experts on technology and development with business, government and academic backgrounds. This section explains the choices we made.

In STT foresights, these choices are not pre-determined before the launch of a project. It is the first task of an STT project leader to identify the most promising niche and reformulate the project focus accordingly. These niches promise a relevant contribution to the understanding of the future interaction of technology and society, making use of the strengths of STT. These include the capacity to build new knowledge networks of personally committed high-level experts with a wide range of backgrounds, and to explore an issue flexibly, creatively and independently. The niche should also be of relevance to Dutch society, whether this be business, government, academia or civil society. And STT's niches are often neglected by other organizations at the time of their formulation.

Why Africa?

The possibility of not applying a regional focus was ruled out very early in the project. We did not expect to deliver meaningful results while working simultaneously on four continents in networks that would first have to find common ground across multiple cultural barriers. A global focus would have forced the project towards a level of abstraction at which its practical relevance would have been compromised.

Between the options, there were many reasons to focus on Africa. During the last decade, Africa has outgrown the world economy and, despite the recent financial crisis, this trend is projected to continue in the future. For some technologies Africa even exhibits the highest growth rates in the world, mobile communication being the most prominent example. Africa really is rising. Despite these developments, the global technological gap is most persistent, poverty is denser than elsewhere and less is known about technology in Africa when compared with other developing regions.

The combination of a highly dynamic region with excellent opportunities for development on the one hand, and a desperate need to improve the quality of life for a large part of the population on the other, makes Africa an exciting and worthwhile project target.

This impression was confirmed in conversations with experts on development and technology. Without previously mentioning a regional focus, most experts used examples from Africa to explain their arguments. When asked directly which, if any, regional focus should be applied, the overwhelming majority chose Africa, more specifically Sub-Saharan Africa. The latter focus was applied because North Africa is economically and technologically much more integrated with Europe. Also, the drivers of technological change, opportunities and threats differed substantially between the regions north and south of the Sahara. Most international organizations categorize Sub-Saharan Africa as Africa without Algeria, Egypt, Libya, Morocco, Sudan, Tunisia and Western Sahara and we follow that definition in this book, unless mentioned otherwise. We also neglect the specific issues concerning Africa's small island states.



✕ *Sub-Saharan Africa*

Why technology?

The focus on technology is part of STT's core mission to explore futures of technology and society. When applied to Africa, this focus delivers interesting results. Africa is mostly understood in terms of its problems (the crisis stereotype) or in terms of its wild beauty (the exotic stereotype). The technology perspective is useful to see beyond these stereotypes, to reframe Africa. It makes the recent economic successes of Africa tangible and opportunities for future development visible. In addition, it brings with it new actors and new networks. Large technology companies, for example, would have considered Africa a non-market a few years ago but are now committing to the continent. Software companies are increasingly building programming skills in Africa and learning from local innovators. And because Africa's population pyramid still deserves the name, technology adoption is progressing faster than elsewhere. Beyond all of this, technology does save and extend lives. The availability of clean drinking water, of reliable electricity, of access to communication and transport services does increase life expectancy, as health education and entrepreneurship benefit. Chapter 3 explores the technology aspect in more depth.

Why business?

STT projects don't have clients, safeguarding the independence of the foresights. Nevertheless, one of the criteria for the decision to dedicate a foresight to a specific topic is that the results should be relevant to 'someone'. With respect to the future of technology in Africa, the following groups were considered as primary targets: businesses, NGOs, academia and government. Each of these groups could be addressed in the Netherlands, in African countries or on a global or multilateral level. In the end, business became the most important focus of the project. The reasons for this are twofold: first, businesses are the major driver of large-scale technological change; and second, businesses are the most curious to learn about the future of technology.

On a continent where public investment in research and development significantly lags behind every other world region, businesses become the major drivers of technological change by transferring

global technology to Africa. Also, the willingness of businesses to invest resources and capacities in a particular technology in relation to Africa is one of the better indicators for what will happen in the medium-term future. Among the plethora of concepts and ideas that seem to address the needs on the continent, those with major financial backing and those with many competing companies heading in the same direction are those most likely to blossom.

During conversations and interviews, businesses, both in Africa and in the Netherlands, were also most eager to learn about the future of technology and seemed most likely to act on the results. STT foresights thrive on this curiosity and commitment, which lead the participants to share their insights. Several managers argued that they needed the bigger story to convince their superiors to take Africa more seriously as an emerging market. This story is emerging at the present time and this STT foresight contributes a large chunk to it, a chunk that has been relatively neglected for too long. This focus fits perfectly with STT's excellent business network, as well as its policy of taking up an issue for not more than three years and then launching the results through other organizations.

This choice does not imply that this book is irrelevant for non-business readers. On the contrary. NGOs are increasingly co-operating with businesses to leverage their impact and to achieve their goals. The business focus stimulates this interaction. Also, NGOs, be they foreign with a stake in Africa or local, are increasingly faced with a type of change that requires business-like responses. For example, NGOs need to plan strategically for the rapid changes in the communication landscape. They need to invest their resources diligently in projects that are most likely to deliver, taking into account future uncertainties. And development projects without an economic feasibility are unlikely to work beyond a local scale. For the same reasons, the Dutch government is also strengthening its economic relationship with Africa, while weakening classical aid programmes. As for African governments, the quality of governance in African countries is without doubt the most important factor influencing the future of Africa. However, the possible leverage of a foreign and in-

dependent foresight project on African governments seemed overambitious.

About this book

This book is the most tangible of the project's results. Its aim is to make you think again about Africa and how you see Africa, wherever in the world you are. Its purpose is to make you question your and our ideas about Africa. The book adds a technology voice to a global conversation, in which cultural, economic, political, institutional, intellectual and many other voices are also taking part, bringing about a richer image of modern-day Africa. The book is best understood as a journey. We meet and listen to technology and other pioneers, facilitators of change, sceptical experts, intellectual visionaries, cheetahs and hippos (we will come back to what they stand for in Chapter 1). We visit hot spots of technology and explore future successes and failures.

The book is not a comprehensive inventory of technology in Africa. Those looking for a detailed, quantitative overview of sector-specific information and related forecasts will be disappointed, though they might find valuable nuggets. For the current state of technology and short-term trends, other organizations with a pan-African reach and expert partners in all technological sectors produce reports and databases with rapidly increasing quality. References to these are listed among the 'Recommended sources' at the end of most chapters. Neither is the book as a whole a work of science. No overall hypothesis is being formulated, let alone tested and many of the sources, and their analysis would not stand up to commonly accepted scientific criteria. This book is not objective. The interviewees were selected based on their position, their expertise and their ability to think creatively and abstractly. Innovative trends received more attention than well-known ones, businesses more than NGOs. Countries to visit were selected on the basis of their potential to be technology pioneers on the continent. We went where the change is quickest, where the future seems closest and, more than once, where chance brought us. It is one of the luxuries of an STT foresight that serendipity is allowed to unfold its powers.

Sources of information

To interpret this book it is helpful to understand the sources on which it is based: visits on location, interviews, conversations, workshops, quantitative data and literature studies.

Visits on location, interviews and conversations

The most important source of all for any STT foresight lies in people. For the past three years, we have initiated hundreds of conversations on futures of technology in Africa. These can be divided into several groups. In the first phase, open dialogues dominated the project, meetings with anyone with any link to technology in Africa, ranging from world traveller to science fiction author, from self-employed web designer to director of a multi-national, from creative thinker to globally renowned expert, from refugee to ambassador, from activist to minister. Questions included: What do you think about when you think about technology in developing countries? Which questions should this project seek to answer? How does your work or expertise relate to the technology and development? What changes would you put your money on? Who else should be involved and which literature is a must-read? These conversations established and formed the project and resulted in a diverse network that has carried the project along.

Once the shape of the project was emerging, conversations moved from personal conversations to public discussions. Forums of debate included NGOs, such as a workshop at the 2009 1% Event in Amsterdam; academic research, such as a panel debate on ethics, technology and development led by a consortium of the three technical Universities in the Netherlands (3TU); businesses, for example a strategic session with TNO's in-house Flying Innovation Team; and governance, for example a presentation and top-level discussion at the Social and Economic Council of the Netherlands (SER), among many others. These events were always two-way exchanges. The project's ideas and preliminary findings would be presented and feedback would be given, on content, possible sources and partners, similar projects elsewhere, and so on.

The third kind of conversations, formal and informal interviews, were taking place during visits on

location in Kenya, Uganda, Rwandan, South Africa, Nigeria and Ghana. Informal interviews were mostly used to learn about country-specific information, to connect people, to gain access to local networks, to allow serendipity, to be surprised. Formal interviews primarily delivered in-depth information on specific issues or technology domains, long-term visions and ambitions, personal insights on what the future might bring and questions to be followed up. The formal interviews were recorded, transcribed and analysed. In this book, quotes without a reference stem from these interviews. Chapter 10 is based almost exclusively on such interviews, as is a large part of Chapter 8. However, any opinions expressed may be biased by the choice of specific interview segments and by the context in which they are placed. The author of this book is solely responsible for the content and any mistakes and misjudgements.

Interviewees included the following people:

Kenya:

- Salim Amin, Chairman at A24 Media, Nairobi
- Julie Gichuru, Group Digital Business Manager and Talk Show Host at Royal Media Services, Nairobi
- Wambura Kimunyu, an African writer, observer, thinker and dreamer, Nairobi
- Ahmed Sheikh Nabhani, Kiswahili Consultant at the Swahili Cultural Centre, Mombasa
- Nicholas Nesbitt, CEO at KenCall, Nairobi
- Edwin Nyanducha, Founder of Inkubate Ltd, Nairobi
- Dr Sheila Ochugboju, Senior Communications and Outreach Officer at ATPS, Nairobi
- Dr Ahmed Yassin, Director at the Research Institute of Swahili Studies of Eastern Africa, Mombasa

Uganda:

- Dhizaala Sanon Moses, National Planning Authority, Kampala
- Andrew Mwenda, Managing Editor of The Independent, Kampala
- Erostat Nsubuga, CEO at Agro-Genetic Technologies Ltd
- Prof. Joseph Obua, The Inter-University Council for East Africa, Kampala

- Dr Dorothy Okello, Women of Uganda Network (WOUGNET), Kampala
- James Segawa, Medical Equipment Consultants Ltd, Kampala
- Group interview at the National Agricultural Research Organisation (NARO), headed by Dr Ambrose Agona, Kawande

Rwanda:

- Anonymous energy expert at the Ministry of Infrastructure, Kigali
- Anonymous infrastructure planning expert at the Ministry of Infrastructure, Kigali

South Africa:

- Simon Camerer, Executive Head of Marketing at Cell C, Johannesburg
- Simon Dingle, technology journalist, writer, broadcaster and professional speaker, Johannesburg
- Anonymous lead partner Sub-Saharan Africa at a global strategy consultancy, Johannesburg
- Clifford Foster, GBS Partner and Chief Technology Officer at IBM, Johannesburg
- Arthur Goldstuck, Director of World Wide Worx, Johannesburg
- Tanja Hichert, Scenario Planning practitioner and facilitator of strategic conversations, Hichert & Associates and Research Associate at the Institute for Futures Research, Stellenbosch University
- Rafiq Philips, Web AddICT and Marketing Technologist, Cape Town
- Tony Surridge, Senior Manager Advanced Fossil Fuel Use at SANERI, Johannesburg
- Paul Vorster, CEO at the Intelligent Transport Society (ITS), Johannesburg

Nigeria:

- Prof. Michael Adikwu, STEP-B National Project Coordinator, Abuja
- Josh Asanga, Port Manager at the Lagos Port Complex, Nigerian Ports Authority, Lagos
- Adeyemi Fajingbesi, Technical Advisor to the Minister of National Planning on Vision 20:2020, Abuja
- Jason Hurter, Managing Director at Fugro Offshore Survey, Lagos
- Prof. Abdulkarim Obaje, Monitoring and Evalua-

tion Officer at the Federal Ministry of Education, Abuja

- Olatunbosun Obayom, founder of the Bio Applications Initiative, Lagos

Ghana:

- Andrew Tonto Baffour, President of the Ghana Institution of Engineers (GhIE), Accra
- Kofi Bucknor, Managing Partner at Kingdom Zephyr, Accra

During interviews and conversations, most people will find it difficult to think about long-term futures from a cold start. Asking a person point blank what the world or their field will look like in 2030 is unlikely to produce worthwhile results. Therefore, each interview was held following the same six-step open structure, designed to lead the interviewee as smoothly as possible from thinking about the present to thinking about the future.

- After a very short introduction to STT, myself and the project, interviewees were invited to introduce themselves, their field of work and what it has to do with technology. The result is a snapshot of the interviewee's expertise in relation to technology in Africa.
- A time dimension was introduced in a second set of questions by asking for changes observed during the past five years in the field discussed. This established an understanding of the speed of change, as well as indentifying some drivers or obstacles of change.
- A third set of questions explored whether these or other changes could be expected to continue for the next five years and what the consequences would be. This established the first step into the future, providing many leads as well as an inventory of the medium-term expectations of the interviewee.
- In a fourth set of questions, the time horizon was gradually extended. Possible trend breaks were explored, as was the scale of change possible within a decade or two. This phase focused very much on the broader effects of technological change. Questions included: How will a trend affect your life and the lives of your fellow citizens? What will the country look like ten years from

now, if this or that development takes place? What other trends would it interact with?

- A fifth set of questions triggered interviewees to formulate their own long-term Utopia and the obstacles to getting there. What is the best scenario one can imagine and what stands in the way of getting there? These questions often led to very personal conversations about values, hopes and fears. They taught me about the internal motivation and ambition of an interviewee.
- Two questions ended each interview. The first was what the West should learn from Africa; the second, whom else I should meet. The first question was often met with bafflement, smiles and a long silence before an answer was given. The second question allowed me to serendipitously discover new interviewees guided by the local expertise of people who knew my questions and interests.

Workshops

Businesses are usually reluctant to share their insights and activities. This is generally the case, but holds even more in the context of Africa. Doing business in Africa makes Western businesses vulnerable to negative publicity, even if an activity contributes to development. Therefore most companies with a stake in Africa have a Corporate Social Responsibility presentation in which they highlight their support of a local health or education project or a marginal product in their range, specifically targeted at local development.

In order to overcome this and bring about a process of mutual learning, STT partnered with the Netherlands-African Business Council (NABC) in organizing the Discover the Lion workshop series. Each workshop would focus on one technology-intensive commercial sector and bring together between 30 and 50 business representatives, hosted by a generous business partner: IBM hosted workshops on energy, ICT, water and logistics; FrieslandCampina on food; PTC+ on agriculture; and the Technical University Delft on business models. A set of short presentations by industry experts was followed by two hours of group discussions. In this peer-to-peer setting, the participants were happy to share their motivations, their expectations, their concerns, their needs, their questions. These discus-

sions provided valuable guidance in identifying less visible aspects of technology in Africa. Results of these workshops are available at www.stt.nl/DiscoverTheLion.

A different type of workshop was the FutureLab workshop in February 2010 in Kenya. This brought together ten of East Africa's most creative thinkers. In an intensive one-day workshop, we explored futures of East Africa with a time horizon of 20 years, based on a rapid foresight method. The workshop tested many of the preliminary project results and embedded them in different plausible future cultural, political, economic and environmental contexts. The results of this unique event can be found in Chapters 8 and 9.

Quantitative data and statistical projections

The availability of quantitative data on Africa is relatively low. And where data is available, it is often of doubtful quality or outdated. The most comprehensive sources for Pan African data per country are the World Bank's 'World Development Indicators', the IMF's 'World Economic Outlook Databases' and its derivative, the 'Regional Economic Outlook Sub-Saharan Africa', and the 'African Economic Outlook', published by the OECD and the African Development Bank. These sets cover a wide range of economic, social, environmental, institutional and technological indicators and their development, mostly up to two to three years ago. In addition to these overviews, industry-specific global organizations, such as the International Telecoms Union (ITU) or the International Energy Association (IEA), publish useful data. Also, market research companies are increasingly covering Africa in sector-specific research briefs, often including short-term projections.

The data in all of these sources is subject to a high margin of error, even more so the data for least developed countries, smaller economies or countries in conflict. Governments often lack the institutional capacity to measure even key indicators, such as the size of the population or the economy. Especially in rural areas, population numbers are rough estimates, at best. Economic data now frequently includes the unofficial economy, but with pure cash,

subsistence or barter economies, numbers remain very rough. As different methods are used for these estimates in different countries and by different organizations, comparability suffers even more. In addition, for many indicators there is an incentive to over- or underestimate. A region might want to appear poorer to receive extra support or richer to prove good governance. The Penn World Tables, a world-standard compilation of income data, ranks countries with grades A to D by the quality of their data. While industrialized countries mostly score straight As, nearly all Sub-Saharan African countries get a grade of C or D, corresponding to a margin of error of 30 to 40%.

As a consequence of these data problems, even the present is analytically a part of the future, with most of the same uncertainties. Many characteristics of data on Africa violate important conditions for sound statistical analysis. Projections into the future based on extrapolations or regression models are especially problematic. Their value is illustrative more than exact. Decision makers used to basing their assumptions on rich and accurate data should take into account extreme uncertainties and biases. Even improving data can cause problems, for example ghost trends: if an indicator has been consistently underestimated, an increase in accuracy in itself will result in an upward trend; overestimation will result in a downward trend.

And data quality is improving. One cause of this lies in more and better tools to collect data, ranging from satellite images for refining population estimates to crowd-collected data through mobile phones. For the informal settlement of Kibera in Nairobi, for example, population estimates were adjusted from 1 million and more to a current 170,000 in Kenya's latest census, triggered by detailed research. Also, as companies expand their stakes in Africa, they are dedicating extra resources to improving data availability and quality or outsourcing this to independent service providers. For governments, the main incentive to improve their data capacity is the establishment of functioning tax systems. Overall, we can look forward to significantly better and richer data with smaller margins of error on Africa in the coming years.

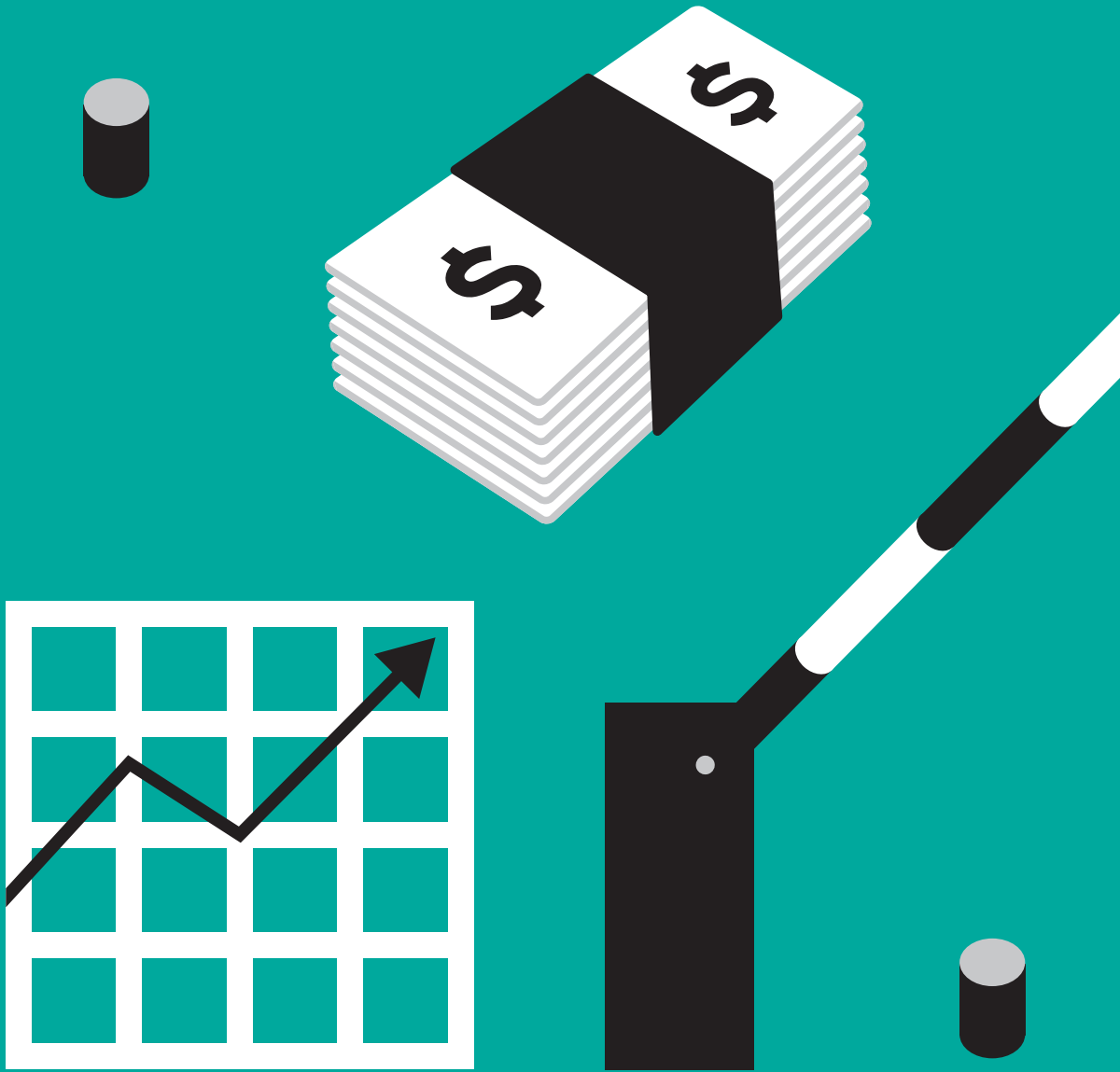
Literature study

Throughout the project, a continuous literature study was executed. This ranged from scientific journals and reports to blogs and newspaper articles. As the project evolved, the content of the sources screened converged more and more on the issue of 'technology and futures'. The publications contributed many of the arguments and examples in this book. Many of the authors were contacted and ended up contributing their knowledge, and several of the initiatives found in the publications were taken up in the itinerary of the visits on location.

Reading guide

Few people will read this book cover to cover, but most readers with an interest in Africa will find valuable information within it. The book can largely be divided into four parts, each with its own character and purpose:

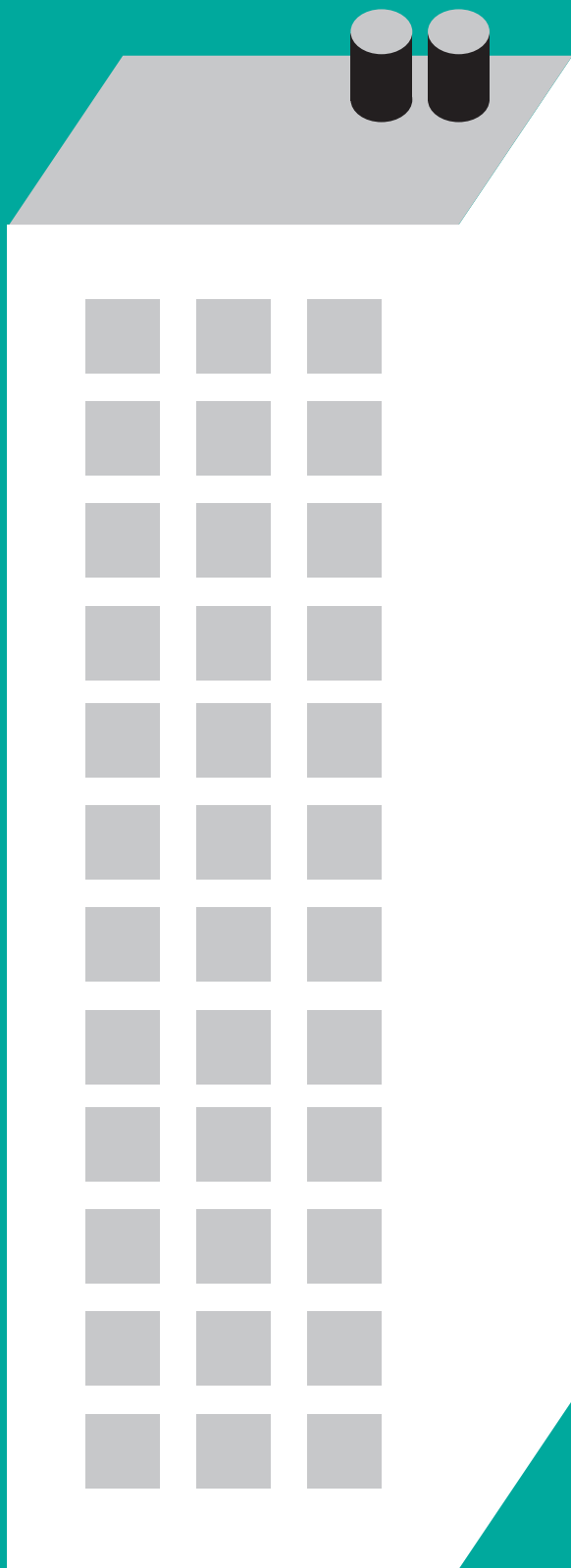
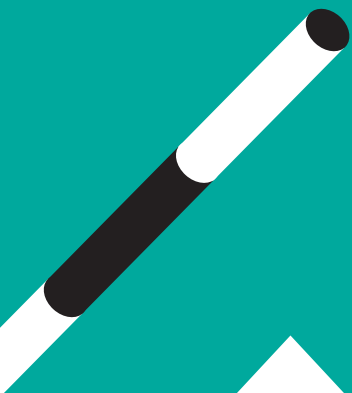
- The first three chapters are mostly of interest for those interested in the motivation and process of long-term thinking in general and on Africa and technology specifically. Chapter 1 sets the stage with an overview of Africa in the 21st century in terms of economic development, population growth and the change in lifestyles accompanying both. In Chapter 2, guest author Geci Karuri-Sebina provides an overview of futures studies in and about Africa. Chapter 3 focuses on the exploration of global technological futures in relation to African futures.
 - Chapters 4 to 7 are of most interest for those with a hands-on interest in Africa. They explore futures of ICT, energy, infrastructure and agriculture, respectively. Each of these chapters provides an overview of the state of technology, major trends and applications, future uncertainties and open questions.
 - Chapters 8 to 11 are of most interest to readers with a strategic interest in Africa, those with a long-term stake. The information gathered in Chapters 4 to 7 is integrated and put into the broader context of societal futures in Chapter 8, based on interview transcriptions from six African countries and a set of scenarios developed in an accelerated scenario planning workshop in Nairobi.
- Chapter 9, with a major contribution from guest author Sheila Ochugboju, discusses the necessity of a societal awareness of and discourse on technological change. Reasons for stimulating this discourse include the improvement of societal choices about technological futures and the facilitation of an African transition from technology consumer to technology innovator. Chapter 10 turns the tables and explores lessons for the West to learn from Africa, based on interview excerpts. Chapter 11 provides a short overview of future changes and contains guidelines for the present on how Western organizations can become future proof and take part in Africa's future.
- Wambura Kimunyu's science fiction story, 'The Last Infirmity of Noble Minds (an excerpt)', ends the book. The story provokes us to take a long view with an Afrocentric perspective. Stories are a powerful way to explore the future and looking beyond the horizon of all we know is an efficient means of thinking out of the box. As this book is being published, a follow-up project of collating a book of African science fiction stories is being discussed.



Chapter 1:

21ST CENTURY

AFRICA



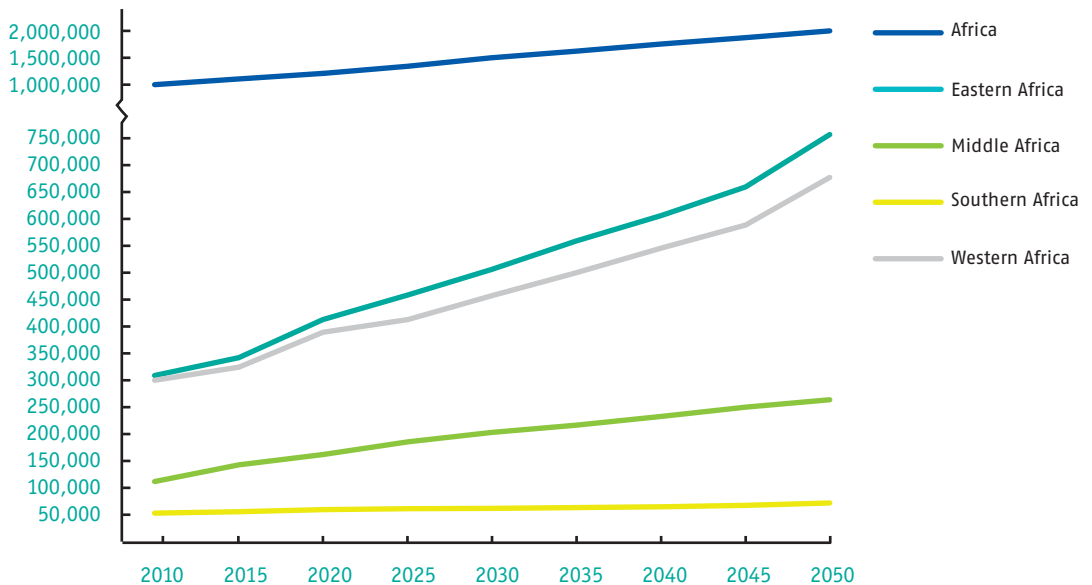


Figure 1-1: United Nations population prospects 2010–2050 in thousands (medium variant). Source: United Nations (2010)

Seeing beyond the stereotypes

“People in the West are fundamentally uneducated about Africa. And it’s not only the people in the street, even the educated classes know little about the continent. That’s why companies and institutions systematically underestimate the potential of Africa.”

These are the words of one of the leading strategy consultants on Sub-Saharan Africa and many share his opinion. Two stereotypes dominate Europe’s image of Africa. The crisis stereotype emphasizes hunger, poverty, conflicts, corruption and widespread mismanagement, thus creating an image of helplessness, incompetence and inferiority. The exotic stereotype accentuates the natural beauty of the landscapes, the colourful cultures expressed in textiles, music and artifacts, the mysticism and the smiles of the poor. A feeling of ‘otherness’ underlies this perception.

Both stereotypes have more than a grain of truth in them. Crisis is widespread and Africa is exotic to the Westerner. However, at least two important aspects are lost in the caricatures: first, Africa’s many impor-

tant assets outside and beyond the stereotypes, such as widespread vibrant entrepreneurship, sophisticated intellectual elites and the ambition to be seen as a respected partner in the global community; and second, the diversity between regions, countries, cultures and socio-economic classes. Generalizing about Africa based solely on the examples of the crises in Congo-Kinshasa, Somalia and Zimbabwe is short-sighted and misleading. A majority of Africans has neither suffered persistent hunger, nor been directly affected by an armed conflict. A middle class is taking root in many African cities. They too have their story. The differences between countries like Ghana and Nigeria or Rwanda and Kenya are at least as big as the differences between any two European or Asian countries.

African economies score some of the highest growth rates in the world, political stability is improving and a young, highly entrepreneurial generation is on the rise. And while many of Africa’s problems deserve global attention, the stories beyond the crisis and the exoticism must be told as well. Not only do they provide surprising insights into the present and future of the continent, they are also the key to continuing the current rise of Africa. Who

but African entrepreneurs is going to create the millions of jobs required to eradicate poverty? Who but African consumers, workers and their employers is going to pay the taxes needed to finance public services sustainably? Who but well-trained African farmers will feed the growing population of the continent? When Barack Obama addressed the Ghanaian parliament in 2009, he summarized it well: *"We must start from the simple premise that Africa's future is up to Africans."* A more educated West would strengthen the many threads of positive change by working with Africans – rich and poor, disenfranchised and elite – as true partners.

However, it is not only for the sake of Africa that new stories should be told. In its own interest, the West urgently needs to educate itself about Africa. Europe has always needed Africa and will continue to need Africa. Being ignorant about vast tracts of arable land, about large resources of oil, gas, rare earths and metals, about largely untapped renewable resources ranging from biomass to sunshine comes at a high price, as does turning your back on the last emerging market and its consumers. Politically, disregarding Africa diminishes the power of the West more than that of Africa, as other partners, including India and China, are happy to deal with Africa on an equal footing. Demographically, wasting the potential for close co-operation between the ageing societies of the West and Africa's increasingly educated youth would be a massive loss to both sides. Geo-politically, discounting Africa will also destabilize other regions. Again, in the words of Barack Obama in Ghana: *"The 21st century will be shaped by what happens not just in Rome or Moscow or Washington, but by what happens in Accra, as well."*

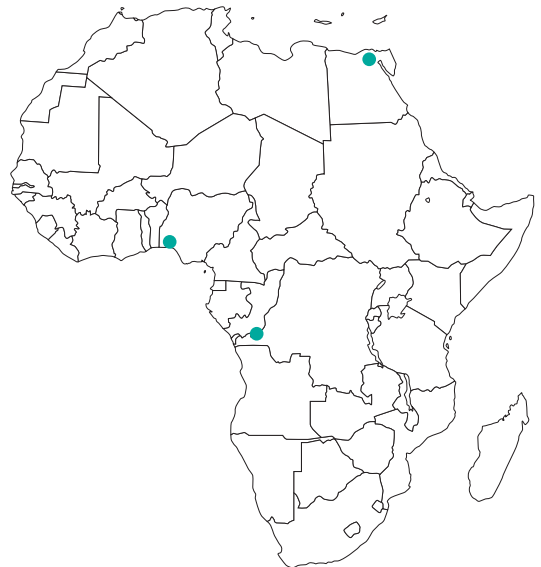
This chapter takes a look at a number of mega-trends that will determine the face of Africa in the 21st century. It provides a short summary of population trends, current economic performance and a less tangible change in vibe.

A growing population

Without doubt, population growth will be an important factor in Africa's future. The United Nations (UN, 2010) estimates that Sub-Saharan

Africa's population of currently 820 million will more than double to almost 1.7 billion by 2050, increasing from its current share of 12% of the world population to 19% in 2050. As Figure 1-1 shows, this growth is pervasive with the exception of Southern Africa (Botswana, Lesotho, Namibia, South Africa and Swaziland). The same estimates stipulate that in 2050, as today, more than half of the population will live in just six countries: Nigeria (158 million inhabitants in 2009/289 million inhabitants in 2050), Ethiopia (85 million/174 million), Congo-Kinshasa (68 million/148 million), South Africa (50 million/57 million), Tanzania (42 million/not available) and Kenya (41 million/85 million).

As a consequence of the ongoing strong population growth, Africa has an extremely young population and a population pyramid that still deserves the name. All countries in Sub-Saharan Africa, with the exception of the small island states, score above world average in the share of 0–14 year olds in their population (CIA, 2009). In addition to its youth, Africa's population is increasingly urban. According to UN-HABITAT (2008), 40% of Africans live in cities



✕ Africa's biggest cities are Cairo, Lagos and Kinshasa. 40 Cities in Sub-Saharan Africa have more than 1 million inhabitants



Figure 1-2: Millions of households per income bracket (numbers include North Africa). Source: McKinsey (2010), own calculations

today. In 2050 this number is estimated to be 62%. East Africa significantly trails behind the rest of Africa in terms of urbanization, with roughly 20% living in the region's cities today, rising to 40% in 2050. The urban centres are found all over the continent, with clusters in Nigeria, where eight large cities are found, and South Africa, with seven cities with more than 1 million inhabitants. In total, the report counts 40 large cities in Sub-Saharan Africa. Africa's top three urban agglomerations are Cairo (Egypt, 11 million), Lagos (Nigeria, 11 million) and Kinshasa (Congo-Kinshasa, 9 million). By 2025 Kinshasa will probably be the biggest city in Africa with almost 17 million inhabitants, followed by Lagos and Cairo (16 million each).

The increasing population and the tendency towards more urbanization are mostly perceived as a challenge. A growing population is more difficult to feed, house, educate and employ. The challenge to supply public services, such as infrastructure, water and health care, increases. But there also is an opportunity in a young population that could well become a driver of economic welfare. According to a recent report by strategic consultancy McKinsey (MGI, 2010):

"Africa's [including North Africa] labor force is expanding. By 2040, it is projected to reach 1.1

billion, overtaking China's or India's. If Africa can provide its young people with the education and skills they need, this large workforce could account for a significant share of both global consumption and production."

The economic rise of Africa

During the first decade of the 21st century, Sub-Saharan Africa's economic performance has been outstanding. According to the IMF's 2010 World Economic Outlook Database, the combined GDP based on purchasing-power-parity (PPP) valuation has doubled from 840 billion international dollars in the year 2000 to 1.7 trillion in 2009, of which the top 10 economies accounted for 78% or 1.3 trillion international dollars in 2009. The average GDP growth rate of the whole region significantly outpaced the world economy. By 2015, the region's GDP (PPP) is expected to near 2.5 trillion international dollars, of which the top ten economies account for almost 2 trillion international dollars, keeping constant their relative share of 78% of Sub-Saharan Africa's GDP. The PPP valuation in international dollars provides an insight into the real growth in economic welfare of the local populations, as it corrects for inflation and differences in purchasing power. For international entrepreneurs, GDP at current prices is more interesting as it allows a direct comparison of the size of economies.

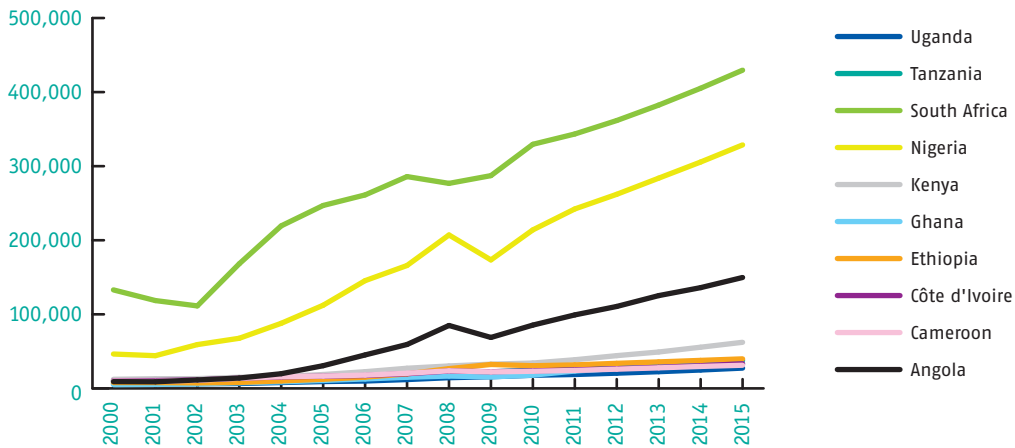


Figure 1-3: The GDP at current prices in millions of US Dollars of the ten largest economies in Sub-Saharan Africa.

Source: IMF World Economic Outlook Database (April 2010)

In those terms GDP multiplied from 321 billion US dollars in 2000 to 885 billion US dollars in 2009. For the year 2015, the IMF estimates this figure to rise to almost 1.5 trillion. Figure 1-2 shows the economic performance of the ten biggest economies in the region at current prices. Interestingly, at the projected growth rates, Nigeria will overtake South Africa and become the largest African economy well before 2050.

The steep economic growth over the past decade went together with an overall decrease in inflation, increasing rates of saving, a halving of external debts and higher rates of direct investment, both local and from abroad. Foreign direct investment alone (including North Africa) increased from 9 billion US dollars in 2000 to 62 billion dollars in 2008. Relative to GDP, this almost equals the investment flow into China (MGI, 2010).

High overall real GDP growth rates make markets attractive for investment, but the development of real GDP per capita really determines whether a country's inhabitants can grow richer. In step with the previous trends, GDP per capita is on the rise for all countries in the region with the exception of the Seychelles and probably Zimbabwe. However, in 2009 GDP per capita was still below 1,000 US dollars in 27 out of 45 countries. It was less

than 365 US dollars (a dollar a day) in Burundi, Congo-Kinshasa, Liberia, Sierra Leone, Malawi and Eritrea. This shows that despite high growth rates, it will take most African countries decades to catch up with their Asian and Latin American emerging market peers and to achieve a level of income that will make it possible to eradicate poverty. At the top end of the list, we find South Africa, Botswana, Mauritius, Gabon, the Seychelles and Equatorial Guinea, with per capita GDPs ranging from 5,000 US dollars to almost 10,000 US dollars. In total 16 countries score above 1,000 US dollars.

Even more important for the reduction of poverty and for analysing consumer markets is the distribution of income between households. An average high income per capita means little if all the wealth is concentrated in very few hands. Unfortunately, the numbers concerning income distribution in Africa are extremely unreliable. Therefore it is a matter of some debate whether economic growth rates and their distribution are actually making a real dent in the pervasive poverty. According to McKinsey (MGI, 2010) the number of households with an income of more than 5,000 US dollars (PPP value at 2005 prices) rose from 57 million in the year 2000 to 84 million in 2008 and could reach 127 million by 2020 (including North Africa). The number of destitute households with

an income below 2,000 US dollars decreased from 55 million in the year 2000 to 47 million dollars in 2008 and is estimated to be 44 million dollars in 2020. Figure 1-3 summarizes these findings. One driver of Africa's economic growth lies in the high resource prices that have favoured African economies for most of the decade. But this is far from the whole story. Angola and Nigeria have certainly grown on the back of oil and gas. Their growth rates can only be decoupled from resource prices if oil revenues are invested into broader economic development. However, a long list of African countries has managed to diversify their economies significantly. In Côte d'Ivoire, Namibia, Zambia, Senegal, Cameroon, Kenya, Ghana, Mozambique, Tanzania and Uganda, the contribution to GDP of the manufacturing and service sectors, such as construction, banking, telecom and retail, surpassed 65% in 2008, with a rising tendency. (MGI, 2010)

Conflicts, political stability and reform

An important driver of economic growth can be found in the realm of stability and governance. Most importantly, the number of conflicts in Africa has decreased. According to the Ploughshares Armed Conflict Report (2009), there was a decrease from 16 conflicts spread over 17 countries in the year 2000 to 11 conflicts in 10 countries in 2008. During this period, conflicts ended, among others, in Congo-Brazzaville (peace agreement signed in 2000), Ethiopia/Eritrea (2001), Angola (civil war in 2002 and Cabinda conflict in 2007), Liberia (2005) and Côte d'Ivoire (2007). While the end of a conflict is no guarantee of development, all countries in this list have shown exceptionally strong growth rates since signing their respective peace agreements.

Africa's political landscape is also changing. Zimbabwe's Robert Mugabe is the final remaining of the first presidents after independence. The number of democratic and peaceful changes of government is growing and citizens are increasingly demanding good governance. Macro-economic stability and micro-economic reforms are a direct consequence of better governance, including improved budgetary discipline. The World Bank's 'Doing Business Report' (2010) lists reforms in 29 countries in Sub-Saharan

Africa, implementing 67 reforms. Nearly half the reforms in the region are focused on making it easier to start a business or trade across borders. Rwanda was the first Sub-Saharan African country to lead the ranking of top reformers, a reward for a steady stream of reforms implemented since 2001.

The positive trends of the past are by no means a guarantee for a peaceful future of good governance. Even with more and more efficient conflict-prevention mechanisms in place today to secure future peace and stability, conflict cannot be ignored and many of the region's democracies are vulnerable. In the words of a leading strategy consultant:

"Africa is a portfolio game. You have to be active in 30 African countries. Two of them might turn out like Zimbabwe, but the rest will compensate with strong earnings."

A new vibe

The demographic, economic and political trends described above are all well documented and contain many signals for an upbeat 21st century in Africa. But reports and spreadsheets offer just a glimpse of the changes in the streets of Nairobi or Lagos. They capture little of the hunger for information, the ambition for personal improvement, the changes in lifestyles and attitudes, the globalization of African minds and the social impacts of an increasingly connected Africa. In my conversations in Kenya, Uganda, Rwanda, South Africa, Nigeria and Ghana, people emphasized again and again how much their life, their city, their country had changed over the past decade. For many, far-away friends are now a phone call or a mouse click away. Unprecedented educational and business opportunities are evolving. Changes in lifestyles, music and slang languages are accelerating. Impatience to catch up with the rest of the world is widespread.

A young generation, for which Ghanaian economist George Ayittey coined the term 'Cheetah generation', is emerging among urban educated youths. They are entrepreneurial, vocal and dislike corruption. Previously, the most intelligent youths aimed for jobs in government or with international NGOs, as these employers secured a decent and reliable

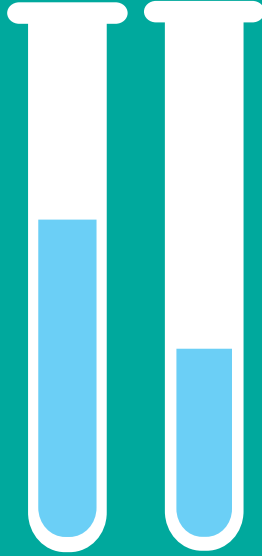
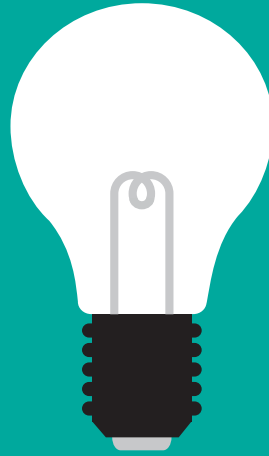
income. Today, employment in the private sector and entrepreneurship are highly regarded and seen as a way to become rich by being productive. The opportunities for those with access to information, higher education and relevant skills are endless and their number is increasing.

These changes are reflected in the mirror windows of the business districts' office buildings. They can be seen in coffee shops, where young urban professionals work at their laptops; they can be seen on Facebook, where millions of Africans network; they can be seen in the increasing number of African blogs and discussion forums. And these changes are increasingly recognized by the members of the Diaspora, many of whom are returning home to build their countries or to benefit from the opportunities. Technology supports many of these developments and Africa's 21st century will be a century of technology-driven change. This book is dedicated to that force.



Recommended sources

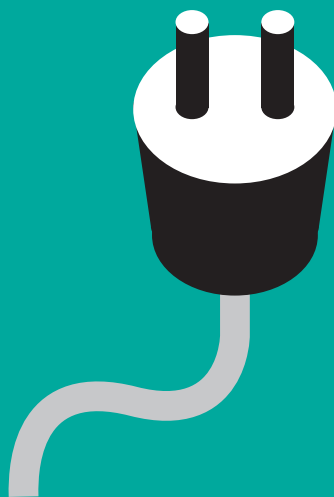
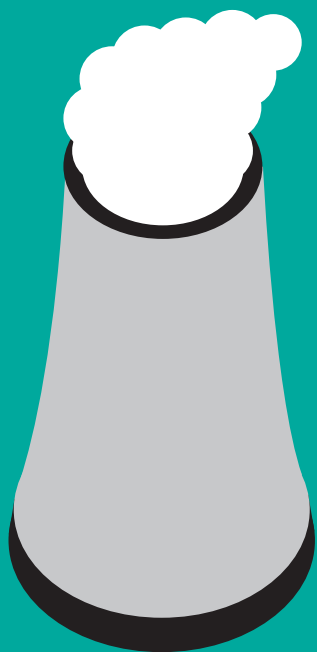
- 'The State of African Cities 2008' is an excellent report summarizing the challenges and opportunities of growing urban centres in Africa. It is published by the United Nations Human Settlements Programme (UN-HABITAT) and available for download on its website. (UN-HABITAT, 2008)
- 'Lions on the move – the progress and potential of African economies', published in 2010 by the McKinsey Global Institute, provides an excellent summary of Africa's economic rise. (MGI, 2010)
- 'Africa Rising – how 900 million African consumers offer more than you think' by Vijay Mahajan provides an excellent, if overoptimistic, insight into African consumer behaviour and markets. (Mahajan, 2008)



Author: Geci Karuri-Sebina

Chapter 2: **AFRICAN FUTURES STUDIES**





This chapter provides a brief introduction to futures thinking about and in Africa. For a long time, Africa used to be a white spot on the world map of formal foresight. This has changed substantially during the past twenty years. Ever more initiatives work on African futures. The chapter first explains the role of Africa in global foresight projects, then provides an overview of national and regional examples. It concludes with reflections on the state and future of African futures studies.

Africa and global futures

Exploring the future of the world is a tempting challenge. Will the 21st century really be the African century? Who will be the world powers in 2050? How will global environmental change evolve? Will there be a clash of civilizations? The many books and reports written to discuss the possible answers to these and similar questions generally ignore Africa (Karuri, 2005). Where they do include Africa, the discussion is often based on broad assumptions or stereotypes. In a highly influential global strategic foresight study, the US National Intelligence Council (2004) provides an extreme example of this: *"most of the uncertainty surrounding Africa over the next twenty years concerns how bad things could possibly get"*. Cilliers (2008) summarizes the underlying sentiment:

"African developments will not become a substantive driver and factor in global scenarios in the next two or three decades. [...] Of all the continents, Africa hardly features as a factor in most global projections. [...] From Washington it is, in many senses, as if the African continent is not part of the world, except as a source of commodities, for humanitarian considerations, or as an object of international intervention to halt the spread of instability."

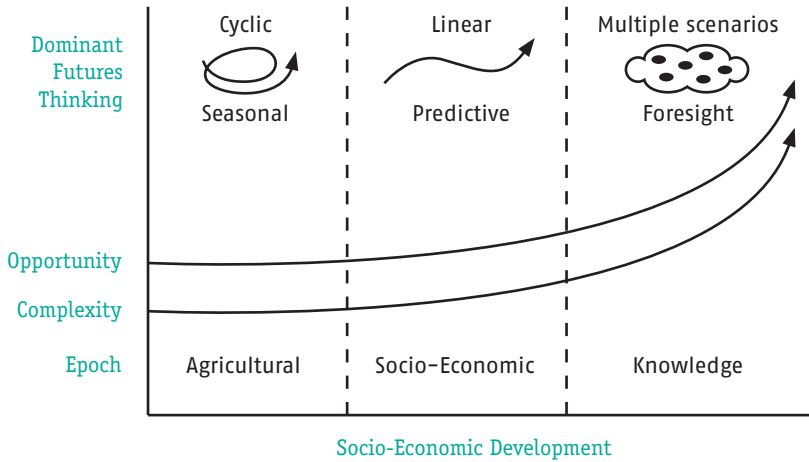
However, Africa does receive topical attention from futurologists. Issue-specific studies project, for example, the growth of mobile phone and internet coverage, the spread of diseases or ongoing population growth. Also, global institutions, such as the UN and related agencies, the World Bank, the IMF or the International Energy Agency, do include Africa in their outlooks. These reports, based on statistical estimates, are the most widely used sources when

exploring Africa's future. More recently, Africa's positive economic performance has received broader attention, much of it triggered by a report from strategic consultancy McKinsey (2010), highlighting the business opportunities on the continent.

A comprehensive study of Africa's future would combine and enrich these fragmented examples of foresight with less measured trends and changes. It would explore possible extreme events and surprises. It would acknowledge the significant differences between countries and cultures on the continent. It would embed these in the context of a changing world. Such a study has yet to be executed.

There are good reasons to include Africa when trying to understand global futures:

- **Population and economics:** The demographic and economic developments on the continent, summarized in the previous chapter, will increase the global impact of the continent.
- **Climate change:** Africa is an epicentre of climate change impacts. The IPCC (2007) expects effects on migration patterns, human health and economic development. These are likely to have knock-on effects on other world regions.
- **Food:** Global food yields are coming under pressure. Causes include soil erosion, extreme weather and a competition for arable land between food and non-food agricultural products, such as biofuels and cotton. At the same time, the number of people to be fed grows and average calorie intake is on the rise. Africa's vast tracts of arable land, much of it still unfarmed, have the potential to feed billions. However, this valuable resource might also cause intercontinental conflict, since cash crops are mostly sold on the world market and Asian governments especially are securing large areas of African land to feed their populations in the coming decades.
- **Energy:** There is a global need to reduce fossil fuel dependency while ensuring energy supplies. Africa's potential to harvest renewable energy from solar, wind, water and biomass sources is large enough for local supply and significant exports. Europe's governments and energy giants are already building the networks connecting the



✕ Figure 2-1: The evolution of foresight tools. Source: Day et al. (2009)

two continents. Unfortunately, Africa's potential stands in stark contrast to the present continued use of traditional biomass for domestic use, diesel generators, coal plants and nuclear ambitions.

- **Social:** Africa's frail health status and systems, evidenced by the doubtful prospects of achieving the minimum targets set out in the Millennium Development Goals, are a matter of global interest for several reasons, not the least is which is the menace of new and globalizing pandemics. At the same time, indigenous knowledge systems and bio-prospecting offer old and new prospects for improved health and longevity.
- **Resources:** The technological gadgets of the global knowledge economy rely heavily on African rare earths and metals. There is quite a bit of Africa in every iPhone, every laptop, every car and every other piece of modern electronics.
- **Global conflicts:** Africa has, once again, become a battleground between global vested interests.

The emerging conclusion must be that Africa's future matters globally.

An inventory of African foresight

The previous section complains about the neglect of Africa in studies of global futures. This section provides a preliminary overview of futures thinking within Africa.

Traditionally, the role of the !Xū (Khoisan) shaman or the Dogon priests has for centuries included looking beyond the present and preparing communities for what may be in store. Day et al. (2009) propose that thinking about the future has been critical to the survival of indigenous peoples around the world for ages. However, the complexity, rate, frequency and inter-dependence of change in the global environment have altered. In an agrarian society, nature's cycle of seasonality is the dominant preoccupation and planning ahead for the rains or the harvest may have been an adequate logic. In industrialized societies the time horizons expand as technology and competition require longer-term planning. In a modern knowledge society, uncertainties are even higher and choices made today frequently affect several future generations. The long view asks for innovative and robust foresight tools. Figure 2-1 illustrates how foresight strategies have adapted to this increase in complexity.

Especially during the past fifty years, methods for 'disciplined thinking about the future' have improved significantly in response to modern challenges. Most large organizations now engage foresight expertise to develop shared visions of desirable futures or to prepare for possible futures, desirable or not. A shared vision is a tool to mobilize forces for moving in a positive direction.

Preparing for possible futures helps to prepare for future eventualities, positive and negative.

The majority of systematic foresight projects in Africa has aimed to develop a vision for mobilization. A first continent-wide wave of national visioning exercises was initiated by the UNDP with the establishment of the African Futures Institute in 1992. The organization, which became an independent NGO in 2004, assisted African countries in using foresight in their long-range planning. Starting off with Côte d'Ivoire, Mauritius, Gabon and Zambia as the early pioneers in 1993/94, 27 African countries have 'National Long-Term Perspective Studies' underway or completed over the past 18 years. Outputs of this nature have included Rwanda's Vision 2020, Kenya's Vision 2030, Nigeria's Vision 2020, Botswana's Vision 2016 and so forth. Formal research on the efficacy of these visions is still to be conducted. Nevertheless, some differences between the different countries are apparent.

- In Rwanda and Botswana, these visions have evolved to become crucial guides for development, clearly communicating the governments' medium- and long-term priorities. Specific targets for the development of infrastructure, housing, ICT, education, health and more were derived from the visions and fulfilment by the responsible government agencies is closely monitored.
- Kenya's foresight has led to the establishment of the 'Vision 2030 Delivery Secretariat'. The organization was set up to co-ordinate the initiatives of the responsible government ministries. While the secretariat has further developed and publicized Vision 2030, the effectiveness of the organization has been limited so far. What is called by cynics the 'Vision 2030 Illusion Secretariat' has yet to build its track record.
- Nigeria's Vision 2020 was revived in 2005, when investment bank Goldman Sachs listed the country as the only African member of the 'Next-11' countries. The Next-11 are emerging economies that might follow the growth pattern of the better-known BRIC countries (Brazil, India and China). The report stated that appropriate reforms could make Nigeria a newly industrialized country by 2025 (Government of Nigeria, 2010). The Nige-

rian government upped the game and proposed 'Vision 20:2020'. In short, Nigeria is going to be one of the top 20 economies in the world by 2020. However, despite its ambitious target, the Vision lacks a focus and specific targets. It is not a vision that people can run with and there is no way to evaluate progress as there is no timeline.

While the UNDP might have triggered a large number of visioning exercises, African foresight projects and initiatives have grown far wider. The following list might not be comprehensive, but it provides a good impression of the diversity:

- Regional institutions, like the Institute for Global Dialogue and the Institute for Security Studies, have conducted regional foresight exercises.
- National institutions that have a significant foresight focus include the Egyptian Centre for Future Studies, a government think tank to Egypt's cabinet focused on issues related to economic, social and political reform, and the Kenya Institute for Economic Affairs. The latter does not have a state mandate, but undertakes national-scale foresight projects in the public interest.
- The private sector has also produced foresight work. Most major corporations working in or with Africa have developed futures intelligence. This is most prominent in sectors with a long-term concern, such as minerals, energy and financial services. The projects are mostly executed by private-sector consultants, often applying methods derived from established formations with international experience such as the Global Business Network.
- International development institutions and think tanks that have had an Africa futures focus also exist. In particular the Society for International Development has been active in East Africa. UN agencies (UNDP, UNAIDS, UNEP, UNIDO, UNESA, IPCC etc.) have undertaken significant and continual foresight projects.
- Foundations like the Rockefeller Foundation have undertaken and stimulated African futures work. The Rockefeller Foundation specifically has African grantees engaged in horizon scanning and trend monitoring in Western African, Southern African and the Greater Horn of East Africa regions. The

World Economic Forum has done general and sector-specific foresight projects involving Africa (e.g. in the mining sector).

- Several academic institutions have engaged with African futures. South Africa's Institute for Futures Research (Stellenbosch University), the Frederick S. Pardee Center for the Study of the Longer-Range Future in the USA (University of Denver) and the Finland Futures Research Centre (University of Turku) are examples.
- International voluntary and professional futures associations such as the World Futures Society, the World Future Studies Federation and Futuribles have African participants, though not on any significant scale, possibly due to the cost and relevance of participation. The Millennium Project, a global futures think tank, has 'Nodes' (or active networks) in Egypt, South Africa and Kenya.
- Two recent conferences held in Africa on the subject of foresight indicated rising awareness and interest in African futures. A 2007 African Futures conference convened by the South Africa Node of the Millennium Project drew attendees from more than ten African countries. The conference found that there was an urgent need to stimulate more futures thinking and collective intelligence given the magnitude, complexity and inter-state dimensions of Africa's challenges. A workshop on African futures convened by the World Economic Forum and Oxford University in 2008 found a high level of activity and demand for public interest 'pan-African' scenarios. It also called for the establishment of communities of practice, as African participants at the session were typically unaware of each other's related work, in some cases even within the same country.

In South Africa foresight has had particular traction. It was one of the very first nations in the world successfully to apply nation-wide scenario-based discourses about its future from the late 1980s to the early 1990s (Spies, 2004). South Africa's High Road/Low Road scenarios (Segal, 2007) and Mont Fleur scenarios (Le Roux et al., 1992) were prominent exercises that enjoy global recognition in the foresight community. South Africa also ranks among many leading countries in the world which have future-oriented strategy or foresight units to

contribute to their national policy process (Millennium Project, 2008). In a historical analysis of the role of foresight study in South Africa, Segal (2007), identified dozens of major South African national and some regional futures exercises dating back to the 1970s, their number increasing exponentially over time. It also indicated that an additional range of specialized and closed foresight studies had been carried out within the proprietary strategic planning processes of corporations, banks and government departments. South Africa also has the only known futures postgraduate qualification on the continent (MPhil at the Institute for Futures Research at the University of Stellenbosch), and there are few such programmes even globally.

In 2009, Foresight for Development Africa was also established with support from the Rockefeller Foundation, an initiative which is trying to be an aggregator and knowledge management system for African foresight content and networks. The platform's library can be accessed online at www.foresightfordevelopment.org and currently comprises close to 200 public foresight products related to Africa, about a third of which are South Africa focused. Although, as this chapter has shown, South Africa has tended to be possibly the most active African country in terms of significant engagement with futures and foresight, it is also the case that the current results may merely reflect the limitations in internet connectivity and online publishing in African countries.

Reflections on African foresight

Even the level of activity reflected above, relative to Europe and the USA the volume of African futures studies is limited. This tends to be the case with most research of any kind regarding Africa. Relative to the limited available resources and capacities, however, the African futures community can be considered to be extremely vibrant. Nevertheless, there is more foresight developed on Africa than 'in' Africa (or even 'by' Africa). International actors, ranging from the UN to global corporations, from international NGOs to Western academia, conduct the bulk of the available studies outside South Africa. Methodologically, two extremes of foresight methods dominate on the continent:

quantitative/statistical modelling and scenario building (Karuri-Sebina et al., 2008). Also, with the exception of South Africa, visioning exercises seem to be more common than exercises preparing for possible surprises. Africa's foresight projects would certainly benefit from applying a wider suite of foresight methods and perhaps even the development of new methods, tailored to its specific context.

Although there is a sense that quite a lot of foresight work has been done on or by Africa, there has not been a systematic capturing and analysis of this body of work regionally. Many of the foresight products may also be proprietary, not publicly available or not published/disseminated electronically. This constrains the ability to access and assess African futures products. Evaluating the impact of futures studies in Africa, the degree to which visions have actually led to better decisions and better outcomes, therefore remains a task for the future.

Given the persistence of many of Africa's challenges, one could argue that a lack of long-term action is apparent. Other long-term development indicators support this view. Continued sub-optimal investments in research and development, the poor maintenance of infrastructure, weakened education systems, degenerative agricultural practices and mismanagement of public funds are tell-tale signs that long-range planning and consideration are not as embedded as they could be.

One reason for this apparent lack of applied foresight is that Africa continues to be preoccupied with looking at its present and its past. Vital contemporary matters occupy government and public resources, pushing future problems or long-term solutions down the list of priorities. In a personal interview in July 2009, Kenyan media entrepreneur Salim Amin illustrates the point:

"If you ask me, where we are going to be in 15 years, I don't know. This country, for example, could be burning in two years, literally could be burnt to the ground, if we do not sort out our politics now."

Thinking about the future might not be bearable under such circumstances. The high degree of uncertainty and the high likelihood of extreme events might also lead to the conclusion that it is impossible to develop plausible, let alone desirable, futures. And even if one could succeed in this, the requirements for creating or averting certain futures may not be acceptable or possible for the protagonist.

The barriers to a foresight culture may lie even deeper than that. In her book 'The Challenge for Africa: A New Vision' (2009), Nobel Prize Laureate Wangari Maathai suggests moral, spiritual, cultural and psychological reasons for the failure to implement positive, long-term visions. According to Maathai, the deep psychological scars borne (and dealt) by Africans during years of colonialism and through to a less-than-ideal post-colonial era no doubt affect the psyche of Africa, the so-called 'legacy of woes'. Other cultural factors should also not be underestimated (Stein, 2010). A mystic or fatalistic disposition, for example, which is not uncommon in some African cultures, could negatively affect the future orientation of some societies. Importantly, the external locus of control for the conceptualization of Africa's development path since the 19th century has had the most significant impact on determining that path, and the possibility or impossibility of perceiving and crafting different futures.

To overcome this, John Ohiorhenuan proposes the powerful metaphor of a 'self-narrative' to overcome these obstacles. Such a narrative would have to be informed by an awareness of contemporary trends and future possibilities in the world (Lombardo, 2007). He identifies six essential virtues in the development of a self-narrative: self-responsibility; courage and determination; transcendence – defined as being dedicated to some worthy ideal beyond one's self, a preferable future for humanity; the pursuit of truth and honesty; real courage, which involves acknowledging and facing the problems, risks and uncertainties of life; and wisdom, described as the capacity to apply deep and comprehensive knowledge ethically for the betterment of oneself and humanity in the future.

These virtues are critical ingredients to having an Africa that does deeply and consistently think about the future. The recipe is not one that is only to be served up to African leadership, but also to the followership of the continent, who themselves must participate in a new self-narrative and 'culture of foresight'. Wangari Maathai supports this call by declaring that *"Africans need to think and act for themselves"*. Only then would the future be Africa's to conceive, create and navigate.

About the author

Geci Karuri-Sebina, Chairperson of the South Africa Node of the Millennium Project, and Research Associate at the Institute for Economic Research on Innovation (IERI), Tshwane University of Technology, Pretoria, South Africa.
Email: geci@sampnode.co.za

Recommended sources

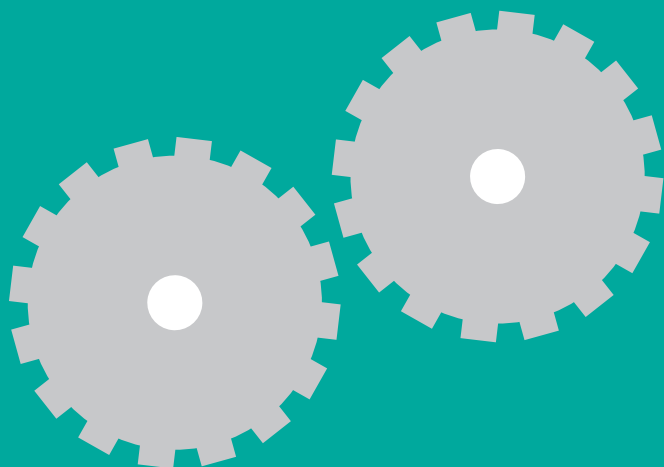
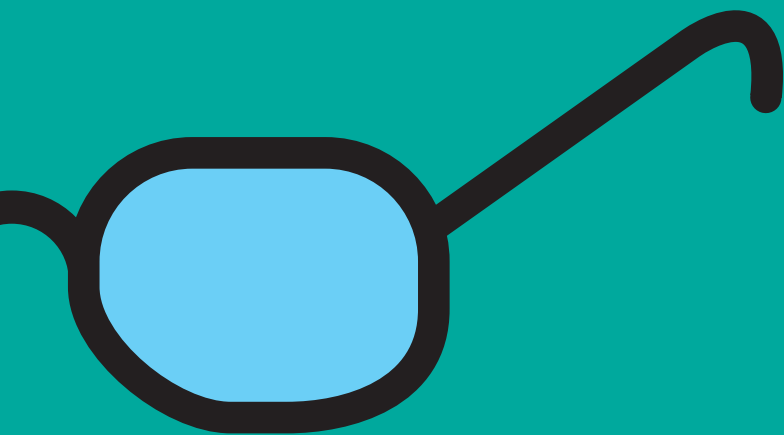


- Foresight for Development is an emerging knowledge-sharing platform, and currently the only open-access repository and social network for foresight-related information resources on Africa. It can be found at: www.foresightfordevelopment.org
- 'Breaking the Mould: The Role of Scenarios in Shaping South Africa's Future', authored by Nick Segal for the South Africa Node of the Millennium Project in 2007, is one of few analyses conducted on the role that foresight has played in specific national development trajectories on the continent. (Segal, 2007)
- 'A Guide to Conducting Futures Studies in Africa', published by African Futures investigates various foresight methods and attempts to highlight methods that appear best suited to foresight in Africa. (African Futures et al., 2002)



Chapter 3:

EXPLORING TECHNOLOGY FUTURES



People have vivid dreams of what technology can do for Africa. In Nairobi, Wambura summarizes the essence of many of these dreams:

"I think technology is an opportunity, not an enemy of the people. Get the roads to where the people are, get the mobile phones to people and then see what they do with it. Some will want to do business with it, others will just think. So just connect them and then stand by, because it is not so much about deciding what people are going to do, but giving them the tools to do things."

Ideas about which tools are most important to kick-start development or to open the door to opportunity have changed over time, but technology has been an important element in the ambitions for the future of African countries for the past 50 years. In the 1960s, most of the newly independent African states formulated the ambition to become industrial societies, to converge technologically with the former colonial powers. Projects such as the Akosombo dam in Ghana were built to kick-start this development by supplying sufficient electricity for a future of processing natural resources and manufacturing. A critique of this capital-intensive and large-scale approach was formulated, among many others, by E.F. Schumacher in his book 'Small Is Beautiful' (Schumacher, 1973). Schumacher proposed so-called appropriate or intermediate technology as an alternative. This would be labour intensive instead of capital intensive, and ideally designed and produced locally.

Many local NGOs and initiatives still follow this approach today, producing relatively fuel-efficient stoves, nifty farming tools or affordable pumps, food-drying installations, irrigation devices and solar water-heating systems. Even though local successes have been achieved, intermediate technology has no documented impact on a continental scale. Because of the failure to transfer technology to Africa or to develop it locally, the focus shifted in the late 1990s towards education and thus towards capacity building.

Under the heading of 'science and technology' development, the transfer of knowledge and skills was

considered much more important than the transfer of physical technology. Strengthening educational systems, as well as science communities, in developing countries became a primary objective. The establishment and support of national Academies of Science and partnerships between African and Western or Asian universities are typical initiatives.

Currently, the benefits of transferring physical technology, especially in the form of basic infrastructure, is getting renewed attention. Road and rail infrastructure, power plants and electricity networks, as well as ICT systems, are at the top of the list of projects executed, often by Chinese partners contracted by African governments. That basic infrastructure opens up a range of options for further development. Businesses can trade more efficiently, education and health services reach further and modern technology becomes feasible.

On African technology

This book is about futures of technology in Africa and the question is justified whether there is such a thing as African technology. One important answer is that most technology is African, as Rafiq Philips, a marketing technologist from Cape Town, explains:

"There is Africa in almost all technology. The raw materials probably come from Africa, get to China, get processed and come back."

But while some development initiatives work on technology specifically designed for or in Africa, such as solar cooking devices or special wood stoves, most interviewees experience technology as a global phenomenon. Rafiq again:

"I don't want to separate African technology. Technology is technology, it works where it works, tech has no borders. With a few adjustments, a technology that is going to solve a problem can be adapted slightly to solve another problem in a multi-world."

Nicholas Nesbitt, CEO of KenCall, agrees:

"It's like the cappuccino coming from New York to Nairobi. Everything that's there will come

here and there's nothing different about the DNA of the African villager from the American farmer. They will get whatever is appropriate for them."

The fact that technology is global and that aspirations worldwide are similar to a certain degree helps in exploring technological futures in Africa. Many of the advantages and disadvantages, potentials and risks are global, and countries that have already implemented a technology do provide useful cases for countries that haven't. But while the consumption of technology might be global, the innovation and production of technology are not. The internet and the mobile are not something that started in Africa. The recent technological change largely arose on the back of somebody else's innovations. Chapter 9 explores, among other issues, what is required to change that. For now, the technological modernization of Africa gets far too little local input.

On the speed of technology futures

One of the most difficult aspects in exploring futures is getting the timelines right. How fast will a trend evolve, when will it reach saturation level? With a relative lack of data and no analogous developments in the past, estimating speeds becomes even more challenging for Africa. Current signals are confusing. Some changes happen very fast. The CEO of a Kenyan company gives an example:

"My assistant and lots of people at work, they're on Twitter and they're Tweeting all day long about what's happening. No one even knew what Twitter was, what is it, July? They didn't even know what Twitter was in March."

One obvious driver of technological change is its usefulness, as Sheila Ochugboju explains:

"The beautiful thing about Africa is that we are early adopters of technology that solves problems. We do not have as many cultural barriers as I see in Europe. There you can comfortably use a piece of lower technology and keep on with your life another ten years, and not adopt the latest thing. Because you can

still get along. But in Africa we are absolutely hungry for the latest thing. You can give a farmer a phone, and you say you can find out what the prices are at market, just press here; he will take it."

And the delay in transporting small-scale technology from Europe to Kenya is negligible. Nicholas Nesbitt enjoys bringing the latest technology to Kenya:

"The benefit we have right now is, we don't have to wait to participate in the development of technology. You can buy it in London one day, and it can be used here in Kenya today. If it is on the internet, as soon as it is released you can use it right away. You don't have to wait! I sound very excited and I am very excited."

However, the enthusiasm about fast-moving technologies should not overrule the fact that many technological domains are still stagnating in Africa. Access to electricity, for example, has hardly improved over the past years, as investment, construction and maintenance have been neglected. And even for the fast-moving ICT industry, the current speed might slow down future dynamics, as Salim Amin explains:

"The advantage that we've always had is that by the time a technology gets here it has morphed itself to its applications. We don't go through the teething problems of the technology. We get the best or the latest model. But then we often get stuck with that model. We don't actually evolve as the technology evolves."

There are several ways that have been used in this STT foresight to sift through the timelines. Some of these are self-evident: it takes at least five years to build a power plant from scratch, so energy is unlikely to change dramatically within the next five years in a region unless plans or building are in progress already. For international transport infrastructure, this time span is even longer. For ICT, on the other hand, five years is already well beyond the planning horizon of most market players. Things can happen more quickly in this field.

Also, some trends depend on each other. Industrial manufacturing is unlikely to rise quickly while energy supply remains a limiting factor. Only on the longer term can such obstacles be overcome.

Furthermore, in interviews with those responsible for building roads or power plants, one can often elicit the level of trust the interviewees have in the developments they describe. The difference between what is planned on paper and what is actually happening can be small or large, and those close to the development usually can estimate the size of the gap quite accurately. Scale, however, is the most important criterion for establishing timelines.

On scale and technology futures

In international publications on Africa, little difference is made between inspiring, but small-scale, individual ideas and pan-African megatrends. The installation of a containerized classroom of computers in rural Ghana is reported in the same manner as the massive leaps in connectivity that Africa is undergoing. The first affects the lives of a small community and requires an investment of several thousand US dollars, the second affects the lives of the majority on the continent and requires an investment of several hundred million US dollars. However, a picture of a group of children sitting behind a computer, or better even, smiling and waving at the camera, is much easier to publish than one of a cable and a dark bungalow of transmitters. In terms of future impact and in terms of timelines, this book distinguishes four levels: concepts, seeds of change, trends and megatrends.

- A concept is an idea that has not yet been implemented. An artist's impression, a blog entry or a scale model communicate the idea. An example are the many emergency shelters designed by architecture students as class assignments all over the world. Some of them are highly innovative, but the probability of future practical relevance is one in thousands. Concepts inspire and are wonderful conversation pieces.
- A seed of change is a unique project or product that has already been implemented in one or a very few places, usually by a single organization or consortium. It works locally, often with

external support, but its scalability and self-sufficiency are still uncertain. An example are the household biogas installations of the young engineer Olatunbosun Obayom in Nigeria, which produce gas suitable for a cooking stove from human faeces. Another example is Google's SMS search. In Uganda, the company introduced an SMS interface for its search engine. It allows the user to send a query and receive results by SMS, no internet or data access required. A couple of prototypes of a seed of change will have been installed, the idea is technologically convincing and the remaining obstacles seem surmountable, but momentum is lacking. Seeds of change are worth observing when thinking about medium-term technological futures, because they are the universe of practical possibilities.

- A trend is a type of project or product that is implemented by several competing actors, possibly in different ways. An example would be low-cost satellite connectivity. A couple of initiatives are currently building satellites with the purpose of serving rural areas in the global south. Their specific technologies differ, they compete with each other and more than one consortium has enough trust in the potential of the technology to succeed for them to invest in it. Trends often seem obvious to those who are professionally interested in the given sector, but much less visible to outsiders. Making trends visible and putting them in context is one of the challenges and values of comprehensive futures studies.
- A megatrend is a type of project or product where many competing initiatives scramble to implement it as quickly as possible. Mobile money is a prime example. Hundreds of mobile phone providers, banks, money-transfer companies and independent service providers are rushing to roll out the best technology to transfer money from one mobile phone to another, between mobile phones and bank accounts, or between any two bank accounts using the mobile phone. The level of momentum in this sector, the number of actors, the amount of resources and the current success of these systems make megatrends strong predictors for the medium-term future. It's not a question of whether a megatrend happens, but exactly how fast and which horse will win.

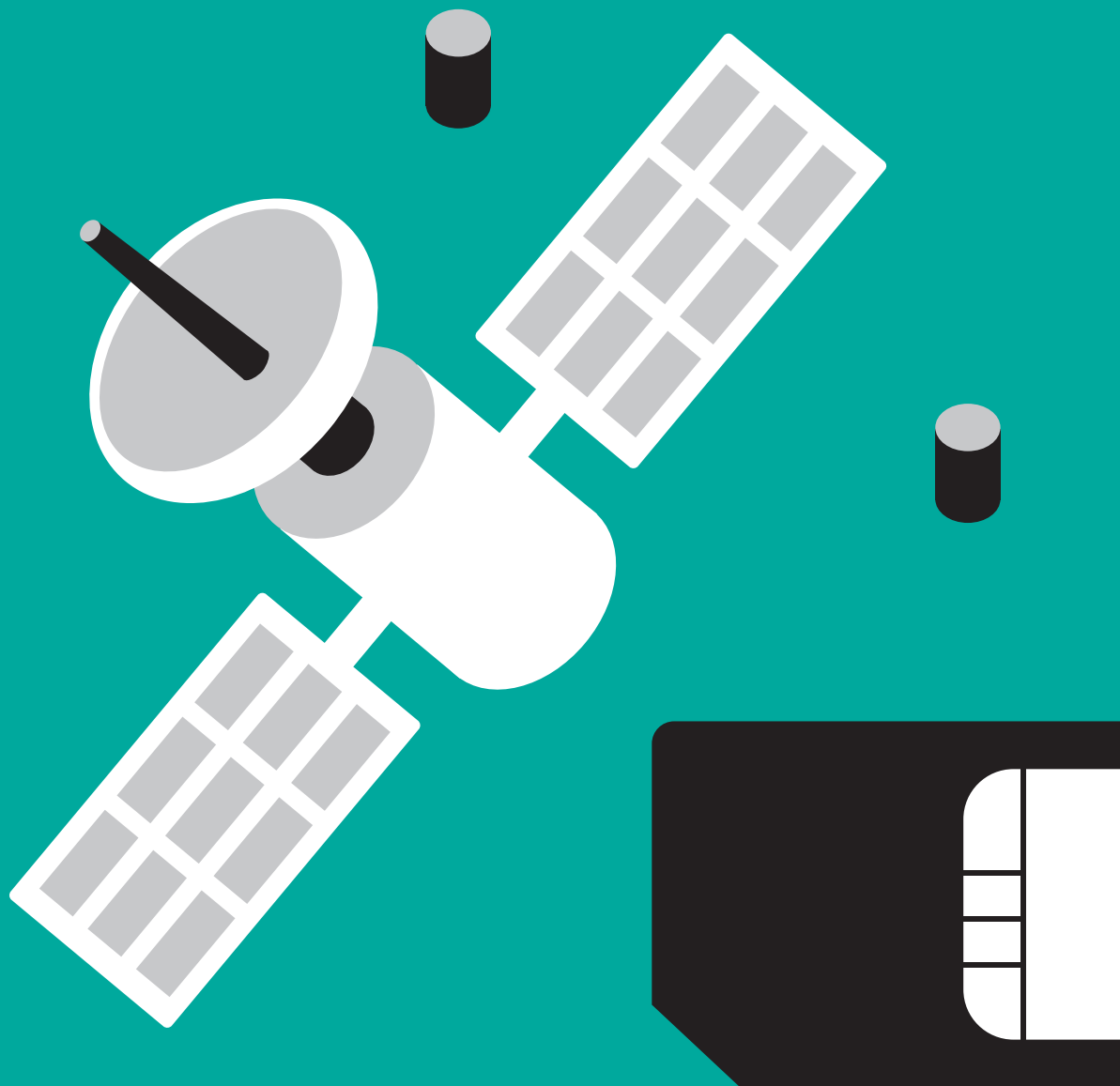
On negative futures and technology

Technologies cannot only develop slowly, they can also have highly detrimental effects. A farming technology can ruin the soil, contaminated industrial emissions can cause health problems and new technologies can destroy valuable local skills, as has happened in the textiles industry, for example. Technology will help solve problems, but it also brings new challenges.

Some of the downsides seem to be global. A Kenyan mother describes a personal worry about technology:

"Small kids who have phones are able to access all kinds of stuff. In Kenya it's become an issue already. I would not imagine giving my nine-year-old son a mobile phone because, while they want to download music and games, they can also go to a portal which has X-rated videos available."

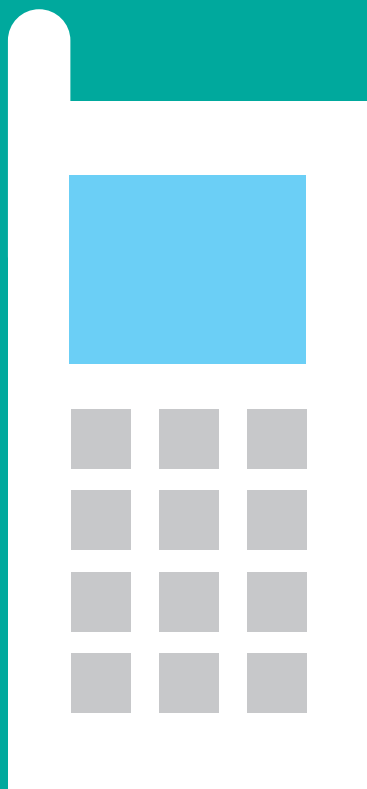
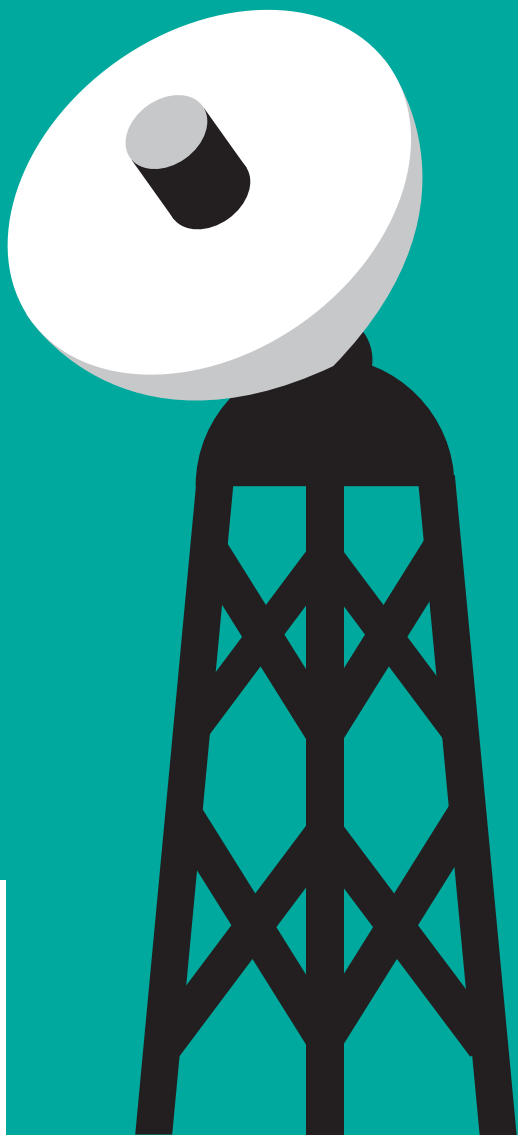
Just because the potential of a technology is so wonderful doesn't mean that a discourse on potential threats should be neglected. Therefore, each chapter explicitly describes some of the risks and downsides. Managing these will be equally important in Africa as it is anywhere else.



With contributions from Ben White and Gertjan van Stam

Chapter 4:

AFRICA WILL BE FLAT



'The World Is Flat', announced Thomas L. Friedman in the title of his bestseller, which explores globalization (Friedman, 2005). Friedman sketches the emergence of a level playing field, where all economic competitors have an equal opportunity. The book identifies the ubiquitous access to global communications as the main driver of this process. Africa, at the time, was far from being a part of Friedman's 'flat' world. When the book was published in 2005, only one in every 10 Africans owned a mobile phone, one in 50 had access to the internet and one in 100 had a fixed-line telephone at home. The digital gap disenfranchised a whole continent in a globalizing world.

Since 2005, the continent's ICT infrastructure has been growing at unprecedented rates. This chapter first focuses on the rise of the mobile phone and the increasing availability of bandwidth. It then sketches the transition from today's dominance of the mobile phone to tomorrow's ubiquity of the mobile web. The further penetration of mobile communication in Africa and the increasing availability of bandwidth trigger two megatrends: mobile money changes Africa's monetary economy and navigation; and tracking and tracing services change the logistics of Africa. The final section of the chapter explores the seeds of software made in Africa and how African developers are changing the game.

The mobile revolution

There are very few technological innovations that have penetrated Africa as much as the mobile phone has. If any, the list would include the radio, the combustion engine, the pocket calculator and, unfortunately, the AK47 automatic rifle. *"The mobile phone has had a bigger impact on Africa than colonization,"* says Salim Amin, chairman of A24 Media in Nairobi. The mobile phone has certainly affected the lives of the vast majority of Africans and becomes Africa's Swiss army knife. Wambura Kimunyu explains why all this is being bundled into the one device: *"We demand much more of our mobile phone than other people, who have other options."* In other words, the mobile infrastructure is the only infrastructure that reliably reaches almost everywhere instantly and thus it absorbs all services for which this is helpful.

Mobile phone growth

The story of the mobile phone in Africa is one of exceptional growth. In 1995, a total of 600,000 mobile phones were in use in Sub-Saharan Africa, of which almost 90% were in South Africa. By 2009, the number surpassed the mark of 300 million units, a growth of 51,300%. In the process the continent has largely 'leapfrogged' the fixed line and its copper wires. South Africa was the first to reach mobile market saturation and Nigeria grew to become the biggest market on the continent, with 75 million phones in use in 2009. Figure 4-1 shows the historic track record of the world's fastest-growing mobile market.

Public as well as private investment, infrastructure development, availability of cheaper handsets and the continent-wide take-off of mobile money services sustain the growth. The quality of the services is also improving. While most countries use 2G technology, the trend is to upgrade to 3G. The latter allows for higher data transfer rates, enabling the use of data services while talking on the phone. Kenya, Nigeria, Rwanda, South Africa, Tanzania and Zambia are among the countries with 3G networks. However, despite the high growth rates and the ubiquity of mobile devices, Africa remains the region with the lowest penetration rate. Depending on the source and definition, 30-40% of the population are mobile phone users, ranging from more than 90% in South Africa to less than 5% in Zimbabwe. The current lack of infrastructure, regulatory red tape and the occasional act of sabotage are obstacles to further expansion. Profitability is another issue. Companies earn less and less revenue per customer as they target ever poorer market segments. And finally, competition in the industry is fierce.

Quantitative estimates for how mobile telephony will develop in Africa beyond the next two years are informed guesses at best, because of the high uncertainties involved. The trend, however, is undisputed. The number of users will continue to increase at high rates. The biggest growth in volume is going to take place in Nigeria, for which market research company RNCOS forecasts 131 million mobile phones by 2013 (RNCOS, 2010). Country- or region-specific circumstances will accelerate or delay this

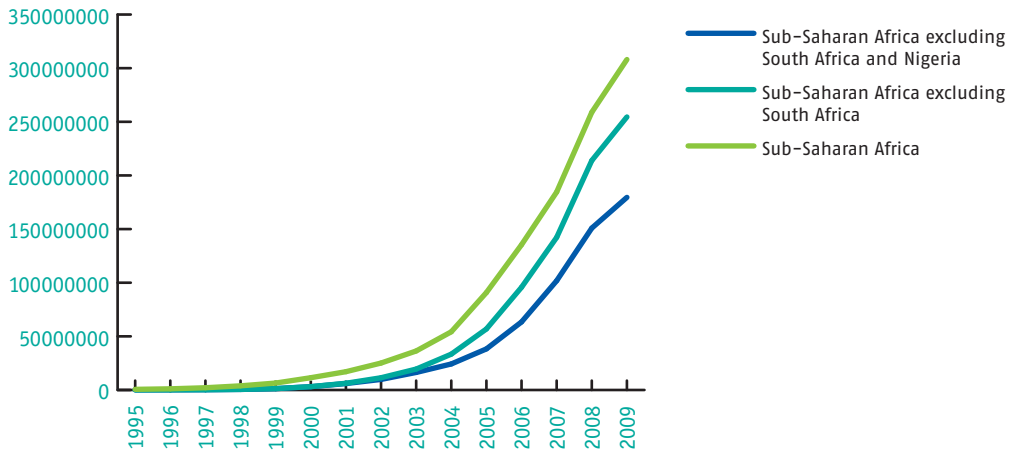


Figure 4-1: The number of mobile phone users in Sub-Saharan Africa. Source: Africa Development Indicators, World Bank, RNCOS, own calculations

trend locally. For example, if political stability in Zimbabwe improves, mobile phone penetration will grow explosively, because of the country's current low penetration rate. In another example, West Africa's mobile market will grow quicker than average on the back of intercontinental fibre-optic cables reaching the region. Over the next decade, the continent's penetration rates are likely to converge with the saturated levels of the developed world today. The more advanced African economies will reach that milestone within three to five years.

The second ICT wave: internet

In 'The World Is Flat', Friedman describes ten so-called flatteners driving the process towards a commercial level playing field. Nine of the flatteners require data connectivity as they are related to software, communication devices and the way in which people use ICTs to organize processes efficiently. The tenth flattener was the fall of the Berlin Wall. Sub-Saharan Africa is disconnected from that 'flat' world of connectivity. Internet rates in Sub-Saharan Africa are higher and connections less reliable than anywhere else in the world. Prices were especially steep in East Africa, where until very recently, expensive satellite connections were the only viable access route to the world's digital highways. In Nairobi, until the summer of 2009 it could cost 5,000 US dollars a month to rent an internet connection

that would be comparable to the average European urban household's connection in capacity, but not in reliability. Prices in Europe were about 100 times lower, primarily because high-capacity fibre-optic cables carry most of the data traffic.

Rolling out bandwidth

From 2002 until 2009, Sub-Saharan Africa's only data cable was the SAT3/SAFE fibre-optic cable. A consortium lead by Telkom SA installed the cable in 2002. It runs from Spain and Portugal to South Africa with several landing points in West Africa (SAT3). From South Africa, the connection continues to India and Malaysia without further landing points on the mainland (SAFE), thus leaving East Africa unconnected. SAT3/SAFE's technical capacity is limited at currently 340 Gb/s for SAT3 and 130 Gb/s for SAFE, a fraction of the capacity of typical modern cables. The system also suffered from the fact that several national operators had monopolies at their respective landing points. Despite these obstacles, internet user numbers in Africa grew steadily, surpassing the mark of 1 million users outside of South Africa in the year 2000. By 2008, there were 35 million users, of which 11 million were in Nigeria and 4 million in South Africa. Figure 4-2 shows this development.

To alleviate the East African bandwidth starvation, a consortium of African telecom operators and inter-

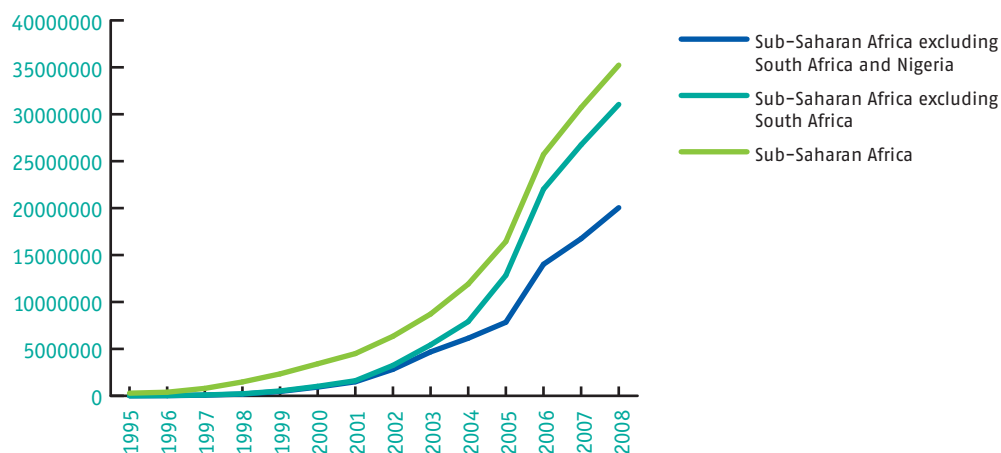


Figure 4-2: The number of internet users in Sub-Saharan Africa. Source: Africa Development Indicators, World Bank

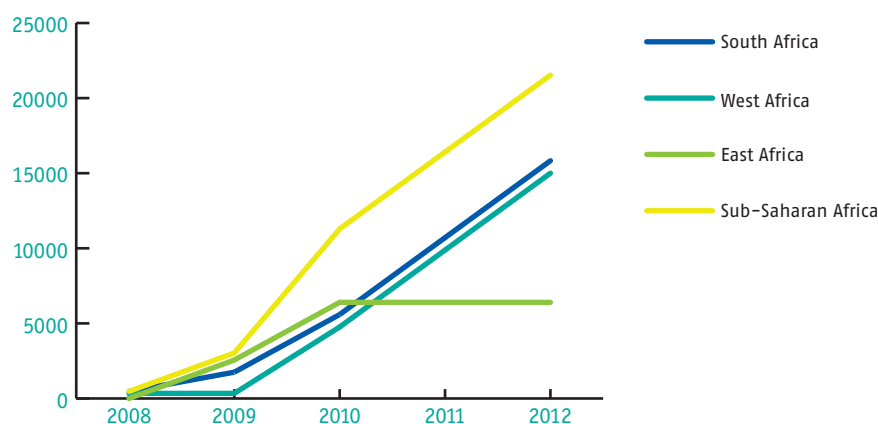


Figure 4-3: The capacity of incoming fibre-optic cables in Gigabit per second (Gb/s). Source: Manypossibilities.net/African-undersea-cables, own calculations

national development financial institutions signed a memorandum of understanding in 2003 to build the so-called EASSy cable. Initiated as a development co-operation project, EASSy should have been the first link to bring reliable and affordable connectivity with Europe to South Africa, Mozambique, Madagascar, Tanzania, Kenya, Somalia, Djibouti and Sudan. However, the implementation of this laudable plan was delayed for several years by negotiations about finance, access, ownership and other issues. This is not surprising, as the consortium of owners mixed many parties and interests. The full list of consor-

tium members included the African Development Bank (AfDB), the development bank of France (AFD), the European Investment Bank (EIB), Germany's development bank (KfW), the International Finance Corporation (IFC), Botswana Telecommunications Corporation, U-COM Burundi, Onatel Burundi, Djibouti Telecom, Telkom Kenya Limited, TDM – Mozambique, Dalkom Somalia, Zanzibar Telecom Limited, Uganda Telecom Limited, Lesotho Telecommunications Authority and Gilat Satcom Nigeria Limited. Construction finally began in 2008 and in July 2010 the cable went live with a capacity of 3,840 Gb/s.

By that time EASSy had already been overtaken by two other cables. The 1,280 Gb/s Seacom cable was launched in July 2009 and links South Africa, Mozambique, Tanzania and Kenya to India and Europe. Three months later, the TEAMS cable was put online with a similar capacity, connecting Kenya directly to the Middle East. Both were initiated and installed by commercial consortia. On the African West Coast connectivity is also set to improve dramatically. Four different cables will be connected in 2010, 2011 and 2012. Two of the four cables, GL01 (online since Q3/2010 with 2,500 Gb/s) and MaIn OnE (Q3/2010, 1,920 Gb/s), are limited to West Africa with landing points in Europe, Senegal, Ghana and Nigeria. The other two cables, WACS (Q2/2011, 5,120 Gb/s) and ACE (Q2/2012, 5,120 Gb/s), will link with more than 20 countries between Europe and South Africa. Nigeria alone will see its bandwidth increase by 15,000% in the period from 2009 to 2012. Figure 4-3 shows the increase of bandwidth per region and for Sub-Saharan Africa as a whole.

The submarine fibre-optic cables have their landing sites along the coast. Backbone cables connect these sites with major cities inland. In most African countries, government- or telecom industry-led national backbone initiatives roll out networks between population centres. Countries without direct access to the submarine cables link into these. Rwanda, a country with the ambition of becoming an ICT hub in Africa, links to Seacom through Ugandan and Kenyan fibre. For lower-capacity connections, point-to-point microwave transmission is used. Rwanda employed this technology when the cable link with Uganda was delayed. In West Africa, Ghana and Nigeria provide access for some of their less- and unconnected neighbours. These networks are spreading quickly, driven by the expected benefits, high public pressure and prestige. By 2013, Eritrea and Western Sahara will be the only African countries without direct access to a data cable.

Within countries, the inhabitants of major cities are the first to profit from reliable connections and increased competition for their customs. The situation in less-populated rural regions has changed much less so far. This also has to do with the fact that existing national cable structures are often owned

by electricity or railway companies, which installed them for their own use and were prohibited by law to sell any excess capacity. Most countries are now changing these regulations, releasing significant extra bandwidth to the market along the routes of electricity cables, rail tracks and similar infrastructure.

Even the most optimistic observers would not have expected this rapid expansion of fibre-optic cables. Figure 4-4 shows how future expectations evolved. As recently as 2008, few people believed that all three cables planned at that time (Seacom, EASSy and one West African cable) would actually be built by 2010. Less than two years later, four cables are active and the construction of four more is either under way or imminent. Anyone building their business case on a lack of bandwidth in Africa, for example satellite companies, saw their projected profit margins melt away. Those depending on bandwidth could suddenly move forward much faster than expected. And the future might well have more surprises in store. Rumours suggest that another cable is about to be announced. The Efive cable's first trunk would connect South Africa with



By 2013, Eritrea and Western Sahara will be the only two countries without direct access to a data cable

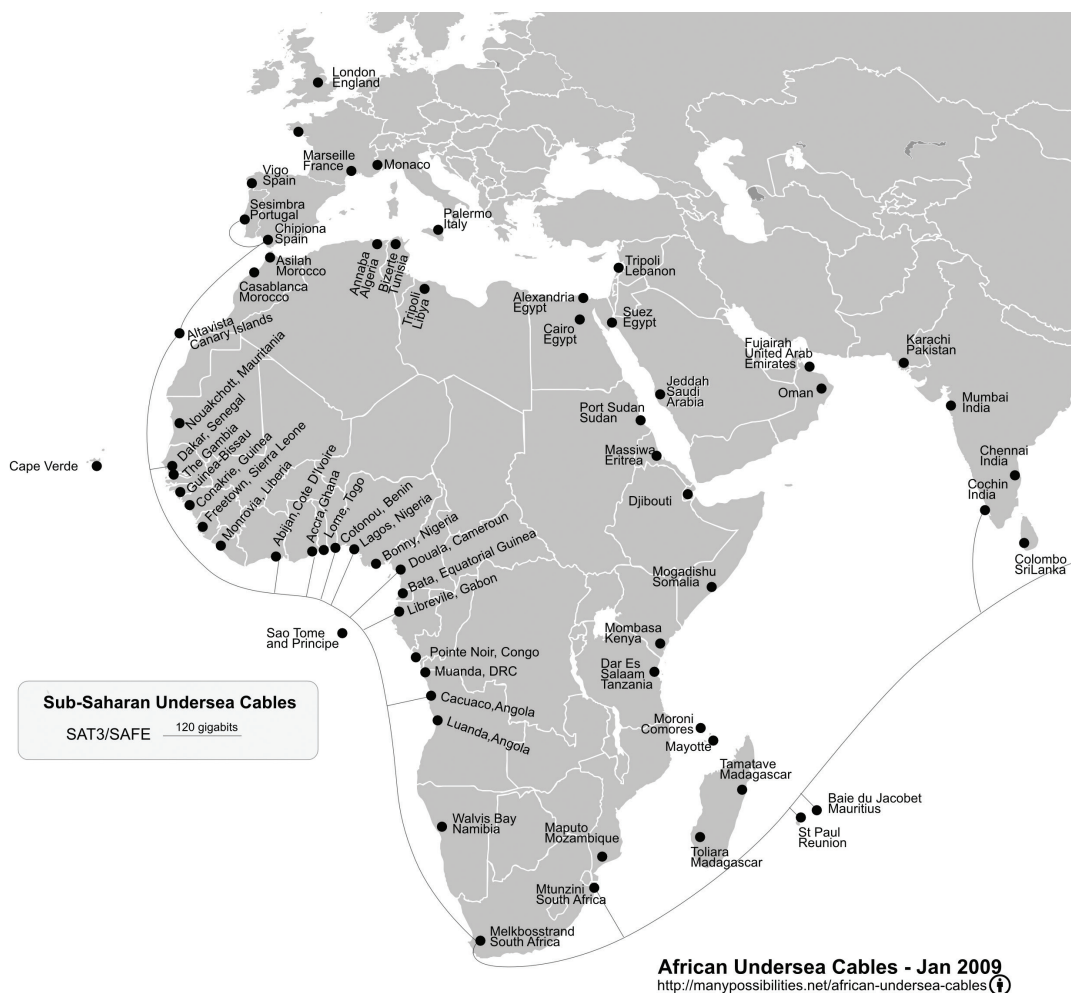


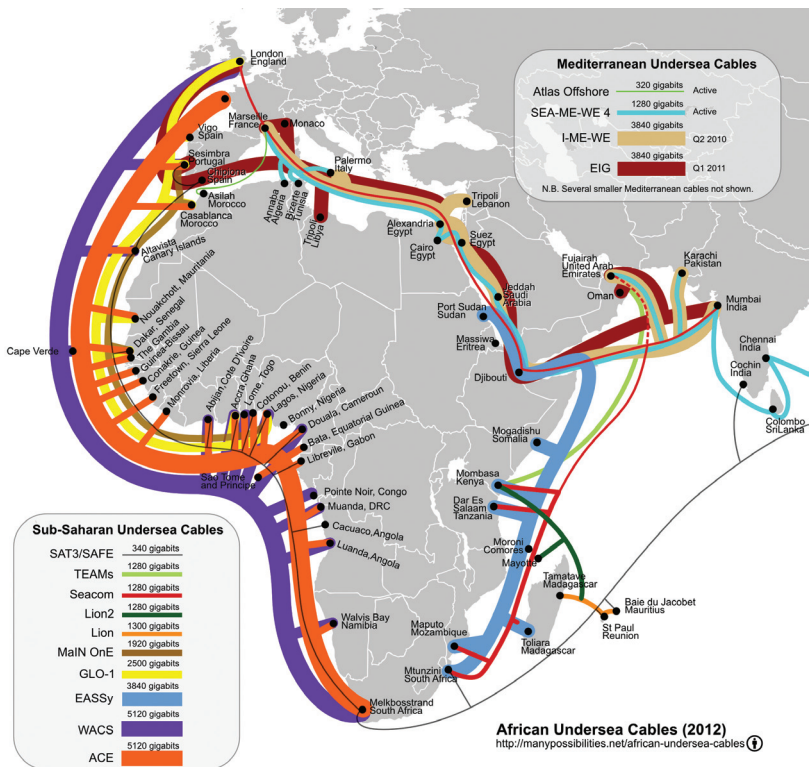
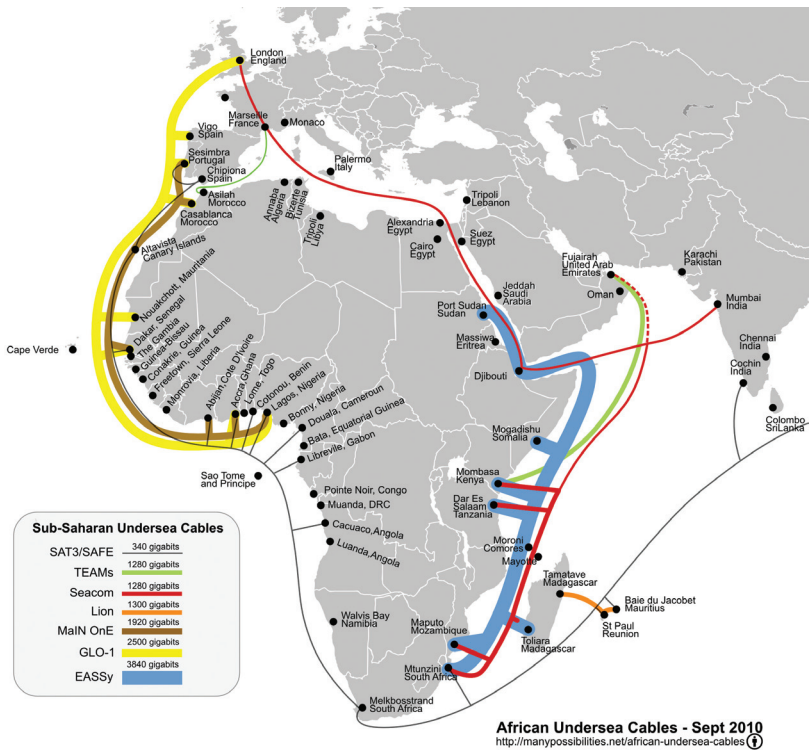
Figure 4-4: The evolution of fibre-optic cables connecting Africa. Maps show a) cables connected in January 2009, b) cables connected in September 2010 and c) cables expected to be connected by 2012. Source: manypossibilities.net/african-undersea-cables, Copyright: CC-BY

Angola and Nigeria, and a second trunk would cross the Atlantic between Angola and Brazil. It would be the first data connection between Africa and Latin America.

Connectivity beyond cables

It is not only new cables that can increase overall connectivity. Existing cables can also be upgraded by improving the technology at the onshore sending and receiving stations. The cable itself remains unchanged, but the transmission capacity of the cable

nevertheless increases. Another source of increasing inter-continental bandwidth in the future lies in the dedicated satellite systems that are installed to complement the cable systems. One of these is initiated by O3b Networks. The company plans to launch a fleet of satellites, newly developed for the medium earth orbit. Most communication satellites use the much more distant geostationary orbit, where satellites will remain constantly above the same land area. The lower orbit reduces the cost of placing the satellites and data transmission time,



while allowing for higher transponder capacity. With these innovations, 03b aims to serve markets within 45 degrees South and North of the Equator at competitive prices, fully covering Africa, Latin America, Australia and large tracts of Asia. The effort is backed by Google, HSBC and other partners.

At a regional and local level, the current improvement largely comes from combining the existing GSM infrastructure with fibre-optic cable backbones. Beyond their range, technological innovations increase the range of wireless last-mile data solutions, such as WiFi and WiMax, effectively creating last-50-mile solutions. Once a settlement has access, innovative options for extending the surrounding area of coverage abound. A simple yet efficient technology to extend range can be found in mesh networks. Each unit in such a network, for example a GSM site or a laptop, connects to each other unit within its range, creating a web of connected sites or computers. Now, if one of the units has data access, all other units can make indirect use of that connection. In this way even relatively isolated GSM sites can be connected, albeit at lower capacity.

The cost of installing the data network equipment is continuously decreasing, turning ever smaller groups of population into profitable target markets. Driven by innovations from India and China, prices for low-capacity and easy-to-install GSM masts are dropping quickly. The simpler systems are less likely to fail and easier to repair. Recent models can be transported by cart and installed by low-skilled workers. All it takes is a cement foundation and four large bolts. While African cities increasingly employ world-standard technology, more remote areas profit from such intermediate solutions.

Decreasing energy use and alternative fuels also reduce operating costs. Kenyan telecom company Safaricom is one of a number of providers who are rolling out green cellular sites. The challenge with conventional sites is that there is no electricity on site, so the equipment is powered by a diesel generator. The fuel itself is expensive, as is getting it out to the site. Once these obstacles are overcome, the fuel gets stolen. The green sites run on a small

solar panel, a small wind generator or a combination of both. Together with a rechargeable battery, the energy is sufficient to keep the equipment running 80% of the time. A small diesel generator provides emergency backup for the remaining 20% of the time. Within 36 months the extra investment is recuperated through lower costs of energy. The really ingenious feature on this equipment is its protection against theft. Each site has an outlet at which anyone can charge their mobile phone for free. The local communities value this service highly, as the alternative would be a long and expensive trip to the nearest power source. Because of this added value, the local community also protects the site, significantly reducing theft and vandalism.

A less imminent but powerful factor in increasing data access for African users is local hosting. Most of Africa's data traffic currently makes use of inter-continental cables, because server space on the continent is limited. Most phone calls from one African country to another will be routed through inter-continental connections and very few websites are actually located on African servers. Every call and every website accessed incurs the high transmission costs and delays of the inter-continental connections, using bandwidth capacity all along the way. One reason for the reluctance to build servers on a large scale in Africa is the energy use of a server station. A typical Google data centre requires a reliable electricity supply of 30MW. In 2009, the country of Rwanda with its 10.5 million inhabitants had a maximum power supply of 69MW, including 30MW of leased diesel generators, rendering the idea of establishing a data centre an impossibility. Nevertheless, the even smaller servers that are to be installed in the basements of government buildings or offices could already be helpful. These could even be normal computers connected to build a content delivery network (CDN). Each of the computers in the system contains copies of data. By placing the machines strategically in a network, bandwidth for data access can be maximized, because a user will automatically access the data at a location nearby. The data traffic is thus spread nicely over small sections of the network, rather than clogging up a central server.

The impact of access

The mobile phone has saved lives and it has stimulated economic development. It has reduced market inefficiencies and enabled new businesses. These effects are widely accepted and for many already a reality today. In the context of this book, a long list of benefits would be looking backwards. Nevertheless, a few points on the impact of mobiles should be mentioned.

It is said of Sudanese mobile phone pioneer Mo Ibrahim that he considered it impossible to keep a dictatorship in place in a country where mobile penetration had reached a certain threshold. The ability of people to exchange information freely would itself be a democratizing factor. Supporting this view, there are numerous examples of where mobile phones have been used to expose inconsistencies in election results between local polling stations and national aggregates. A recent example of the mobile phone's use in democratic processes is Kenya's referendum on a new constitution on 4 August 2010. According to local newspaper Business Daily:

"The digital shift contributed to making the referendum a more transparent affair. More than 27,000 GPRS-enabled mobile phones were used to send results from polling stations to the main tallying centre. [...] On Uchaguzi.co.ke (uchaguzi is decision in Swahili), minute-by-minute updates of the process were sent by users with mobile phones from around the country. [...] On Twitter, the tag #kenyadecides – which gathers all updates on the referendum – emerged as one of the most popular topics trending on the website globally."

The new technology also has an impact on those who are in government, as a Ghanaian businessman explains:

"My theory is that technology is making governments irrelevant. When I was growing up, the director of Ghana telecom was an important man. He could put a phone in your house and if it broke down, he could send a repair man in two weeks. The fact that you had

a telephone in the house meant that you were very privileged. Today nobody knows who the director of Ghana telecom is. They don't care, they don't need his phone, they don't need his product."

In all the well-deserved enthusiasm for the benefits of the mobile phone and its derivatives, the risks are often overlooked. The most obvious risk is financial. While Europeans spend little more than 1% of their average monthly income on mobile communication, Africans spend 17.7%. At this level of cost, the risk of a debt spiral is very real. Issues of privacy, which are already a potential problem in countries with high degrees of accountability of the powers of the state, become even more threatening in countries with less accountability. For example, the ability to track the whereabouts of a political dissident can be life threatening for the target and his associates. The mobile phone also enables new kinds of scams and crimes. Several countries, including the heavyweights South Africa, Nigeria and Kenya, have responded to mobile phone-based fraud and the use of unregistered phones in kidnappings by requiring proof of identity and registration of all mobile numbers. Mobile communication can even cost lives. During the post-election violence in 2007/2008 in Kenya, mobs were organized and incited with hate messages by SMS. Up to 1,500 people lost their lives. At the peak of the violence, the government considered shutting down the whole mobile communication network in order to reduce the violence, a measure that the providers averted by sending out soothing messages to all of their subscribers calling for peace. More recently, unrest in Mozambique over price hikes in bread, electricity, water and transport was fuelled by a viral SMS campaign. At least 13 people were killed and hundreds were reported injured in the August 2010 incidents.

The most important impacts, positive and negative, result from the increase in speed introduced by the mobile phone. Gathering and sharing information, as well as co-ordinating activities across large distances, were cumbersome processes before the emergence of a modern ICT infrastructure. But they are also crucial to almost any economic and social

activity. Speeding up these processes from taking weeks and months to only hours and minutes has a profound impact on productivity and the kind of activities that can be exploited.

From mobile phones to mobile web

From the numbers, maps and technological developments described above, it is evident that despite the boom of the past years, African ICT is still in its infancy. But what will the future look like? In what order will changes take place? Will Africa 'leapfrog' the desktop computer and move straight to the mobile web?

To understand this, it is helpful first to take a look at some peculiar details of present ICT use, especially the mobile phone. The number of mobile phones is probably already near the mark of 400 million, but most of these phones are very cheap or secondhand devices, which hardly ever have usable airtime loaded on them. The primary purpose is to be reachable and not to be able to call others. This also explains a very common way to communicate with a mobile phone in Africa: 'beeping' or 'intentionally missed calls'. Calling another person and hanging up after the first ring is a signal to call back transmitted at zero cost to the user (but not to the provider). More complex communication includes pre-arranged codes. Ringing twice before hanging up might signal a 15-minute delay, for example.

The standard for communication is calling. In contrast to the developed world, more calls are being made than SMSs sent. Low levels of literacy are one explanation, another is a preference for the more personal conversation over the flat message. The latter reason seems to carry more weight, as SMS is the tool of choice for most add-on services. Advertising, money transactions, trading, insuring, getting expert advice, tracking and tracing, education, health services, applying for documents and updating your Facebook profile are a few examples of what can be done by SMS. New services are added every day. For those who can afford it, sending pictures captured with a phone's camera is a popular way to communicate. This is especially true for the younger generation. For most users, these will be the tools to work with for the coming

two or three years, as most of these devices are not internet capable.

The next step, from the simple communication described above to using the internet on the mobile phone, is quite large, as Arthur Goldstuck, director of South African internet consultancy World Wide Worx explains:

"A good example is the Nokia 6310. It's a reliable old phone. It has GPRS internet access and I can check emails on it, but with tremendous difficulty. So people assume, because the phone has got these capabilities, people would use it to access the web. They do not."

The number of phones with convenient internet access is low. As a rough estimate, about 2% of African phones could be classified as smartphones with user-friendly mobile web capabilities. Especially in urban settings, it is not unusual to see Blackberrys, iPhones and other cutting-edge devices. But most market experts have tempered my own optimistic expectations of how fast the number of such devices and their cheaper substitutes from Nokia or Chinese producers would make a real dent in mobile phone statistics. 100 million smartphone-like devices on the continent by 2015 is an average of the informal estimates by market experts. Simon Dingle explains another reason why the step towards the internet is a big one:

"In Europe, people learnt about the internet on a computer, and they are now learning to use it on a mobile phone. Many Africans are experiencing the internet for the first time on a mobile device. If people haven't used the internet on a computer, it's very difficult to conceptualize what it is and how it works and how to use it. So the dynamics in that perspective are completely different from the Europeans. Mobile in Africa is all the technology they know for some people."

One could conclude that while Africa might well 'leapfrog' the desktop computer, the group of people who will do so in the near future is relatively small. 100 million people represent an attractive

and worthwhile market and any mobile company would be happy to add them to its customer base. At the same time, 800 million people are likely to have neither smartphones nor computers. For them, their standard GSM will remain their access gate to the 'flat' world.

Africa's favourites

Once people have web access, Google and Facebook are by far the most popular sites across the continent today and they are getting ready for future growth in Africa, primarily on the back of mobile phone access. Google has already opened nine offices and organized a whole series of developer workshops. The company also launched specifically tailored products, like Google SMS search or Google SMS trade. Both allow queries to be sent to Google by SMS, either for information or for buying and selling goods. The reply also comes by SMS, with options for further information. The services were introduced in Uganda in 2009 and others are likely to follow. Google also supports local initiatives, such as those translating the interfaces of the search engine into vernacular languages. In a global comparison, Google's Africa activities are tiny. Nevertheless, it is one of the most visible web companies on the continent, only outperformed by Facebook.

Facebook has become Africa's major networking site for urbanites as well as a valuable source of information for the connected. The site is popular because it enables communication with a whole network at once, in contrast to one-on-one communications on the phone. Nigerian president Goodluck Jonathan announced his intention to run in the country's next presidential elections in January 2011 by placing a declaration on the networking site on 15 September 2010. At the beginning of that year 10 million Africans were with him on Facebook and their numbers are increasing, with monthly growth rates of 5% on average. In remote areas, a third of all internet users are Facebook members.

A stroke of genius was Facebook's strategy of introducing free access to its site at 0.facebook.com. The site is a lighter and faster version of the mobile site m.facebook.com. It has the same functional-

ity, with the exception that pictures are only shown when explicitly asked for and at regular data costs. Telecom operators collaborating with Facebook offer their clients free access to 0.facebook.com as a highly attractive service. So far, it's a multiple-win strategy. Facebook gets a bigger reach, telecom operators attract and retain clients and the users can access information and networks at no extra cost.

Another popular site is YouTube. Once sufficient bandwidth is available, watching videos takes off. Arthur Goldstuck thinks this is part of a bigger trend. When I ask him what the next big thing on Africa's web is going to be, he doesn't hesitate:

"Video. One of the big growth areas once the problems are behind us, is going to be video. It will change the way people communicate, but also the way people document what they are doing and share information. So instead of sending a document for a project proposal, you actually send a video of you or your team talking about what you are going to do and showing some things that you have done. I believe in the long term everything will become a lot more visual and a lot more video oriented."

The M-wave

Once mobile access is widespread, the opportunities are endless. At the most basic level, it becomes possible to supply users with sound and video files, as well as apps for a wide variety of purposes. However, the traffic will also be bi-directional. Collecting images, sounds and video, shot by users, to build databases and the content of websites becomes an option. Finally, communities of peers will intensively share information, be that on music, politics or health. Simon Camerer, head of marketing at Cell C in Johannesburg, explains what else the M-wave might bring in his view:

"You will see a number of interesting initiatives, like M-health, M-agriculture, M-environment and M-solar. For Africa or at least South Africa M-health and M-agriculture will be key. In M-health important information can be shared with an SMS. HIV/AIDS sufferers have to take drugs on specific timings."

You put that in a system and the patient will receive an SMS on the dot that says 'take it now'. At a more fundamental level, working the ecosystem between doctors, insurance agents, health insurance companies, mobile operators and hospitals in a mobile way would provide tremendous help to Africans across the continent. M-agriculture could help just by giving weather forecasts. Another option is the more sophisticated telemetry. Wine farmers in the Western Cape have sensors throughout their vineyards with SIM cards inside them measuring temperature, humidity and sending that information by SMS every single hour to a centralized computer. And it's all mobile."

The affix 'M' has now become almost as ubiquitous as the mobile phone itself. Every self-respecting NGO now launches a mobile initiative targeting its field of activity, universities develop mobile education modules, mobile government is being called for and businesses rush to make use of the most efficient way to reach African consumers directly. The opportunities are big, but the degree of change can also be daunting, for example for Julie Gichuru, a media entrepreneur and TV anchor in Nairobi:

"We've got eleven different radio stations and we're asking the listeners what agricultural content they need, because our economy is primarily held up by the agricultural sector. So people are calling and saying 'I'm a tomato farmer' or 'I'm a potato farmer, I really want to know about potato diseases'. And we are now developing a content strategy through the various radio stations and their platforms that meets the needs of these people. Right now we're using Safaricom Live. In the future it will probably be our own platform, where they can access that information."

But when I think this through into the future, it's almost frightening for me. The challenge for us is to churn out the content and the information that the users require as fast as they are going to require it. You have Google with this massive search engine, you have Wikipedia with all this information stored. But how do we

start to give our people access to that information in vernacular languages? I don't know whether our content producers are ready to meet the needs that are going to arise."

The effect of the M-wave largely depends on how quickly the least connected can catch up and benefit. One person who is working towards a future where the internet is widely available and put to good use in remote areas is Gertjan van Stam. He works in Macha, an isolated rural community in Zambia. Getting an internet connection was an important first step towards the integral development of the village, followed by investments in infrastructure, a small airfield, a primary school, a training institute, a community centre and an HIV/AIDS clinic. Finally, basic provisions such as water and electricity were expanded. Gertjan reflects on the technological future of the community in the following story.

How Macha Works tomorrow

Gertjan van Stam, initiator of Macha Works

ICT infrastructure is one of the most common infrastructures in Africa. In some countries, Zambia is one of them, more money is invested in GSM masts and internet backbones than in the construction of roads, water supply or electricity grids. Sparsely populated rural areas are often sidelined in the rush to connect capitals to the rest of the world and provincial centres to the capital. These areas are characterized by dispersed homesteads, inhabited by extended families living off subsistence agricultural activities. Even if such a community is connected, enshrined cultures delay the adoption of the new technology. However, a recent boost of new infrastructure and equipment has brought tangible benefits. Macha's health institutions now use standardized electronic health records rolling over patient information instantly. The school and the rural community centre were also connected to the digital highway. After being exposed to the internet at the health centre and the school, the people of Macha began to

use the new technology in their day-to-day activities. The biggest increase in adoption came when the traditional leaders embraced the use of ICTs.

Looking back from 2020

Two decades have passed since the ICT revolution began to hit Africa around the turn of the century. The technological wave has revolutionized Africa like nothing else. By 2020, it has given communities like Macha a voice and measurably improved service quality. Health volunteers in Macha and elsewhere use hand-held devices when diagnosing patients. These smartphone-based gadgets provide access to the symptoms and disease databases of the World Health Organization. For complicated cases, doctors in the capital and experts employed by an Indian development agency are available for consultation. The volunteers also use the voice and video training modules, which are based on the best practices in rural health care from 15 African and 5 Asian countries.

After having been exposed to the benefits of being connected in their health work, the volunteers increasingly use the internet privately. Those with wireless coverage reaching their home use their web-enabled phones much like laptops were used in the West in 2010. They download music and small videos, connect



✕ Setting up containerized LinkNet Resource Container in rural Chilongo, Zambia. Source: Gertjan van Stam, Macha Works (<http://www.machaworks.org/en/>)

with peers and friends elsewhere, explore education and employment opportunities, run web-based mini-businesses and order supplies from the capital. Those without coverage or a device, the majority of Macha's inhabitants, meet at the community centre with its shared computer facilities. At the centre, farmers access animal health information provided by the government and exchange ideas for treatment with farmers elsewhere. It is a recurring topic of discussion whether one should follow the bureaucrat's advice for medication or apply one of the solutions collected in a database of traditional agricultural and health practices.

Unfortunately, the use of local languages is under pressure as the younger generation resorts to English to communicate with youths in other countries. And with the traditional languages, traditional best practices are also fading away. Even the skill to use traditional instruments has diminished. Only those few who have been able to gain attention abroad continue to play, but they do not return to the village very often. Family members are now more dispersed, following opportunities discovered online. Nevertheless, resources continue to be shared among family members. It has taken corporations and service providers quite some time to realize this and adjust their products and services accordingly. The banking sector was the first to adjust, with the rise of mobile money in 2010. Through mobile phones, banking services are now available to all and one family member with a sound credit record can vouch for another elsewhere. Even remittances from abroad can be used to guarantee loans, leveraging the financial possibilities in the community. The transport sector followed suit, expanding capacities for delivering goods. Traders take orders for goods on the phone while they visit the capital and bring supplies to even the most remote locations, but some have specialized in transporting goods from one rural community to another, enabling families to pool their harvest in order to gain bargaining power with the wholesaler. By 2020, the middlemen in the supply chain for local staple foods were fully

replaced by transport entrepreneurs transporting the goods for their clients.

Family-centred systems make it difficult for outsiders, foreign companies and service providers to enter these vibrant local platforms. But at the same time, the reverse connection from the communities to external players is improving. Governments are informed on a real-time basis about the health and education status of the population, as aggregation of information is now possible. In addition, sensors in ICT equipment provide for aggregated information flows to institutions to ensure effective interventions during calamities. ICT experts in rural areas also monitor and manage ICT systems and services for their own and other communities, with access to open-source interfaces with the larger ubiquitous ICT systems. Where the networks do not reach, local developed technologies extend the networks to provide for services. Local entrepreneurs use customer information, available at their finger tips, to manage and tailor services. Research and development activities in rural Africa have produced an array of sturdy and affordable products in areas as diverse as ICT, energy and transport. In fact, some inventions from rural Africa have contributed greatly to the development of lasting, sustainable products and services in more developed countries.

Despite the fast progress and spread of connectivity, digital exclusion remains. In some cases the physical infrastructure is still lacking; in others, prices for communication access are unaffordable for the poorest. Those not able to link into the ICT infrastructure have found access to resources even more restricted than before, and have continued to struggle for their existence. Will 2030 bring a better life for all?

Future megatrends

Up to Gertjan's scenario story, this chapter has mostly dealt with ongoing or imminent developments. These are fast and significant, changing Africa's ICT landscape fundamentally. There is no doubt

that Africa is getting connected at a rapid pace and in some niches its ICT sector is ahead of the rest of the world. The pre-paid mobile phone was first introduced in South Africa, the first international roaming area applying local rates was introduced by pioneering provider Celtel, the range of services delivered on the back of a simple SIM card is unsurpassed. These developments unleash a new generation of products and services. At the same time, the monopolies of the satellite companies are broken as data cables land in Africa. With increasing competition, prices decrease and the overall service level improves. According to Paul Budde Communication (Paul Budde Communications, 2010), Kenya's bandwidth prices have dropped by 90% since SEACOM first landed in Mombasa. A similar development can be expected for West Africa, once WACS lands to break the existing monopolies. On the back of these developments, two megatrends are already emerging that will change the face of Africa for ever. First, mobile money will change the economy. Second, geo-location applications will revolutionize navigation, tracking and tracing.

Megatrend 1: Mobile money changes the economy

The most imminent and forceful megatrend is the rise of mobile money in Africa. Being able to store money securely on a mobile phone and transfer it from one to another has tremendous added value. Loopholes in Kenyan banking laws allowed Safaricom to offer a mobile money transfer service without being subject to strict banking regulation. Therefore pioneering service M-Pesa was set up in Kenya in 2007, becoming an immediate hit. There is no set-up fee for the customer and when he or she receives the money, it can be used immediately. Per transaction, a low fee is being charged. The process of sending money is about as difficult as topping up airtime and is based on the same technology. M-money offers mobile operators the opportunity to increase their revenues while also positioning themselves attractively.

According to local media in Nairobi, the number of M-Pesa subscribers had grown to almost 12 million by July 2010 from 7 million in July 2009. Since 2007, total transactions amount to 525.84 billion Kenyan shillings or 6.5 billion US dollars, and there are now

19,500 M-Pesa agents where money can be up-loaded or cashed. In July 2010 alone, the equivalent of 400 million US dollars was sent from one mobile phone to another just on the Kenyan M-Pesa system. The market pioneer still is the market leader, but competition is on the rise. In August 2010, MTN's Kenyan MobileMoney service had 890,000 registered users, aiming for 2 million by December. And mobile money systems are spreading across the continent like wildfire. The following is a collection of news headlines from <http://mobilemoneyafrica.com> between January and July 2010:

"Mobile Operators eye Nigerian Banks uneaten pies in 2010 (03-01-2010); New online payment system comes to Tanzania phone users (04-01-2010); XIPWIRE Launches Mobile Payment Service (06-01-2010); Zain expands 'Zap' Mobile Commerce service to Malawi, Niger and Sierra Leone (06-01-2010); Orange to offer mobile money transfer services (15-01-2010); In Sierra Leone, Splash Mobile Money Transfer Goes National (18-01-2010); Warid to start mobile money [in Uganda] (27-01-2010); MTN launches Mobile Money transfer in Rwanda (28-01-2010); UBA to Start Mobile Money Banking Services in Uganda (03-02-2010); CellTrust Introduces Mobile Payment Pilot in Nigeria (12-02-2010); Splash and MoreMagic Solutions Expand Mobile Money Transfer in Sierra Leone (17-02-2010); iPay becomes second service to offer mobile online shopping in Kenya (28-02-2010); Equity [Bank Uganda] to join mobile banking (01-03-2010); Vodafone and Afric Xpress to launch mobile payment services in Ghana (02-03-2010); Mobile transfers save money and lives in Somalia (04-03-2010); Mobile Union Launches Online Remittance Service (04-03-2010); Kenya's MPESA now has 9 Million customers (06-03-2010); Over Rwf60 million moved in 'Mobile Money' transfers (12-03-2010); Boost for Mobile Banking for the Unbanked as CGAP, DFID Announce New Partnership (12-03-2010); Firm set to sell Kenyan music online using MobileMoney (14-03-2010); Zain Ghana introduces Zap mobile money service (17-03-2010); SIMBA Telecoms creates first mobile money banking hall in Uganda (19-03-2010); Uganda Telecom Launches Mobile Money

(28-03-2010); Vodacom's Mobile Money Solution [for South Africa] (31-03-2010); African Centre for Mobile Financial Inclusion for May Launch (18-04-2010); Football Betting Innovation In Kenya via MPESA (30-04-2010); MTN Mobile money hits Rwf590m (07-05-2010); Africa leads the way in mobile money (13-05-2010); Zain Kenya Plans To Roll Out Mobile Transfer Service (14-05-2010); MTN Uganda sees explosive growth in mobile money (24-05-2010); BPR to Roll-Out Mobile Banking in Rwanda (05-06-2010); Telecom Operator, BK to Partner in 'Mobile Money' Service in Rwanda (01-07-2010); Splash Money Transfer Launched Easy "Splash pay" Service [in Sierra Leone] (06-07-2010); Mobile Banking Sees Success in Senegal (19-07-2010); We Could Adopt Use of M-Pesa, Says U.S. (19-07-2010)"

M-pesa-like systems are not the only players in the market. Banks increasingly make use of mobile applications to let customers transfer money. The latest systems even allow transactions between bank accounts and mobile phones, effectively turning the phone number into a credit account number. An example is Kenyan Equity Bank. The bank already pioneered the process of banking the poor by introducing a zero opening balance bank account. Traditionally, banks required a minimum deposit when opening a new bank account, barring those without savings from the banking system. By waiving that requirement, Equity Bank became the instant bank of choice for the poor. The bank earns its revenues with the subsequent transaction costs, while also gaining market share and exposure. In 2010, Equity Bank and Safaricom launched the M-Kesho account, building on the success of M-Pesa. This allows users to deposit money into accounts with the bank, earn interest on deposits, and have access to microcredit, short-term loans, medical and personal insurance, as well as accident insurance. With the rollout of these services plus the extension of their network of conventional and vehicle-mounted mobile branches, as well as ATMs, Equity Bank has grown from fewer than 100,000 customers to 3.4 million in less than a decade.

The triangle of money transfer, banking services and insurance is expecting significant growth in the

future. The UK Department for International Development (DFID, 2009) has published a set of scenarios for branchless banking in which it identified four factors fuelling the expansion of branchless banking: industry belief in future profitability; enabling regulatory change; a dramatic fall in connectivity costs; and the creation of cash-handling agents using existing networks. All four apply in the case of M-Kesho and similar initiatives. Their future profitability is beyond doubt, as the market leaders are already scoring profits with their services. And because of the potential of the banking services in terms of development, an increasing number of governments is eager to put appropriate regulation in place. The dramatic fall in connectivity costs is likely to continue, while the mobile phone providers' networks of agents are an excellent channel to market banking and insurance products as well. Trust is another key factor. The uptake of mobile money in Uganda was a lot slower than that in Kenya, because the country had experienced the collapse of banks and losses of savings only a few years earlier. Trust in financial institutions was low in Uganda, while Kenyans were considering their mobile phones and bank accounts a safer place for their savings than cash in their pocket. The trust is generated by letting users test the service extensively and by recruiting a critical mass of users, who will promote the service by word of mouth.

As more services appear on the market, competition and inter-operability between different operators' products become an issue. Because every service needs a critical mass of users to add value, only two or three systems are likely to survive per market. As the inter-relations between these service providers and other financial institutions become stronger, the pressure to co-operate increases. Analogous to the emergence of inter-operability between banks in ATM services, collaboration is likely to emerge in the field of mobile money over the next three years. It will be possible to send money between large groups of banks, insurance agents and money transfer service providers. Regional and international transfers are also in preparation; a small number of pioneer projects are running. One of these connects the UK and Kenya, allowing remittances to be sent from a registered British mobile phone to any M-Pesa-registered phone in Kenya.

The quick expansion of mobile money transfers, branchless banking and insurances is a certain bet on the future. According to the DFID (2009), four forces shape the future of these services:

- Demographic changes: Young and urban people are more likely to be early adopters and promote a service. Countries with a young population and with a strong trend of urbanization, such as most African countries, will therefore experience a quicker shift towards mobile solutions.
- Government actions: Governments will claim a stronger role as financial sector regulators and encourage access to low-cost banking. However, not all governments play this positive role and there are regulatory obstacles.
- Crime: In Africa, most crime directly affecting the population at large is cash crime, as opposed to e-crime. Thefts and robberies target the cash in pocket or in register of individuals or businesses. As long as the risk of such crime is high, e-solutions will be preferable. Even if the mobile phone is lost, the money in the account linked to it can be reclaimed, because of pincode protection. In the longer term, e-crime might be catching up, threatening trust in the service.
- The mobile web: This will further reduce financial transaction costs, strengthening competition between different systems.

Despite the bright possibilities, there are also threats and uncertainties concerning the sector. First of all, not all governments are willing or able to provide the best possible regulation. The advent of mobile money has implications for fiscal and monetary policy, taxes and even the informal economy, including corruption channels. These systems are often resistant to change as vested interests or straightforward conservatism delay the change. An important factor is the degree to which non-banks are allowed to issue e-money, a freedom which is obviously strongly opposed by the banking lobby. However, few countries will be able to afford delaying the availability of branchless banking services, as this would significantly compromise their economic strength. While the spread of mobile money is certain, the acceptance of secondary services, such as insur-

ance and microcredit through mobile channels, is much less so. Primary products are life insurance, health insurance and crop insurance. An interesting case of the latter is the almost fully automated Kilimo Salama project – Swahili for ‘safe farming’ – a micro insurance combining mobile phone payment and automated weather stations. Farmers pay an extra 5% of the value of the high-yielding seeds, chemicals and fertilizers sold by companies registered with the Kilimo Salama partnership. A mobile phone camera is used to scan a bar code of the goods sold, automatically registering the insurance policy with the insurance provider. Farmers receive a confirmation of the insurance policy via a text message. 30 solar-powered weather stations, each covering a 15–20-kilometre radius, are the backbone of the system and each farmer must be registered to one of them. Depending on their weather measurements and the climate required by the seed purchased, the system calculates whether there has been a severe enough drought or excessive rainfall for the farmers to receive compensation for their lost crop. When the weather conditions lie outside pre-defined parameters, payouts are made automatically through M-Pesa without the need to file a claim. Farmers can therefore afford to farm the next season even if this year’s crop was a failure. The success of the system, which was launched in May 2010, is yet to be seen. Nevertheless, independent of the outcome, profitably selling insurance through mobile channels is still in its infancy.

Depending on regulation and the way competition in the sector develops, monopolies could evolve that would threaten the low prices and innovation of new services. The biggest player in the market is able to provide the highest added value as it connects the largest number of people. Such a position is hard to attack. Once a dominant market player has evolved, the financial system becomes vulnerable to failures, malfunctions and mismanagement within a single organization. The consequences of a large-scale failure of a money transfer system like M-Pesa are difficult to oversee, but would at the very least include rising unrest, similar to that caused by a bank that is threatened by bankruptcy.

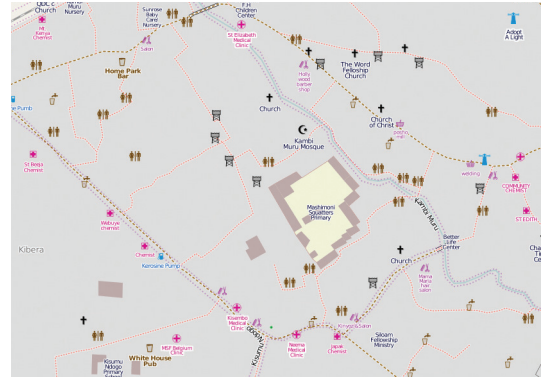


Figure 4–5: Open Street Map of Kibera. Source: Open-StreetMap contributors, CC-BY-SA

Megatrend 2: Geo-location

Basic tracking systems have been in use in Africa for a few years, driven by local ingenuity. Fleet management and car security companies across the continent offer the installation of hidden GSM- or GPS-based units in vehicles. GPS is the same technique that is used in navigation systems in cars. At regular intervals the units send information about the location of a vehicle, its speed, fuel level, the number of times a door has been opened and other information to a central database. Fleet managers, for example taxi entrepreneurs, can closely monitor their drivers and vehicles, reducing private trips and fuel theft while also helping to dispatch vehicles efficiently. In a case of an emergency, say a car jacking, the vehicle can even be disabled by SMS. When threatened, a driver can give up a car without resistance, call the manager and have the car disabled. The car then sends its location and can be recovered. In Zambia, a similar system is used to monitor 2,500 kilometres of railways. Each locomotive has an SMS unit on board. Dispatchers at the stations are thus always well informed about possible delays and misuse of the material is reduced. The whole system from idea to implementation cost three months in time and 160,000 US dollars, a cheap yet efficient way to monitor Zambia’s railway equipment.

More recently, mobile phone apps with geo-location services are gaining ground. In regions where maps, street names and other navigation infor-

mation is either non-existent or undocumented, the added value of such services is significant. In addition to improved fleet management systems, map drawing apps were among the first applications. A widely known example is the effort to draw a map of Kibera, supposedly Africa's largest slum. Local volunteers scouted the area on foot, marking roads, footways and points of relevance, including health stations, churches, waterpumps, shops and so on on their phones. The result is one of the first comprehensive maps of Kibera, shown in Figure 4–5.

Commercial parties are also providing maps as an additional service with their products. Most mobile phone producers include GPS chips in their smartphones and more and more maps are available for navigation software, such as Google Maps. Getting lost in an African city will be an experience of the past in the very near future.

The information gathered when putting together a simple map can have a profound impact. Kibera was widely quoted as being Africa's largest slum, with a population of 1 million. Several efforts to develop a concise map of the slum have resulted in considerable doubts about this estimate. Followed up by satellite imagery studies and household surveys, the number is now estimated to stand at between 170,000 and 270,000, a fraction of the globally known estimate. The official Kenyan census now puts Kibera's population at 170,070 (Map Kibera, 2010).

Geo-location apps are increasingly helping governments to build a population census, which in turn is crucial for the efficient provision of public services and tax systems. They help tourists to find their way across areas for which maps were outdated, expensive or non-existent. NGOs help them to efficiently plan their efforts or to track their material; entrepreneurs gather information on their markets. The list of possible applications is endless: e-commerce, government statistics, tourism, media, environmental issues, social networking, agriculture, water, combating crime, security, surveys, remote site management, and disaster warnings and documentation, to name a few.

Two trends in their infancy

Two more trends could well become megatrends in the coming years.

Low data costs fuel business

The consequences of falling data transaction costs for the future are easily underestimated. Price drops by up to 90% make a whole range of business models viable that were hitherto impossible. Straightforward online shopping is one possibility, whether it's a Malian selling his or her curios to a boutique in New York after having established a connection online or a Lagos pizza delivery service. E-books, distance education and telework are three other examples, each of which has the potential to grow significantly in Africa over the coming years.

Reliable information

Most of Africa is a statistician's nightmare. Numbers are chronically unreliable. Economic numbers rely on estimates of the informal economy, population data rely on ancient and insufficient surveys, and numbers are manipulated upwards and downwards as interests dictate. However, companies, NGOs and governments depend on accurate and timely information to optimize their processes and investments. With a modern ICT infrastructure, it is only a question of a good business model or an efficient organization to gather data through the users of millions of mobile phones or a dedicated team of agents. These systems will emerge and improve data quantity and quality for Africa.

Made in Africa

So far, most of Africa's ICT revolution seems to be one of technology consumption. Technologies from the West are imported, sometimes adapted and then launched. But a closer look reveals a staggering diversity of local initiatives wanting to prove that Africa can be a hub for technological innovation. And many of these initiatives focus on online services, apps and other ICT tools. Ben White, initiator of the venture capital network VC4Africa, initiator of investment programme AfriLabs and IT strategy consultant at Dutch development organization HIVOS, has followed the ICT innovators of Kampala closely and describes their eagerness to meet the challenges ahead.

Cheetahs await their turn at the table

Ben White

Despite the obstacles

More than 40% of Sub-Saharan Africa's population is younger than 14. That African countries will face an increase in job-creation pressure is an understatement. We are essentially looking at a ticking time bomb, writes the 'New Vision' in Uganda. But it would be short-sighted to lump Africa's youth together as part of a growing problem. If anything, this young African generation has the ambition to solve Africa's problems. The mobile phone and, increasingly, the internet are their tools. With every passing minute thousands of young people gain access.

Imagine starting in primary school where you had to share a five-year-old text book with three other students and graduating ten years later, getting instant access to the world's combined intelligence. These individuals are eager to connect, exchange information and learn at a faster rate than was ever before possible. Africa now represents one of the fastest-growing regions for the world's largest social utility Facebook. Africa's youth are addicted to information and fearlessly leap into the information age. And it's not only about downloading and uploading content. These young people are teaching themselves how to write code, deconstruct applications, create content and re-purpose tools. Status.ug, for example, is a platform that allows Uganda's 60,000 Facebook users to update their online profile via SMS, a very useful service for people who can't afford to pay for an hour in an internet cafe.

Connectivity is not yet a given. Alex travels two hours a day to access the university WiFi network and download the content he needs for building his products as a software developer. Others petition family and friends persistently to sell a goat to pay for a computer. And even with internet access, plenty of obstacles remain. Just getting hard-

ware and software proves to be a significant challenge, let alone the costs of operating a startup business. A young entrepreneur builds early prototypes in open source code, because it is the only code he has access to. Some are afraid to share ideas, because someone else might steal them. Funding is another key issue. Banks do not appreciate the budding tech businesses, microcredit is too small and private-sector investors lack success stories. It is still friends, family and fools tapping into these ideas and offering support where they can. Once an idea evolves, finding the connections needed to grow a business is difficult. And even once everything is arranged, setting up a formal business requires documents. How do you get a national identity card when you don't have an address, know your age or have the money needed to open a bank account?

For most of these whizz kids, international clients are too far away. In the struggle to service businesses, many try to take a crack at the consumer market. But in most African countries fewer than 5% of the population are actually connected to the internet, the numbers far from allowing the implementation of viable business models. Many look to innovate on mobile phones, but unfortunately too many stories of telecom providers stealing ideas and blocking out potentially competing services keep bright ideas in their infancy. The business is left to a growing network of tech incubators mushrooming across the continent and small venture funds hunting out the diamonds in the rough. These are the practical challenges that make any entrepreneur think twice, but for how long?

Tomorrow's opportunities

Now internet connections are becoming ubiquitous, the mobile web is set to leapfrog African youth into the next century, and their desire for an alternative future is unstoppable. George Ayittey, a Ghanaian economist and the author of several books on Africa, including 'Africa Unchained' and the forthcoming

ing 'Defeating Dictators in Africa and Around The World' first coined the term 'Cheetah Generation.' The idea refers to a new and angry generation of young African graduates and professionals who look at African issues and problems from a totally different perspective. They are dynamic, intellectually agile and pragmatic. They may be the 'restless generation', but they are also Africa's new hope. They take a no-nonsense approach to corruption, inefficiency, ineptitude, incompetence or buffoonery. Whereas the older generations (Ayithey calls them Hippos) constantly see problems, the Cheetahs see business opportunities. More importantly, the Cheetah generation has no qualms about thinking outside the box or getting their hands dirty, characteristics needed to make things happen.

The potential can be seen in new companies like Cellulant, a mobile commerce business that manages, delivers and bills for digital content and commerce services. Starting at the age of 23, Ken Njoroge is now running one of the most respected mid-sized companies in Kenya. One of the first to realize that mobile telephony was growing fast in Africa, Cellulant made its mark. On its first day the company sold over 16,000 ringtones at a cost of Ksh.75 each. During its first year Cellulant made approximately Ksh.60,000 per month and in 2007 the firm was already turning a profit. As of 2010, the firm has over 12 million customers in eight countries across Africa and a team of over 90 people. It is not surprising that this Cheetah plans to take Cellulant to the Nairobi Stock Exchange, in what could be one of many IPOs to come. Ken, now 35, strongly believes that young people are changing the game. He explains:

"Young people are energetic and easily learn new things. In ICT things keep changing and we need innovative young people with fresh ideas, who take on new ideas with optimism, unwavering determination and energy."

Examples like Cellulant are only the tip of an iceberg. Thousands of young people are starting to see the sheer number of opportunities and are quickly lining up with their ideas on how to solve them. Alex, the co-founder of Altoja Computer World, a young software company in Kampala, explains:

"The jobs that are available are not attractive for someone passionate about software. You could do data entry for 100,000 to 200,000 shillings a month, but that's not the point. We want to build our own business and have a vision now."

Equipped with unprecedented knowledge, the stage is set for an epic showdown that will change the face of the continent for ever. A young student with a mobile phone is ready to take on a generation stuck in history, part of a new struggle to convince the older generations that they are on to something really big. A 23 year old builds a national database of criminal records for the government police force, a small team of young developers manages a bank's internal IT system. How can a CEO appreciate the implications when he still prints out his e-mails and dictates his responses?

The road ahead is a hard one, the will of these young minds will be tested and most will fold. But the few who persist and succeed will make the difference. Just ask anyone on the streets of Kampala, Nairobi, Accra or Lagos about the potential. Their eyes will light up as they spew out their plans for the coming year. The optimism is overwhelming and contagious. Already the Diaspora are returning to the continent and setting up shop. They are eagerly tapping into this youthful generation and setting out on their quiet mission to change the world. It would be foolish to underestimate this young generation waiting for their turn at the table.

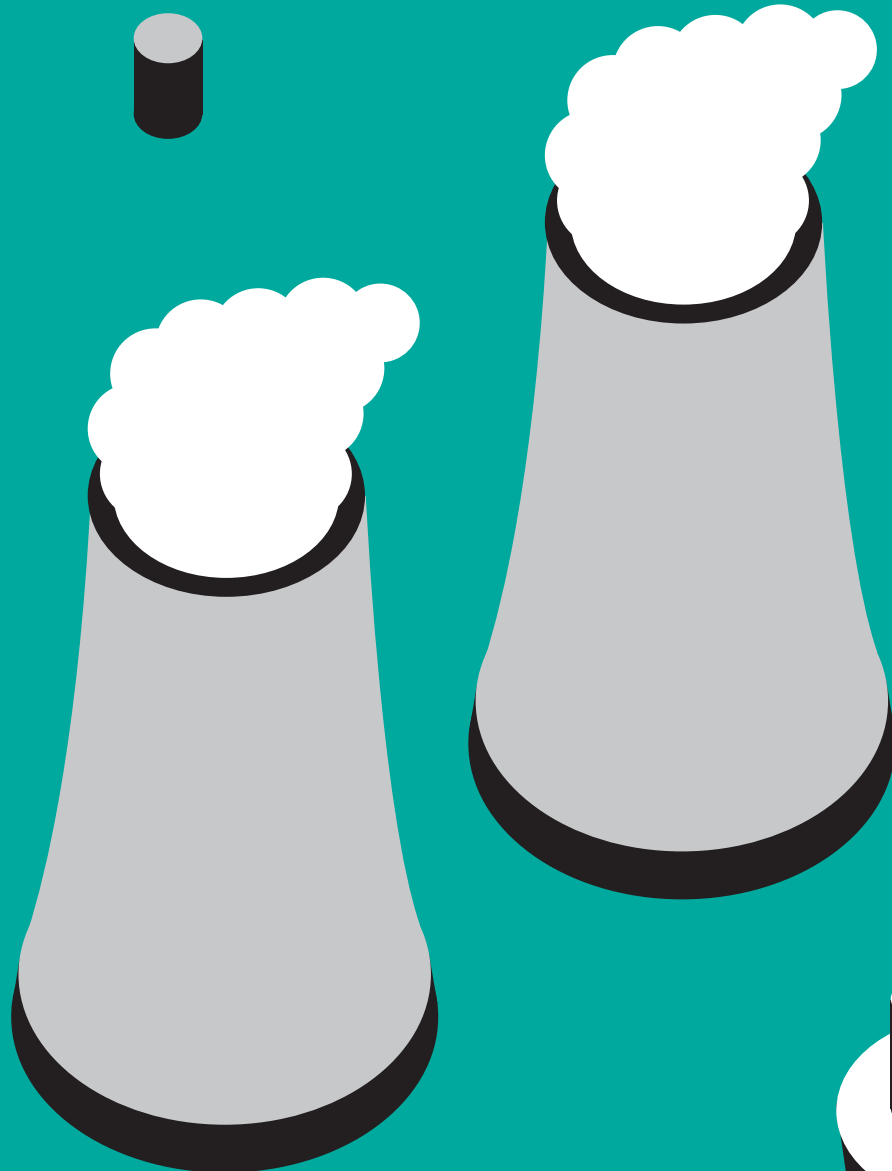
Ben White's story is set in Kampala, but it could just as well be Accra, Lagos or Nairobi. Initiatives to claim a piece of the future by building something that contributes can be found all over Africa. Kenyan blogger Wambura Kimunyu has a vision that breathes Cheetah all over:

"The question is, can we become the world centre for some aspects of mobile phone communications technology? We have the human resources, we have a demanding population. Also, people here have a very strong sense of mobile technology, because of their reliance on the mobile phone and services like mobile money. Now we need to build technology capacity. Once you have that, then you are competing at par with Silicon Valley or whatever. And then you can become whoever you want to be."



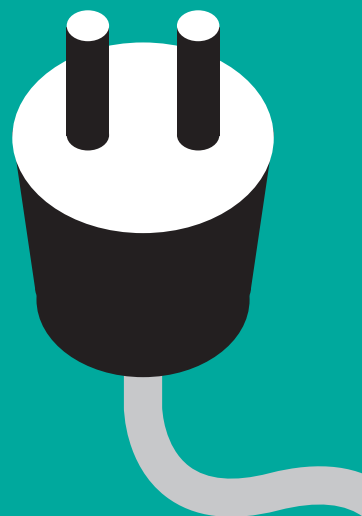
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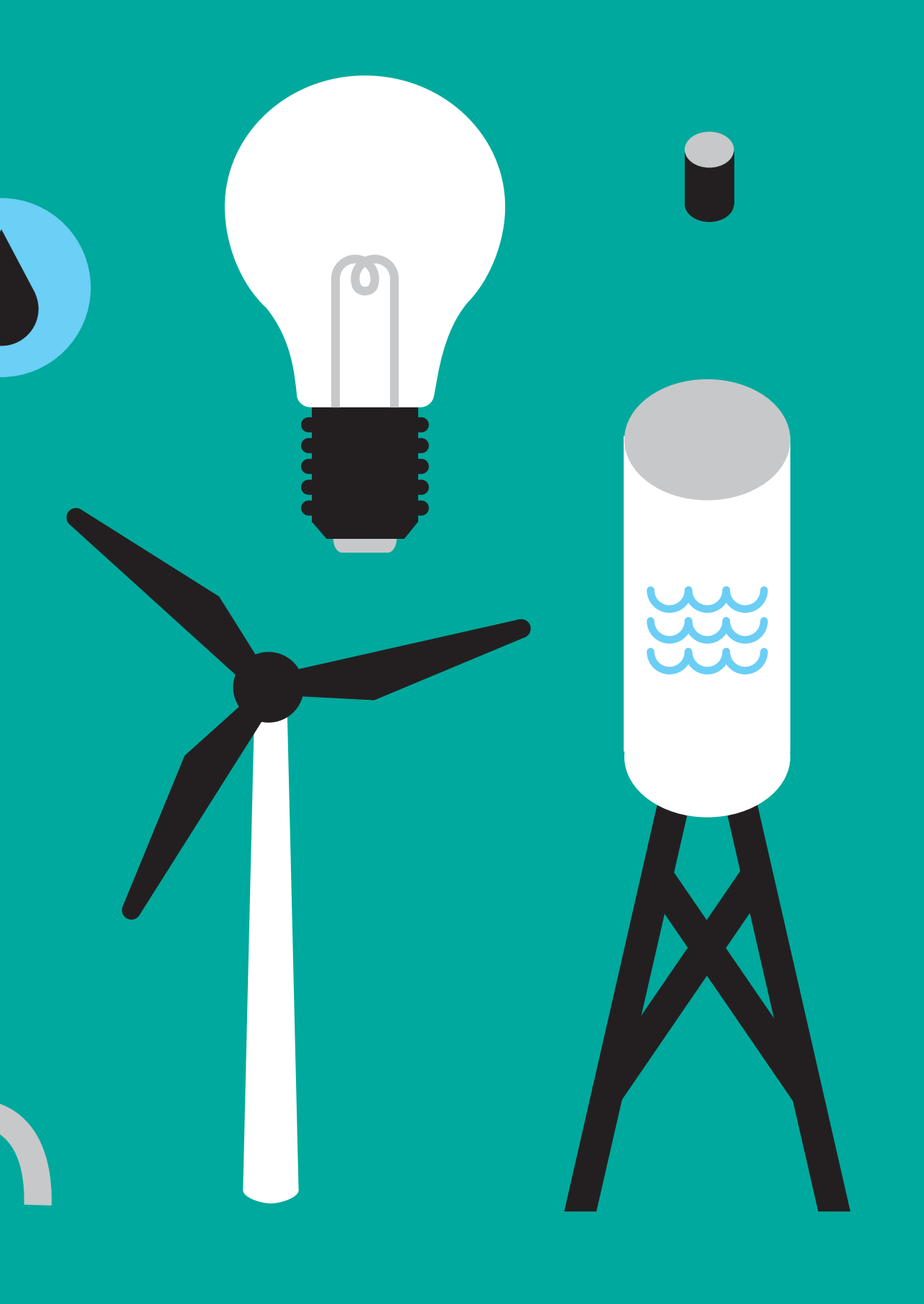
- Books are too slow for Africa's ICT boom. Follow the industry news at <http://biztechafrica.com> or the spread of mobile money at www.mobilemoneyafrica.com.
- An excellent e-mail newsletter on the ICT industry in Africa is published by consultant Russell Southwood. For subscription, visit: www.balancingact-africa.com.
- Steve Song of the Shuttleworth foundation publishes an up-to-date and widely used map of submarine fibre-optic cables connecting Africa at <http://manypossibilities.net/african-undersea-cables>.



With contributions from Birthe Paul and Janneke Brouwers

Chapter 5: **ENERGIZING AFRICA**





There exists a strong belief in the transformative power of electricity, in particular where Africa is concerned. International financing institutions, NGOs, national governments, all agree that electricity is an important enabler for the further social-economic development of Sub-Saharan Africa, which still lives up to its reputation as the dark continent since large areas are devoid of any light during night-time.

Figure 5-1 shows Africa at night, a NASA image composed of thousands of satellite photographs. The bright spots are sources of light, an indicator of the availability of electricity, the presence of people and of their economic activity. Light usage per person rises with income as both consumption and investment activities increase (Vernon Henderson et al., 2009). Africa's lack of night light therefore denotes low population density for some areas and low economic activity for others. Overall the image reflects the fact that all households in Sub-Saharan Africa, together with their almost 800 million individuals, consume about the same amount of electricity as New York's 19.5 million inhabitants, when one excludes South Africa.

The largest cluster of lights in Africa is visible in South Africa's Gauteng province, comprising the cities of Johannesburg and Pretoria. The region is Africa's current economic powerhouse by any standards. It contributes nearly 10% to the total GDP of Sub-Saharan Africa and Gauteng's neighbouring provinces produce 40% of the continent's electricity. In West Africa, Nigeria stands out with its approximately 60 million diesel generators, as does the West African highway along from Nigeria towards Benin, Togo, Ghana and onwards. In East Africa, light sources are largely restricted to major cities, such as Nairobi and Kampala. In the north of the continent, a crisp line of light following the river Nile is very visible from the mouth of the river up to the Aswan dams, as is the coastal region of Tunisia, Algeria and Morocco.

Overview

According to the Africa Infrastructure Country Diagnostic (AICD) (Foster et al., 2010), Sub-Saharan Africa has a total electricity generation capacity of 68 giga-

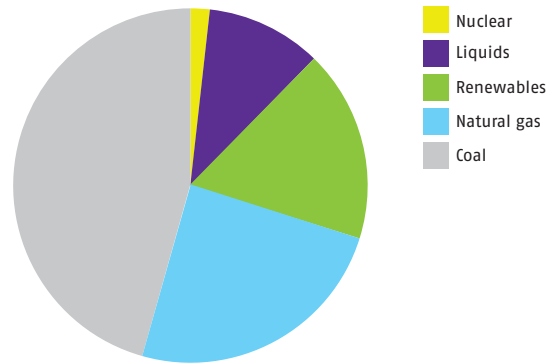


Figure 5-2: Africa's electricity mix by fuel. Source: IEA World Energy Outlook 2010 (IEA, 2010)

watts (GW), of which 40 GW are South African. The remaining 28 GW are spread unevenly across the continent, 25% of which is currently not producing energy. In other words, about 70% of all the energy in Sub-Saharan Africa is generated in South Africa. Figure 5-2 shows what the main energy sources are (including North Africa, which is responsible for most of the natural gas). Liquids are mostly oil and diesel, and renewable sources are overwhelmingly hydropower.

During the last decade more than 30 countries in Sub-Saharan Africa, including South Africa, have suffered acute electricity crises. Rented diesel generators linked to the national power grids, so-called emergency power plants, are the electricity source of choice for governments all over the continent, to fill the gap between demand and supply for electricity without delay.

For Africa's households, charcoal, wood and other traditional biomass are still the most important sources of energy. An overall 80% of the population relies on these fuels for cooking. In Sub-Saharan Africa's urban areas, 60% does so. In the 1980s South Asia and Africa were about on a par with respect to electricity generation per capita. Today, South Asia outperforms Africa by a factor of three. Latin Americans even have ten times the capacity per capita at their disposal. The same gap is emerging in terms of access to electricity. In Sub-Saharan Africa less than 25% of the population has access, compared



✕ Figure 5-1: Africa and Europe at night. Source: NASA

to 50% in South Asia and 80% in Latin America. More than 550 million people in Sub-Saharan Africa are not connected to an electricity grid. A lack of planning and investment, mismanagement, institutional obstacles, insufficient maintenance and ageing installations are reasons for the widening electricity gap between Africa and its peers in other developing regions. Outside South Africa, electricity consumption per capita has actually been falling as production has stagnated and populations grow.

In addition to the quantity of electricity, reliability and quality are issues. Power outages affect industrial activities on average 56 days each year, leading to significant losses in productivity, damaged equipment and an urgent need to install expensive backup capacity. Even more common than blackouts are so-called brownouts, during which the net voltage decreases from the 240 Volt standard to as low as 120 Volts. On the other hand, surges to up to 400 Volts are also not uncommon. Computer equipment and standardized industrial processes, such as the heat treatment of food, are particularly affected by brownouts and spikes. Almost 50% of the companies operating on the African continent see the lack of a reliable electricity supply as a major problem with respect to their activities.

Within each of Africa's larger regions, power pools have been formed to facilitate the dispatching of surplus capacity from one country to another. The outputs of the different power plants are scheduled according to increasing marginal cost, technical and contractual characteristics and dispatched to meet current demand. The Southern African Development Community (SADC) created the South African Power Pool (SAPP) in 1995 and the Economic Community of West African States (ECOWAS) created WAPP in 2001. Each of these power pools covers a very extensive area, including 12 and 15 countries respectively. These two pools are also the only ones with considerable trading in energy actually taking place. The Central African Power Pool (CAPP) was created in early 2005. Recently, an East African Power Pool (EAPP) has been created, aiming to connect Burundi, Congo-Kinshasa, Egypt, Ethiopia, Kenya, Rwanda and Sudan with a possible extension to include Tanzania, Djibouti, Libya and Uganda.

Regional differences

The averages summarizing the African power landscape hide massive differences between and within countries. In Southern Africa, the coal-fired power plants of the Republic of South Africa dominate the energy mix. East Africa is strongly dependent on hydropower. In West Africa, energy sources are increasingly diversified between different countries, as the West African Gas Pipeline is beginning to deliver natural gas from the Nigerian oil fields to Togo, Benin and Ghana. The following overview illustrates the different characters of energy sectors across the continent based on a number of key facts and interview impressions.

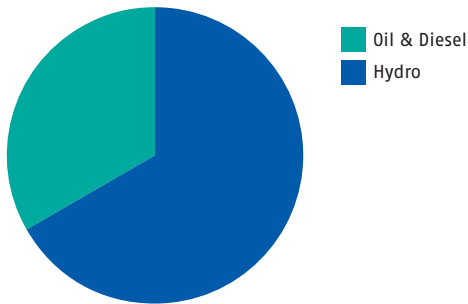
✉ Sources:

Installed capacity in gigawatt: US Energy Information Administration, Rwanda Ministry of Infrastructure, and Nigerian government officials

% of companies identifying the lack of electricity as a major constraint: Africa Development Indicators

Interview quotes anonymized at interviewee requests.

Ghana



Installed capacity in gigawatt: **1.7**

Per capita in watt: **74**

% of companies identifying the lack of electricity as a major constraint: **86.2**

Reliability

"We have one of the best electricity sectors in Africa. Our power supply is not often interrupted, though we have had small problems recently. At times, there has been too little water in the Akosombo dam and we also had operational difficulties."

Capacity

"The government's strategic objective for energy supply is 5,000 MW. Currently we stand at about 2,000 MW. We have about 1,000 MW of projects under construction by different parties."

PPP

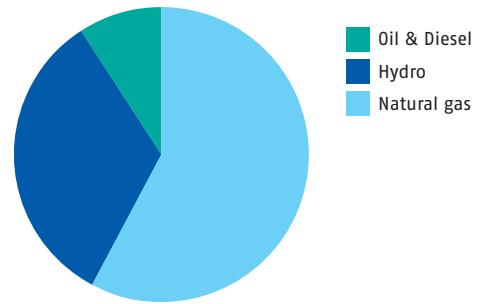
"For the remaining 2,000 MW, the government hopes to attract private investors, in Private Public Partnerships, once gas is delivered from Nigeria through the West African Gas Pipeline."

You could see the private sector really jumping into this space in a very big way and do away with the model where the government is the most important provider of energy."

Finance

"A major difficulty is financial capital. All energy projects are heavily capital intensive and at times of financial crisis it is especially difficult to raise it."

Nigeria



Installed capacity in gigawatt: **2.5**

Per capita in watt: **17**

% of companies identifying the lack of electricity as a major constraint: **75.9**

NEPA

"Never Expect Power Always is how we remember the name of NEPA, our National Electric Power Authority. NEPA switches electricity on and off whenever they like. They are not accountable to anybody."

Government

"The government has been paying a lot of lip service. Last year the government said it planned to increase power generation to 6,000 MW. This will not materialize. As long as this crisis remains we will not be able to achieve whatever the government plans or what we have in our Vision 2020."

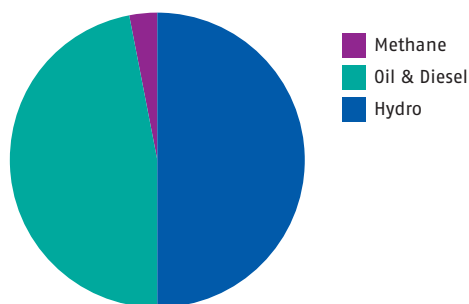
Generators

"Nigeria's industry sector is mostly running on diesel generators and that is very expensive. At our office, we run 24 hours a day on generators, because the town network is hardly existent in this region and when it's there it's even worse. Recently, there was a spike of 380 Volts and you could hear our equipment breaking. We have two generators, one to provide back up for the other."

Cost

"Nigerians spend more than 5 billion US dollars a year to fuel their diesel generators."

Rwanda



Installed capacity in gigawatt: **0.07**

Per capita in watt: **7**

% of companies identifying the lack of electricity as a major constraint: **54.99**

Pace

"The Rwandan energy sector is moving very fast. Five years ago, we had 35 MW and there were rolling load sheds all over the place and the city was dark most of the time. Now we are at 69 MW, and by 2012 we will have 130 MW online."

Interconnections

"We are building interconnections to the neighbouring countries. We cannot have too much energy generation in the region."

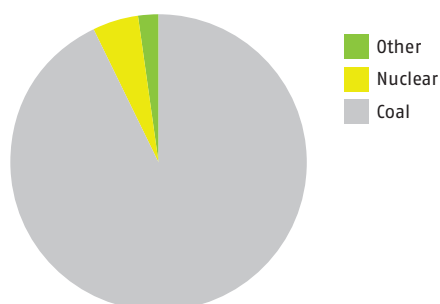
Access

"So far only 6% of the Rwandan population is connected to the grid. By 2012 we want to have 16%, which is tripling access in another 3½ years. That will firstly be for domestic purposes. As we go on, we want people to develop small and medium enterprises. By 2020 we envisage having 35% of the population connected to the grid."

Industry

"Google had approached Rwanda to put a data server here which basically would consume as much energy as half of Rwanda uses at the moment. They would need about 30 MW just for a data server, so they decided not to come here."

South Africa



Installed capacity in gigawatt: **43**

Per capita in watt: **891**

% of companies identifying the lack of electricity as a major constraint: **20.8**

Cheap electricity

"People want electricity, they want it cheap. But without a price increase, we are going to have blackouts and brownouts again."

Coal

"Coal will continue to dominate South Africa's energy mix until 2020. We have enough coal for 150 years and the refurbished coal-fired stations now have a lifespan of 40–60 years."

Size matters

"4,000 MW is the standard capacity for coal plants for South Africa. When we build a power station, we build it big."

Concentration

"If you survey the panorama from a hilltop in Mpumalanga province you can see 40% of Africa's power supply."

Full access

"The government target is to achieve universal access to electricity by 2012."

Nuclear

"Eskom aims to double its overall generating capacity to 80,000 MW over the next 20 years. Nuclear energy will contribute about half of the new capacity."

Energy futures

If publications in Western media were any indication of Africa's energy futures, then solar energy would be the most likely electricity source for the continent's future. One factor in this perception is the Desertec Industrial Initiative. This consortium of the Desertec Foundation and 17 European companies proposes to exploit solar and wind energy potentials in deserts in North Africa and the Middle East. The project's backbone is the installation of up to 100 large concentrated solar power (CSP) plants in the Sahara Desert. A CSP plant consists of banks of several hundred giant mirrors that cover large areas of land. Sunlight can be focused on to a central tube or receptor filled with water by controlling the mirror's position. Inside the receptor, the water is vaporized into steam, which is channelled off to drive turbines that generate electricity. Heat storage tanks using molten salt or concrete blocks can be used to store heat to power the steam turbines at night and at times of peak demand. Waste heat may be used to desalinate seawater, which could help in satisfying local needs for fresh water. The generated electricity would be transmitted to Europe and Africa by a grid of yet-to-be-built high-voltage direct current cables (HVDC). While the technology seems appealing, it is not likely to be applied in Sub-Saharan Africa as long as other sources are still underexploited. In fact, in the whole region, a single CSP plant has been planned. It would be located in Upington in South Africa, if it were ever to be built, which seems doubtful at this time.

Wind farms are more popular, since the coasts of South Africa and Namibia, as well as the Rift Valley, offer excellent wind energy conditions. However, these are not going to have as much impact on Africa's energy futures as more conventional sources. According to the AICD, only 7% of the continent's economically feasible hydropower potential is currently being exploited. If fully utilized, hydropower alone could generate an estimated 937 TWh per year. In comparison, the IEA estimates that 462 TWh/year distributed over on-grid, mini-grid and isolated off-grid applications would be sufficient to achieve universal electricity access by the year 2030 (OECD/IEA, 2010). Gas reserves of 5.2 trillion cubic

feet are located in Nigeria and significant additional reserves have been identified in Southern Africa, Mozambique, Namibia and Angola. Nigeria (36 billion barrels) and Angola (9 billion barrels) host the continent's largest oil reserves, but an increasing number of smaller deposits in other countries have been identified, including fields in Sudan, Gabon, Congo-Brazzaville, Chad, Equatorial Guinea and several others. (Eberhard et al., 2008)

Looking into the future, energy is one of the areas for which sector-specific future scenarios do exist. Three publications stand out:

- The 'EIA International Energy Outlook 2010' contains an outlook for international energy markets until the year 2035 and is annually updated. (www.eia.doe.gov/oiaf/ieo)
- The 'IEA World Energy Outlook' is another annual publication. The 2010 edition has yet to be released at the time of writing, but a chapter on 'Energy Poverty: How to Make Modern Energy Access Universal' has already been released. The full report will cover energy futures until 2035. (www.worldenergyoutlook.org).
- Shell published two scenarios for a future in which the aim is to increase the availability of energy while reducing carbon dioxide emissions under the title 'Shell energy scenarios to 2050'. (www.shell.com/scenarios)

The latter publication is rather short on information about Africa. Scramble, a rather negative scenario of scarcity and a lack of co-operation, sketches the following future:

"Political pressures become intense in those developing countries where rising aspirations are suddenly disappointed. International relationships come under strain as well. Russia's internal use of its oil stifles expected growth in Eastern Europe and the energy have-nots, such as low-income African nations, struggle for access. Eventually, this lack of action creates fertile conditions for politically opportunistic blame for extreme weather events and supply crunches – and triggers knee-jerk, politically-driven responses."

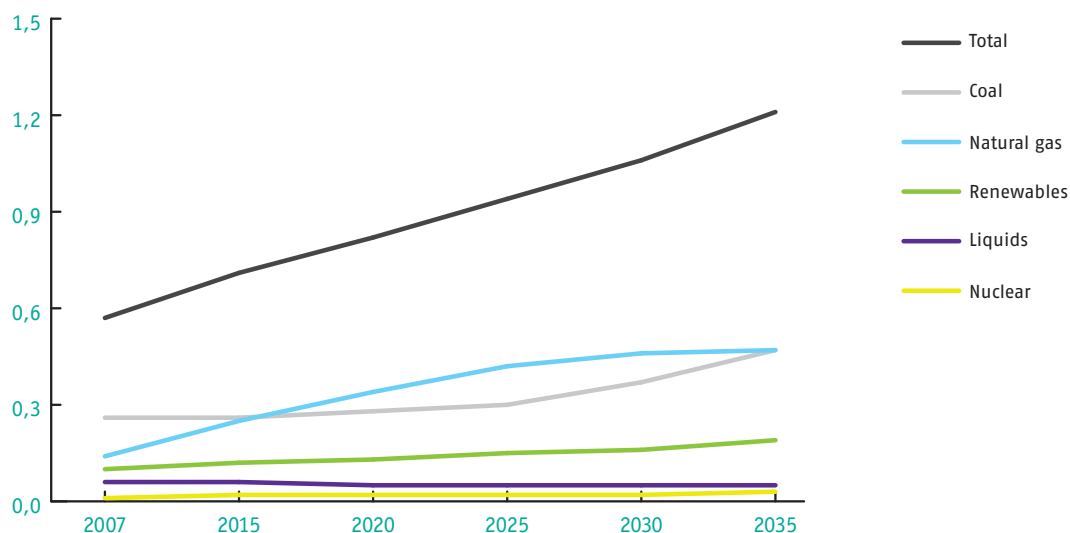


Figure 5-3: Net electricity generation in Africa by fuel, 2007–2035 in trillion kilowatt-hours. Source: EIA International Energy Outlook 2010 (EIA, 2010)

The more positive Blueprint scenario still relies largely on fossil fuels, but sees opportunities for Africa's rural population:

"Benefits also begin to emerge from accelerated growth in distributed power generation from wind and solar energy. New wind turbines and more cost-effective solar panels are easily exported to rural areas, and in a relatively brief time, many African villages have a wind- or solar-powered energy supply for drawing water from deeper, cleaner wells – and for later development needs."

The other two publications make statistical projections into the future. Differences occur because of the different methods used and because of slightly diverging assumptions, especially concerning future economic and population growth. For example, the EIA expects GDP for the Sub-Saharan Africa region to grow by an average of 3.6% per year, while the IEA expects 3.7%. The differences in assumptions and in outcomes are negligible considering the fact that these estimates should be interpreted with considerable care anyway. The time horizons of 20 to 25 years bring considerable uncertainties with them. Figure 5-3 shows the future expectations according to the EIA International Energy Outlook 2010.

Reliance on fossil fuels is expected to continue. Coal-fired power plants, which were the region's largest source of electricity in 2007, accounting for 45% of total generation, provide a 39% share in 2035. Natural gas-fired generation expands strongly, from 25% of the total in 2007 to 39% in 2035. While overall electricity production is expected to double in the next 25 years and growth rates for energy production are somewhat higher than population growth, energy consumption per capita will still be 20 times higher in OECD countries (2,835 kWh) than in Sub-Saharan Africa (132 kWh) by 2030. Also, while by 2030 50% of the region's people are expected to have access to electricity, their absolute number is projected to rise from 585 million in 2009 to 652 million by 2030.

At present, Africa's largest power plants are South Africa's coal-fired thermal plants, which range among the largest coal-fired power plants in the world. However, in the foreseeable future they could be dwarfed by one of the world's most ambitious power generation projects: the Grand Inga dam. Its construction would substantially alter Africa's energy futures. Birthe Paul summarizes the project.

Grand Inga Dam

Birthe Paul

Grand Inga is a hydroelectric dam envisaged to cross the entire Congo River 225 km downstream of Kinshasa. The dam would divert the river flow into the Bundi Valley. If realized, it would be the world's largest hydropower project, with an expected generation capacity of 39,000 MW. It would significantly exceed the capacity of the two existing dams Inga I (350 MW) and Inga II (1,400 MW), and of planned Inga III (4,800 MW), all located at nearby smaller river branches. Grand Inga's installed capacity would even be more than double that of the Three Gorges Dam in China, which is currently ranked as the largest energy-generating unit ever built. Large-scale projects at the Inga site have been discussed for years. However, it is questionable whether Grand Inga will ever be built, as the DRC government was unable to manage the construction and finance of the much smaller Inga III plant. Once building did commence, six to twelve years would be required for completion, as well as an investment of up 80 billion US dollars. This investment would not only pay for the plant itself, but also for a massive new distribution system ranging from South Africa to the Sahel and possibly beyond.

In 2008, the African Development Bank (AfDB) disbursed 15 million US dollars for a feasibility study of the project. Other sympathetic parties include the World Bank, the Western Power Corridor (Westcor), as well as an alliance of utility companies from South Africa, DRC, Angola, Namibia and Botswana. The New Partnership for African Development (NEPAD), the Southern Africa Development Community (SADC), the World Energy Council (WEC) and Eskom, Africa's largest power company, are also backing the project.

Investors and supporters hope that Grand Inga will boost Africa's electricity by meeting one third of the current needs, while enough energy will be left over to be exported to Europe. Potentially providing electricity to 500 million

Africans, the dam could generate trickle-down benefits and reduce poverty. Opponents question this regarding the fact that most of the poor live in rural areas outside the reach of power grids. Also, civil society has been largely excluded from the planning process and little is known about further prospects.

Political instability across the region where transmission grids would be built is probably the most serious concern regarding the project. The DRC is one of the least politically stable and most corruption-plagued countries in Africa. Over three million people have died since 1998 due to civil war and strife and with more than 75% of its population undernourished, DRC is second to none in terms of hunger. Furthermore, Transparency International's Corruption Perception Index ranked it among the top 15 most corrupt countries worldwide. Centralizing much of Africa's electricity at Grand Inga would attract conflicts. Given this, there are growing concerns that the project will benefit local elites and foreign industrial interests rather than easing the needs of Africa's poor.

Sources:

(World Energy Council, 2007)

(NewNet News, 2010)

Scenarios

Janneke Brouwers, who followed an internship at STT concentrating on the socio-cultural aspects of energy futures, imagines in the first of the two following scenarios what the impact of building Grand Inga would be. The second scenario describes the effects of the opposite strategy, in which energy supply is much more decentralized.

Two scenarios on energy futures

Janneke Brouwers

Scenario 1: The supergrid scenario

In this scenario all political and commercial forces are joined in the creation of a pan-African supergrid, through linking the different

regional power pools together. Decentralized electrification has low priority. As governments try to secure their own national supplies, emphasis is placed on the creation of a large number of new generators based on hydro-electric dams and nuclear stations. The great hydropower of the river Congo, especially at Inga, will play an important role in shaping the African electrical infrastructure. The image of the transmission grid as star-shaped with Inga at the heart has inspired African electricity planners for many years. The dreams of a united and independent Africa, that have haunted Africa's political leaders since the early days of independence, have once more been rekindled. The Great Inga dam by itself already almost doubles present total electricity generation in Africa from 59,000 MW to at least 98,000 MW.

However, such a strong increase in the electricity supply needs justification for its expenses, which are high, in particular the cost of thousands of miles of transmission cables. The choice of large generators such as Inga, which have a long construction time, means that the problem of a supply shortage will be replaced with a lack of demand. Strong discrepancies will arise between supply and demand. Big buyers are required, who are willing to disproportionately invest in infrastructure. The Grand Inga will be built not so much as a power source for all Africa, but for the urban centres located in Southern Africa, Egypt and the Mediterranean. Central Africa will be recolonized, though this time not primarily by European powers.

Electric current, traditionally defined as the least transportable energy form over long distances, becomes an important export product comparable to that of oil. Due to the centralized nature of the transmission grid, research and development will focus on reducing transport costs and speed. Clearly, this scenario will benefit urban areas over the rural hinterland and exacerbate the demarcation between the energy rich and the energy poor, of which the

rural poor also face the bleakest consequences of drought. The differences between nations will also increase. Both local and international protests will arise, giving a sour flavour to the great feats of the engineers, though vandalism – being largely an urban phenomenon – remains low. Some technical discoveries are introduced to improve the fate of the inhabitants of affected areas. Villages next to transmission poles will be able to withdraw small amounts of electricity directly from the AC lines. Yet this 'technical' approach to solve social inequality will also reinforce perceptions of intentional political disempowerment.

Urbanization will continue at a rapid rate, but population growth will decrease slowly. Large cities are eventually given more leeway and political power to govern their own electricity distribution. The inner cities such as Cape Town, Lagos and Nairobi – where electricity will be abundantly available – will become increasingly wealthy and will reinforce their role as 'lighting examples'. Though the supergrid policies do much damage to local ecosystems, as is presently the case in the Merowe project in Sudan, individual cities do their absolute best to renew themselves and to improve their image as innovative and environmentally conscious places. Cape Town is the new 'city of light' as public lighting is prioritized and presented in an artful display. Electrical transportations systems are constructed to facilitate inner-city traffic. Cities will have their own biofuel fields and road systems will be able to retrieve kinetic energy.

Violence and vandalism have tainted social life and the physical appearance of the city. Both local and national authorities feel themselves obliged to restructure the inner cities to ensure good traffic flows and resource management. Comparatively rich South Africa is the first to make its move. In the first 25 years the electricity supply is improved by the physical extension of the South African Power Pool and investments in large-scale infrastructure abroad and at home. In Southern Africa a start

is made with the construction of nuclear plants and finally the first bricks are put in place for the construction of the Great Inga, which will eventually add at least 40 GW to the current African consumption rate of 60 GW, of which a large share will be exported to the South African investor at very reasonable prices. The various city centres must become more hospitable as public places, rather than consisting of individuals locked behind fortified walls.

Scenario 2: Stand alone, stand together

Local electricity councils and independent electrification co-operatives that are allowed to generate and distribute electric power and set their own tariffs accelerate the progress of rural electrification in developing countries. In contrast to the islands scenario, this vision relies on local market developments rather than on large multitasking multinationals taking charge.

A good example is Urambo village, which lies somewhat over 80 kilometres west of Tabora in the north-western corner of Tanzania. In discussions between the Urambo District Council, representatives from TANESCO and the Electric Consumers Committee in 1993, it was agreed that an informal arrangement prevented sustainable development of the electricity supply in Urambo. For the first time in Tanzania, electricity consumers could form an electrification co-operative that would own, maintain and develop the system. The electricity consumers that had already used the service were invited to register as members of the co-operative and pay a registration fee equivalent to 9 USD and buy at least one share equivalent to 13 USD (1994). The registration fee was in December 2002 equivalent to 5.3 USD and the share to 7.4 USD. Also, a connection fee of 5.3 USD and an advance have been introduced, which have to be paid by the consumer before being connected. At the start there were doubts about the ability of the co-operative to fulfil its commitments, as only 67 consumers registered as members of the co-operative, of which only seven had paid for registration and a share. Since

then, the credibility of the co-operative has improved greatly. It has demonstrated that a village in Tanzania can manage its own electricity supply system when given adequate technical, management and financial support. It has certainly been important that a local office of the national utility is located within a reasonable distance to assist the young co-operative. The example of Urambo shows that even in rural villages, it is possible to find a fraction of the population that has the ability and willingness to pay a price much higher than grid electricity when managerial control is transferred to the co-operative.

Co-operatives are commercial enterprises, not public institutions, yet their public role is recognized and their inclusiveness is stressed. Furthermore, during the first phase of their establishment, they are heavily reliant on outside governmental support. This scenario is about creating fruitful conditions for self-government and local self-reliability. In this scenario African governments come to recognize the damaging role of foreign competitors and subsidized products on local markets, and strive towards the conversion of consumerism to self-production. Utilities gradually switch roles from producers to consultancies and client support. These transitions will come close to what was previously sought after: power market sector reform. Yet reform will not consist of the splitting of generation, transmission and distribution functions, but the splitting of knowledge and consultancy services, technology retailers and the producers/consumers.

Looking at the futures of energy technology in Africa, it makes sense to distinguish between on-grid technologies, which require substantive transmission networks much as described in the first scenario, and off-grid and mini-grid technologies, which dominate the second scenario. The technologies involved differ fundamentally and so do the future expectations for the connected versus those of the unconnected.

Futures of on-grid energy

To feed their expanding electricity grids, most African governments plan to rely primarily on the traditional model of large, centralized systems. Coal and gas are the main conventional fuels. Hydro-power will deliver the overwhelming majority of the growth in renewable energy. The largest of a large number of hydro projects underway is the construction of the Gilgel Gibe III dam on the Omo river in Ethiopia. Once completed, it will be the largest hydroelectric plant in Africa with a power output of about 1,870 MW. South Africa will continue to rely to some degree on nuclear power, though the construction of a new Pebble Bed Modular Reactor in South Africa will be delayed indefinitely. Nigeria also has nuclear ambitions.

On-grid leased diesel generators are a popular temporary measure to overcome electricity shortages while new plants are being developed. However, their use is likely to be phased out as projects under construction come online. In East Africa, retiring the generators is mainly dependent on rainfall. If the dams are sufficiently full, hundreds of megawatts of emergency power in the region are switched off. Maintaining the use of diesel generators is an extremely expensive option, which roughly doubles energy prices and increases dependency on the oil price.

Wind energy will be making a slow but steady entrance as an on-grid generation technology. One of the first large wind farms to go online in Sub-Saharan Africa is the Lake Turkana Wind Power project (LTWP). The 353 wind turbines, each with a capacity of 850 KW, are estimated to contribute 300 MW of power to Kenya's national electricity grid. At full capacity, the farm would increase Kenya's current total installed power by up to 30%. In addition to the installation of the wind turbines, the project comprises a 428 km transmission line to Suswa, as well as road upgrades and construction. The project has been delayed by a lack of funding.

Another interesting source of on-grid energy, especially in East Africa, is geothermal power. Kenya alone has an estimated geothermal potential of 7,000 MW. The Kenya Electricity Generating Company (KenGen) has already collected considerable exper-

tise with the technology in different pilot projects in the region and is currently tendering for the construction of two 140 MW geothermal power plants in Olkaria, near Naivasha. Neighbouring countries are exploring similar projects.

A unique energy source is the methane dissolved at the bottom of Lake Kivu, bordering Rwanda, Congo-Kinshasa and Burundi. It is the only lake in the world, with a sufficiently high methane concentration and the right conditions for energy production. The methane has to be extracted from a depth of 300 to 500 metres below the surface. There is literally no proven technology for harvesting this. A pilot plant is operational in Rwanda producing 2 MW and an agreement has been signed with the Congo to move ahead with a 200 MW joint project.

While these projects will substantially improve the energy supply in terms of quantity, quality and reach, the situation for energy-intensive businesses and sparsely populated areas at a distance from transmission cables will change very little over the next decade. Public electricity grids are unlikely to support major industrial activity. The EIA leaves little room for interpretation in its conclusion concerning industrial energy use until 2035:

"Without a substantial departure from historical patterns of governance and economic activity, low levels of industrial energy use in Africa can be expected to persist."

Futures of off-grid energy

The lack of access to energy and the low quality of the existing supply are serious constraints on social, economic and technological development. The idea of a decentralized energy system seems appealing for those African countries that are sparsely populated or are unlikely to raise the expertise and the capital required to build far-reaching national grids. Even in 2020, the conventional diesel generator is likely to be the most common source of power for relatively energy-intensive applications for many of those still unconnected to the grid. It scores highly in terms of reliability, mobility and versatility. Until now, the costs of alternative solutions powerful enough to supply a village

or settlement with enough electricity to power all household needs, including refrigeration, cooking and ironing, as well as the use of tools such as welding equipment or mills in small businesses, has been prohibitive. The cost of energy storage in battery packs is a particularly costly aspect of wind, solar and mini-hydropower. However, on a smaller scale a revolution of decentralization seems finally about to gather momentum after many years of disappointment.

At the smallest scale, electronic devices are increasingly being powered by solar cells, replacing expensive batteries. Even the poorest will be able to afford solar-driven chargers for their devices: radios, mobile phones, LED lamps, possibly even sewing machines, small electric tools or a laptop computer. The ubiquitous and reliable availability of light, communication and other low-power applications will significantly improve the opportunities of the rural population. The availability of light especially will allow increases in productivity in many sectors, including health and education. But there is a real lack of light for now. According to a credible estimate, there are more mobile phones than lightbulbs in Uganda and probably in Sub-Saharan Africa, excluding South Africa (Appfrica.net, 2009).

Other technologies are also becoming available. The World Bank runs the Lighting Africa initiative, which *“supports the private sector to develop the market for modern off-grid lighting technologies”*. An inventory of suitable technologies proposed by commercial parties includes, in addition to solar, the following options: wind, pedals, wind-up, pico-hydro, bio-gas/fuel (from cassava waste) and so-called energy boxes. These are batteries charged at central market places that are leased out to households. New ideas and technologies, many also geared to saving energy and thus making a light or other application last longer on a single charge, are being proposed regularly. Also, the devices are becoming cheaper and/or more robust. The multitude of possibilities is the main reason for the expectation that these applications will be ubiquitous within five to ten years. Not only will suitable technologies be available, they will also be highly affordable.

On a slightly bigger scale, the renewable energy technology with the fastest momentum is hydropower. British NGO Practical Action (<http://practicalaction.org>) classifies the different levels of hydropower as follows:

- Large-hydro: More than 100 MW and usually feeding into a large electricity grid
- Medium-hydro: 15–100 MW – usually feeding a grid
- Small-hydro: 1–15 MW – usually feeding into a grid
- Mini-hydro: Above 100 kW, but below 1 MW
- Micro-hydro: From 5kW up to 100 kW; usually providing power for a small community or rural industry in remote areas away from the grid
- Pico-hydro: From a few hundred watts up to 5kW

Especially at the bottom end of this list, developments can be expected. The cost advantage of small-scale installations lies in the fact that micro-hydro means that power is generated close to the energy consumer, avoiding transmission costs. East African governments together have included several hundred megawatts of non-grid-connected hydro projects in their respective national energy forecasts, often offering incentives or support for their installation. Other renewable options, such as locally sourced biofuels from agricultural residues and plants on marginal lands, as well as solar cells, are being pioneered, but are generally not supported by governments. Especially for solar cells, the rapid price erosion for the product will certainly change that within the 20-year time horizon of this project.

The one thing that is unlikely to change significantly in the next 20 years is the use of charcoal, wood and other biomass for cooking. The IEA estimates in its World Energy Outlook 2010 that the share of Africa's population relying on these sources will decrease rather slowly, from the current 80% to 70% by 2030.

Two worlds combine

A pragmatic mix of on-grid and off-grid solutions will be the fastest way to increase energy access while decreasing dependency on a single source of fuel. Rwanda is one of the most outspoken and ambitious countries in this respect, as an interviewee at the Ministry of Infrastructure explains:

"We are trying to diversify. Two hydropower plants on the Rezizi river are in the study stage. We are rolling out the exploitation of methane gas in Lake Kivu. The government is also looking into developing geothermal energy. Solar electrification is pursued by the government for remote rural social institutions that will not be connected to the electricity grid within the next five years. We are also currently compiling a wind atlas to see if we have wind potential. In addition, we are developing several hydro micro power projects all over the country."

Another meeting of two worlds will also affect the future of energy in Africa. Global trends towards higher efficiency and smaller-scale applications (such as micro- and pico-hydro modules or local biofuel applications), as well as better energy storage technologies, could benefit the African continent more than any other, even though they are not being researched with Africa in mind. It is this emergence of a global energy research agenda with high relevance for Africa that will drive the progress of technological options for the continent.

However, energy will also divide worlds. The inequalities between African countries concerning the energy sector are likely to become even more pronounced for two reasons. First, the major potentials are concentrated in very few countries. Oil and gas are concentrated in Nigeria and Angola, coal in South Africa and hydropower options in Congo-Kinshasa and Ethiopia. However, the exploitation of these large potentials with the construction of power plants and international transmission networks requires appropriate governance. With the exception of South Africa, scores in this respect are not good for the countries concerned; for Congo-Kinshasa, they are outright devastating.

The second reason for continued inequalities is that some governments are undertaking much more efficient energy advancement programmes than others. Rwanda is a prime example of a small country with an unprecedented growth rate in the energy field. How much the laggards will be able to learn from the leaders remains to be seen, but a period of significant disparities is inevitable.

Similar inequalities will continue to exist within countries. The poorest and least connected will have to wait until 2050 and later in many countries until true energy access is granted, while for the wealthier part of the population, even current decentralized energy systems are affordable.

The energy tipping point

After a chapter about the fast developments in the ICT sector, the energy sector seems at first slightly farther removed from a revolution. However, the face of energy on the continent has already changed. A bigger variety of energy sources is being tapped into than ever before and new, as well as cheaper, technologies are lining up. Statistical models, especially when they are run at a global level, where new technologies are introduced at a slower rate because of existing installations, do not provide reliable estimates under conditions in which fundamentally different options are being introduced.

For those countries that still have difficulties in realizing most of their current energy ambitions, the tipping point will indeed be far away and they are likely to stick to the projections of the models above, where per capita electricity supply hardly rises. In these cases, technology is the least of the problems. Bad governance or a lack of governance and the existence of conflicts will hamper development and allow little room for alternative sources. Under such uncertainties, individual investments in non-mobile forms of energy generation are highly unlikely.

However, all the countries we have visited in the course of this project, with the exception of Nigeria, have shown with projects recently completed or under construction that a faster pace than that proposed in the global scenarios is possible. And Nigeria certainly has the potential to outperform expectations.

This outperformance of conservative expectations is more likely with respect to households than to industry. For large-scale industrial consumers to receive more electricity than expected, specific conditions will have to be met. Resources must be

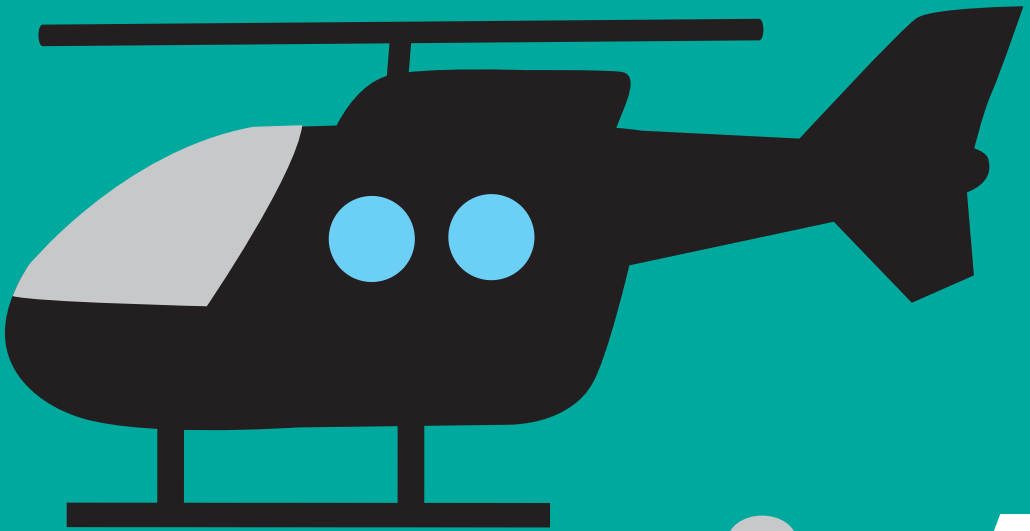
available, good governance is a prerequisite and, of course, the potential must be present.

The number of probable technological innovations and improvements delivering small amounts of electricity reliably and affordably is large, and so is the variety of these technologies. This increases the likelihood of success, as many different paths lead to the desired result. It is conceivable that the number of electric lamps and torches will, driven by affordable solutions, trump the number of mobile phones. It is the fact that most consumer electronics will no longer require either a grid connection or batteries that positions Africa close to an energy tipping point.



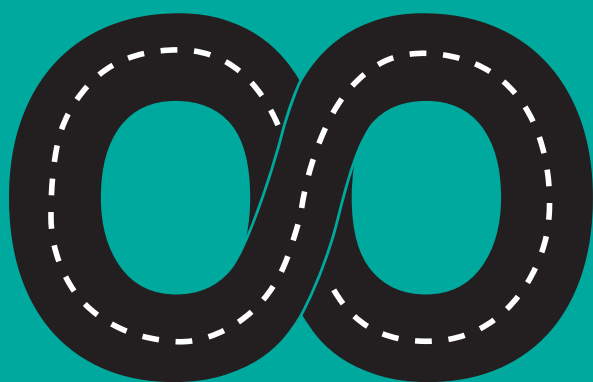
Recommended sources

- The AICD Background Paper 6, 'Underpowered: The State of the Power Sector in Sub-Saharan Africa' provides an excellent overview of the current state of energy. It is available at www.infrastructureafrica.org.
- The chapter on 'Energy Poverty: How to Make Modern Energy Access Universal' in the 'IEA World Energy Outlook 2010' provides a similar overview of the future potential within the boundaries of current technologies (www.worldenergyoutlook.org).
- www.lightingafrica.org is well worth visiting for small-scale solutions.



Chapter 6:

THE ROAD LESS PAVED



Mobile communication has for the first time in Africa's history introduced an infrastructure that reliably and affordably reaches to all corners of the continent. Not a single country is excluded. It is the first truly pan-African infrastructure.

To place Africa close to a tipping point in its development, this information infrastructure must be complemented by a physical infrastructure for the transport of people and goods. All economic sectors rely to some degree on physical connections with their suppliers and markets. Penetrating international and intercontinental markets cannot be achieved without infrastructure improvements. Insufficient infrastructure causes high transaction costs, which increase living costs, limit opportunities for production in rural areas and reduce competitiveness.

To explore the possibility of a tipping point with respect to infrastructure, it is helpful first to understand its current state and the related challenges. The World Bank report 'Africa's Infrastructure: A Time for Transformation' (Foster et al., 2010) provides an excellent overview of the current state of infrastructure and challenges involved. All data concerning the state of infrastructure in this chapter are based on this report and related background documents, unless otherwise specified.

At present, Africa's physical infrastructure severely lags behind that of the rest of the world in terms of both quality and quantity. International donors have also neglected the sector for a long time. This is reflected in the fact that 83% of the 16.2 billion US dollars spent annually on transport infrastructure between 2001 and 2006 were financed locally or by private-sector initiatives, while official development assistance contributed 1.8 billion US dollars per year. Only with the recent economic revival on the continent has the development of an efficient transport infrastructure gained priority and transcended the interests of the resource industries.

There are specific difficulties related to the development of physical infrastructures in Africa. Overall population density is very low, at 36 people per square kilometre. So is urbanization, as Chapter

1 outlines. In addition, many of the continent's countries are relatively small, landlocked or both. Limited financial resources for maintenance exacerbate the difficulties once infrastructure has been installed. Under these circumstances, politically unstable, low-income countries in particular face extreme difficulties and the development of trans-continental transport routes is hampered.

Western economies are used to having access to several overlapping infrastructures. The choice between using road, rail, air or water transport is largely a question of cost and speed. For virtually every type of good, different modes of transport are available, often efficiently combined through intermodal terminals. This high degree of flexibility ensures the quality, the throughput, as well as the reliability and resilience of the transport sector. If one mode of transport fails, another mode is usually available as a second-best option. Such a multi-modal transport network lies in the distant future for most countries in Sub-Saharan Africa, with the exception of a few of South Africa's provinces. However, progress is gathering momentum, as the following overview of the different modes of transport will show.

Air transport

The quickest way to implement a transport connection between two places is by scheduling a flight between them. Therefore, the evolution of the aviation network on the African continent can be interpreted as a lead indicator for what will happen with other modes of transport. And the signs are positive.

Most of Africa's air traffic is passenger traffic, though some export goods rely on air traffic as well, such as flowers from Kenya and fish from Tanzania. Over the past decade, overall traffic has increased by about 6% annually. Domestic, international and intercontinental flights all exhibited positive developments.

Intercontinental routes are dominated by three hubs and the airlines based at these hubs: South African Airways in Johannesburg, Kenyan Airways in Nairobi and Ethiopian Airlines in Addis Ababa.



✕ *Africa's most important air transport hubs*

All three hubs have seen considerable growth, serving 36% of all international routes within Sub-Saharan Africa as well. On a minority of routes, North African, Middle Eastern and European companies are active.

With most of the intercontinental traffic concentrated on Southern and East Africa, developments in West and Central Africa have largely stagnated. In the region, the fluctuation in airlines and routes offered has been relatively high. Only Nigeria has been able to offer a significant number of international and intercontinental connections. 16 other West and Central African countries have actually lost international connections between 2004 and 2007, including significant losses in the Central African Republic, Chad, Mauritania and the Seychelles.

Nigeria also stands out in terms of domestic routes. The number of passenger seats offered in the country increased by a staggering 67% per year over the period 2004 to 2007. The Lagos-Abuja route is served about every 30 minutes by several competing airlines at peak times, making Lagos the busiest airport south of the Sahara and outside South Africa. Mozambique and South Africa also booked

significant growth in domestic flights. In all other countries combined, domestic traffic declined by 1% per year and numerous connections were taken out of service as many of the heavily subsidized state operators of smaller countries closed down, increasing market concentration. As few as 15 airlines are responsible for 60% of all passenger seats offered in Sub-Saharan Africa, and for 82% of all international flights within the region.

The overall aviation infrastructure is improving in terms of quantity and quality, with the exception of less-frequented domestic routes. The relatively short time it takes to expand air transport infrastructure implies that air traffic volumes will grow with the overall economy. Existing hubs will profit most from this development: their growth is likely to be reinforced and competition will increase. Smaller destinations will remain relatively expensive to reach as large jumps in volume would be required for competition to unfold.

Sea transport

The fastest change related to freight transport can be observed in Africa's harbours. Port capacities are being increased from Dakar to Durban and from Maputo to Mombasa, significantly facilitating the import and export of goods. Between 1995 and 2005, the volume of general and containerized cargo turnover in African ports increased threefold. In terms of general cargo, Southern Africa enjoyed the highest growth, while container traffic increased most significantly in West Africa. In 1995 ports between Dakar and Lagos handled a total of 673,400 containers; by 2005 this number had risen to 3,126,901, just surpassing the container volume in Southern Africa. The absolute values are tiny by international comparison. West Africa accounts for about 1% of global container traffic. Nevertheless, these growth rates are an important indicator of the region's economic vitality. Most of Africa's landlocked countries have access routes to more than one port. Expected delays en route, at border crossings and at the ports determine which route is selected. Costs for transporting goods to and from Africa by sea are still high, partly because of unbalanced freight. Dry and liquid bulks, including grain, ferro-chrome, coal and oil, are largely exported,

while containers and other general cargo are largely imported. In monetary terms, oil is by far West Africa's most important export product, accounting for 85% of all exports.

For regional trade, the main ports are Abidjan, Dar es Salaam, Djibouti, Durban and Mombasa. Because these ports are at some distance from the majority of international shipping routes, their relevance to global trade will remain limited. Overall port equipment is poor, while port-related costs are high. Security risks add to these costs.

Africa's 25 major ports are increasingly being upgraded and new ports are being developed. However, the main challenges for the future will be improving security and reducing administrative and regulatory bottlenecks. Especially reducing the cycle times of trucks loading and unloading goods at the port, as well as the dwelling times of containers, would bring much larger efficiency gains than a physical expansion of port facilities. Physical expansion would mainly be required for the ability to accommodate larger vessels. In the East Asian trade, mostly vessels loading 8,000–11,000 containers are being used, while with a few exceptions, African ports are limited to vessels with a capacity of less than 2,000 containers.

In terms of future expectations, African ports hold the opportunity to grow significantly when non-physical restrictions are diminished. The increased capacity would mainly be used by relatively small vessels that are appropriate for the limited overall trade volume. An increase in trans-continental traffic on large vessels is unlikely to take place. Since the slow and expensive transit of goods through Africa's ports is a major contributor to the continent's exceptionally high transport and transaction costs, efficiency gains would be highly beneficial for all economic sectors.

Road transport

The road network, the backbone of Africa's transport infrastructure, is rapidly improving, but still lagging behind other world regions in some respects. The density of paved roads in Africa measured in length per square kilometre of arable

land is less than a quarter of that of other low-income countries. In relation to population size and economic performance, Sub-Saharan Africa actually outperforms South Asia. Nevertheless, rural areas in particular are not well connected. Two-thirds of rural inhabitants live more than 2 kilometres away from the nearest road that is passable throughout the year. To close the gap in terms of physical infrastructure, all-season roads would have to be implemented between population centres, border crossings and ports, also providing access to productive agricultural land.

The quality of the road network differs significantly between countries. Overall, about half of the main roads and a quarter of rural roads are in good condition. Burkina Faso, Kenya and Malawi score highly with respect to the quality of main and rural networks. South Africa has the best network of main roads, but scores poorly with respect to rural roads. On average, richer countries have a better network of main roads, although not necessarily better rural networks. Also, flat and arid countries have better-quality roads than hilly and mountainous ones. Beyond income and climate effects, significant differences still do exist, pointing towards institutional differences.

The best roads are the trunk roads, connecting ports to industrial centres, bypassing opportunities to connect with neighbouring countries and markets within a region. All of these roads combined have an estimated length of 10,000 kilometres and carry trade with a value of 200 billion US dollars per year. Because of their crucial role, connections will further increase in these niches.

A long-standing dream is the development of a trans-continental road network. In the late 18th century, the British Empire proposed a road from Cairo to Cape Town, also known as the Rhodesian highway. In 1971, the UN Economic Commission for Africa proposed a more complete network of trans-continental roads and, more recently, the World Bank's Development Research Group proposed a 100,000-kilometre network connecting all African capitals. East-West connections would include Dakar to Djibouti, Dakar to Mombasa via Lagos, and

Lobito to Beira. North–South routes would connect Cape Town to Addis Ababa and Khartoum towards East Africa, as well as to Kinshasa and Ndjamena towards West and Central Africa. Existing sections of this trans-continental network of paved corridors are frequently interrupted by stretches of tracks that are only passable when climate conditions are favourable. Between 60,000 and 100,000 road kilometres would have to be built to complete a trans-continental road network.

Several interviewees have suggested that the cost of building roads might actually be reduced by how we use technology. A Kenyan consultant explains this as follows:

“Technology could have an impact on road construction. Obviously the Kenya Highway Institute has really upped its game. Now they are starting to apply some best practices, not the huge wasteful methods of the past. So they can build many more roads, they are able to do much more with the same amount of resources.”

Kofi Bucknor, a Ghanaian private equity investor, describes a similar image:

“If you look at the way roads are constructed today and you compare it to the way of 10 years ago you can see the impact of technology. You used to see 60–70 workers for a kilometre on a road-building site. Today, for a kilometre you see two trucks, one heavy machine and six people working. With new technology, more fuel-efficient machines are building better roads. The cost of infrastructure is coming down, the obstacle to delivering infrastructure is coming down.”

If this effect of reduced costs and improved quality through modern technology is really taking place, it has not yet been empirically documented. On the contrary, the costs of road construction have risen substantially in recent years. High oil prices have been one factor. Others include management and governance issues.

The major bottlenecks in road construction and utilization are not physical but institutional. However, most countries have introduced major reforms in the sector, creating autonomous so-called road funds. These collect road user charges to be spent on road maintenance without passing through the general government budgets. A second step has been the creation of road agencies, independent government bodies responsible for contracting out the construction of roads. In addition, regional and country-specific issues are increasingly being addressed.

In the future, the high priority given to access and transport infrastructure will drive the further extension of road networks, while maintenance will improve. This holds especially for politically stable countries. However, it will require at least two decades to connect rural areas and to develop a trans-continental road network. Until then, physical and institutional improvements will be implemented for regional sections. Examples are the West African highway and the Mombasa–Kampala highway. In addition, trunk roads will be extended and improved, increasing their reach. In time, these developments will lead to reduced transport costs for most African regions.

Rail transport

Until the 1980s railways were an important mode of transport for many African economies, because of poor road conditions or government regulation forcing certain types of trade to use rail networks. Since the liberalization of railway networks and improvements in the road infrastructure, South Africa is the only country where railroads are still essential for the economy.

In total, 47 railways were in service in 32 countries in 2008. The entire network comprises 69,000 kilometres, of which 55,000 are currently in use. Most of the railway lines are single-track trunk lines, connecting inland economic centres with seaports. The only exceptions are several lines originating in South Africa, reaching north as far as Congo–Kinshasa and Lusaka. Most of the infrastructure has been built lightly and tracks as well as rolling stock are often in poor condition. Much of Africa’s



✘ Figure 6-1: The Nairobi–Mombasa passenger train.
Source: private

rail infrastructure has not been upgraded since its installation. The oldest sections are now more than 100 years in service. The capacity is therefore limited by low axle loads, low average speed, frequent breakdowns and very limited facilities. Probably the most ambitious railway construction and refurbishment programme is underway in Nigeria. The government is working on rehabilitating the connection between the port of Lagos on the coast, the trading city of Ibadan and the agricultural centre of Kano in the north of the country, also connecting with the capital Abuja. Land-locked Rwanda is likely to establish a rail connection to the coast through Tanzania.

On most routes in Africa, passenger trains are running, albeit with decreasing passenger loads as roads are being upgraded. One of these passenger lines runs from Kinshasa to Nairobi, shown in Figure 6-1.

Suburban commuter rail systems only exist in Dakar and in South Africa. For the city of Lagos plans for the implementation of up to seven lines exist, but progress has yet to be made. Plans for a trans-continental rail network have existed for over a century. However, in most cases expected trade volumes are too low to justify the investment. Nevertheless, on paper there is no shortage of ambitious projects. A Ugandan government representative explains his government's vision, including interesting cost-saving measures:

"The final goal is an electric railway system, linking Kenya, Tanzania, Uganda and Sudan. We cannot be there alone, the other countries have to be with us. In the medium term we are going to upgrade the current system and build alternative rail lines to keep it in function. We need the railway urgently for our imports and exports. The vision is clear. We have pronounced it ourselves and agreed on the documentation of the technical parts. Now we are just laying down the implementation mechanisms for embarking on it. It is expensive. So we are all saying, why don't we use our manpower? Why don't we use our personnel to help us, including army units? They are not fighting all the time. Why don't we build army corps in each of the five East African countries? Engineering army corps can do a lot. They can help us to do some of the work more cheaply and systematically. All this is part of the Union."

Upgrading infrastructure

The poor quality of Africa's infrastructure requires concerted efforts on many fronts to achieve progress. It requires expertise and reliable partners, who are willing and able to deliver projects at affordable rates.

The construction and maintenance of infrastructure are strongly globalized in Africa. In the past, most projects were executed by European companies, although over the last few years Chinese companies have increasingly entered the construction market. Sheila Ochugboju describes her perception of that new relationship:

"We have not factored in a different relationship that is changing infrastructure, which is China. China is changing the way things are. The Chinese are building infrastructure, and they are doing it systematically, doggedly, and at a pace that is shocking. They are bringing in technology, they are teaching people how to use it, they are transferring skills. The critical mass of the effect of China in Africa will become apparent when everything is completed in terms of bridges, dams etc. What we do not know is really what that relationship is about and what drives it. I think we will be looking more like Asia, we will adopt more Asian technology, more Asian cultures; we may merge it with our cultures. It will change how we look and who we are. China is a very competitive community, and how it merges with Africa will change things more than any other thing we are talking about. What does China want to look like and what effect does it want to have on Africa? What is China's vision for Africa? That is the vision we should be looking at. Because that is going to affect how we look at ourselves, for sure."

But China is not the only new player in the market. Nigeria has bought 25 locomotives in Brazil, Tanzania's railway system is managed by an Indian company, Russia invests in Sudanese infrastructure, and African governments and businesses are increasingly versed in deciding between the different global options. In terms of infrastructure projects, Europe is losing ground and would do well to take note of Africa's global outlook.

To build networks for several modes of transport simultaneously is a difficult task. Rwanda is one country with an extensive and detailed plan for upgrading its roads and airport, as well as installing a rail connection to connect the landlocked country to nearby seaports. Rwanda's current infrastructure mainly consists of its airport, as well as a highly degraded road network. An official at the Ministry of Infrastructure in Kigali outlines how this is going to change:

"Our transportation costs are very high. About 40% of the price of any product that you get is due to transport costs. Our long-term plan is first of all to get the core network, the classified road network, ship shape and then get into the rural areas. We have about 4,600 kilometres of roads that have to be rehabilitated, and that's just the core road network. We are trying to get that up to motorable standards right now. We also have about 8,000 kilometres of feeder roads in the hinterland. That's where the agriculture and production areas are. Aside from that, we are also constructing a new airport. Right now, that project is at the detailed design stage. We expect it to be completed by January next year (2010). We have two seaports that we see in Kigali: Mombasa and Dar es Salaam. Dar es Salaam is 1,400 kilometres and one border crossing away, Mombasa is about 2,000 kilometres away and you have to cross two borders. So extending the existing railway line from Dar es Salaam in Tanzania to Kigali and Bujumbura is our best option. We are conducting the feasibility design right now and by next year we will go into the detailed planning. This railway line is mainly for cargo, but also for passengers. The coming of the railway line would significantly reduce our transport cost. In the long term, we also want to link other places to the transport network of Rwanda. There will be a railway line coming from Kisumu in Kenya. If we link that line to Kigali it will also enhance the transport system. Another idea is a line from Lusaka to Kigali through Bujumbura. This is going to happen very soon, probably within the next 10 years."

Infrastructure investments are constantly under pressure, because of the lack of financial resources, as the same official explains:

"The key thing here in Africa is resources, financial resources to implement projects like these. These days implementing infrastructure projects is extremely expensive and there are other priorities in Africa. Instead of building a superhighway across the continent, we have to

take care of our schools, health sector, all that stuff. So all those things take precedence over infrastructure, sometimes because there's no point in building a high-tech transportation system that people can't afford."

Ambitious railway projects in particular suffer from these cuts. Their high costs for construction, operation and maintenance are often hardly justified. A Kenyan consultant gives another reason for the slow progress in terms of railways:

"To upgrade a railway line is a very large expense, and you can't do a quarter of it and say: we'll look for more money later. On roads, you can tarmac a section, then stop and use the rest as rough as it is. For a railway, you have to get the whole package."

Priorities on which projects do go ahead and which do not are often also a question of political power. In colonial times, connections between neighbouring countries were intentionally underdeveloped to avoid clashes with competing colonial powers. Today, by strategically upgrading infrastructure for some regions while neglecting others, supporters and opponents can be provided with different economic, social and democratic opportunities. Of course, transport infrastructure is also a tool for integration. The East African Union is pushing forward extensive infrastructural interconnections, as is ECOWAS, with the West African Highway as its main building block.

In an international context, infrastructure can also be a tool for negotiation. An interesting example is the proposed paved road cutting through the Serengeti national park in Tanzania. The highway would connect the city of Arusha to the coastal town of Musoma and has triggered massive protests from conservation experts as the route cuts through essential animal migration routes. An alternative route further south has been proposed and, according to some observers, the Tanzanian government's strategy might well be to provoke protests to such a degree that international donors will be willing to pay for some of the road along the lower-impact trajectory.

The economic opportunities arising with the extension and upgrading of infrastructure are well understood. Wambura Kimunyu in Kenya expresses how the same opportunities might influence on a human scale:

"People communicate with people. Why can I not go and take a course at Lagos business school? It is a very good business school as I hear it, and their lecturers are fantastic. I cannot benefit from them because I am all the way in Nairobi, but technology should be able to get us to interact with the best."

I also wonder what my mother would do with a train that comes from my up-country home, which is not very far away, about 2 hours. There is no train, but let's put a train between Nairobi and where she lives. Just what would she do? Where would she go? Would she become more of a farmer? How many businesses would she start? If you just put down the infrastructure, what does that mean for her life? Just lay down the infrastructure and stand back and see. I think that's what I believe."

Wambura Kimunyu's vision ties in well with another image of the future. Figure 6-2 gives an impression of the African continent at night in a future of substantially extended infrastructure.

The future of infrastructure

Figure 6-2 shows a continent with substantial developments in road, rail, air and seaport infrastructure. The image does not reflect the location of actual projects, but it does illustrate how ease of access can change a region fundamentally. Light spreads with transport infrastructure, as trade and other economic activities develop and settlements are established and grow.

At present, Africa's infrastructure is far removed from providing a coverage that is comparable to that of the mobile phone. However, the evolving ICT infrastructure will have more and more tangible effects on how transport infrastructures are being used. Tracking systems for goods and vehicles, monitoring systems for perishable goods, automatic



✕ Figure 6-2: Artist impression of Africa at night with its infrastructure potential realized. Source: NASA with own adaptations

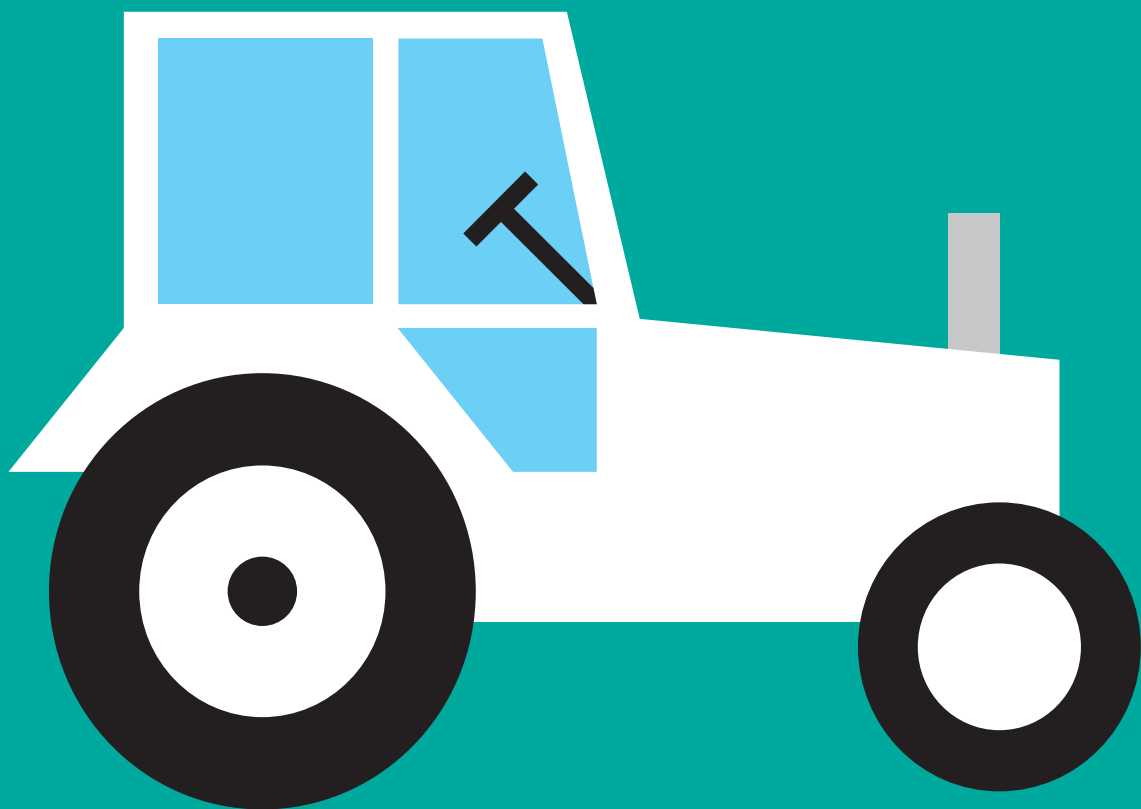
inventory solutions, theft protection measures and other ICT applications allow for a different and more efficient use of existing infrastructures. Chapter 4 provides some insights into these aspects.

Africa's physical infrastructure has improved significantly over the past three decades and is likely to continue this trend in the future. Because the construction of transport infrastructure of any mode is a slow and expensive process and because funds largely have to be raised from public funds, results will become visible with some delay. The first places to benefit will be the existing main transport corridors, often trunks between seaports and economic centres. In countries where the government is specifically addressing the needs of the rural population and where agricultural production promises sufficient trade volumes, the transport infrastructure, mostly roads, will spread. Looking ahead two decades and more, the evolution of a trans-continental transport network seems inevitable. Such a network would finally unlock the potential of trade within Sub-Saharan Africa.

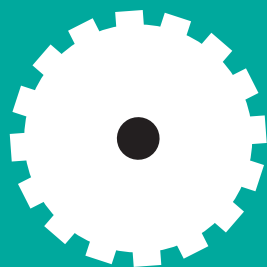
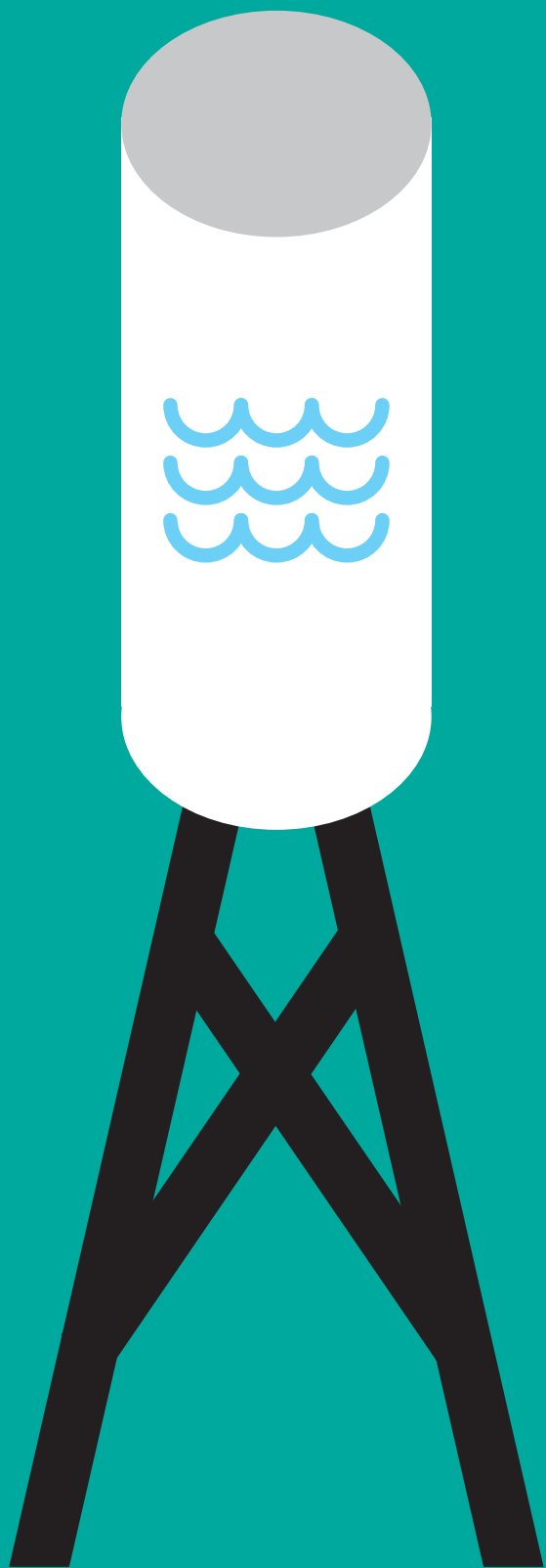


Recommended sources

- 'Africa's Infrastructure: A Time for Transformation' is an excellent and thorough inventory of the current state of all types of infrastructure on the continent. It is published by the International Bank for Reconstruction and Development and the World Bank. The report, as well as additional data and maps are available at <http://www.infrastructureafrica.org/aicd/>.



Chapter 7: **SEEDS OF CHANGE**



The relevance of discussing ICT, energy and infrastructure when exploring futures of technology in Africa is self-evident. Achieving progress in these fields is a question of technological innovation and its implementation. Also, for each of these fields, a pan-African trend is observable. There are pioneers and there are laggards, but one overall direction exists.

This chapter covers agriculture, an issue for which the primary drivers are less directly related to developments in physical technologies and where a common trend is difficult to discern. Fundamental discussions exist about how to achieve agricultural progress. Yet the sector is of key importance for the majority of Africa's population and for the future of the continent. And there are bright signs. According to the Overseas Development Institute, 17 of the 30 fastest-growing agricultural economies are in Sub-Saharan Africa. (Wiggins, 2005)

Almost two-thirds of all Africans live in rural areas and more than 90% of these depend on agriculture for a living. The majority of employment and a significant share of Africa's GDP depend on the sector.



▣ Countries for which agriculture is responsible for more than 50% of the GDP

According to FAO statistics, nine African countries depend on agriculture for more than 50% of their GDP, ranging up to 99% in Djibouti. And all strategies to fundamentally alleviate hunger and poverty include the aim of improving agricultural performance. Food insecurity, desertification, climate change, migration and conflict are just some of the issues, intimately linked with the future of agriculture in Africa.

At present, Sub-Saharan Africa's agricultural productivity is the lowest in the world. On a per capita basis output is even decreasing, because population growth is higher than the growth in agricultural output. 80% of the growth in output that has been achieved is due to increasing the land area used for agriculture, rather than due to gains in productivity per hectare. Cotton and soybeans in Nigeria are two of very few examples where yield per hectare has significantly increased.

There are no doubts about the potential of Africa's agriculture. 60% of the world's arable yet cultivated land is located on the continent, yields per hectare could be significantly improved, rainfall levels are comparable to South Asian and Latin America and far above European and North American levels, and there is no lack of cheap labour. In fact, the potential of agriculture on the continent is so large, that external investors are increasingly securing African land for their own food security, for the production of biofuels and for the attractive projected returns on investment, according to the FAO (FAO et al., 2009).

There are two fundamentally different perspectives on Africa's agriculture. One is a commercial agriculture perspective focused on the economic potential. The other puts development issues at the centre, with a focus on smallholder and subsistence farms. The commercial sector produces cash crops, such as food, fodder, fuel and other non-food crops, especially cotton, for the world market. Increasingly, this type of agriculture is combined with land deals. Recent examples include a 452,500 ha biofuel project in Madagascar, a 150,000 ha livestock project in Ethiopia, and a 100,000 ha irrigation project in Mali, all owned by external investors. Backed by sufficient capital, these projects are situated on

prime land with a relatively large use of fertilizers. Smallholder farms are often located on peripheral land and the farmers frequently lack the capital to buy high-yield seeds or fertilizer. Beyond the subsistence level, they do produce for local and international markets. The two perspectives are also reflected to some degree in two different visions on what the future of Africa's agriculture should be.

The first envisions a future of high fertilizer use and the use of ever-improving hybrid seeds that promise high yields and climate resistance. The soil is perceived as a chemical component in the process. The use of fertilizer is necessary, because phosphorus deficiency is widespread and is one of the main constraints to food production in sub-humid and semi-arid Africa. Most of the commercial sector follows that vision and several governments are encouraging smallholder farms with subsidies, training and other initiatives to follow this trajectory. In the long term, one of the main threats to this strategy is the fact that phosphorus reserves are diminishing and the cost of fertilizers is escalating rapidly. If too little fertilizer is applied, the soil quality quickly deteriorates. Once the soil is depleted or washed away and its ecosystem functions are easily lost, it can take up to two decades of careful management to restore this wealth.

The Kofi Annan-backed Alliance for a Green Revolution in Africa (AGRA) tends to lean towards this kind of vision, while also combining science and research with the needs of agricultural business and farmers. The intention is to duplicate Asia's green revolution in terms of productivity. The initiative receives substantial support from the Rockefeller Foundation and bases its drive towards commercializing agriculture on the argument that a 1% growth in agriculture produces a 1.5% growth across the economy.

The second vision applies techniques like crop rotation, manure or agroforestry and achieves high yields with the support of functioning ecosystem cycles. In this vision, the soil is not only a chemical component, but also a supplier of ecosystem functions, such as carbon capture, nutrient cycling, reduction in temperature and hydrological func-

tions. The benefit of the additional soil functions is that even in highly degraded land it is possible to increase productivity by decreasing the area in cultivation, because ecological land provides benefits to the surrounding cultivated area, increasing productivity and yields, as well as moderating extreme weather events. Also, community-based innovations and local knowledge are applied intensively. This approach to agriculture is mostly applied on clusters of smaller farms, but it is scalable. Such a system is more labour intensive, but at the same time requires less capital. However, to unfold its full capacity, to rebuild a lost soil ecosystem, requires about a decade, depending on the conditions.

This type of agriculture has been proposed in the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) report 'Agriculture at a Crossroads' (2009), which focuses on an environmentally friendly approach to agriculture. It proposes, for example, paying smallholders not to drain wetlands or clear forest.

Exploring the future of Africa's agriculture in general would require the sector to be considered from the commercial and the development perspective. It would require analysis of the risks and opportunities related to different approaches in all of Africa's climates and ecosystem types. It would require an understanding of local customs, regulations and circumstances. A whole book and a lifetime of study dedicated to this issue would not suffice to dare to guess Africa's agricultural future on such a grand scale. This chapter is therefore limited to an overview of the technological aspects.

Technological drivers of agriculture

Looking at the technological futures in the sector, a number of possible drivers can be identified. Each of these brings highly context-specific opportunities and risks along with it.

Plant varieties

The most common type of agricultural technology mentioned in combination with a look forward is the development and application of new plant varieties. Depending on the type, the advanced

varieties promise higher yields, resistance to diseases or drought resistance. Increasingly, the new varieties are hybrid seeds and are mostly developed by international research initiatives or businesses. A hybrid seed is produced by artificially cross-pollinating plants. They cannot be saved, new seed must be purchased for each planting, making them more suitable for capital-intensive forms of farming. The World Bank report 'Awakening Africa's Sleeping Giant' lists four examples of the introduction of new varieties and their impacts (World Bank and FAO, 2009):

- Improved disease-resistant and early-maturing maize varieties were a major driver of maize production growth in Nigeria during the 1980s. Extensive adoption of hybrid maize similarly led to robust maize production growth in Zambia.
- Rapid adoption of cassava varieties with improved resistance to cassava mosaic virus led to dramatic increases in cassava production in Nigeria during the 1990s. The development of a regional programme for biological control of mealybug averted a mealybug disaster in Nigeria.
- Rice research yielded a promising breakthrough during the 1990s in the form of New Rice for Africa (NERICA) rice varieties, which are based on a hybrid combination of Asian and African rice species. NERICA varieties feature improved drought and weed tolerance, and they yield well under low-input conditions. By 2007, NERICA varieties were being
- grown on about 200,000 hectares, mostly in Côte d'Ivoire and Guinea.

Genetic modification, hybridization and cross-breeding are all applied to improve Africa's staple and cash crops. This biotechnology revolution makes possible the relatively rapid development of tailored plants that address the constraints limiting an expansion of cash crops in Africa. A prerequisite for this development is the development of regulatory and research capacity, as until now most of the plants are being developed internationally.

Soil management techniques

A much discussed issue under the header of technological innovation is that of crop and soil

management technologies, such as appropriate tillage practices. In Asia and Latin America, advanced methods of managing crops, soil and its fertility for the long term have significantly contributed to increasing yields. These success stories still have to emerge in Africa, despite serious levels of soil degradation and soil-fertility mining. While modern techniques of soil management developed in Asia and Latin America cannot be transferred without adaptation, Africa could still benefit from the steep learning curve of the past few decades.

According to the World Bank (World Bank and FAO, 2009), one of the most significantly underused types of land is the Guinea Savannah. It covers about 700 million hectares in Africa in a warm, tropical climate with 800–1,200 millimetres of rainfall annually, allowing for a growing period of 150–210 days. One third of all the land in Sub-Saharan Africa, including more than two-thirds of Mozambique's, Nigeria's and Zambia's land, is of this type. Much of the related area is sparsely populated, yet it accounts for a quarter of the population. Only 6% of it is cultivated. Improved management techniques would focus on raising moisture-retention capacity, reducing erosion and depletion, as well as replenishing the soil.

Mechanization

During the 1970s and 1980s considerable development efforts were dedicated to the mechanization of Africa's agriculture. The expectation that tractors, pumps and post-harvest processing equipment would bring about significant improvements in agricultural output was largely disappointed and agro-industrial development stagnated. According to the FAO and UNIDO (FAO et al., 2008), the scope of mechanization has widened since then. Among the tools that should be put to use, the report lists tractors of various types as well as animal-powered and human-powered implements and tools, and internal combustion engines, electric motors, solar power and other methods of energy conversion, irrigation systems, food processing and related technologies and equipment. The potential of each tool differs widely per region. A tractor might be beneficial in one area, but lead to soil damage in another. The negative effects of mechanized farming without

detailed attention to local circumstances can, for example, be seen in the semi-mechanized rainfed systems of the Sudan, where soil degradation has led to dropping yields.

In contrast to subsidies stimulating the use of fertilizer, there are few incentives stimulating mechanization. According to the World Bank, rental markets develop quickly wherever machinery use is profitable. Usually rental markets develop first for tractors used for land preparation and planting.

One aspect of mechanization that deserves separate attention is processing technology. By increasing the technological capacity to process agricultural products within a region or a country, multiple gains are possible. At the farm level, simple processing techniques can help to preserve food or reduce labour intensity. A positive example is found in Nigeria, where mechanical graters for gari (a cassava-based Nigerian dish) preparation reduced the women's workload for fermenting cassava, allowing them to plant more cassava and increase the returns to their labour. When applied to products destined for international markets, a larger share of the value added remains within the economy. Another example is in the cocoa markets in Ghana and Nigeria, both of which are aiming to reduce the export of unprocessed cocoa and instead sell cocoa powder, cocoa butter and eventually chocolate. From juice production in Nigeria to macadamia nuts in Kenya, from fruit salads in Mozambique to cotton in Burkina Faso, the possibilities for gain are substantial. In many cases, the increased processing capacity is also in the interest of overseas clients, given that world market quality standards are met. For some products, shipping costs are significantly reduced as much of what will be processing waste will not have to be transported. The development of processing capacities holds great potential, especially for serving local and regional markets.

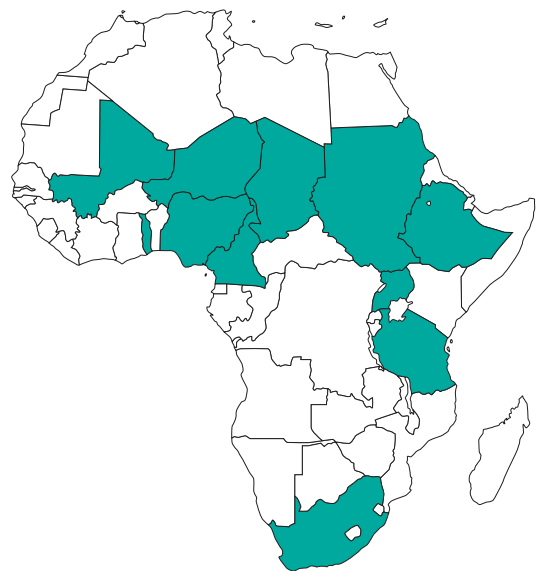
Irrigation

Africa's water resources are spread unevenly over a wide range of agroecological zones. Access to water can vary strongly and suddenly. Irrigation is one tool that can be used to mitigate the negative consequences of these characteristics. According to

the AICD, only 7 million hectares or 3.5% of all land in Sub-Saharan Africa are equipped for irrigation (Svendsen et al., 2008).

AICD maps out two future images to illustrate the crucial role of irrigation in making Africa's agriculture future proof. In a negative scenario, without more irrigation, harvests will gradually decline, mainly because of climate change. This would significantly increase malnutrition and the need for more and more expensive cereal imports. The contrasting positive scenario assumes that Africa's irrigated area could be tripled by 2050. Food supply would increase, cereal imports would decrease. There would be an estimated 2 million fewer malnourished children than under the lower-irrigation scenario. This positive effect would roughly compensate for the expected negative effects of climate change.

The largest irrigation potential in terms of commercial farming builds on the assumption that hydropower dams are being developed, reducing the cost of irrigation for large areas. Countries with a large potential in this respect are Ethiopia, Nigeria,



✕ Countries with an unused potential for small scale irrigation exceeding 100,000 hectares

Sudan and Zimbabwe. However, the largest gain in irrigation is related to smallholder farms. On-farm water storage in small reservoirs and farm ponds, water-harvesting structures collecting local runoff and the installation of water distribution infrastructure such as treadle pumps can be done at low cost and can bring significant improvements for land located within a three-hour drive to the nearest significant town. Profitable projects would cover 5.4 million hectares, almost half of which are located in Nigeria.

Physical rehabilitation of irrigation and drainage networks, improved technologies and appropriate agricultural mechanization can help to reduce costs, increase the efficiency of water use and make hitherto uneconomic projects feasible. Nevertheless, as the following overview of how to overcome implementation challenges shows, bottlenecks to the development of irrigation are mostly not technological (Svendsen et al., 2008):

- National agricultural water-development strategies need to be promoted and embedded into wider sectoral strategies for agriculture, rural development and water.
- Investment is required in institutional reforms to improve coordination among the government organizations responsible for infrastructure development and those responsible for irrigated farming.
- Future designs and investment decisions should be based solely on economic viability, farm-level profitability and sustainability.
- Investments in agricultural water are part of a comprehensive package to increase outputs, including empowered farmer organizations; sustainable, efficient and accountable agricultural support services; and accessible, profitable markets.

Infrastructure

Most African agricultural products are not competitive on the world market. Exceptions include cotton, sugar and maize, which are exported profitably from a few countries.

Even reaching regional markets comes at a significant mark-up. Generally, a lack of transport

infrastructure severely compromises the competitiveness of African agriculture. On the one hand, the high costs for logistics provide an entry barrier protecting local producers. On the other hand, the same costs need to be included in the cost price of Africa's exports, pushing them well beyond competitive levels. For example, Mozambican farmers, who are highly competitive in producing cassava for the domestic market, would have to cut domestic production and logistics costs by more than 80% to become competitive exporters of cassava to Europe. But even locally, reaching the nearest market or processing plant comes at a premium when the majority of farmers live more than 2 kilometres away from the nearest all-season road. Decisions on what to produce and what to invest in are dominated by the aspect of logistics, which also hampers the food security within countries. Chapter 6 provides an overview of what to expect in this respect.

Information

The spread of communications technology will have an impact on agriculture. The most immediate impact is related to the mobile phone revolution. African farmers and traders can quickly and affordably exchange information about potential sources of demand and supply, increasing market and production efficiency.

Nicholas Nesbitt, CEO of KenCall, describes how this exchange might emerge into a more structured information system:

"We are planning a technical 24/7 helpline for rural farmers. The mobile phone can become their instant education piece. Not only do they get information about the agronomy or animal husbandry – my cow is sick or my plant is sick – but we can also tap them into markets: what is the price for a certain product? We can also give them information about storage facilities, storage sites, storage rates, that kind of thing. While you are doing this you can collect information about the farmers. You can get a CRM application where you are tracking each farmer, what he has: 6 acres of tea, 3 acres of this or that, 70 cows, the prices he is selling certain things. That information can be made avail-

able to financial institutions, micro-finance banks and so on. Now they can apply appropriate credit. With that kind of information, farmers may not need basic information any more. They may be interested in prices, in crop insurance and even other kinds of education. The large farmers (we have 3000 top exporters) and providers like Monsanto might want to communicate down and communicate up. Who has beans that are going to be harvested on Monday, so they know how much to put on that plane in Nairobi on Monday? Who's got it on Tuesday, who's got it on Wednesday, so all the crops don't come together at the same time. To create this communication between markets and sell value-added things is a huge application of technology."

KenCall's helpline is very much focused on the supply side. On the demand side, information can also change consumption patterns, as an example taken from 'Awakening Africa's sleeping giant' shows (World Bank and FAO, 2009):

"Promotion of soybean recipes in Nigeria led to increased local trading of soybean food products, with attendant improvement in the nutritional status of many Nigerians, particularly infants and school children. Increased demand for soybean-derived products in turn led to increased production of soybeans. Nigeria, with more than a half million hectares of soybeans, is the only significant producer of soybeans for human consumption in Africa."

Technology transfer

Most of the technological drivers listed above rely at least partially on innovations outside of Africa. The transfer of technology is therefore an aspect that should not be neglected. UNCTAD (2009) lists several levels at which technology transfer can take place.

- The transfer of tacit know-how and skills between people internationally, regionally, nationally or between organizations is the most efficient path of transfer.
- Increasingly specialized producers, traders and

processors benefit from the linkages with buyers and other competitors in the market, exchanging machinery and equipment, marketing skills, management standards, quality protocols and production systems.

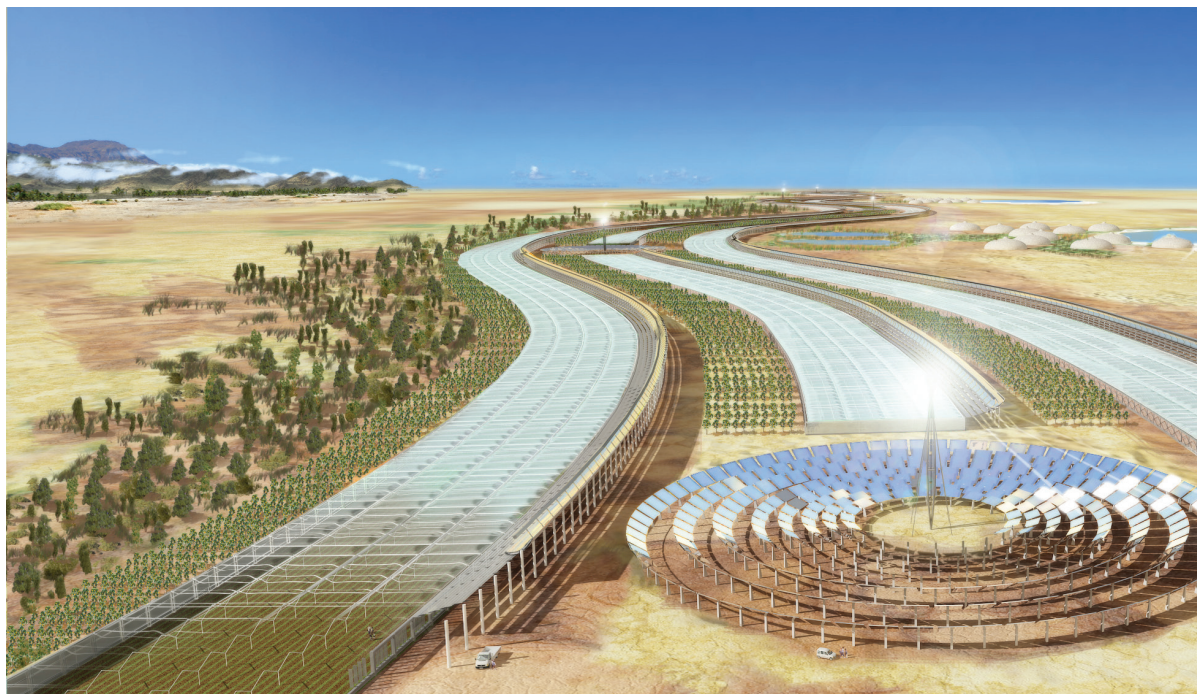
- South-South cooperation addresses issues of productivity at bilateral, regional and interregional levels and can include exchange of best practices, technologies and technicians on agricultural production.
- Increasingly important is market-driven technology transfer. Technology seekers from developing countries identify partners in the technologically advanced countries to acquire relevant technologies.

All the transfer paths benefit from a high mobility of the stakeholders, from the development of local knowledge and expertise, from the availability of appropriate finances, and from favourable circumstances for entrepreneurship. As the initial costs of introducing a new technology are quite high, non-African as well as African governments and NGOs are operating as initial financiers, match-makers or facilitators.

From a European perspective, the level of South-South technology transfer should not be underestimated. Asian countries, including India, China and Malaysia, but also Latin America, do increasingly exchange relevant knowledge with their African peers, because of their extensive experience with robust low-cost solutions.

Future outlook

A fine example of South-South technology transfer is the treadle pump, powered by a person's body weight. The pump lifts water several metres and can substitute for a motorized pump, which is more expensive in terms of initial investment and running costs. Its most frequent application is to draw water from lakes and rivers, replacing the much less efficient bucket irrigation. The treadle pump can increase farmers' incomes and the number of growing seasons; it can extend the range of viable crops and increase their quality. Treadle pumps were initially developed in Bangladesh in the 1980s and are now widely used in Africa on smallholder farms.



✘ Figure 7-1: The Sahara Forest Project. Source: Bellona Foundation, Bill Watts, Exploration Architecture and Seawater Greenhouse Ltd

In stark contrast with this technology and clearly focused on high-productivity commercial agriculture is the Sahara Forest Project. This is a technology- and capital-intensive approach to farming in sunny and arid regions. It combines a concentrated solar power (CSP) plant, producing heat and power, with so-called seawater greenhouses. These use the energy generated by the CSP to produce freshwater from seawater, which in turn is being used for growing food and biomass inside and outside the greenhouses. The approach is especially well suited for the production of high-quality crops with applications as fuel, food, fodder and fertilizer. A demonstration centre is currently under development. Figure 7-1 shows an artist's impression.

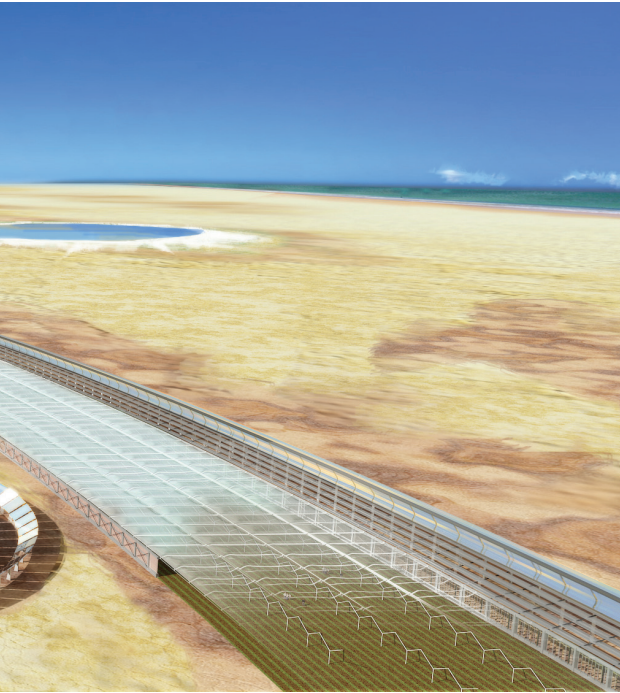
But not only outsiders think of high-tech futures for Africa's agriculture. Nicholas Nesbitt describes what he has in mind for Africa's agriculture in 2030:

"There will be farmers in 30 years who will be sitting in their offices 300 miles north of Nairobi or sitting in a tractor downloading in-

formation from someone in China and holding a conference call as they are driving. They will have a telepresence machine to share expertise on the latest irrigating technique or mechanical technique. Their client in Iowa is watching the planting process online and giving advice on how exactly to plant. Absolutely without a doubt that's going to happen here.

Without a doubt, there will still be some people in mud huts because they will be disenfranchised from the system. It is not going to be heaven on Earth, but not only mud huts, either. Skylines similar to Nairobi will be in other parts of the country. However, people will still be the same, they are not fundamentally going to change.

That guy who is driving the tractor while holding a conference call, he will be growing 2000 acres of some product for somebody elsewhere in the world. Farming will be outsourced to Africa. He will make a lot of money. He will still



be greedy and he will have the same human needs that people have today. He will want a Range Rover, he will want a six-bedroom house and a swimming pool for his kids, a gym and a virtual reality system. And technology will enable that."

The two projects and Nesbitt's vision show the extreme range of technological futures in agriculture. For millions of farmers, treadle pumps, drip irrigation and other small-scale technologies will fundamentally improve their future yields and livelihoods. These tools will be combined with increasing mobile communication and information, allowing best practices to spread quicker and gains to be realized more efficiently. As small farms are similar in efficiency to large farms in terms of local produce, these gains in efficiency will translate into real gains for farmers and consumers.

For investors and large companies with a focus on the world market, the future of African agriculture will look quite different. Increasingly, capital,

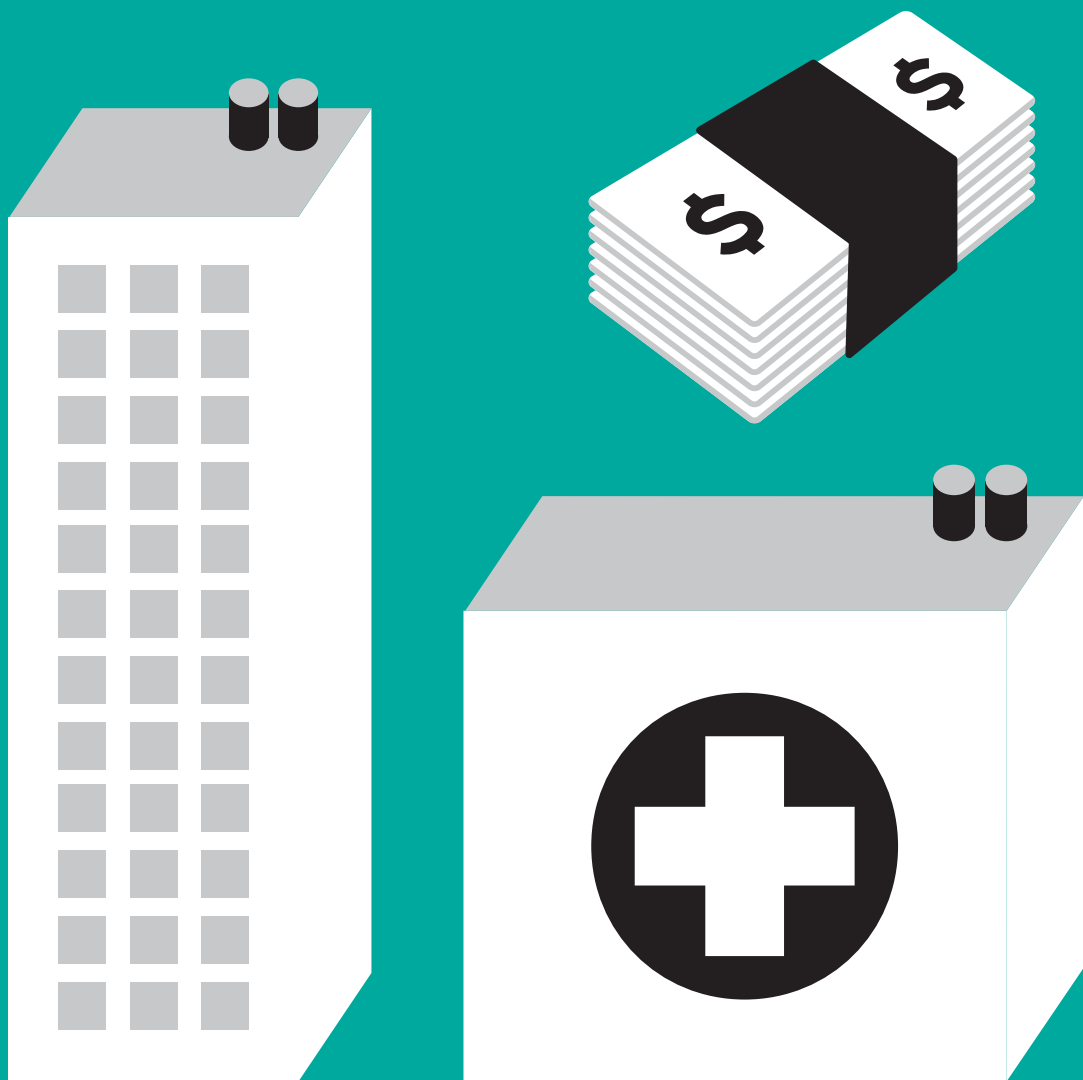
fertilizer, water and energy-intensive farming systems for cash crops will emerge. Africa does have the potential to feed itself as well as international markets. And increasing food scarcity attracts international investment on the continent to ensure food security elsewhere.

The dividing line between the two farming systems is likely to shift as infrastructure spreads. The more accessible a region is, the more likely it is to produce for the world market. As infrastructure spreads slowly, smallholder farmers will increasingly move to marginal lands. How this conflict is being resolved and whether large-scale farming methods will continue to rely on fertilizer-intensive production modes or also apply ecosystem-friendly methods will determine the future of agriculture in Africa. The conflict between serving world markets to earn much-needed revenue and the need to feed local populations and employ millions of farmers on small farms in the process could well result in a middle path, but as of yet, few images of that have appeared.



Recommended sources

- The IAASTD report 'Agriculture at a Crossroads' provides an excellent overview of agricultural knowledge, science and technology with an emphasis on local threats and opportunities. The report is available at www.agassessment.org.
- The World Bank's '2008 World Development Report' explores the role of agriculture in development. The report is available at www.worldbank.org/wdr.
- The UNCTAD 'Technology and Innovation Report 2010 – Enhancing Food Security in Africa through Science, Technology and Innovation' provides an overview of technologies and their context. It is available in the digital library at www.unctad.org.



With contributions from Wambura Kimunyu, Njoroge Matathia, Tonee Ndungu and Sheila Ochugboju

Chapter 8:

TOO MANY FUTURES





Each of the previous four chapters has a specific technological focus. This chapter has a broader range and focuses on developments beyond the year 2020. It provides glimpses of opportunities, ambitions, threats and fears in relation to Africa's futures.

For the first section of this chapter, interviewees were asked to formulate their own long-term Utopia and the obstacles in getting there. What is the best scenario one can imagine for the next 20 years and what stands in its way? What will be the factors influencing Africa's future?

The second section describes a set of scenarios that illustrate the diversity of possible futures. The scenarios are based on a FutureLab accelerated scenario workshop held in Nairobi in February 2010. Technology is only one of many factors in the storylines. Other factors include politics, economics, culture, lifestyles and many more.

Imagining out-of-the-box futures and expressing unconventional and provocative ideas requires that interviewees and workshop participants do not second guess their own answers with respect to their likelihood or possible consequences. Therefore, all interview and workshop contributions to this chapter are anonymous.

Visions uncut – the long view in the interviews

It is difficult to imagine futures that are not based on current trends and concerns, futures that are beyond business as usual.

Specific predictions are difficult to make, as a South African ICT expert explains while considering what kind of communication devices might emerge, although he can't resist adding one certainty:

"What would the device look like that we would use? 30 years ago, nobody even dreamed that anything like today could possibly exist. People then were thinking completely differently. They were thinking of space ships that still had monochrome CRT monitors in them. I can't tell you what is happening 30 years from now, nobody can; not in Europe, not here, not in the

States. However, if we do look 30 years into the future, obviously we will still be trailing behind the first world."

When thinking about long-term futures, small things can have a big impact. A Lagos-based entrepreneur illustrates this based on a newspaper advertisement:

"All the land around here was vacant and in the hands of property developers who didn't start building. They were waiting for everyone else to make the first move. The government then advertised in the newspaper that the owners of the land would have to commence building within seven days or the government would reclaim the land. The next minute you had a building boom going on. That meant more employment, more factories, more development with just one advert. That is surprising. And it makes me have a positive outlook. If Nigeria can get through this nonsense with the military and militants and that, I can see a big city."

The question of political stability and the quality of leadership is an important one that is raised in every conversation on long-term futures. An East African entrepreneur sees the opportunity and the risk:

"Africa has the potential to be a world power 15 to 20 years from now. How do we get from where we are today to having the status of a world power? Most important is this radical shift from the power being in the hands of a few to being in the hands of the masses. Leadership has to change on this continent and it will change, either by violent revolution or by peaceful 'democracy'. Democracy in inverted commas because that's a very broad brush to put on people. The democracy that's in the West doesn't necessarily work on this continent. But some form of leadership has to change. This continent needs 53 Nelson Mandelas. It needs 53 Barack Obamas. And there are people that could do it. It's just that they have never been given the opportunity. Since the days of the colonial times, the power has rested in a very

small elite group of families that kind of think that they run these countries like their own personal property. And that has to change. The majority of governments on this continent kept control by controlling information. They didn't allow people to know what was going on. Now, as information becomes more available, as technology makes it easier for people to access information, those days have gone I think. And the people in this continent are going to eventually stand and say, you know what? We don't have food, we don't have water, we don't have anything and you fuckers are sitting up in your big mansions, driving your big Mercedes and stuff – it's not going to happen. We elected you. You are public servants. You work for us, we pay your salaries. Now let's see some of that return. And if you can't do the job, you're out. And I think that shift is happening in many countries around the continent."

Another answer focuses on the ability to bring curiosity and access to knowledge together. The ability to find answers that fit the continent will reshape it:

"I am one of the few people that actually believe in those visionary pictures of cities of the future. I love that 2030 picture of what Nairobi will look like with the flyover, with multi-layered highways and all of that. I see it as completely possible that we will have it. Why not? It is just one big building project that will be harnessing technology. We will also be harnessing water in different ways, we will be getting electricity from all sorts of ways we didn't imagine. It will be done not with the classical technologies that we now see, like solar power; we will be using blends of technologies. And I believe that indigenous models will spring up that marry those. Those things are not being taken up in the way they should be because something doesn't connect with our culture, ourselves or our vision. There is no technology that we have now that will translate in its pure form into Africa; nothing, not one type. It will always be indigenous and adapted if it is going to live.

All that will happen because the mindsets of Africans will change, I hope, to that Asian mindset of reverse technology: you take it apart, you build it, you use the bit that you want and then you move with it. That will happen when we give ourselves permission to do that. I imagine the average child growing up in Africa now seeing a problem and understanding that there is a technological or scientific basis to that problem and the technology can help to solve it. That is not so hard. I was that child. I grew up in Nigeria and when I was about nine in the '70s and I looked at things and I wondered what was inside, I simply cut them up. I opened them up, and all I needed was two or three other conversations and I would have been able to innovate and construct something. So that is not something particularly new, it is about where do we source those tools that allow us to create that answer. Technology now allows us to look at where the sources are in a way that we never could before. I can ask a question anywhere and find somewhere in the world that somebody has a solution. We never had that capacity before. Therefore, whatever problem I have in my village, in digging a well or whatever, I will find the tools around me and the know-how somewhere else and create the solution exactly where I am. That kind of change is what Africa will have, that is what the African child will be like in 10 years.

That mind change will have to happen first before a radically different future begins, before we see wide-scale change. We will not develop out of nothing like those in Dubai until we get a mindset shift and that will take 10 years. Then we will be able to look at a desert and imagine 'Dubai'. We have already done some things. Abuja was nothing and now it is a city and it is gorgeous. We are very proud of it. It looks like something in South Africa, it works, it is clean, it is fantastic. So we can look at a desert and imagine a city, a city that other people want to come to. That is a mindset shift. We will be having more Dubais in this desert area.

We will not have as much conflict as we have been having of late because we are more of a global community. We are more interested in a collective outcome than we have ever been at any other point in the history of mankind. So I think all those class issues, all those other tensions of dividing up the world, or divide and rule are really on their way out. You cannot do that any more, because we are so connected, we have a global vision. That is going to change everything.

Our boundaries will be more fluid. It would be wonderful if they disappeared in the next 15 years. At least some boundaries will disappear. Perhaps Africa will just be North, South, East, West, Centre. There would not be 54 countries, there will be just 5 regions with groupings of people who are connecting. In 15 years' time we will not be having national governments. Economically, we cannot afford it in many countries. Many tiny countries with tiny governments, it is ridiculous. We have to harness our collective power. The external forces that stopped us from doing so are weak now, and we are becoming more empowered. That is the Africa I am thinking of. That is where I am going."

Not everyone can see a city where there is a desert now. But many can see Europe or Asia and their visions for the future do reflect that. Government plans and the officials who put them forward are particularly prone to these 'copycat futures'. A Ugandan government official explains his vision for what his country's future will look like:

"Our vision is to see this country become a modern economy similar to the countries in Europe. We want Uganda to be like Europe in 30 years. So in terms of infrastructure you just mirror what you see in beautiful countries like Switzerland, Norway, and even the Netherlands. Those are the kind of models we want to copy. Some others have problems. They left too much to the market forces and it is difficult to undo some of the bad planning that has happened there.

We also admire countries like Malaysia and Singapore, who were like us about 20 years ago. In fact, Uganda was doing better than Malaysia in the '60s, but now they have taken off. They have taken advantage of certain small things, and yet we have many more resources in this country, many more to enable us to take off. And we are thinking that the current per capita income of about 323.40 US dollars should be growing to more than 1,000 US dollars. It must be. We are developing a set of five-year plans, aimed at achieving milestones along that path to the targets that we are setting. We are setting targets in the future about everything in this country, about what we think a modern country looks like. Even in the rural areas we are talking about what kind of land use we want to see happening in the villages. We are even tackling very sensitive issues like land tenure. What kind of land tenure do we want to see? We are tackling population. What is the population that we expect to have in 30 years? What do we want it to be? Can we do anything to make sure that it is? All these are sensitive issues that we are tackling and pronouncing ourselves on. Therefore we will achieve our targets."

A Ghanaian government official does not refer to specific countries, but he does sketch a future in which all will be like Europe today, but with a risk of falling back:

"For the year 2020, if things go the way we want, then I foresee well-educated, well-informed and healthy people in the country. We will have enough money to finance the construction of infrastructure that will provide access to the whole country. As a consequence, the type of settlements will change. The cities will become denser because we won't have enough land to spread as we are currently spreading. The people will build their own country instead of moving away.

But we should be aware. Certain countries have gone through this before and they had everything and they've lost it. They went back

down before coming up again. Wealth is not the issue in determining our progress, it's how you use it. You have to use this wealth for the people. That is important. How we spend our wealth depends on the right kind of leaders. Not only in terms of government, but also in other fields. We need, for example, the right leaders in the university and in businesses. Leaders with the people in mind. Then we will improve and see education, health, money and infrastructure."

A Nigerian official explains his country's vision, which has been inspired by the prospect that Nigeria is likely to become Africa's biggest economy in time. In this case, the rest of the world is explicitly set as a benchmark.

"The idea of envisioning Nigeria to become one of the 20 largest economies in the world was based on two pillars. The first pillar is the magnitude of the GDP. We are targeting a minimum of 900 billion US dollars GDP. The second pillar is based on the per-capita income and we set the target at a minimum of 4,000 US dollars. Those are the two crucial targets. Beyond that, we are also looking at the Millennium Development Goals and all the related indicators: poverty, child mortality, environmental degradation, trade relationships, governance and so on. Everything we are talking about is based on technological advancement. Actually, science and technology happens to be one of the major themes out of the 29 thematic fields we talked about in the process of developing our vision for 2020.

Achieving our targets will require massive investments into various sectors of the economy. We are also talking about diversifying the economy, we are talking about reforming particularly the political system, the elections and the election system, we are talking of investing in technological advancement. I think the latter has been the Achilles' heel of development in so-called developing countries. We have merely paid lip service to technological advancement. Now we've seen the need to

really embrace it and make a quantum leap. If you invest very little you will discover you are not going to make any impact. By changing our investment profile we will be able to change the structure of the economy."

Outside the circuits of government visions, more concrete ideas can be found on the future. In these futures as well, mirror images of technologically leading countries outside Africa can be found, but this time in the shared dreams and fears that might actually become reality in Africa earlier than elsewhere, as a South African technology pioneer explains:

"Everybody will be connected all the time and they will be connected to the most sophisticated devices all the way. Web-enabled people will be always on with the networks that are being connected. The speeds are going to be increasing customer experience. Once everybody is connected and once this web space of people can be mobilized, it becomes a massive agent for change, an agent for good. We've seen that kind of social network in power happening on the web, we are going to see it in mobiles – in a way I just see the one fusing into the other at some point. Is that Utopia? I don't know. Aren't we going into a situation where in we can hack into our memories? At some point we are going to go into web rehab."

Another South African ICT pioneer thinks about the future in much more current terms:

"ICT will change the way people work, the way people view the workplace itself. And the generation in school today is not going to want to be stuck in an office if the work they do does not depend on the office environment. The phone could well become the computer box and TV tuner. It could well serve as a backup, but it will not replace the front end of the computer screen or the TV screen. These sound like small technological changes, but they will transform society as much as the advent of the digital age has transformed the West."

In Lagos, traffic is a major concern. In a city in which traffic jams rank among the biggest and most persistent on the continent, tiny improvements seem a long way off. One citizen explains what he hopes to see by the year 2020:

"The country will look fairly advanced, very advanced. The transport system should improve, the economy should improve. Ten years from now, the benefits of the Bus Rapid Transit system should be visible. Also, we have street lights, but are they effective? A police man has to stand there under the sun waving his hand – that is a lot of waste of human energy. Things should be done better. We should have a constant light supply ten years from now. That is what we are dreaming and I think that is a dream that can come true."

These excerpts of futures show that any development that is likely to take place over the next decades is likely to follow the Western example. Overall, these futures exhibit little deviations from copying richer countries.

FutureLab – the scenarios

Interviews are one way to elicit snippets of futures. However, any possible future is the result of the interplay of a wide range of factors, of which technology is one. These interactions are best explored with the help of a diverse group of people in an open workshop setting. Some of the interactions to be explored are evident. Infrastructure cannot be built without financial capital and thus depends on a favourable economic climate. Environmental change has significant impacts on agricultural systems. Political stability influences social aspects, such as crime or social cohesion. Other interrelations are more subtle or unexpected. The proverbial butterfly can cause a hurricane. In its early stages, the mobile phone was such a butterfly. One leader, one influential idea, one change in a faraway place, can change the course of a country or a continent for better or for worse.

Scenarios come in two different types. Envisioning scenarios describe a desirable future and a path towards it. This kind of scenario is especially

well suited to generate momentum for a preferred development. Once a vision is widely accepted, all actors can identify their own ways of contributing to it. Priorities can be established, decisions weighed and uncertainties about future actions reduced.

Explorative scenarios, on the other hand, describe different ways in which the future might evolve. Such a set of scenarios provides a framework for reflection of one's own expectations and activities. Explorative scenarios are best applied to map out diversity and to develop long-term strategic options in an uncertain environment. They also increase the likelihood of identifying opportunities, threats and windows of opportunity for influencing developments at an early stage.

Neither of the two types of scenarios is a prediction. The plural in the title of this book, 'Futures of Technology in Africa', refers to the fact that the future has not yet happened and, as a consequence, many futures are possible. Futurists do not study 'the' future, but the many desirable and undesirable possibilities.

There is a widely shared vision for Africa and the following interview quote is a good summary:

"Progress for me on this continent is where no man, woman or child ever goes hungry to bed or starves to the grave. Every African has food, water to drink and bathe – basics that in the West are taken for granted. This will be major progress on this continent. The rest will all fall into place."

However important this vision is, it needs to be specified in order to generate momentum. The Millennium Development Goals and the underlying task-force plans are one example of doing so. By focusing on a set of key achievements for the future, massive resources have been mobilized and efforts combined to move towards the common goals. National visions, such as Kenya's Vision 2030, are another example of envisioning scenarios. By mapping out a national future, all actors in society become accountable for achieving it.



Figure 8-1: Accelerated scenario planning in action in Nairobi. Source: Joshua Wanyama

Explorative scenarios are much rarer in and about the African continent and African countries, as Chapter 2 shows. Several interviewees have given the extremeness of possible future scenarios as a reason. Kenya might be in a civil war before the next election or it might become a positive leader in East Africa. Rwanda stands between truly remarkable quantitative development improvements and another outbreak of massive violence. Nigeria stands between becoming a globally emerging economy, following the path of the BRIC countries, and falling apart into several regions in a chaotic process. Also, the high probability of high-impact interruptions in the short run is discouraging the development of long-term future scenarios.

However, it does not take much to overcome these concerns, as I have experienced during my travels, interviews and workshops. The scenario workshop on which the structure of this chapter is based proves the point. Ten participants engaged in an

intensive process of delineating future scenarios in an accelerated scenario planning workshop (Figure 8-1). The Nairobi process was based on a seven-step approach:

- Clarifying scope and context
- Identifying stakeholders
- Identifying driving forces
- Selecting key un/certainties
- Building scenarios
- Reflecting on the roles of technology
- Selecting options and actions

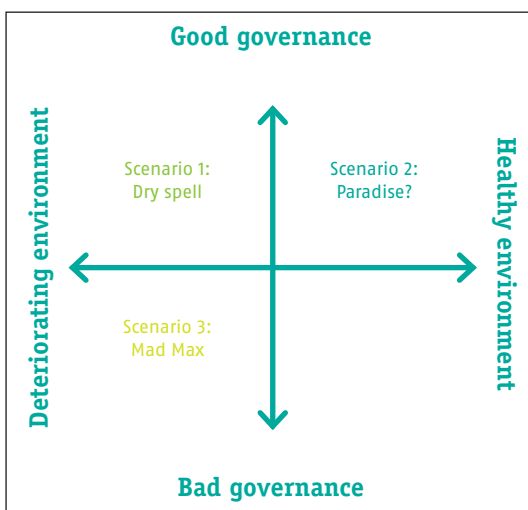
The scope of the workshop was to explore East Africa's futures over a time horizon of 20 years, with the goal to gain a better understanding of the macro dynamics shaping East Africa's futures. A large number of societal actors are the stakeholders in these futures, often with multiple roles. The list below comprises those who influence the futures of East Africa and those who are being influenced:

"Me; International community; International donors; NGOs; Security organizations; Organized crime; Warlords; Army; Farmers; Business; Entrepreneurs; SMEs; Angel investors; Venture capitalists; Private equity money; Innovators; Technological experts; Communication industry; Media; Academia; Politicians; Government; Opposition; Community elders; Religious groups; Women; Youth; National minorities; Indigenous groups; Students; Artists; Writers; Film producers; the Millennials; Philanthropists; Educators; Diaspora."

Drivers shape the parameters in which the actors operate. They can be social trends, economic realities, technological drivers, a regulatory environment and so on. In order to explore possible futures, it is necessary to explore the diversity of issues that might shape it. In a scenario process, there are therefore no wrong answers in this quest for variety. The following list was drafted during the workshop:

"Human nature; Technology; Wide access to ICT; Communication; Poor-rich divide; Unemployment; Crime; Fragmented communities; Poverty > Urban poor/Rural poor; Refugees;

Food security; Lifestyles; Imported food; Loss of agricultural skills; Food/water shortage; Media; Geographical position; Population; Globalization; Competition for resources; Climate change; Urbanization; Disconnected communities; Parallel lives; Access to health; Security; Government policies; Science; Stability; Trade; Self-expression; Personal branding; Religion; Personalization of media; New markets; Individual self; Old money; Infrastructure; Roads; Ports; Railways; Airports; Economic growth; Terrorism; Fundamentalism; Revolutionaries; Wealth per capita incomes; Gated communities culture; Environmental degradation; Natural disasters; Historical injustices; Grassroots uprising; Government; Politics; Loss of relevance of government policies; Culture; History; Geopolitics; Corruption and transparency; Donor policies; Professions; Political stability; Regional integration; Spirituality; New national identities; Global citizenship; Freedom; Balance; International Criminal Court; Rule of law; Art; Education; Religion; Leisure; Entertainment; Health; Funds; Aspirations; Refugee groups; Displaced people; Constitutions; Education; Needs of people; Entrepreneurial spirit; Devolution of power; Slavery; Land policies."



❑ Figure 8-2: Scenarios driven by differences in the quality of governance and the state of the environment

Exploring all possible developments for all drivers is not an option, but it is possible to make an initial estimate of which drivers are most likely to have a heavy influence on the general direction in which the future will evolve. This ranking is based on two criteria: un/certainty and impact. Some developments are more foreseeable than others. The path of urbanization, for example, seems more foreseeable than that of the quality of governance. Uncertainties are factors that may emerge and shape the future – we don't know which way they are going to go. Those uncertainties with a high potential impact are selected to build the scenario framework.

The group identified 'the quality of governance' and 'the health of the environment' as the two drivers combining the biggest uncertainty with the highest potential impact. Three of the four possible combinations of these two uncertainties were translated into a scenario, as Figure 8-2 shows.

For each of the scenarios, possible reactions are explored in terms of the uncertainties and in terms of stakeholder responses. In small groups, causalities, mutual reinforcements, vicious and virtuous circles, vested interests and the strength of driving forces are identified, resulting in the four scenarios below. These scenarios have been written up by Wambura Kimunyu, Njoroge Matathia, Tonee Ndungu and Sheila Ochugboju based on workshop results.

Scenario 1: Dry spell

2010 is an erratic year insofar as the weather is concerned. With the passing of the years, the situation worsens. The seasonal rains that underwrite Kenya's economic mainstay, rainfed agriculture, become increasingly unreliable. Drought becomes the rule rather than the exception. Average temperatures continue to rise. The Sahara continues its southward march. Lakes and rivers run dry. Tensions rise between communities as they compete for resources: pastoralists and farmers fight over land. Everybody competes with everybody else for smaller and smaller pools of water. Herds of animals die. Crops fail.

On the political front, the 2012 elections yield a largely recycled parliament and government. Kenyans grit their teeth and take what is handed to them. The political class continues to be too embroiled in self-serving squabbling and jostling for power to pay heed to ominous signs of environmental deterioration and social unrest all around them. Except when these can be used to score political points, of course. Rural communities, deprived of their source of livelihood, become increasingly impoverished. The young and able migrate to the cities, in pursuit of a better life; the vast majority stream into the slums, which are already overcrowded and bursting at the seams.

The gap between the rich, largely participants in and beneficiaries of Kenya's bustling knowledge and information economy, and the poor, those rendered vulnerable by the decline in Kenya's agricultural sector, continues to widen.

Tensions rise in tandem. It becomes clear that things cannot continue as they are. They must get better, or they will get far worse.

A small group of visionary first-term members of parliament emerges post-2012. They determine to be the difference, to defy the pull towards base politics and to work towards pushing through key game-changing legislation such as a land-use bill that seeks to optimize the use of Kenya's land resource, taking into account both economic and environmental considerations.

It is an uphill battle and they lose more than they win. They make many mistakes and it is clear that their zeal exceeds their political savvy. Still, Kenyans take notice, not of the end result but of the effort.

In 2017, one among this new crop of politicians is elected president. The race is close, but the message is clear: Kenyans are tired of the same old, they are ready for a new way of being Kenyan. Unfortunately, the mandate is not overwhelming.

The new government sets out to effect the change it has promised Kenyans, but it struggles against a disgruntled and uncooperative opposition that is dominated by the old guard. They deliver on some key promises, such as curbing corruption and building industrial and technology parks geared towards attracting foreign investments and providing employment to Kenyan youth. But they soon realise that the social rifts are more insidious and will take longer to heal than they had anticipated. Despite their best efforts, they encounter much scepticism and impatience and make little headway. Kenyans, impatient for change, do not allow the new president a second chance. He is voted out in the next elections.

However, Kenyans have also developed a very clear idea of what they want in their leaders and what they want their leaders to deliver to them, so they send packing practically all the remaining old guard in the 2022 elections.

Consequently, another progressive visionary leader takes the helm with a clearer mandate and immediately begins to build on the foundation laid by her predecessor. The journey towards meaningful change began in 2017, but it becomes fully entrenched in Kenyans' view of themselves in 2022. This is the year that they turn the corner in their minds and scale the 'point of no return'.

Convinced that Kenyans retreat into their divisive definitions of themselves most when they believe that this is the only way to guarantee access to scarce resources, the president and her team work to articulate a clear process by which all Kenyans have relatively equal access to Kenya's human, physical and knowledge resources, independent of location or community of belonging. It is not an easy task, but they make enough headway to earn the trust of the people.

The threat of conflict in the face of scarce resources is not eliminated altogether, but the government is for the most part successful in neutralizing up-and-coming warlords or self-declared community leaders seeking to exploit the discontent or scarcity of resources to achieve their own ends. On the climate and environment front, matters come to a head. In the early 2020s, unrelenting scorching temperatures translate into a heatwave that kills hundreds of people, the vast majority aged above 50 or below 5. It is an unmistakable wake-up call. Already, 70% of the population lives in urban centres, with a whopping 50% in the capital city of Nairobi.

Many of them are still living in non-permanent dwellings and lack basic necessities such as water and lighting. The government sets about to fulfil the promise made by successive past governments to provide decent housing for all by embarking on an internationally funded housing project of massive proportions in partnership with the private sector to provide low-cost housing for every Kenyan family. The project is to be implemented over a period of

ten years. These houses come equipped with the now widely available basic climate-control devices to avert a disaster similar to what happened during the heatwave.

In addition, new legislation is passed so that all new buildings must be equipped with basic climate-control technologies. Landlords of existing properties are also required to install climate-control devices of a specific standard. The plan is effectively to convert every indoor space into a climate-controlled space by 2030. The climate-control project is dubbed the 'Cities as Refuge' project.

To ease the state of overcrowding in Nairobi, the government sets about upgrading strategic towns in each of Kenya's ten constituent states (formerly provinces). It gives incentives to institutions of learning, local and foreign investors as well as citizens to relocate to these new centres, each of which is a centre of excellence for one or more of Kenya's key economic activities and houses the headquarters of a key government function. Citizens can access all necessary government services online, via their mobile phone, or within a one-hour bus ride. Key to ensuring the success of this decentralization is the development of an excellent infrastructure network connecting Kenya's town network in multiple ways so as to allow ease of movement from one to the next by air, road or rail.

To jumpstart agricultural activity once again in order to ensure that the country is able to feed itself for strategic reasons, the government imports existing technologies and practices that support the harvesting of rain, the conversion of sea water into a viable water resource and the mining of deep earth water. The new government also builds on the land-consolidation policy instituted by the previous government by creating incentives for the consolidation of agriculturally viable land and disincentives for the division of this land to any size below ten acres. In this new land-use dispensation, land is more often owned corporately, by family foundations and territorial cooperatives than

by individuals. The government also institutes a process of channelling local and international agricultural research available to practitioners, with a view to encouraging the uptake of a new family of high-yield, drought-resistant crops.

To empower the young and the poor, the government institutes entrepreneur-friendly policies such as bolstering second-tier technical institutions and management training, as well as providing access to cheap finance for new businesses. Robust education and innovation policies create an environment conducive to entrepreneurship and Kenya, which is already a global leader in telecommunications innovation, cements this position further and widens its sphere of competence to the broader ICT sector to compete on a par with global leaders such as India. The Kenyan diaspora participates in this drive by bringing 'home' skills gained from their international sojourns and sending cash to fund the new and fledgling businesses.

Unfortunately, the extreme weather that has become the norm has led to a drastic reduction in the animal population, which in turn has led to the demise of one Kenya's prime foreign-exchange earners, tourism.

On the social front, the incidence of ailments induced by extreme climate, such as skin and lung diseases, is on the rise. So are diseases associated with poor nutrition, especially among the less fortunate in society. In response, the government directs funding and effort towards making a good standard of both preventive and curative healthcare available to all – to the poor for free, and to everybody else at an affordable cost. A key aspect of this effort is the mainstreaming of indigenous health research, with a view to developing proprietary solutions that can be administered widely by healthcare professionals or self-administered at reasonable cost.

Scenario 2: Paradise?

In this scenario, the ideal situation is a positive input from both the government and the environment. The impact would be socially and economically beneficial and would raise the standard of living of both the people living in the country and those in the Diaspora who are usually concerned about sending their money back home.

"When Africa is a paradise, government will be of the people, for the people and by the people. The daily lives of African people will be guided by principles of good governance, freedom and equity. But in such a world, would the state institutions assume too great a power? Would technology be used to spy into people's lives in order to maintain the peace? In liberal democracies such as the UK, the average Briton is captured by surveillance cameras at least 25 times a day."

In this scenario, security would greatly improve and education would be widely available at an affordable cost, if not completely free. Housing, though not necessarily cheap, would be within the reach of many more people and health would be a socially sustainable system. The country would concentrate more on environmental issues and external business and political relationships, because the internal systems of government would cater for the people. The taxes would cater for the unfortunate and elderly, while the infrastructure would widen the reach of trade and commerce on the country. If Kenya was to be an example of this, the case for the country would be worlds apart from what it is now. To start with, there would be more cities and less congestion in the single real city of Nairobi. It would no longer serve as the capital of both business and government. The fragmentation of sectors to different cities would mean a greater disbursement of human and financial resources and a better ratio of people to space. With communication being of crucial importance and travel in need of efficiency and speed, infrastructure would be a priority and trains, road, rail and air would

be available in different parts of the country at different levels of size and capability. As a result, movement would be greatly facilitated.

The political culture would also be different. A more civil strategy would be adopted in handling matters of public interest and public resources. The justice system would widely oversee the implementation of the law, with little if any involvement of political or public influence, and the security apparatus would be a force to respect rather than regret. Education would facilitate a larger range of careers and permit the creation of new varieties of professions, concentrating on art more than science. The continual dependence on a particular commodity such as agriculture or tourism would reduce and more forms of strategies for economic independence would take their place.

Home-built solutions would mean more internal financial exchanges and export material, giving the value of the currency much more strength. Entrepreneurs would have a better chance of having businesses and more people would seek employment within the country rather than abroad. Those working from outside the country would have a real interest in investing and working back home, thus increasing the productivity of the nation. There would be a more vibrant leisure and art scene and many more bands, painters, carvers, decorators and those of exquisite taste would get involved in the scene.

This scenario seems the most conducive to growth and the development of both the social and economical aspects of a country. However, unforeseen challenges arise. Social structures in such scenarios tend to break easily, because there is less need of them. Families disintegrate as children start to leave home for schools that are far away and have more than adequate boarding facilities. The family unit is placed under undue strain when financial challenges are present, and in many cases this brings families closer. But when there is little need for teamwork within the

home, a silent but steady lack of interest and connection is created in the family unit. Such anomalies lead to the slow degradation of the family unit and vices among all the members, including children from the early age of 5 years.

A strong economy attracts various vices that seem positive at first but quickly turn negative. The first five that come to the fore are immigration, travel, education, technology and welfare. Immigration is usually the first sign of a good economy and good governance. More people from worse areas settle in the country with the intention of building a life for themselves. The pressures of such settlement can vary from xenophobia to extremism and can include a cultural clash or dilution and the medical and psychological implications caused by a simple change of lifestyle or by exploitation. An explosion in human trafficking in more developed countries has involved immigrants to a high degree. The slave trade, drug trafficking and other vices are also activities built around the illusions immigrants have of better lives in developed countries.

Travelling is another opportunity that this scenario provides for the citizens of the country studied. Holidays, sports events, business opportunities and family-related trips mean that these people are exposed to more from around the world than their counterparts. While this may seem to be of great advantage, there are great disadvantages to it as well. An example is the negative interference they have in the places they visit. Whether it is by using the power of their currency to buy property that would have been for locals or the environmental damage caused by outsourcing companies hired for less cost, the involvement of foreigners in poorer countries tends to slow the progress of the country itself. Additional effects such as cultural transfers that cause culture clashes, for example in sexual orientation and dress codes, can damage the interaction between generations in a country's evolving culture.

"When Africa is a Paradise, the environment will be a healthy ecosystem that maintains biodiversity, displaying a beneficial inter-dependence between humankind and nature. But will this environment be natural or genetically engineered? Will normal systems of birth and death be circumvented by technology and therefore new unforeseen ecosystems emerge, with more virulent threats? Superbugs and viruses?"

Education that has well-developed foundations tends to celebrate more art-based studies than scientific studies. This means that as the education system improves, more and more students tend to take up social and art studies than scientific ones. As students from foreign countries come to join our scenario country's education system, they tend to move along with the idea of social and art-based studies that on their return home can hardly apply in their environment. This usually renders them unnecessary in their countries of origin. The spin-offs from this include unemployment, frustration, dependency and a lack of personal and collective fulfilment and progress.

Technology has to be the simplest of the good-to-bad effects that our scenario can offer. When in a country of such advancement, this comes easily and the lifestyle is of efficiency and clarity. People living in that environment cannot adapt to other environments as easily, making them at a disadvantage on a change of environment. Examples include banking, security, health and transport. In addition to this, the idea of integrating foreigners into such a system can prove difficult beyond measure. The additional side effects of reliance on machines to do things is the human coldness that is created as a result. Most people, who in less technological settings would have to interact more with others, tend to be cold and removed because of their lack of such person-to-person interactions. This develops more rigid and still individuals without the ability to connect fully with others. People end up becoming one of two extremes: either completely detached and indifferent, or radical and rebellious with

various interpretations of their rebelliousness (in fashion, art, music, character, behaviour, habits and so on).

"When Africa is a Paradise will the masses of African people – over 80% today who struggle for lives through rural agriculture – find new ways of living in modern knowledge economies, like in Germany, where less than 5% of the population engage in agriculture and yet feed the nation and export surplus abroad? Will this change the communal culture that characterizes Africa today? As people become urbanized, with nuclear families and the cutting of ties between cities and village, will old traditions die out and an amorphous culture emerge? Will people be happier or will there be a rise in depression, mental illness and Western ailments of alienation?"

Welfare is supposedly the most successful strategy of our scenario country. People incapable of taking care of themselves are taken care of by the state. This sounds good to begin with, because the assumption is that people using this service are truly in need of it. However, this has become a rare truth. A lot of people have chosen to become completely state dependent. Ignoring the opportunity before them and the impact they can have on their societies, they instead choose to live off the state and make a life for themselves that way. The opportunities lost in that mindset are immeasurable and, while the system has kept people in genuine need of help alive, many more have used it to destroy their own potential.

Scenario 3: Mad Max

This was defined as a Mad Max situation and a country that finds itself here is on the brink of anarchy. All the key social, political and economic indicators of a stable state begin to disappear or have already gone.

The economy declines as production becomes either non-existent or grossly inefficient. This

is because both the raw materials as well as the human resources required for the production for their extraction and manufacturing are depleted. With a deteriorated environment, large-scale food production becomes either difficult or, in the worst-case scenario, impossible. A food crisis emerges.

A consequence of both the food crisis and the deteriorating environment relates to the health and wellbeing of the individual and society. While the deteriorating environment affects his physical health and that of the people around him, destroys his livelihood and probably dislocates him, an individual becomes demoralized and psycho-social problems are on the ascendancy. The family and other social units/institutions start to crumble as a more ad hoc competition for diminishing resources develops. The existing social norms and roles shift and deviant groupings such as criminal gangs become normative. Furthermore, civil strife builds quickly to all-out war, as conflict and competition, rather than consensus, become the preferred, if not the most efficient, means to goal fulfilment.

Emigration becomes the ultimate ticket to survival and the most productive members of the society, those most capable of emigration, depart and with them many of the possible solutions out of the chaos. Politically, as the population becomes more restive and as more and more people find themselves with nothing to lose, the nation becomes unstable. Social justice becomes an elusive quality as the government grows more concerned about protecting its own existence rather than that of its people. It is more likely to invest more in defence and internal security rather than in service delivery to the citizens. The potential for revolution increases.

All in all, bad governance coupled with a deteriorating environment creates a situation where everything that can go wrong does go wrong. The gap between the rich and the poor widens as the poor continue to get deeper and deeper

into a vicious cycle of poverty, with their access to resources shrinking further and further. In response to this, the citizens start to seek new ways of coping. Self-interest becomes the guiding principle through which the individual is self-motivated to define new bonds that will allow him at least to survive. Self-organized communities, independent of the existing power structures, emerge and with them a new crop of leaders.

More and more people escape to religion and, all else having failed to explain the environmental, political, economic and social decay, fundamentalism becomes more appealing. In response to the food crisis, more and more smallholder farms come into being. People begin to come up with innovative ways of growing their own food and, especially in cities, growing a lot of food in a small space. An example of this is urban farming in Kibera, where people grow food on gunny bags.

To bridge the gap between supply and demand in consumer goods, a vibrant black market emerges. Technologies in this scenario will tend to be less capital intensive as people find innovative ways of running their lives with limited resources.

Learning from the scenarios

The FutureLab scenarios are a strategic planner's nightmare. Many relatively small, yet plausible events have large and ambiguous consequences. The resulting uncertainties are significant.

The scenarios do contain at least one surprising lesson. Even though governance and the environment are important, they do not make or break the future. The 'Paradise?' scenario attracts many problems and the opposite 'Mad Max' scenario offers opportunities. In either of the two scenarios, many individuals can choose to benefit from the possibilities or be a part of the problem. The mindsets and the decisions of society make the difference. It is everybody's responsibility to shape the future.

The evolution of technology in the three scenarios shows how dependent technological futures are on their context. However, crisis does not stop change. In a crisis situation, small-scale, decentralized and flexible solutions prevail, such as the LED lamp and urban gardening techniques. Independent producers serve basic needs, technology imports are restricted to a minimum of reliable goods with high added value.

Scenarios of good governance allow the accelerated roll-out of large scale technologies. Communication networks, transport infrastructure and energy supply all benefit from a context of expected stability. On an individual level, the higher incomes initially achieved in the 'Paradise?' scenario allow consumers to buy the latest gadget, such as virtual reality tools. Keeping the ambiguous paradise free from intruders facilitates the introduction of security technologies. The technological convergence with other world regions is complete with the introduction of nuclear power.

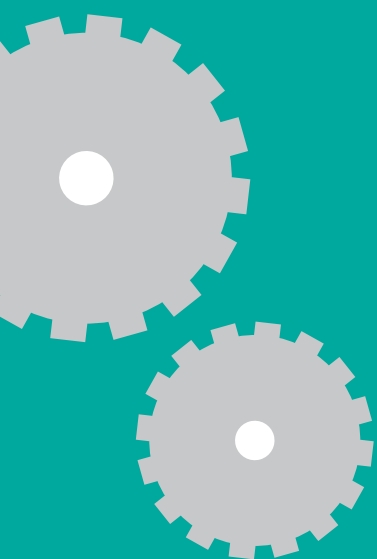
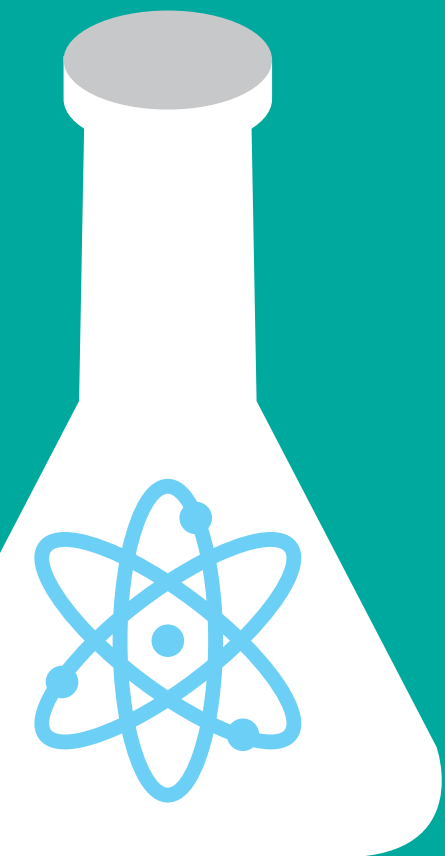
The environmental conditions determine the space in which a society can operate. Scarcity can cause competition and conflict, as well as co-operation and synergies. Under the life threatening conditions of the 'Mad Max' scenario, destructive co-operation, such as criminal gangs, gain the upper hand until conditions settle down. The 'Dry Spell' scenario describes this process of stabilisation, construction following destruction. A healthy environment, however, is by no means a guarantee for a sustainably positive future.

The scenarios show that technology can facilitate change, but is unlikely to fundamentally alter a society against all odds. New technologies do offer opportunities, even more so under stable conditions. Once the stable conditions are threatened, the value of technology diminishes. Education (developing the mindset) and governance are more important, as are protecting natural resources and providing access to them for all. Technology is most important, when it can support this.



With Sheila Ochugboju

Chapter 9: **TECHNOLOGY IN CONTEXT**



Africa's rapid and fundamental technological change offers many opportunities, but just as many threats. Failing to utilize technology in a positive way will result in destructive developments. Failing to appropriate suitable technology for Africa and Africans will result in corporate re-colonization.

In those developed countries where freedom of speech applies, the introduction of new technologies generally goes together with a public discourse. Parliaments, businesses, academic experts, think tanks, lobby groups, media of all kinds and the public as a whole participate, weighing issues, advantages and disadvantages. Roles in this unmanaged process include explaining, inquiring, polarizing, seeking consensus, listening, broadcasting, questioning, propagating, seeking alternatives, requesting regulation, debating and so on. This discourse has a strong influence on the way in which technologies evolve in society. The quality of the discourse and the way in which technology is embedded in society improve with the capacity to understand a technology, its context, its implications, its side effects and with an understanding of the different opinions and perspectives on each of these.

Africa's technological futures depend on the way in which the societal discourses evolve, as much as on the implementation of tangible technology. In the first section of this chapter, Sheila Ochugboju explores the process of technological change, highlighting three initiatives that foster the appropriation of technological knowledge for Africa. The second section builds on that and proposes ways to further stimulate a technology related societal discourse in Africa.

Technology and change: Building learning capabilities through public understanding of science and technology initiatives in Africa

"New ideas do not penetrate the sciences when old scientists become convinced; they penetrate the sciences when the old scientists die off."

(Thomas Kuhn, 'The Structure of Scientific Revolutions')

These are interesting times of change for many people living on the African continent. Across the world today we are repeatedly confronted with the idea that 'the only constant is change', a truism of life since at least the time of Heraclitus, circa 500 BC (Senge, 1999). Yet in Africa the stark asymmetries of change make it hard to map with significant accuracy exactly how technology is changing civil society and what that may mean for the future of technology in Africa. Change is an organic process, which acts in opposition to counteracting forces and limiting factors within the systems where the change occurs. Therefore, in this era of technological change, some things that are impediments to growth need to die off first, in order for new ideas to emerge and become inculcated into the lives of ordinary people across Africa. This is because nothing changes without personal transformation and it is in developing the capacity to do things differently that the real opportunities for progress can be seen. This paper outlines three public understandings of science and technology initiatives in Africa, ongoing since 2007, which have shown some promise in transforming how people view their daily interactions with science, technology and innovation.

In many ways, Africa has remained on the cusp of a promise for far too long. This is evident when you compare the continent's growth to that of its Asian counterparts. The development trajectory for Africa has somehow become stunted, and many of the possibilities for growth and transformation have not yet been realized.

Much has been said about the impact of the revolution in information and communication technologies (ICT) on the growth and transformation of societies. However, Africa is still trying to catch up with this revolution in many ways. Computer and internet use across the region lags behind the rest of the world and there are huge disparities among and within countries, structured along the enduring social and spatial hierarchies of location (urban-rural), class, gender and age. There are also wide national variations in internet usage among African countries, with countries such as Algeria, Morocco, Nigeria, Egypt, Ghana, Kenya, Sudan and Uganda dominating the statistics. Despite the obvious accelerations in

growth, it is still clear that the percentage of internet users from the African continent falls far short of expectations two decades into this surge of global telecommunications. In fact, the rate of penetration is about a third below the world average.

Yet the rise of the mobile phone networks is an example of a strong internal technological driver, which is locally driven and has rapidly changed African business and politics over the past ten years. In 2001, only 3% of Africans had a telephone of any sort; now there are 450 million mobile phone users. This is a consumer-led revolution, where subscribers are accessing a complex convergence of new technologies (computers, the internet and cellular telephony) for mobile banking, business and social network development. These platforms are changing how people navigate their environment and these interactions are becoming more legible for the first time in history. We are more able to observe and measure how people actually live and what their interests are, and the majority of that information is now being self-produced. The networked population in Africa is engaged in this incredible voluntary increase in the amount of information being produced about Africa in legible ways. The ideas emanating from the 'dark continent' (Stanley, 1879) are being codified, so tacit or indigenous knowledge systems are becoming more explicit and perhaps finding new relevance and value in translation or articulation.

The challenge of understanding, reflecting on and embedding the technological changes and their consequences in African societies remains unsolved, however. Old knowledge systems need to be adapted to inform a new generation of Africans about technology, fostering new ideas that can be shared, shaped and incubated by enterprise hubs that bring innovations to the market, and thus transform the African continent from a consumer of technology to a source of ideas, concepts and products. What is required are well-designed, trans-disciplinary, capacity-building programmes for public engagement and public understanding of science and technology. The following sections list three examples of such programmes.

Beyond technology consumption

The Science, Ethics and Technological Responsibility in Developing and Emerging Countries programme, SET-DEV for short, fosters capacity building in an academic context. (<http://www.set-dev.eu/>)

The move from knowledge dependence to knowledge creation would propel Africans from being net consumers of technology into the role of knowledge producers. Universities, colleges and research institutes have to revisit their role in the socialization of science and technology and assert their relevance to the communities they are built to serve. A project funded by the European Commission under the 7th Framework Programme called Science, Ethics and Technological Responsibility in Developing and Emerging Countries (SET-DEV), which began in 2008, intends to bridge that gap by bringing science closer to African societies, and meeting the changing needs of the dynamic continent. It also challenges African people themselves to offer evidence-based solutions through the socialization of scientific and technological research (STR). It includes several aspects: scientific practice, scientific mediation, scientific communication, evaluation, innovation, governance, gender and cognitive aspects. The culmination of this exercise, which was constructed through a series of activities between 11 partners in the SET-DEV project in Africa, Europe and India, is two key documents: an African Manifesto for Science and Technology, and an Indian Manifesto for Science and Technology.

During my involvement in the project, we held a series of capacity-building workshops in Kenya and Nigeria to inform the drafting process of the African Manifesto, with a cross-section of participants (25–50) from young technology enthusiasts to university professors and community activists.

The project was designed to foster shared learning between our European and Indian partners and it allowed the African partners – led by the African technology Policy Studies network, ATPS (<http://www.atpsnet.org/programmes/RCB/set-dev/index.php>) – to create a unique forum to draft an important document looking at the philosophical and ideological underpinnings of scientific and techno-

logical research (STR) in Africa. It also examined the policy and institutional constraints to socialization of STR in Africa. A Handbook on STR for research institutions in Kenya was produced in the process, through study co-ordination, capacity building, training and awareness-raising initiatives across the three continents. Indeed, a major contributing factor to the success of the project was the range of partners, from academic or research science institutions, NGOs and community-based organizations. The diversity of their skills and combined spheres of influence scaled up the impact of the project as it was disseminated across three continents. Perhaps the most valuable learning for the organizations involved was in finding new ways to value the knowledge each of them brought to the project. The developed and the developing worlds met as knowledge partners, each leading different aspects of the work packages, thereby building the capacity of the other in some tangible way.

Towards adaptation

The African Science cafés network fosters public engagement with science and technology by providing an accessible and welcoming forum.

The African science cafés were created to offer a self-sustaining model for public engagement, to help shift perceptions about science and technology for communities across Africa. The first African Science café was officially launched by the British Council in 2007 at the 'Sasol SciFest' Science Festival in Grahamstown, South Africa in March 2007, on the subject of climate change. My role as the UK project coordinator was to translate the European Café Scientifique (<http://www.cafes-scientifique.org/>) concept into a more adaptable form for African communities, where oral traditions predominate and where literal interpretations of scientific concepts may not always suit the culture of the audience. Whereas public engagement around science models in Europe espouses simplicity and transparency in dialogue, many African oral traditions place a high emphasis on poetic and eulogistic interpretations of knowledge (Njogu et al., 2009). The reciters of apae praises of Akan royalty in Ghana, the oriki (praise poetry) of the Yoruba in Nigeria and the Gikuyu gicandi genre

of Kenya are forms of verse where meaning is distributed across several sites and agents, bringing together closely bound communities and embedding messages within a communal context. Using such creative agents at the beginning or end of an African Science Café transmutes the message from the scientist and encodes it within the context of the community's concerns.

Rudi Horak, head and curator of an interactive science centre at the University of Pretoria, was one of the first people to facilitate a science café in South Africa. A science café was held called PhuZa Scientifique: The Science of African Beer. Rudi explains:

"People take it for granted that there is science and technological innovation behind almost every aspect of their daily lives, from the cars they drive to the food they eat, the beer they drink and the clothes they wear."

(<http://www.britishcouncil.org/africa-african-science-cafes.htm>)

Today, there are thriving science cafés in Kenya (<http://scienceincommunity.wordpress.com/2008/12/08/the-african-science-cafe-movement/>), South Africa, Uganda and Ghana. They are led by local groups who connect scientists in universities with policy makers and the general public.

Promoting innovation

Technology, Entertainment and Design, TED (www.ted.com), puts Africa's technology pioneers and visionaries on the global stage and exposes them to their global peers.

In June 2007, the influential NGO 'TED' held its first conference in Africa, titled 'Africa: The Next Chapter'. Thought leaders from across the continent gathered with counterparts from around the globe to build new and lasting collaborations. What made this even more significant was the fact that the combined networks of the TED community were able to bring together Bono, the rockstar philanthropist with a heart for Africa, the President of Tanzania, Ngozi Okonjo-Iweala, the pioneering former Nigerian Finance Minister and many others to discuss a diverse range of 'ideas worth sharing'

about the next big thing to emerge on the African continent. About 100 'TEDAfrica' Fellows were nominated to join this eminent gathering, which counts Bill Gates, Oprah Winfrey, industry and world leaders as regular participants at the annual TED conferences. The defining moment of the TEDAfrica conference in Arusha that year was when William Kamkwamba, 'The Boy who harnessed the wind' (<http://williamkamkwamba.typepad.com/>), took to the stage to tell the moving story of how he built a windmill from scrap metal parts as a schoolboy of 14, working from rough plans he found in a library book called 'Using Energy' and modifying them to fit his needs. This young inventor from Malawi answered the challenge of living in a desperately poor African village with no hope of electricity being generated for his community, by using old bicycle parts, bits of wood, four lights and two radios from his family home. It is this spirit of innovation and enterprise that TED seeks to inspire.

A recurring feature of the TED Fellows network is that though many of us either live or work in Africa, our lives, careers and perspectives are shaped by international, often global networks. Through TED, an African peer group has emerged. TED fellows in Africa continue to be very active in broadening the communication spaces for ideas on technology and innovation. The creation of the innovation hub (<http://www.ihub.co.ke>) in Nairobi in March 2010 is an example of a physical space for technologists, investors, tech companies and hackers in Nairobi.

The annual TEDx Nairobi (www.tedxnairobi.com) event is an example of an independently organized TED event that brings together local innovators to re-imagine the future of Nairobi and its place in Africa. Other TEDx communities exist in Kenya, such as TEDxKibera, TEDxCinema and other like-minded gatherings. Across Africa there are about 40–50 TEDx events taking place each year in different locations, from Nigeria to Rwanda, Tanzania, South Africa, Ethiopia and many more. In the increasingly crowded media landscape of the 21st century, it is still a challenge for Africa to acquire the global capacity to define itself rather than being defined by others, especially by those invested in perpetuating negative images of Africa. The Africa Knows website,

www.africaknows.com, is another Ted Community initiative, which offers an online gallery and marketplace for images of Africa. The aim of this website is to create a platform for photographers across Africa to produce, curate and sell their own work using the internet. At the same time, it offers the world a different stock of images telling different stories about life in Africa today.

Reinforcing growth – Sustaining change

Change in Africa is happening at a fundamental level: forecasts estimate continued above-average growth and investment for Sub-Saharan Africa's economy. But the pace of technology diffusion may impose limits to growth and national wealth creation. Investing more resources in building the human capital of African innovators and infusing mainstream culture with new learning capabilities is a key to embedding change for future development. The Nigerian inventor Philip Emeagwali keenly illustrates how new thinking can quickly transform old systems and usher in new realities. He helped in the discovery of the supercomputer, the technology that spawned the internet. In 1989 he won the Institute of Electronics and Electrical Engineers' Gordon Bell Prize, considered the Nobel Prize of computing. Since then, he has won more than 100 prizes for his work and Apple Computer has used his microprocessor technology in its Power Mac G4 model. In an interview with 'Time magazine', Emeagwali explained his subjective experience of his ground-breaking innovation:

"The internet as we know it today did not cross my mind. I was hypothesizing a planetary-sized supercomputer and, broadly speaking, my focus was on how the present creates the future and how our image of the future inspires the present."

(<http://www.time.com/time/2007/blackhistmth/bios/04.html>)

These change agents are acting as catalysts to energize how people use technology and the media to interrogate the key questions of their lives. These outer shifts are indicators of greater internal shifts in people's values, aspirations and behaviours. I would like to believe that these individual changes are more profound than they appear on the surface



✘ Figure 9-1: Discussing the use of gadgets and exploring technological progress in Nairobi. Source: Joshua Wanyama

and that their longer-term impact may be stronger than we now imagine. The new networks emerging will one day coalesce into a critical mass able to propel Africa into the new trajectory of sustainable growth and transformation awaiting the continent in the near future.

Embedding technology

In Western academia and societies, there is a long tradition of science and technology studies, of technological impact assessment of public discourses on the opportunities and threats related to technology. Intensive public discussions on the value of atomic energy, the planting of genetically modified organisms or the best ways to decrease the impacts of global warming are current examples. These discourses are not limited to political or academic participants. A wide range of societal actors take part, ranging from NGOs to business representatives,

from activists to the retired. And societal discourses do influence the way technology develops, the way it is applied, the way it influences our lives.

Africa's current technological transformation will over time cause the emergence of similar discourses. However, in order to maximize the benefits and minimize the threats embedded in technology, it would be helpful to accelerate this emergence, because the discourse lies at the root of truly appropriating technology, making it one's own. Some interview transcripts illustrate the seeds of that discourse and hold ideas on how different societal actors can contribute, each in their own way.

For businesses, the fact that technology will progress is a given and there is no doubt about the direction of that progress. It is heading in the direction of the West and will catch up with New York:

"I am sitting here, I am a Ghanaian. I spend many years abroad. But now I can sit here in my country and there's no difference between me sitting here and in New York or London in terms of my access to internet telecommunications to be able to do my work access. And pretty soon I'll be sitting here, I'll put on a switch and I could have a video phone and talk to somebody face to face."

Technology is often promoted in Africa as a solution to many of its problems, but a hidden agenda and its side effects should not go unnoticed, as a Kenyan media expert explains:

"My mind is so focused on uplifting people, but let's be honest. The biggest thing is going to be entertainment. Comedy is massive in this country. Satire is huge, especially political satire, people love it, they can't get enough of it. And what political satire does is that it opens up the democratic space. Because the more you can laugh at your leaders the more you question them."

The discourse on technology will not be limited to Africa, but Africa will increasingly become a voice in global discussions, as Wambura Kimunyu describes:

"In the next 10 to 15 years, Africa's microphone will continue to raise the volume slowly, slowly. Right now it is happening in a very small way with the internet and blogging. You are hearing people. We are reacting to issues very much faster than we used to, because we have an immediate forum to do that. But imagine if the microphone was out there and loud, then the possibilities are fantastic. I don't have to agree with Dambisa Moyo's ideas, I don't have to totally agree with doing something, but I totally love that she is speaking and people are listening to her. Once we are at that point, then we have raised the level of dignity of the African people and our sense of being in charge of our destiny. We are not sort of waiting for someone to come and suggest to us what to do. So it is an ego raiser as well."

Science

In the 1960s technology was widely seen as an unequivocally positive driver of change. The speed at which technology would solve the world's problems was only limited by the human pace of research and development. In time, nuclear power would bring endless energy, cheap cars endless mobility and robots would take over the menial labour. Since then, the perception of technology has changed. It has become ambiguous. One of the consequences was the emergence of scientific technological impact assessments (TIA). These assessments explore the wider and indirect consequences of introducing or not introducing a given technology. While straightforwardly implementing TIA in an African context is unlikely to deliver meaningful results, the scientific community needs to stimulate the development of an analogous concept to discuss some of the following questions: What are the opportunities and risks related to a technology? Who are the relevant stakeholders and what are their preferences? What will change and is that positive or negative?

Business

The private sector is currently the main driver of technological change in Africa. Because of the current predominant distribution of roles, with Africa being a technological consumer and the West and China being its technology suppliers, there is little exchange between the two parties. To embed technology in the African context requires that gap to be bridged. Examples attempting to do so are increasingly emerging. IBM's Global Innovation Outlook Africa is one example, another is Google's developer workshops for African programmers. Venture capital awards for African technology innovators, offers of collaboration and other initiatives require a local presence. Businesses should offer that presence in their own interest and enable a meaningful exchange. And consumers should demand that openness from the companies from which they buy.

There is also great potential in making that discourse pan-African and thus taking ownership of desirable developments in collaboration, as Salim Amin explains:

"We can actually do business within the continent, there is enough wealth. We don't have to wait for the handout from overseas. We just have to understand our neighbours, our region and our continent and understand how they do business. We have to be pan-Africanists as opposed to being individual countries. This is the only way this continent will ever grow to be a world power."

Governments

Technology will change how governance is being conducted. It holds the potential to fundamentally alter many persistent elements of political cultures. One of them is accountability, as Sheila Ochugboju explains:

"Technology can give us the capacity to build better systems of governance if we use technology to become more transparent. In Nigeria, they are trying to use it in voting systems, to avoid vote rigging. You have more technological methods, biometric, thumbprint, so that this person absolutely has to be this person. There is no way that you can steal the ballot box or do any other thing. Technology is actually going to improve voting systems in Nigeria, going to help in the next election."

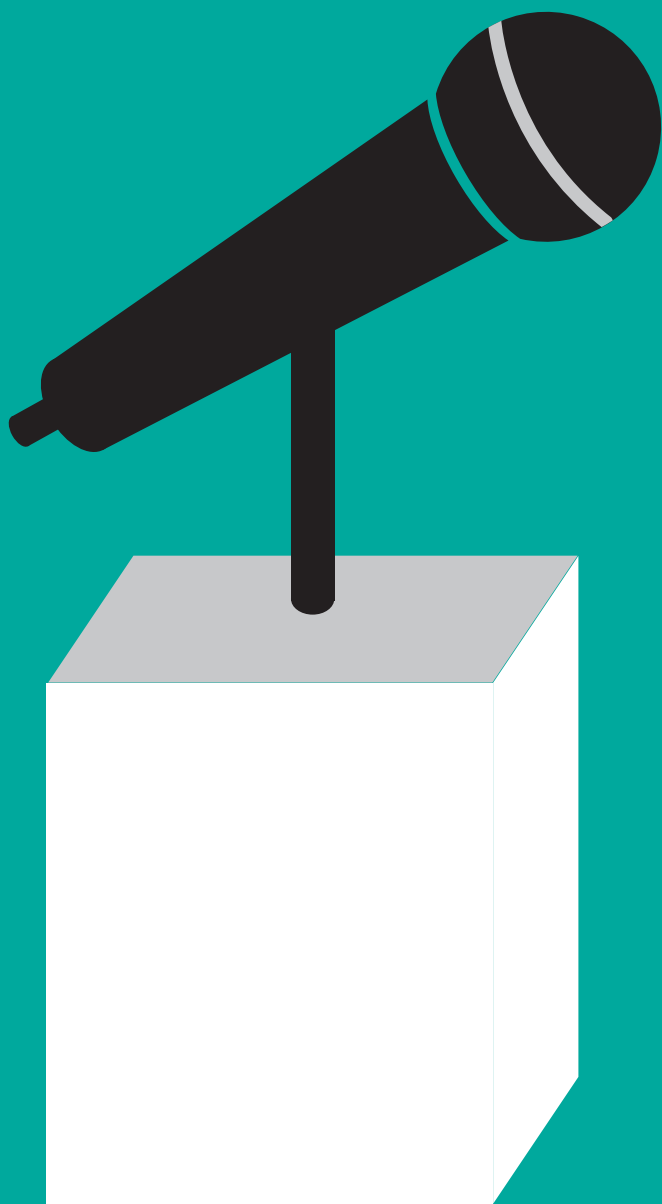
But not only do governments become accountable, they can also demand accountability of others:

"Tracking the financial movement of money in large-scale public-sector projects, that is something many organizations have been advocating for a long time. You have websites that say, OK, they gave 10 million for building a road. How far is it gone? Who has it? Who has the contract? If there is enough bottom-up advocacy for us to see the money, track the money, follow the money, we will change the game in many ways, because you cannot hide it under any kind of ambiguous cover, the money. You know how much it is, where it is, where the receipts are. You know. Those things are changing the world."

At this point in time, African governments are to some degree sidelined with respect to the intro-

duction of technology, leading to a perceived loss of authority. Efforts to regain this authority often result in disruptive actions, like shutting down an operation, an outright ban or the type of negotiations that can only have one winner. In order to avoid this and ensure a constructive discourse on which technologies are welcome and under what conditions, governments need to facilitate dialogue with other societal actors. This includes the businesses that introduce technologies, the consumers demanding them, the opponents of such developments and other stakeholders. Only in such a process can a political technological culture emerge that provides guidelines for the futures of technology.

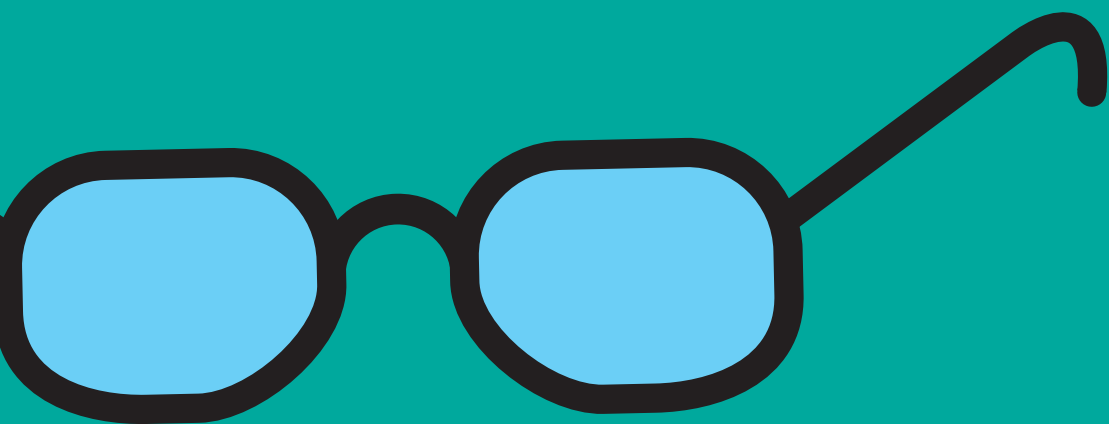
The next chapter showcases one model for furthering such a societal discourse: listening to each other, looking for what drives the other, searching for lessons to learn from the other.



Chapter 10:

LEARNING

FROM AFRICA



This book is mostly about the impact of technology in Africa and to a lesser extent about the reverse, the impact of Africa on its technology. These issues are intimately linked to the question of what Africa can adopt and adapt from the rest of the world. Most of the technologies covered in this book are rooted in knowledge and industrial economies elsewhere: mobile phones from Europe and the US, cars and health technology from India, virtually everything easily affordable from China, to name a few. But what is the undercurrent that flows the other way? What has the rest of the world learned from Africa and what should it learn? Over the past three years I have asked hundreds of people what Europe should learn from Africa in terms of technology and beyond.

If one excludes South Africa's considerable contributions, the list of technology exports from Africa is disappointingly short. A special kind of low-maintenance water filter was first developed in Namibia and then applied in other emerging markets; a machine for pounding yams from Nigeria is now used in India in an adapted version; a few bamboo bicycles are exported from Ghana to Europe and North America. More recently, a number of African software products and mobile phone-related technologies have found incidental use elsewhere in the world. Nevertheless, the scale of technological learning from Africa is limited. South African ICT consultant Arthur Goldstuck illustrates this:

"The West can learn from Africa's difficulties and how to solve them. There have been a few game changes in Africa. We have seen how the South leapfrogs landline communication, for example. Despite the high costs, what it highlights is the fact that communication is a very basic human need. The reason people are willing to incur the cost of buying a phone and paying high cell phone charges is because of the intrinsic need to communicate and the intrinsic value of that communication. This isn't as obvious in developed countries because they have always had pervasive communications. The other real game change is the mobile phone based money transfer service M-pesa in Kenya. What we found out is that throughout Africa use of mobile technologies are a lot more

innovative than in developed countries. I'm not talking about iPhone type innovation. I'm talking about how people find ways to make their lives more efficient in ways not envisioned by the developer of a product."

Nevertheless, the Nigerian engineer Olatunbosun Obayom echoes many of my interviewees when he says: *"We are learning from the West whether we like it or not. It's not a matter of being humble, it's the reality of it."* According to World Intellectual Property Organization (WIPO) data, only six in every 10,000 patents filed worldwide originate in Sub-Saharan Africa. This number drops below one in 10,000 when South Africa is excluded, a total of 145 patents filed in 35 African countries during the year 2008 (WIPO, 2010).

Culture and science

The patent statistics do no justice to what Sub-Saharan Africa has contributed and is contributing to global knowledge and are an insufficient answer to my question. Hospitality, sharing and seeing oneself as a member of an extended family or an even larger group is a highly efficient strategy when it comes to keeping everyone alive in marginal situations. It is therefore not surprising that the most common answer to my question of what the West should learn from Africa pointed towards culture. Hundreds of people all over the continent have responded along the lines of Professor Adikwu:

"In the fabric of every society in Europe people are sort of segregated. Somebody could die inside for three months and nobody knows he is dead. But here in Nigeria every person is another person's keeper. That's one culture. Wars will break it down, then the fabric of a whole society is finished, but for now, I think that is what people should learn from us. You wake up and knock, 'hi there you!', 'how are your parents?', 'how are your children?'. I think every society should copy us for that. Particularly in this country, we are very good at being our brother's keeper."

But there are more than cultural lessons to be learned from Africa. In Nigeria, Professor Adikwu

explained to me that studying Africa's history of science would be a first step to recognizing the continent's contribution:

"In one of the lectures I delivered, I was talking about African ideas. There are practices that are original to us. Our forefathers had their own implements for farming and their own type of engineering. These ideas have never been studied. For instance, I read pharmacy. If you go to the UK, they teach history of medicine, history of pharmacy, and grants are given to do that research. Why can't we do that? Let's study our whole system, so that we also know. I think African scientists can do that. We have more than artifacts, but people need to study them. Our methods of treating disease should be subjected to thorough study, or Nollywood films. The latter are doing very well because they are African ideas of what people do in the open and in secret, crystallized in the form of films. Unless we study these things, we will for a long time be tied to the Western sides in our own ways."

A fine example of a study that explores African scientific history south of the Sahara and that underscores Professor Adikwu's view is Ron Eglash's book 'African Fractals: Modern Computing and Indigenous Design' (Eglash, 1999). Eglash explores the fractal properties of architecture, settlement planning, fence building and symbolic writing in several African cultures. He concludes that in some cases, such as fence construction, the intricate mathematics of optimization have been solved through experience. However, in the case of Bamana sand divination, a symbolic writing code widely spread over Africa, he found that the fractal properties were explicitly formalized, requiring considerable sophistication in formal mathematics. Eglash then constructs a path connecting the Bamana symbols to the development of the digital binary code used in modern computing. In other words, Eglash proposes that every computer contains a piece of African cultural history.

A second step to increase the awareness of what the West has learned and could learn from Africans would be to codify, patent and publish African research in Africa. Sheila Ochugboju is an Accra-based

Nigerian. In the previous chapter, she introduced the SET-DEV project, in which she worked with teams of Kenyans, Europeans and Indians to develop a manifesto for science and technology research. She explains:

"One of the things we are tackling in the manifesto is the difference between tacit knowledge and codified knowledge. Our manifesto starts with the statement that African science and technology has always been embedded in African culture. It has always been there, but the way it has been carried forward in an oral tradition and in a tacit form has given it a different value in a system than values codified and measured knowledge. What you measure is what you value, what you don't measure you don't value. We Africans are so tied into solving our problems in present time. We have not taken the time to codify a lot of our knowledge, therefore we have lost a lot, for example in bio piracy and intellectual properties issues. What institutions like ours have to do and are doing is codifying tacit knowledge and recognizing its value in all forms of research."

Our African researchers use African science and technology for Africans in Africa. We have to recognize that this is happening in Africa, has always happened in Africa, and has been part of a background for a lot of infrastructural developments in the UK and worldwide till today. Researchers are doing their work here, then are going abroad codifying, patenting it, adding a little bit of gloss, and selling it back to us. Often we don't recognize it, often they don't recognize what they are doing either. So it is not always a deliberately exploitative thing. We have taught the West a lot, we have taught them a lot in every field, I can't even begin to measure. My whole life I have been talking to young people about reclaiming lost knowledge in science, in maths, in how we live in social innovations, even in cultural innovations. There is no field that we could not name you the knowledge that Africa has brought to Africans and to the world. More and more we are codifying this to inspire young people."

The following example, given by Kenyan blogger Wambura Kimunyu, explains the importance of codifying African knowledge:

"There is a lot of medical knowledge that is resident in fewer and fewer people in Africa now. I was part of an Africa cultural knowledge class about a year ago and we invited a medicine man. These days they are sometimes thought of as witchdoctors in Kenya, but I think he was actually a professional medicine man. We started to ask him questions about what he does and how he knows what he knows. And he was so hesitant to share anything. In fact it really drove me crazy. He was elderly and I was asking him, 'So when you die, what happens, do you know?' He answered, 'I am sorry, but I cannot share what I know, because somebody will steal it, and then they will use it, and I will not benefit from it.

That is one of the reasons that we have not been able to share, and he actually knew so much about trees and plants and things that it knocked me back. You might have species here that you don't have out there, you actually have them locked in in this country or on this continent, remedies to things that we can't even begin to imagine. Unfortunately there is no legal basis for this kind of knowledge. We have to build systems where it is clear who has property rights in this case. If this man knew that he could share knowledge and still benefit from it, and not end up poor, perhaps he would share."

Wambura Kimunyu also proposes language as a source of learning:

"Language and science are two areas I would dig for a lot more value from Africa. In addition, they are very much interconnected with religion. In Africa, those three areas have got such depths we are not digging out because we are coming with a ready prepared framework to fit this knowledge into. I would really like to look what is there. You might find ideas about the heavens that are far more sophisticated.

Egypt is not so far. If the Egyptians came to Nubia or Somalia, there might be knowledge that trickled down to Eastern Africa and could be dug out of language if somebody was looking for it. But we are not looking for it because we have a framework already, a Western civilization framework. The civilization that rules defines the framework. It would actually be fantastic having software to just decode all these languages and put them in and see what is common. Suppose you use that to compare languages 30 km away, 300 km away, 3000 km away. What does that tell you about world history? It depends on who is looking, and that is why I would not blame a Western scientist or philosopher coming here and seeing things through the frame that they were given. But we have to build up our own linguists in that level. Then we set them forth out there to think about the answers to these questions and then we will be totally amazed, I think."

Economics and resilience

If one widens the scope a little and looks at ways to live and organize a society, there is much more to learn. Nairobi-based media entrepreneur Salim Amin emphasizes how Africans can teach the West how to deal with scarcity without losing dignity or the pleasure to live:

"Africans are possibly the most enterprising people in the world. I think they are the best economists in the world. Think of a guy earning minimum wage in this country, which is the equivalent of about 60 US dollars a month, and he still manages to survive, to feed a family, put the kids through school, educate them. It's quite a remarkable economic achievement.

One of the things that I found completely fascinating, travelling around the continent, is actually how happy the majority of Africans are. The warmth, the sharing, the fact that you will go to the tiniest, middle of nowhere village where they really have nothing, but they will make you welcome and they will share the little that they have with you. And they're actually happy and grateful that you've taken the

time to understand their story, to listen to them and to hear what they have to say. I think that trait has been lost in the West. The big goal of the capitalist society is about making lots of money, it's about having lots of houses, lots of cars. That is what is equated with happiness. And I think this financial crisis is a very good wake-up call for the rest of the world. The reason this continent hasn't been affected as badly as the rest of the world is that we don't have that culture of borrowing. African culture is, if you can afford something, you buy it. You pay cash and you buy it."

The leading partner for Sub-Saharan Africa of a global strategy consulting firm, lays out that an engagement in Africa can teach Western companies how to be successful in other markets:

"SAB Miller is prominent in Africa. They have cracked the model. They have breweries all over the place. They know how to deal with an independent distribution, an informal distribution. They know how to get their beer into the countryside in Nigeria. They are becoming a globally successful company. They have come out of South Africa and they have learned how to work in Africa. They have even strengthened some of the US guys which they have taken over. They actually have a stronger business model to adapt to other markets."

You can say the same thing about MTN, being the largest mobile player. MTN players are hugely successful across the continent and seem to have a high degree of flexibility. They go into Iraq, where everybody is fighting and they are printing money. They have sound business practices. They have cracked what kind of business model to run, where and how to do this. They would have scared everybody else. It just didn't happen, because the South African government didn't want them to invest in these markets. They are well positioned to figure out how to work in India, how to work in Asia, how to work in South America."

Tanja Hichert, a South African futurist, takes the

notion of learning to deal with scarcity and crisis even further and explores the concept of resilience:

"Unfortunately, in a place like Africa we are in great danger of suffering heavily when it comes to increased competition, increased conflict, increased turbulence, that sort of things linked to increasing complexity. Interestingly, systems scientists are telling us that with increasing complexity, what is needed is resilience and adaptation and I think Africans are brilliant at that. South Africans are particularly good at that. We are quite resilient as a people. But what we need are resilient institutions and infrastructure as well. And it would be absolutely fascinating if one were to start a dialogue here and devote resources to developing more resilient institutions and perhaps more resilient infrastructure. There is a lack of infrastructure. If one now goes and puts in infrastructure right from scratch, try make it a lot more resilient. Of course, there is also the soft side of education and skills. It's a matter of knowing this, spreading the message, tapping into it and just coming up with different solutions that are not Eurocentric, Anglo-Saxon, 'regular' solutions."

Learning from mistakes

But while most respondents would find an aspect of positive learning, some are also advised to learn from the negatives. Self-declared optimist and Kenyan TV anchor Julie Gichuru surprised herself with the following answer:

"That you really need good governance, otherwise you're in shit. It's sad, but I find that a really difficult question to answer. I think the biggest lesson that Africa can give the world is that we cannot have selfish leaders. We must have leaders who are there to serve the public, we must have leaders who unite rather than divide. When a leader preaches fear to win an election there's something wrong with him, not with the people he's preaching fear against. It's sad, that we are going to have to learn from Africa's mistakes, because there's very little positive to learn from. Hopefully it can change, is all that I can say."

Learning from Rwanda

While I found the reference to the culture of what South Africans call Ubuntu, to sharing, to being part of a group in all the countries I visited, while many conversation partners mentioned tacit and uncoded knowledge, while some had examples of African knowledge not being attributed to Africa, one country distinctly stood out with a different set of replies: Rwanda. Where elsewhere people would hesitate to answer my question, rolling it over in their mind, the Rwandans I spoke to never hesitated: The two responses below are representative and capture the sentiment:

"We are in a hurry to get forward and there is a lot of will from everybody to reach further in a short period of time. We started in 2008 with some ambitious targets that we want to have achieved by 2012. And we are on track in 2009 according to what we have seen so far, especially in the transportation sector. So Rwanda has a will to get there in the shortest possible time, coming back from its history. I think other countries can learn that everything is possible, whatever the constraints. If you have the will you can achieve it. (Anonymous infrastructure planning expert at the Rwandan Ministry of Infrastructure, Rwanda)

Rwanda has shown that if you are strongly determined to do something, you will get the necessary support. A lot of other countries would wait until they get the support from outside to start initiatives. The Rwandan government says, with or without support, we have to go in this direction, and they just move ahead. That spurs a lot of support, because the country shows that they are determined. If you do not have ambitious targets, you are never going to get anywhere. Even if we reach 70% of the target, we are still well off, compared to a lot of what is happening in the region where the economy is actually much stronger than in Rwanda. Rwanda has proven in a lot of sectors that they are really determined to move ahead fast. I do not see why we should not reach there. Everybody is really motivated to go ahead and not to be scared of taking decisions.

Take decisions and then revise them, if you have to, but do not hesitate. A lot of countries take so long to reach any decision that it is already overtaken by events by the time people get to taking a decision. Rwanda really is different in that regard. The government is eager to take decisions, to listen to others, to listen to examples from all over the world, and to listen to advice. This is something other countries can really learn from us. The more open you are, the more options you have in which direction you can potentially move.

Really special in Rwanda and good for the quick development is that women are very much involved in the government, in the parliament, in decision making and in strongly pushing development. About 40% of the cabinet is female ministers, 56% of the parliamentarians are women in Rwanda. This is the highest rate in the world for a parliament. Which again shows you that as long as you are willing to do things and as long as you are willing to move, you are welcome to do whatever it takes for the development of the country." (Anonymous energy expert at the Rwandan Ministry of Infrastructure)

Keep learning from Africa

The question of what the rest of the world could learn from Africa opened many doors, intrigued and surprised my interview partners, raised smiles and eyebrows. Asking this question is important. It is a matter of respect, as well as a signal to my African counterparts, that I visit them in order to listen, to understand and to learn. In more than a few cases, the question triggered a long-lasting trail of thoughts that resonated with the interview partners long after we had gone our separate ways. Positing the question increases the awareness of what there might be to learn, even after the preliminary answer has been given.

Not asking the question would be a sign of arrogance. The West has been economically hugely successful and made considerable progress in terms of its internal peace and political stability. However, this powerful success is intimately linked to global

environmental problems, such as climate change, pervasive pollution, massive resource depletion and loss of biodiversity. It is not linked to an increase in happiness. Such a society would do well to strive to learn from a continent that offers a plethora of different ways to organize life in groups, be it families, clans or multi-ethnic settlements. Lessons for an age of zero material growth rates, imposed by limited resources, are also worth learning, as is how to deal with harsh changes in a resilient manner. These and other lessons are worth learning, despite the fact that hunger and poverty are widespread, that conflicts and corruption exist.

As far as the future is concerned, Africa will have a lot more to teach the West and the West would be wise to listen as much to Africa as to any other world region. Science, technological innovation and access to education in Africa are on the rise. Creative ideas abound and, according to several interviewees, *“the mental velocity has dramatically improved”*. One of the drivers behind this development is the increased access to the internet, where factual knowledge can be retrieved, inspiring stories can be shared and ideas can be further developed with a global peer group. Seeing these forces at work, the conclusion is inevitable that what the West can learn from Africa will grow and change – if the West is willing to listen.

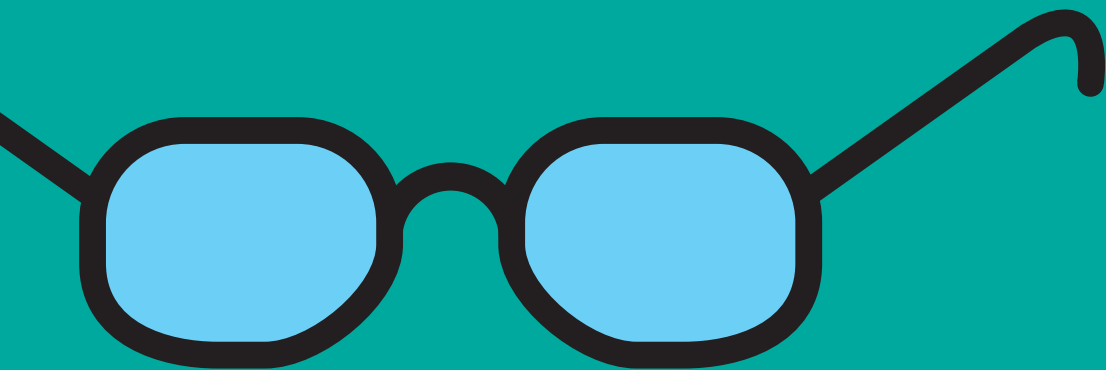


Recommended sources

- The best sources for learning from Africa are travelling and listening. No book or report can replace that.
- Ron Eglash's book on African fractals is summarized in an inspiring presentation that can be found at http://www.ted.com/talks/ron_eglash_on_african_fractals.html.



Chapter 11: **A GUIDE FOR THE FUTURE**



The face of Africa is changing and the world is beginning to notice. Implementing world-class technology has been the ambition of many African countries since their independence. Today, this ambition is becoming a reality in specific technological niches and in the future even more fundamental developments can be foreseen. The first section of this chapter provides an overview of the fundamental, technology-related change covering Africa. The second section of this chapter explores appropriate responses to these developments.

Tippling point signals

ICT

A lot of Africa's change is technology related. For the first time in the continent's history, a truly transcontinental infrastructure exists, covering north, south, east and west, coasts and hinterland. However, the mobile phone network will not remain the only such network for long. At least two more ICT-based networks are about to reach all corners of Africa: a money transfer network and a data transfer network.

The transfer costs of information and of money in Africa used to be the highest in the world in monetary cost as well as in time spent. Transferring money to a village in a rural area used to require reliable contact people and having the time for a long bus ride. For a transfer of information, one had to add the cost of bringing together a large group of people or to visit many individuals. In the future, transfer costs will be on a par with or below global rates.

The combination of three networks – voice, content and payments – in a reliable and relatively affordable transcontinental and even global network, where there was none before, is a powerful one. Innovative business models will profit from low transaction costs. Development projects will be rolled out more efficiently, monitored more closely, and lessons learned from successes and failures will spread more quickly. Geographically expanding personal networks will make a difference to the lives of individuals. Africa-centred platforms will evolve, allowing users to access information on demand on any specific issue. Global platforms will increas-

ingly include African content. Collecting reliable and timely information will become feasible for the first time, ranging from a population census to the amount of soap sold in a rural kiosk, from a land-use survey to epidemiological information.

There should be little doubt about the large scale of the impact. Vivid dreams about what the new technologies can do for Africa are widely shared, including the efficient supply of a wide range of public services, from managing utility bills on a pay-as-you-use basis to tax credits, from centralized health databases to better schooling, from fighting corruption to making governments accountable.

However, not all impacts are going to be positive. Continental networks will be used to incinerate conflicts, organize crime, exclude groups and denounce individuals. As everywhere else in the world, privacy will be violated, debts will be incurred, media addiction will occur, pornographic material will be accessible for children. These and other threats are serious and should not come unexpected. Both sides of the ICT coin are at a tipping point.

Infrastructure

Physical transcontinental networks in the form of roads, rail tracks or high-voltage transmission lines remain an ambition for the future. On a continental level, the quickest way to implement a transport connection between two places is by scheduling a flight between them. Therefore, the healthy growth of the aviation sector across most of the African continent can be interpreted as a lead indicator for what will happen with other modes of transport. New hubs have emerged, airports are being built and upgraded, fleets are expanding.

At the regional level infrastructural integration is progressing consistently. Regional connectivity in the form of roads and rail is improving steadily despite the fact that building infrastructure is a slow and capital-intensive process. The sparse road networks connecting some neighbouring countries are being upgraded, and economically important thoroughfares are being built. Increasingly competitive and efficiently operated seaports are being

connected to population and industry centres inland. The steady progress will improve accessibility over the next two decades.

Electricity

To promote the regional integration of electricity, power pools have been set up in East Africa, West Africa, Southern Africa and Central Africa. They are at different stages in their development, but they do follow a common path. Many current projects are guided by the ambition to replace emergency diesel-fuelled power plants with longer-term solutions, hiding some of the progress booked in the energy sector. Hydropower, coal and gas will remain the backbone of the continent's electricity sector. Nevertheless, other forms of generation do gain ground: geothermal power in the Great Lakes region, wind energy in Southern Africa, biomass and solar energy projects at selected sites all over the continent. Some of these projects are actually preludes to a fundamentally changing energy landscape, but within the 20-year time horizon of this project, their impact will be limited. Yet little by little progress will be made, although it will not be fast. Governments cling to their monopolies, investors eschew the risks and other priorities prevail.

The true energy revolution of the next decade will not depend on centralized power stations and high-voltage grids. Within that decade, personal, small-scale, off-grid energy will be ubiquitous on the African continent. While the overwhelming majority of private households will remain unconnected to the electricity grid, they will be able to afford energy sources to run an LED lamp, a radio, a mobile phone, a sewing machine, small tools or a laptop computer. These will be based on various techniques, ranging from solar cells to wind-up technology, depending on the budget and the location.

The ubiquitous and reliable availability of light, communication and other low-power applications will significantly improve the opportunities of the rural population. The disappearance of candles and kerosene lights will improve health while saving money, productive activities, health care and education can be extended into the evening hours, and

micro-businesses will be operating more efficiently as the cost of energy drops from buying expensive batteries to virtually zero. The future of off-grid applications is literally bright.

The emergence of grid-independent electronic devices is the first of the signals for a tipping point that does leave the well-trodden development trajectory of the West. The majority of future technological ambitions in Africa are focused on becoming fully industrialized countries with technological systems and an infrastructure that resembles those of the Western world. This is reflected in national long-term plans as well as in personal conversations. So assuming that Africa is at a tipping point, we have a very good idea about the direction in which the coin is going to flip. It is conceivable, but outside the scope of this book, that the increasing ubiquity of technology will also lead to an increasing awareness of alternatives to a uniform global technology.

Global technology

There are benefits of being part of a uniform global technology agenda. Africa's development is intimately linked to a change in the global technology agenda. Climate-resistant crops, cheap medical diagnostics and cures, affordable communication devices, alternative sources of energy, improved energy storage and biomaterials are a few examples of fields of research that are of global relevance. Each of these has a high relevance for Africa as well. This increasing overlap of global technology priorities and Africa's technology needs is a new development and it is self-reinforcing. The fact that Africa is moving towards a globally compatible ICT infrastructure facilitates the implementation of other global technologies, since they can connect to the existing system. As the technology base broadens, more and more technologies will become relevant in the African context.

Changing flows of information are accelerating the implementation of technology. The use of global communication media, the global mobility of African students, the commitment of members of the Diaspora to their countries of origin and the increasing quality of tertiary education in Africa all

work in favour of technological capacities and a broader awareness. And in contrast to most European countries, the resulting expertise is truly global, as those schooled in Brazil, Malaysia, India or Russia collaborate with their peers with a European or North American education. Sheila Ochugboju describes the effects on the future awareness of the continent:

"Africa is still a dark continent to itself. Africans don't see themselves because it's very hard to have a pan-African vision, an African picture of who you are. So I think that many of us, by virtue of having been outside of Africa and having travelled around Africa, develop that vision."

Agriculture

Agriculture is the one example in this book where an alternative path to the dominant global technology agenda is getting widespread attention. The fertilizer, water and energy-intensive monocultures of the global industrial agriculture are gaining ground in Africa, but at the same time and with similar momentum more ecosystem-focused approaches are emerging. These alternatives are most widespread in Asia and the global South, from where methods and tools are adapted for their application in Africa. It is far from evident and highly dependent on local cultural, regulatory, climatic and other conditions which system secures more livelihoods and which system sustainably delivers higher yields. In terms of a future outlook, it is the competition between these two approaches that will shape the next decade.

Scale

With the exception of the ICT sector, most absolute changes in each of the fields listed above are small. When starting from a small base, all change also seems small, no matter how big the relative growth is. Nevertheless, it is the power of the exponential function to turn large relative changes into large absolute changes over time. And Africa is gathering momentum on that trajectory.

The future's travel guide

The changing face of Africa will have impacts on the continent itself, as well as elsewhere. It offers risks

and opportunities and it requires responses. The main value of futures studies lies in its capacity to provide guidance for the present. This section covers the most important lessons.

Proximity

Africa has never been closer to the rest of the world, including Europe. The continent is a phone call, an email, a click on Facebook or a direct flight away from Europe. This proximity offers opportunities, but realizing these requires an open door, physically and mentally.

The mental mind shift is best accomplished by taking a second and even a third look at the continent – by questioning all our assumptions and concepts. How persistent these assumptions are is humorously and eloquently described by Kenyan writer Binyavanga Wainaina in his much-publicized sarcastic essay 'How to write about Africa' (Wainaina, 2005). It begins with the following lines:

"Always use the word 'Africa' or 'Darkness' or 'Safari' in your title. Subtitles may include the words 'Zanzibar', 'Masai', 'Zulu', 'Zambezi', 'Congo', 'Nile', 'Big', 'Sky', 'Shadow', 'Drum', 'Sun' or 'Bygone'. Also useful are words such as 'Guerrillas', 'Timeless', 'Primordial' and 'Tribal'. [...] Never have a picture of a well-adjusted African on the cover of your book, or in it, unless that African has won the Nobel Prize."

Wainaina goes on to elaborate in exceptional detail how people, food, landscapes and other aspects of Africa should be described; that is, how they are described by those writing about the continent. The fact that an essay of fewer than 1400 words can describe much of what is written about Africa so poignantly leads to the inevitable conclusion that our knowledge of modern-day Africa is deficient.

We are misled by what Nigerian writer Chimamanda Adichie calls the 'danger of the single story': isolated fragments of information lead to significant misunderstandings and misjudgements. By giving in to the single story, we are limiting our perception of the continent, and we are taking decisions

based on incomplete information. Ultimately, this limitation also compromises the ability to identify solutions to the problems that so persistently claim our attention as part of the single story.

The question of what Africa's technological futures might look like has forced us to question our assumptions and reframed our image of Africa. With that small mental shift, we have gained space for a better understanding and enriched Africa's multiple stories.

Knowledge and information

For businesses and development organizations, the second look at Africa will include the assembly and analysis of spreadsheets. There are many reasons why this might be misleading. Data is generally outdated, often biased, chronically unreliable, incomplete and easily misinterpreted when one is ignorant about specific local contexts. Taking decisions on activities in Africa purely on the basis of abstract numbers is treacherous.

The advice related to this problem is to ask a lot, to listen well and to know the place. And then ask again, because things might have changed since you asked last. Before decision support software started co-ruling corporate behaviour, rich semantic understanding and intimate familiarity with a market were the main foundations for business decisions. This is a rich source of knowledge and should not be neglected.

Africa's most successful businesses are those that localize best. Their staff interact in local networks, establish trusting relationships with key partners, attract local expertise, collect relevant and timely data, and are keenly aware of locally specific changes, such as adjustments in relevant regulations or the efforts of competitors. Managing activities in Africa from offices in Amsterdam or Dallas is likely to cause problems and missed opportunities. And while this might sound trivial, it is a much-ignored piece of advice.

Google has very efficiently developed a localized standing and expertise. By opening several lightly staffed offices on the continent, the company has become omnipresent without a significant invest-

ment. At the same time, Google has become a part of local networks and is able to identify opportunities as well as problems at a very early stage. Because few competitors have set up shop on the continent, innovators will literally gatecrash the Google offices to notify the company of their recent activities and future plans. Furthermore, a local representative can be shared between different partners, making a local office affordable even for medium-sized companies.

Recognizing regional diversity

Once a local understanding has been developed, it should not easily be generalized or transferred. In another piece of advice on how to write about Africa, Wainaina suggests the following:

"Don't get bogged down with precise descriptions. Africa is big: fifty-four countries, 900 million people who are too busy starving and dying and warring and emigrating to read your book."

Africa is a diverse continent in every respect. Africa's opportunities are unequally distributed, as are its problems and risks. One can easily be discouraged by comparing Africa's overall transport infrastructure, energy capacities or agricultural output to those of other world regions. Yet, for each of these issues, countries can be found in Africa that outperform global trends in terms of growth and that are on a promising trajectory of convergence. With respect to Asia, it is common to make a distinction between developments in China and those in India, between those in Burma and those in Malaysia. With respect to Africa, the rest of the world still has to sharpen their ability to see and interpret the differences. The one aspect that blocks almost all progress and development is conflict. Congo-Kinshasa, Somalia, Zimbabwe. Progress comes to a standstill, halting transcontinental developments. However, that should not blind anyone to the increasing number of stable countries with democratic elections and institutional reforms.

Africa has never been a homogenous continent and it is becoming even less so in terms of development achievements. Some countries are significantly

closer to a tipping point than others. Being aware of the differences between countries now and in the future is therefore crucial.

Downsides and uncertainties

People have dreams about what technology can do for Africa and many of these are expressed in this book. However, it is important to realize that the hope of achieving the dreams might well cloud the view of the undesired side-effects. Systematic technology impact assessment, widely applied in developed societies, is hardly ever applied with respect to Africa. That neglect is going to become apparent in the future as more and more well-intentioned technologies find a secondary or tertiary use with detrimental effects.

The uncertainties about Africa's future also hold a lesson. For businesses, Africa requires a portfolio approach. Predicting over the long term which countries are going to lead and which will stagnate would be a risky bet. If at all possible, activities should therefore be distributed over several countries. Governments, on the other hand, should dedicate their efforts to reducing the uncertainties. This ranges from resolving conflicts to transparent decision making, from creating predictable investment conditions to long-term planning. One of the roles for NGOs with respect to the uncertainties is to support those who are most affected in dealing with them.

Trusting the trends

Most importantly, some trends have been irreversibly set in motion. Halting the expansion of mobile communication, of LED lights or of mobile money services, is not a likely future possibility. Responding to such trends is not optional, it is obligatory. Just like everywhere else, dynamic change rewards forward-looking actors.

For businesses, irreversible trends offer the opportunity of growing markets and some certainty about future developments. However, the same trends might also threaten a business's market. As LED lights become ubiquitous, for example, the US\$10 billion African market for lamp oil is going to be wiped out.

For NGOs, these trends offer the opportunity to focus on other bottlenecks. Once a trend is market driven, trying to accelerate its trickling down to the poor with altruistic intentions becomes difficult without undesired side-effects. An entrepreneur in an informal settlement, for example, is much less likely to start a computer school if he runs the risk that an NGO will import equipment and compete with him on unequal terms. A favourite one-liner of MIT professor and One-Laptop-Per-Child pioneer Nicholas Negroponte sums up the lesson:

"If the market will do it, then stop doing it."

The future of 'Futures of Technology in Africa'

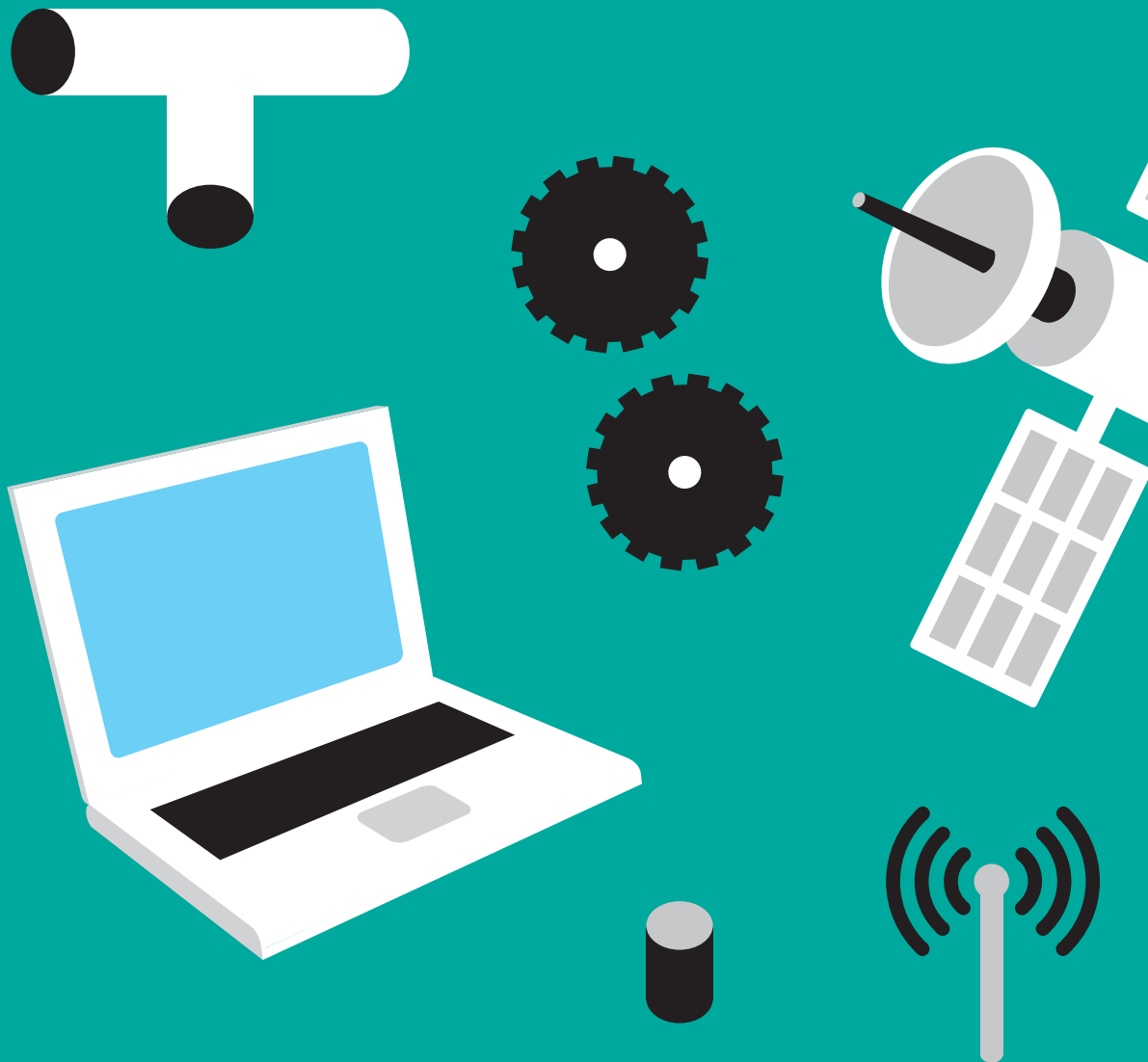
The task of exploring the futures of technology in Africa is a massive one. The scale and speed of developments are overwhelming, as are the remaining challenges. This book is a contribution to a better understanding of ongoing and future trends. As is the case with all STT publications, the launch of this book marks the end of the foresight project as well as the start of implementing some of its lessons.

STT will embark on a series of presentations, workshops and seminars to discuss the results of the project and help other organizations with an interest or a stake in Africa to integrate them into their practices. Also, we will keep asking and listening as Africa's future comes at us faster than ever before.



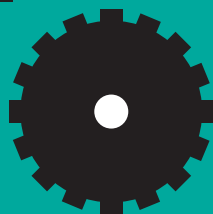
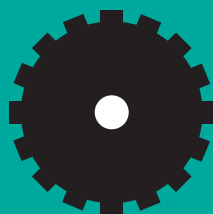
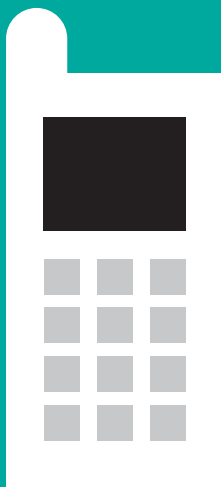
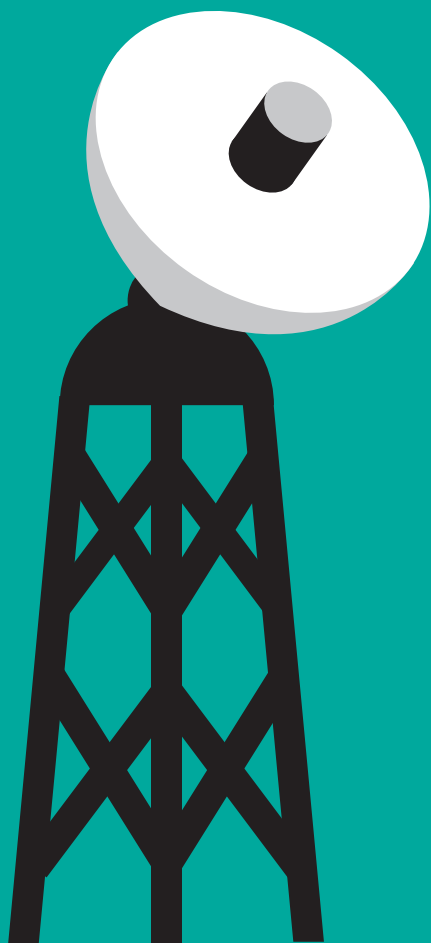
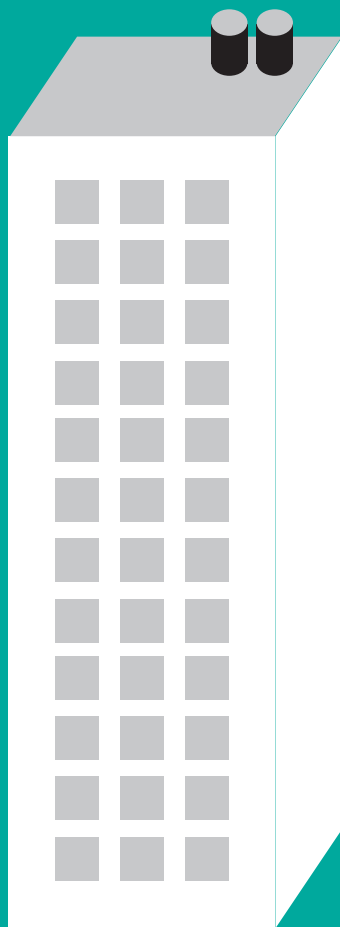
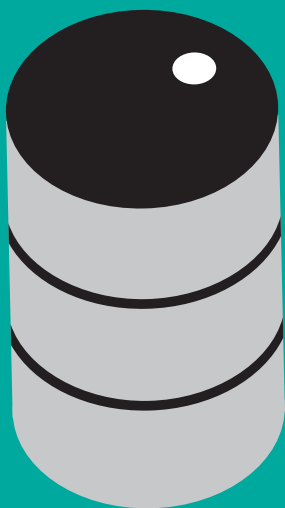
Recommended sources

- Binyavanga Wainaina's essay 'How to Write about Africa' is highly recommended for those who want to confront their own assumptions about Africa. The essay is available online at <http://www.granta.com/Magazine/92/How-to-Write-about-Africa/>.
- Chimamanda Adichie's TED talk on 'the danger of the single story' is available at http://www.ted.com/talks/chimamanda_adichie_the_danger_of_a_single_story.html



Author: Wambura Kimunyu

A Kenyan Science Fiction story:
**THE LAST INFIRMITY
OF NOBLE MINDS
(AN EXCERPT)**



A Kenyan Science Fiction story

Hubert Mwakaba, Secretary for International Affairs, is not looking forward to the virtual brief he has scheduled with Naanyu Kantai, Governor in Chief of the State of Kenya. She will not like what he has to report. He cannot report what she would like to hear – yet.

Still, what must be done must be done.

He niftily clasps the PR07 bracelet around his left wrist and lightly taps it twice to call up his boss, taking a deep breath as he does so in anticipation of a scathing session. She affirms his signal on the third buzz and is soon standing virtually in front of him.

But she's distracted. Someone is exiting her office.

Hubert listens to the hurried clip-clip of footsteps fading away, the hum of a door sliding open and shut, followed by an ominous silence that is heavy with the weight of unfinished business.

When Naanyu turns towards him, she is scowling.

"Hi, Hubert," she says, raising her index finger. "Give me one."

She turns to step out of the virtual circle clearly demarcated by a luminous green light, then pauses and presses her bracelet, redirecting his feed to the "Know Kenya" transmission that is the default on all government-issue PR07 bracelets. He sighs resignedly. She has effectively declared him captive, he does not know for how long. He pauses the session so that his own virtual circle turns orange, exits and plops down on the minimalist white leather sofa stashed against the far left corner of his hotel suite.

He scrolls absent-mindedly down the "Know Kenya" menu, selects his favourite channel, Trivia, and inserts his password after the prompt, to recall his last session. Question number 56 pops up.

"56. Which visionary first conceived Kilima as the new capital city of Kenya?"

He scrolls down to "C", presses enter, and makes a mental note to be sure to goad Achieng Hamisi, Secretary for State Heritage and Cultural Affairs, about the quality of her Know Kenya questions. Or lack thereof.

Distractedly, he switches to the news channel, selecting international news from the menu of offerings. The Global Economic Council's vote to institute strict trade sanctions against Texas is still the top news item. Texas, which has been a bit of a rogue nation since its official secession from the US of A eleven years previously, is being punished for its adamant refusal to switch to green energy sources or, failing which, to pay hefty petroleum-use penalties.

"Hubert?"

Naanyu reactivates the feed and Hubert lithely rises and steps back into the virtual circle, simultaneously adjusting his ear clip, ready to re-engage.

"Talk to me, Hubert," his boss brusquely instructs, adding, somewhat belatedly and vaguely, "sorry for that. You won't believe what the Hack Brigade got up to this time."

The fact now dawns on Hubert that he beeped at the worst time possible. The Hack Brigade, Kenya's most notorious cyber-criminal gang, has recently ramped up its activity and is wreaking havoc beyond the country's physical boundaries, sending the state Digital Diplomacy Department scampering to manage the international outrage.

That fact in itself would be enough to paint the cloud hanging over Naanyu's brow. But there's more: her son, Dunya, is a hacker with suspected links to the brigade.

The Last Infirmity Of Noble Minds (an excerpt)

Kenya's International Affairs Secretary instinctively gropes for an exit to a conversation that is clearly doomed from the start.

"I'm sorry. Maybe we can talk later. This isn't urgent," he offers.

"It's OK, go ahead," Naanyu says, waving her left hand in the air to dismiss his expressed concern.

He attempts another delaying tactic: "How's Kilima?"

"Kilima is Kilima is Kilima. How's Maputo? Has Zafrul Falak signed on the dotted line? You'd better have that signature, Hubert. I need good news and that is the only good news officially slated for today."

"Well, here's the thing," he begins, immediately arousing Naanyu's suspicions.

"Good news, Hubert," she instructs, interrupting him. "I'm not in a mood to hear anything else. Don't go telling me that Chita got the better of you."

"Well..." he attempts to begin again, only to be cut off once more by his boss.

"Good news, Hubert. Go get me my good news. Direct beep me when you have it. You told me you could handle this. I'll give you up to midnight to do your thing, but then, with all due respect to whatever card you claim to have in your back pocket, I'll be there by 10 am tomorrow on the Speed if I haven't heard from you. So you have 14 hours to conjure up that good news."

That last statement is phrased as a lecture and delivered as a closing remark. Naanyu does not wait for a response from Hubert. With an impatient tap on her bracelet, her virtual circle disappears and she is gone.

"So. That went well," he mutters to himself under his breath, as he strolls back to collapse against the white couch.

He is effectively caught between Scylla and Charybdis. What he had been smoking when he sold himself as equal to this challenge is beyond him.

At breakfast he had suffered a vicious verbal lashing from Chita Makani, chief governor of Greater Limpopo. He'd fallen foul of the leader of the southern African state for his attempt to persuade him to withdraw his competing bid to host the PRO7 African headquarters.

It had gotten ugly. Chita was not Naanyu's biggest fan by a long shot. It could have gotten even uglier, though: Chita was restrained from fully expressing himself by his deference to Hubert on account of the latter having been his senior when they had both attended the Union's premier boy's high school in the state of Ghana.

The bottom line, however, was that Greater Limpopo was not withdrawing its bid to host the PRO7 headquarters. It was both politically inexpedient for Chita, the next year being an election year, and driven by a personal vendetta: Naanyu had outmanoeuvred him in their last head-to-head encounter, winning the bid to host the 2032 Olympic opening and closing ceremonies on the back of a wildly ambitious Stadium cum Village Project that had bordered on the ridiculous.

That had come and that had gone. Chita had derived some pleasure from the fact that Kenya had had to turn to Greater Limpopo for supplies to feed the tens of millions who flocked to Kilima for the Olympics. But it didn't entirely heal the hurt of having lost the ceremonies bid to Naanyu in the first place.

A Kenyan Science Fiction story

Beating her to the finishing line in the race for the PR07 African headquarters would do that. It would restore equilibrium to their intensively competitive relationship.

So yes, that breakfast meeting hadn't exactly gone as Hubert had hoped.

Hubert sits up. No time to waste: time to pull that last card out of his back pocket.

He does his calculations.

Effectively, he has 20 hours, notwithstanding Naanyu's midnight threat. If she plans to take the Speedline rather than fly and to get to Maputo by 10 am, she'll only need to leave Kenya at 7.30 am. So he's got 20 hours.

But he knows that by midnight, protocol will dictate that she informs her security team of her impending Speedline travel plans. (They will spend all of 15 minutes trying to convince her to travel by air. She will be adamant. They will leave to do her bidding.)

Naanyu Kantai had spent the better part of her late forties and early fifties campaigning fiercely for the construction of the four major interconnecting Speedlines that now pumped life and vital goods up and down and across the expanse of Sub-Saharan Africa at previously unimagined land speeds. These lines were her proudest achievement and her self-proclaimed legacy to the Union. She still used them at every chance she got, although now she had to concede the need for a special cabin on the line and heightened security arrangements.

But the truth was, the last thing that she wanted to do right now was travel. Hubert knew this and he knew that she knew that he knew this.

Hubert has 20 hours, but 20 hours is not forever and although he doesn't want to play that last card, he has run out of options.

Would, for the sake of relations between the two states, that he had been able to convince Chita to withdraw his bid voluntarily rather than having to resort to pulling it out from under him like a rug.

Now, however, Hubert is out of time. It is time to roll out the do-or-die option: 'Plan Z'.

Zafrul Falak is the President and CEO of PR07, the ninth largest company in the world by capitalization and the global leader in communications hardware. The Sub-Saharan Union is the fourth most populous country in the world and the second largest market for PR07's virtual communication devices. Hosting the PR07 headquarters would be an economic boon for any state. That is why Zafrul is by far the hottest item in Maputo this time of year. But, despite the overwhelming demand for his time, the Kenyan team is fairly certain it knows how to secure a VIP pass.

All it will take, really, is the positioning of three people at a negotiating table, each armed with a strategic offering in hand and an appetite to negotiate based on something they want badly enough.

Enter Hubert's secret weapon, Bob Clay, the European Energy Minister.

Bob Clay will get Zafrul Falak to the table if Hubert asks him to. Hubert will take it from there.

If his plan works, an adroitly executed game of musical chairs might yet yield the result he so boldly promised his boss last month.

Bob Clay will come to the table at Hubert's request because he is spearheading European efforts to pipe 50GW of energy from Kenya's vast sun farms northwards to Europe in time to warm the winter of 2036, expected to be the harshest winter yet of the

The Last Infirmary Of Noble Minds (an excerpt)

21st century. He is at that Union summit to participate as moderator in the strategic energy panel.

Zafrul will come to the table at Bob's invitation because his country wants to purchase a sophisticated sonic space missile defence system from England in light of recent developments in its part of the world, and Bob has the wherewithal to open the door to that conversation.

Bob and Hubert's discussions, being at an advanced stage, are in the public domain. Zafrul, however, does not know that Hubert knows that he has been appointed special emissary tasked with the responsibility of securing the defence system deal. It's a private presidential assignment, but one that feeds his appetite for challenge and his ambition for power. Nor is he aware that Hubert knows that he has approached Bob, his former classmate during their postgraduate studies in Egypt, to open the right doors to enable his country to secure the deal.

Even Bob does not know how much Hubert knows.

But Hubert knows, because he cultivates a vast international network of relationships and connections and because he makes it his business to know. It was on account of having witnessed at first hand his ability to leverage his considerable international network to get things done that Naanyu appointed him International Secretary when she came into office six years previously.

And one day soon, when Naanyu becomes President of the Sub-Saharan Union – and she will – he is fairly certain that he will ascend to become its Senior Minister for International Affairs. That is why it is doubly important that he secures this deal: he is convinced that his fortunes are tied to those of Naanyu Kantai, and next year, as Chita Makani pointed out, was an election year.

His mental ducks in a neat little row, Hubert stands up and heads to the door, on the other side of which is the mobile office set up by his four-

member core staff. As he does so, he lifts his wrist slightly to allow his bracelet to validate his approach. The door slides open to let him lean out and gesture at his PA, Mwende Gatere, to come into his suite.

"So," she wants to know as soon as she steps through the door. "How did it go with the boss?"

"Don't ask," is all Hubert has to say.

"That bad, eh?" she grimaces. "Pole," she consoles him.

He doesn't want to rehash it. "On to plan Z. Pull together that dinner with Zafrul and Bob."

"OK, I'll see what I can do," Mwende replies, already in execution mode and turned on her heel to exit his suite.

"Make it happen, Mwende. You know how to."

About the author

Wambura Kimunyu, an African, writer, observer, thinker and dreamer.

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LIST OF ABBREVIATIONS

• 3TU	Federation of Delft University of Technology, Eindhoven University of Technology and the University of Twente
• AFD	Agence Française de Développement, the development bank of France
• AfDB	African Development Bank
• AICD	Africa Infrastructure Country Diagnostic
• ATPS	African Technology Policy Studies
• AWT	Dutch Advisory Council for Science and Technology Policy
• BRIC	Brazil, India and China
• BRT	Bus Rapid Transit System
• CAPP	Central African Power Pool
• CRT	Cathode Ray Tube
• CSP	Concentrated Solar Power
• DFID	UK Department for International Development
• DRC	Democratic Republic of the Congo
• EAPP	East African Power Pool
• ECOWAS	Economic Community of West African States
• EIA U.S.	United States Energy Information Administration
• EIB	European Investment Bank
• GDP	Gross Domestic Product
• GW	gigawatts
• HIVOS	Humanist Institute for Development Cooperation
• HVDC	High-Voltage Direct Current
• ICT	Information and Communication Technology
• IEA	International Energy Agency
• IFC	International Finance Corporation
• IMF	International Monetary Fund
• IPCC	Intergovernmental Panel on Climate Change
• IPO	Initial Public Offering
• ITU	International Telecoms Union
• KenGen	Kenya Electricity Generating Company
• KfW	German development bank for reconstruction
• LTWP	Lake Turkana Wind Power project
• M-Kesho	mobile money deposit service
• M-Pesa	mobile money transfer service
• NABC	Netherlands-African Business Council
• NEPA	National Electric Power Authority
• NEPAD	The New Partnership for African Development
• NGO	Non-Governmental Organization
• OECD	Organisation for Economic Co-operation and Development
• PHCN	Power Holding Company of Nigeria
• PPP	Purchasing-Power-Parity
• SADC	Southern African Development Community
• SAPP	South African Power Pool
• SER	Social and Economic Council of the Netherlands

- SET-DEV Science, Ethics and Technological Responsibility in Developing and Emerging Countries
- STR Scientific and Technological Research
- STT Netherlands Study Centre for Technology Trends
- TIA Technological Impact Assessment
- TNO Dutch research organization
- UN United Nations
- UNAIDS The Joint United Nations Programme on HIV/AIDS
- UNDP United Nations Development Programme
- UNEP United Nations Environment Programme
- UNESA United Nations Division for Social Policy and Development Programmes
- UN-HABITAT United Nations Human Settlements Programme
- UNIDO United Nations Industrial Development Organization
- WAPP West African Power Pool
- WEC World Energy Council
- Westcor Western Power Corridor
- WiMax Worldwide Interoperability for Microwave Access
- WIPO World Intellectual Property Organization
- WRR Dutch Scientific Council for Government Policy

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- Bob van der Bijl, managing director of the Netherlands-African Business Council
- Jack van Ham, chair of the management board at ICCO
- Hans van der Veen, former director STT, now STT secretary
- Pim de Wit, director, Voices of Africa Media Foundation

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Futures of technology in Africa

The face of Africa is being changed fundamentally by both current and future trends in many areas. Economically, most African countries have outgrown the world economy for the last decade. Politically, the number of conflicts is decreasing and the region is becoming more stable. Culturally, the continent is discovering its own capacities and diversity in a globalizing world. And technologically, Africa has surprised even the most optimistic experts with how it has embraced the potential of the mobile phone. The more than 450 million units in use today are only a prelude to a fundamental ICT revolution in Africa.

Futures of Technology in Africa is based on a foresight project initiated by the STT Netherlands Study Centre for Technology Trends. The project and this book explore the promise of technology as a driver of positive change in this diverse continent. Mobile health applications will save lives, long-distance education will increase skills levels, information technology will make local markets more efficient with benefits for both buyers and sellers, and the accountability of governments will increase with greater access to information. However, the same technology can also be destructive and a cause of significant problems. Either way, technology will affect almost every aspect of life in Africa, including basic needs, agriculture, health, education, culture, business and governance. It is these manifold interrelations of technology with its environment that makes exploring its future so interesting and valuable.

What will the future bring? To answer this question, we have travelled to Africa's technology hotspots, such as Nairobi, Johannesburg and Lagos, interviewed technology pioneers, journalists, entrepreneurs, academics and government representatives, held workshops on the future of selected industries and regions, screened publications ranging from weblogs to scientific journals, and built an extensive network of partners.

Futures of Technology in Africa reveals insights into the next two decades of ICT, energy and infrastructure and how developments in these sectors are going to affect everything else. It contains scenarios providing a fascinating glimpse of how the opportunities and risks might play out. You will find advice on how businesses can take part in the opportunities as well as lessons that the West can learn from Africa. As a bonus, the book also contains one of the very few African science fiction stories, specially written for this publication. Whatever your interest in Africa, this book is sure to surprise you.

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