

# **What Do Science, Technology, and Innovation Mean from Africa?**

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## Preface

This book is the culmination of a long-held dream to one day assemble a stellar team of mentors and colleagues to discuss a burdensome question: What do science, technology, and innovation mean from Africa? Put another way: What is Africa in science, technology, and innovation on the one hand, and what are science, technology, and innovation in Africa on the other?

The rationale for asking this question is that Africa appears on the technological map of the world as a blank or as a problem—in fact, as an oceanful of problems—to be solved. But solved by whom? It was very clear to me at the turn of the century that science, technology, and innovation seemed to be things inbound from somewhere outside Africa, usually the West—hence the whole notion of technology transfer as a North to South or West to non-West flow that would *finally* lift the continent up the development ladder in the hope that perhaps, one day, Africa would be developed. Therefore, the basis of the conversation about Africa was that it was a recipient of science, technology, and innovation, not a maker of them.

One cannot answer these difficult questions alone; it takes a village to raise a child. I have never believed in any one method; I believed even less that the European colonial academic traditions that have trapped the production of knowledge about Africa are enough—as free-standing disciplines, each aloof from the other—to even attempt to address the questions stated earlier. As an African scholar trained in science, technology, and society (STS) and African history, I believe in the necessity of having many eyes—a multiple optic—that looks at the same question, the same thing, from different viewpoints. For this book, the only requirement was that all of these many pairs of eyes should concentrate on African ways of looking, meaning-making, and creating and should take Africans as intellectual agents whose perspectives constitute authoritative knowledge and whose actions constitute strategic deployments of endogenous and inbound things.

I had in mind not simply using African voices as empirical fodder for us to then bring in Marx, Foucault, Derrida, Kant, or other (normally) Western scholars to order these voices into knowledge about Africa. In *The Idea of Africa*, V. Y. Mudimbe (1994) traced this

placement of a “Western ratio” at the center of ordering knowledge about Africa. He threw down the gauntlet right at our feet: Could it be possible to decenter the West and recenter African modes of thought?

Thus my hope was to assemble scholars who could go beyond critique—which Mudimbe did not do—by taking African knowledge seriously as epistemology on its own terms, and who could consider themselves (at least those contributors who are Africans by birth or descent) engaged in offering an African perspective. The latter meant that the force of argument was derived from an African point of view, with inbound epistemologies not forming the foundation of but rather constituting ingredients for an Africa-centered position. For scholars that were non-African, I was looking for colleagues who take African innovations and registers seriously enough to expunge Marx, Foucault, or other Western ratios from the base and spine of their argument—indeed, to use African vernaculars as modes of theory, even if they then engaged Western modes of thought and practice.

The question thus became one of methods. What archives could we defer to? How could we read them not simply as sources for our own writing and authority, as scholars like Jan Vansina, Henry Odera-Oruka, and Ngugi wa Thiongo had done in their albeit groundbreaking work, but as African modes of writing and authoritative philosophical texts in their own right? And given that most of these archives were simultaneously philosophies that had never been taken at their own value but were always filtered through the Western weighted scale of what is epistemology, philosophy, “proper historical sources,” and so on, how then should we approach them? How could we acknowledge the way in which writing is no longer pen to paper, or inscriptions on stone, wood, or human body, but the everyday mobilities that transform the human body and mind into the pen at large, inscribing what’s around it with marks?

These questions had decisive implications for the methods of assembling a team to address them. I could not gather all these scholars into one room at once, precisely because of the colonial disciplinary legacies of the production of knowledge about Africa discussed earlier, in which the language of engagement is normally barracked into anthropology, history, geography, philosophy, engineering, and so forth. The task of assembling a team to address these questions had to be piecemeal and, even after this volume, continue to be refined and expanded, particularly because my intention has always been not only to produce usable knowledge, but to intervene practically in advancing Africa’s future through introducing multidisciplinary understandings of science, technology, innovation (and lately entrepreneurship) in society.

The first scholar I decided to include to meet this goal was D. A. Masolo, whose works had first been pointed out to me by my mentor, Mamadou Diouf, during his Reading African Libraries graduate seminar at the University of Michigan, Ann Arbor. Mamadou has this cunning habit of throwing around names that students who are serious about African intellectual history can follow up. That is how I was able to read Aime Césaire, Leopold Senghor, Kwame Nkrumah, W. E. B. Dubois, Frantz Fanon, Paulin Hountondji, Henry Odera-Oruka,

John Mbiti, Okot p'Bitek, Alexis Kagame, Ernest Wamba dia Wamba, Bogumil Jewsiewicki, Ivan Karp, George Shepperson, Kwasi Wiredu, Chinweizu, Adrian Hastings, Achille Mbembe, Paul Tiyambe Zeleza, Mahmood Mamdani, and Ngugi wa Thiongo. And, of course, D. A. Masolo, whose critique was that Ngugi, Odera-Oruka, and Vansina did not go far enough and left open—after negritude, after Pan-Africanism, after African socialism, and even after the “sage philosophy” that Odera-Oruka actively promoted—the search for new archives and modes of African philosophy. I approached these scholars as a learner, and I was looking to apprentice in the African way, in which elders impart knowledge to the young at close quarters.

The debt I owe to Mamadou Diouf for helping me understand the context of the question of the scientific and the technological in Africa from a combined philosophical, historical, contemporary, diagnostic, and prognostic perspective is, quite simply, unpayable. After my textual and face-to-face interactions with the above-mentioned scholars, it became quite clear that the issue at stake for the African reader of technology, the reader of technology in Africa, and better yet African technology, is not just the behavior of science, technology, and innovation but the intellectual work of making things and their strategic deployment. Can one see Africans as intellectuals thinking about and making technology based on intellect?

This question was an acknowledgement of what I had witnessed in everyday interactions with people in different parts of Africa, but even more so during my own childhood in Zimbabwe. In people's mobilities I saw an archive, a statement, a critique, and an authoring of thought into reality through practice, operationalized through the movement of legs, hands, mouth, and other body functions. I wanted to locate the subject of conversation upstream of practice, to understand the intellection that drove it. Some micro-movements of and within the body were involuntary; the concern was with the voluntary actions, delegated by the mind-at-work.

STS had prepared me to understand one version of science and technology, to recognize it when I saw it. This was a vital skill—but it also turned out to be quite blunt for the nature of knowledge I was looking at. Conventional (Western) STS is good at identifying banal forms of science and technology but is severely limited in non-Western contexts, in which things scientific and things technological are not readily recognizable.

Here was the problem in the specific case of Africa. The project of addressing the meanings of science, technology, and innovation from Africa had to be philosophically grounded, because to my understanding the colonial ordering of knowledge had cut up African knowledge, knowledge production, and structures and modes of knowing into tiny pieces. What had once been a whole entity known as a composite was now scattered into specialist disciplines like philosophy, theology/religious studies, African languages and literature, history, economic history, anthropology, and so on. The philosophy I remember being taught in the University of Zimbabwe in the early 1990s was about Socrates, Plato, Aristotle, Kant, Marx, and so on. *Where were the Africans?*

The history I was taught was simply a subject; it was absolutely useless for addressing the everyday life I lived as an African or helping me solve anything. History as taught in school and college was—and still is—utterly elitist and decontextualized, to the extent that it is in danger along with most “arts and humanities” of becoming completely irrelevant for us as Africans. It is not enough to know where we came from, to learn the phonetic arrangement and diction of our languages, or to study theology to earn a degree or teach after graduation. This knowledge is disemboweled into pieces, yet it used to be one whole, inextricable from the practices and sites of production by which it was taught. That is why Masolo had to be present at the MIT workshop; that is why Mamadou Diouf had to be there.

The conversations with Mamadou began in grad school, but those with Masolo started in 2012. I was co-organizing the STS Colloquium with my colleague Michael Fischer, and we found ourselves converging on Masolo, whom Mike knew well from their time at Rice along with another emblematic Kenyan scholar, the late Atieno Odhiambo. We had wonderful conversations. The encounter was to be the beginning of a continuing conversation that endures to the present. Most recently, I have fulfilled my dream to pull together African philosophers and STS scholars, especially my PhD advisor Gabrielle Hecht and those African scholars whose work intersects with and has indelibly shaped my own. The result was the highly successful Anthropocene Campus seminar that I organized at the Haus der Kulturen der Welt (HKW) entitled “Whose? Reading ‘The Technosphere’ and ‘The Anthropocene’ from Africa.” The seminar included lectures from Gabrielle (STS), Masolo (philosophy), Chaz Maviyane-Davies (graphic design), and Shadreck Chirikure (archeology).

The intellectual exchange that resulted in Chirikure’s contribution to this volume occurred during a workshop I convened at the University of the Witwatersrand in 2014 during my three-year tenure as an inaugural Carnegie African Diaspora Fellow (CADF). Entitled “African Laboratories, Laboratories in Africa, Africans in Laboratories,” the workshop sought to explore meanings and practices of *laboratory* from African experiences, departing from its association with the built space, bench science, and, even where bench science was involved, in the hands and minds of Africans. Besides Chirikure (University of Cape Town, paper on pottery and metallurgy), participants also included Lauren Hutchinson (London School of Hygiene and Tropical Medicine, on Kenya’s first post-independence scientists attempting to decolonize malaria research and make it more responsive to local needs and knowledge) and Peter Sekibakiba Lekgoathi (Wits, on African intellectuals whom colonial ethnologists and anthropologists employed as and called *research assistants* despite the “assistants” performing all the research and even authoring certain texts). Dilip Menon, director of the Centre for Indian Studies in Africa, chaired the workshop, which was well-attended beyond Wits. Chirikure’s paper and my introduction (this volume) were presented at this energetic workshop in the Senate Building.

The Wits workshop anticipated a second one I had finalized for MIT with generous funding from the Program in Science, Technology, and Society and the Dean’s Office in the School of Humanities, Arts and Social Sciences. David Kaiser and Deborah Fitzgerald were

the director and dean at the time, respectively, and appreciated the importance of the question—the title of this book—in the global discussion in STS. The workshop, held over two days, November 13–14, 2014, was a culmination of a long process of identifying colleagues from different fields of enquiry and bringing them under one roof to engage in what Zimbabweans call *kuonesana*—helping each other see from perspectives besides one's own.

I had met these colleagues separately and individually; many were seeing each other for the first time. Gillian Marcelle (innovation policy) had facilitated my visiting professorship at Wits, and we shared a passion for innovation policy in the present. Katrien Pype (anthropology) had spent a year on a Marie Curie fellowship in the Program in STS at MIT, and we had also convened a successful workshop on “Technology and Mobility in Africa” at KU Leuven in October 2013. Also, we had begun to think of a special section for the new mobilities journal *Transfers*. I had never met Gloria Emeagwali (history), but had read her work and actively followed her attention to indigenous knowledge as a historian. Kristin Peterson (anthropology) was already a friend of many years dating back to the University of Michigan, when I was a graduate student and she was starting out as an assistant professor at Michigan State University. We used to sit for hours in Espresso Royale on State Street, Ann Arbor, discussing Africa over coffee. She had suggested that Olufunmilayo Arewa (law), her colleague at UC Irvine, would bring a needed perspective to the volume. Toluwalogo Odumosu (engineering/STS) was introduced to me by Garrick Louis (engineering and public policy), whom I had met at the Brown International Advanced Research Institutes (BIARI) summer school in 2013. The person who had invited us both was Geri Augusto (international and public affairs and Africana studies). I had read cyberneticist Ron Eglash's work on African fractals in graduate school, and it had given me confidence that the questions I was asking were not cuckoo. Ellen Foster (STS) was his student at RPI. Alvan Ikoku (comparative literature/medicine) was doing interesting work on Kenyan literatures. Rudo Mudiwa was a graduate student at Indiana University, one to watch for the future but who was still at an early stage in conceptualizing her project. Mamadou Diouf and Masolo were supposed to attend, but personal circumstances robbed us of their much-anticipated presence.

There was good attendance—from colleagues in the Program in STS and beyond. Rosalind Williams gave the welcoming address. Michael Fischer was there from start to finish, as were Abha Sur and Hanna Shell. Many graduate students were in attendance, not least the members of the memorable Introduction to Science, Technology, and Society course I had the pleasure of teaching in 2014. In particular, I wish to thank Peter Oviatt and Ashawari Chaudhuri for helping Judy Spitzer and Randyn Miller with the logistical work. This is also a project first conceived while Marguerite Avery was an acquisitions editor at the MIT Press and that Katie Helke is seeing off wonderfully into publication. This project would be impossible to achieve without a department and school in which if one has good ideas that advance STS in new directions, no effort is spared to realize them.



All in all, the biggest challenge of bringing together diverse voices steeped in their disciplines and practices is that it shakes every participant out of their comfort zone. Sometimes it can lead to heated argument. Yet the reason I enjoy bringing people together from diverse cultures of doing things is exactly that: to avoid knowledge production becoming an echo chamber, and to set up a vibrant multi-optic crucible within which new ideas are forged. For that I pay homage to everyone who participated in the MIT workshop.

As you can tell from the table of contents, not all of the papers from both the Wits and MIT workshops made their way into this book. This was in no way due to a lack of quality but to sticking to deadlines democratically agreed to at the end of both workshops. There was also an editorial question to address of striking a balance between the disciplines represented at both conferences.

It was through Gillian Marcelle that I was able to meet Chux Daniels of the University of Sussex Policy Research Unit (SPRU). On November 28, two weeks after the 2014 MIT workshop, Gillian convened a panel to discuss Africa's development blueprint: Science, Technology, and Innovation Strategy for Africa (STISA). At the time, she had just taken up what turned out to be a brief venture as deputy executive director (DED) in the Centre for Science, Technology and Innovation Indicators (CESTII) in South Africa's Human Sciences Research Council (HSRC). The workshop included, among others, Daan du Toit (deputy director-general for international cooperation and resources in the South African Department of Science and Technology), David Ockwell (deputy director of research at Social, Technical and Environmental Pathways to Sustainability [STEPS] UK), Hambani Masheleni (African Union Commission), and Chux Daniels, who was then finishing his PhD at SPRU. This workshop was also my introduction into science and technology policy circles in Africa.

Gillian Marcelle was supposed to write the chapter on policy for this book, but she was still settling in as the executive director of Research and Technology Park in the British Virgin Islands. Therefore, Chux stepped in to take her place—thus mitigating what was a potentially big loss. Since the HSRC workshop, Chux and I have since continued the conversation, co-convening a successful workshop at the Institute of Development Studies at the University of Sussex in 2015. We are currently editing and transcribing the video footage, with the aim of coauthoring a book on the diaspora in science, technology, and innovation policy and numerous multimedia products. The chapter from Chux crystalizes where we are in terms of the state of debate on the subject; the book seeks to go beyond critique to show how the African diaspora could be positioned as a serious factor in Africa's prosperous future.

# Introduction: What Do Science, Technology, and Innovation Mean from Africa?

Clapperton Chakanetsa Mavhunga

Things do not (always) have the same meaning everywhere; when we insist that only “our” meaning is the “true” meaning, we silence other people’s meanings. What passes as universality is someone else’s culture and just enough power to spread it, even force it, upon others. The things that words denote never start as universal or available everywhere, their meanings already stabilized; they originate from a particular place, community, society, culture, and nation and then, through travel or mobility, become universal, global. The issue to address is why specific words get to be used when, how, and where they are.

Today, our definitions of *science*, *technology*, and *innovation* (STI) originate from countries and cultures that have acquired their dominance of others through global empires—military, capital, and media—and are able to purvey to or even impose upon those without such power their definitions. This asymmetry of definitional power was never lost to commentators in the West, like Edward H. Carr, who emphasized that people care to know and enquire into an event if it is worth knowing. If it is not, they forget about it (Carr 1961, 11). In that same discussion, Carr concluded: “When we take up a work of history, our first concern should be not with the facts which it contains but with the historian who wrote it” (22).

Similarly, in this volume the question is neither what the concepts of science, technology, and innovation mean universally or all the time nor what Western STI transferred or diffused to Africa means to Africans. Instead, we seek to put the concepts of STI up for grabs, on sale epistemologically, so that there is no universal or spatiotemporally transcendent definition. We seek to explore what the technological, the scientific, and the innovative might mean from Africa in lieu of outside introductions or influences. It is important to do this now because we feel that the importation and consumption of rigid Western meanings of STI are a serious and dangerous threat to a self-determined African path to the future.

The concepts of STI matter at this specific historical moment in Africa because there seems to be a feeling that Africa’s time has come. This *Africa is rising* narrative is all over the World Wide Web, often under the name *Afrofuturism*. As if to capture its spirit, in 2014 the African Union issued a Science, Technology, and Innovation Strategy for Africa (STISA 2024), with science, technology, and innovation as the centerpiece of modernity. In the document, the

three concepts are well-articulated according to their Western meanings but seem devoid of meaning coming from Africans themselves, barring a few well-educated elites. In this *Africa is rising* frenzy, there is a risk of uncritical discipleship, fed by corporate missionaries, driving the Africa conversation on STI.

But how does Africa come to STI, especially STI which is assumed as Western or transferred from outside into Africa? What should we make of modernity itself and its reduction to Western standards of measurement? What should we make of the reality that European modernity itself originated within the past five hundred years, a period of imperialism and its exploitative and colonizing tendencies (Mignolo 2011)? Are we certain that what we call “Western” science, technology, and innovation is indeed Western in origin, ingredients, and rationality? After all, from the Greek occupation of Dynastic Egypt of 323 BCE to the European colonization of the nineteenth century and now to this era of “big data,” there has been a long history of translation and mobility of African, Asian, and Islamic knowledge and practices via the medium of colonial occupation and domination (Diop 1974; Mudimbe 1994). We should not be shocked that Europe’s scientific revolution occurred after, not before, the colonization of the Americas and India. Through a global empire, Europe established a vast enterprise capable of reaching far-off lands and gathering the knowledges of other societies, bringing them home to Europe and America, and planting them in botanical gardens, zoos, and labs, subjecting them to biochemical analysis, which ushered in new drugs.

Given all that, Africans are coming to “Western” STI not as outsiders looking in but as coauthors of a knowledge store monopolized through imperialistic power. It is an empowering feeling: Imagine a positive Africa—creative, technological, and scientific in its own way. The problem is not with STI but how it is defined in alienation, such that Africans are made to enter as unsure and trembling visitors to other societies’ achievements. That mindset is ahistorical, whereas the psychology of knowing that science, technology, and innovation are not Houdini acts of white people but the latest iteration of a long process of accumulative, multicultural knowledge production frees the mind to come to STI as a builder—past, present, and future. To that end, we must explore how the terms *science*, *technology*, and *innovation* have evolved into something so Western-centric, commercial, and artifactual to start with so as to put the chapters into context.

### Science, Technology, and Innovation: The Origins of Concepts

In its rigid Western form, the language of *science* emerged in the nineteenth century. Since classical antiquity or the Greco-Roman period (500 BCE–500 CE), science was natural philosophy, with Aristotle and Thales as its key markers. The beginnings of the scientific method are from Europe’s Middle Ages (400–1400 CE); two philosopher-scientists, the Arab and Muslim Ibn al-Haytham (Sabra 1996) and the Englishman and Franciscan Roger Bacon, were its flag bearers. The beginnings of contemporary scientific practice are pegged in Europe’s scientific revolution (1400s–1800s) (Pingree 2005). Knowledge prior to that point is deemed

“prescientific” and “false beliefs,” whereas that after that point is thought of as “scientific,” “modern,” and “true theory” (Golinski 2001).

Thus, despite being systematic observations, pre-1400 methods (Chinese ones, for instance) are relegated to *prescience* because they were based on eyesight (visual observation) rather than laboratory or physical observation (Needham and Gwei-djen 1974, 1983; Needham, Ping-Yu, and Gwei-djen 1976; Needham, Gwei-djen, and Sivin, 1980; Hoffman 1998). What developed as means to fulfill and outcomes of mundane and spiritual needs—like dynastic (black) Egypt’s architecture, astronomy, medicine, and mathematics (Homer 1998, 40)—is deemed *unscientific* (Lloyd 1970, 1979; Sambursky 1974). Thales, Aristotle, Plato, and other Greco-Roman natural philosophers are the “founding fathers” of science because they separated the natural from the spiritual. *Scientific method* became synonymous with the *antispiritual* or *secular*; credit went to a specific individual, not the entire society or school (Cornford 1971; Arieti 2005; Dicks 1970; O’Leary 1949).

Little has changed, as the debates of the last century involving Karl Popper, Ludwik Fleck, Robert Merton, Thomas Kuhn, David Bloor, and Paul Feyerabend illustrate. For Popper, *falsifiability* is the basic criterion for determining whether something is or is not science (Popper [1934] 1992, 102–103). That true or false measure follows Western scientific method and nothing else. Fleck had a more workable view of science as an outcome of not one but many “thought-collectives” and “thought-styles”—collective bodies that share a common culture (Fleck [1935] 1979, 35–47). However, his thought collectives were limited to experimental practice and expertise derived from formal training. For Kuhn (1962), science follows a cyclical pattern of normal science, crisis, revolution, and normal science again. Scientific communities, he said, conform to certain norms until a crisis challenges them, forcing the emergence of a new paradigm that resolves the crisis. Merton ([1942] 1973) defined *science* as “certifiable knowledge”—that is, statements of regularity that are empirically confirmable and logically consistent. In short, what made science scientific was its method—including disinterestedness, peer review, a reward system, competition, and intellectual property. For Bloor, science can only be examined within the social context of its production; the “natural” of science is not devoid of social content, nor is the laboratory a site of pure objectivity unpolluted by interests (Bloor [1976] 1991). Thus, Feyerabend rejects method as a marker for separating science and its others. Science, he says, is “one view among many and not ... the one and only road to truth and reality,” and “the success of ‘science’ cannot be used as an argument for treating as yet unsolved problems in a standardized way” (Feyerabend 1975, viii, 2; also Ayer 1959, 14). Despite these protestations, Western scientific practice continues very much to be a privileged method, the source of all true knowledge.

The word *technology* comes from the Greek root *techne* (an art or craft) and *-ology* (a branch of learning). Nobody really asks: Where did the Greeks get that definition? Or: What did other civilizations, like the Egyptians for instance, call similarly denoted phenomena? Rather, the conversation moves too quickly to the term’s first English translation, referring to the mechanic arts as a field, not an object. *Technology* only became a salient term at a specific

moment in American history—the 1840s, when concepts like the *useful arts* and *mechanical discovery*, *improvements*, and *invention* became inadequate to describe steam power, electricity, the railroad, the telegraph, and myriad other new markers of “progress” (Bigelow 1829). Even in *Das Kapital*, Karl Marx consigned the word to a footnote urging “a critical history of technology” (Marx [1867] 1954, 406n2). The impetus for the concept drew from the so-called second industrial revolution of the Western world (1880–1910) and its products, like the electric light, the radio, the telephone, the X-ray, the airplane, the motion picture, and the automobile (L. Marx 2010).

This is how technology was reduced to a machine, invested “with the power to initiate change, as if it were capable of altering the course of events, of history itself.” Respected American historian of technology Leo Marx’s warning must concern Africa: “By treating these inanimate objects—machines—as causal agents, we divert attention from the human (especially socioeconomic and political) relations responsible for precipitating this social upheaval. Contemporary discourse, private and public, is filled with hackneyed vignettes of technologically activated social change— pithy accounts of ‘the direction technology is taking us’ or ‘changing our lives’” (L. Marx 2010, 574).

The concept of technology has thus been weighed down by its privileging of economies of scale, a Cartesian and arbitrary view of what spaces must produce STI, and assumption of separation of powers between the producers (scientists and engineers in their built laboratory, as experts) and the consumers (society, as laypersons). We are made to believe that engineers design *for*, not *with*, society. A geophysical zoning of the definition and directionality of technology has been hammered into our brains: that technology is for academy-trained engineers, hence the emphasis on experts, and that technology can only come from the West and is “transferred” to the *technology-poor* Global South.

When Western technology travels, it is often cast in similar language. Historians of technology writing about the nineteenth century talk of products of the industrial revolution as “tools of empire” (Headrick 1981) and “tentacles of progress” (Headrick 1988) that enable Europe and America to exercise “power over peoples” (Headrick 2010). With better ships, Europeans could travel far; with quinine, they could stay alive while traveling; and with the telegraph and radio, they could communicate while on the move. Indeed, machines became the “measure of men” and “a spur to overseas expansion” (Adas 1989, 2; also Adas 2009). Yet as David Edgerton (2007) has cautioned in direct response to Headrick and Adas, the behavior of technology in the spaces of design and use “at home” does not always map readily onto foreign lands.

The task of doing STS in nonwestern contexts need not be one of simply tracing the mobility of Western artifacts and practitioners, situating them in the Global South, and commenting on their behavior in different environments, but taking seriously what technology means from the perspective of people of the South. It requires not merely looking at how people respond to incoming things, but placing the latter’s arrival, meanings, knowledges, and materialities within the locals’ technological *longue durée*. The arbitrary restriction of

what constitutes technology to measurable things and experiments in the built laboratory performed only by those with mastery over them constitutes not just an epistemological exclusion, but also an ontological and sociological one (Shiva 1988; Stengers 2008). The propaganda around Western imperialism as civilizing mission was that Europe—and later America—alone had a monopoly of technology to “transfer” to a dark, primitive world. In the Global South, by contrast, both Western science and technology arrived and have lived their lives as tools of racist domination (Fanon 1970a, 1970b; Nandy 1988; Raj 2006; Anderson and Adams 2007).

A vast scholarship has focused on the systematic plunder of “native” plant knowledge to “feed the beast” of imperial technoscience (e.g., Shiva 1997 Osseo-Asare 2014). Another formidable body of literature investigates Western institutions experimenting in or bringing medical technologies to the South (Petryna 2009; Prasad 2014; Peterson 2014; Tilley 2011). Although these are powerful and much-needed explanations and critiques of the workings of Western technology, they still leave wide open opportunities for investigating the Indian or African as the central innovative agent driving or decisively affecting these incoming forces over a longer historical period. The people who have experienced colonialism, racism, and other forms of disadvantage generally come to discourse as the victim or subaltern of technology, inevitably because the chosen period of focus of these scholars (the twentieth century) was one of colonialism and apartheid or of its legacies (e.g., Shiva and the Research Foundation for Science Technology, and Ecology 2000; Moraña, Dussel, and Jáuregui 2008; Hecht 2012; Breckenridge 2014). Normally, when preferring to talk about the subaltern as a technological agent, scholarship focuses mostly on the strategic deployment of incoming ideas and artifacts as the so-called subaltern begins postcolonial self-reconstruction (Rajan 2006; Medina 2011; Prakash 1999; Abraham 1998). Always, the narrative starts from the colonial onward, ignoring that people of the South were already technological before colonialism happened. The language of STS generated from Western philosophical and empirical contexts is also exported and used to order Asian, African, and Latin American knowledge and practices, thus reducing local, non-Western registers to raw material for the scholars’ own intellection.

Africa must be repositioned in technology as other than its pitiable victim. The younger generation—our children, our children’s children—will require a positive African story to be inspired and to aspire. The narrative of victimhood alone will not be enough; the generation of our children, the African millennials, will want to see signposts of creativity—positive stories that will uplift them. As noted elsewhere, even where death is certain, situations insurmountable, people do not just roll over and die or raise arms of surrender. They die fighting (Mavhunga 2015). We have seen many stories of slavery, colonialism, apartheid, poverty, war, and disease associated with the black existence that can make any human being cry and want to “do something to help Africa.” Can we not also write narratives that can inspire Africa to help itself, to do something about its own issues? Where are laughter, joy, happiness, creativity, means-making, and resilience in the African story? We have invested in

showing how cruel others have been and forgotten how resilient, resourceful, and creative we have been in spite of it all.

The image of Africa in the technological imagination is still Hegelian; as scholars we feed and subsidize it by ending only with the trivial and the negative. Hegel himself ([1837] 2007, 99) described the continent as having “no movement or development to exhibit” and belonging to “the Unhistorical, Undeveloped Spirit still involved in the conditions of mere nature.” In *Heart of Darkness*, Joseph Conrad captures well Western man’s movement silhouetted against Africa’s undeveloped spirit (Conrad 1902). Toward the end of the century, Hugh Trevor-Roper declared: “Perhaps in the future, there will be some African history to teach. But, at present there is none: there is only the history of the Europeans in Africa. The rest is darkness” (Philips 2006). Historian of technology Jack Goody (1971) singled out the absence of horse, plow, and wheel as a marker of Africa’s technological inconsequence. For Walter Rodney (1972), the blame was elsewhere: in the export of Africa’s human capital as slaves and its mineral and agricultural resources as industrial raw materials. Europe’s technological development took place at the direct expense of Africa’s. That led Marxist scholars to conclude that Africa was “preindustrial” before European colonization (Marks and Atmore 1980).

This is precisely the problem with simply importing concepts from outside to order intellectual discourse on science, technology, and innovation in Africa. This “imported magic” (Medina, da Costa Marques, and Holmes 2014) is not new. Since 1900, one could make out at least four turns or paradigms—most imposed either by Westerners or their colonial descendants, with Africans merely as “informants.” The first turn (1910s–1930s) concerned two anthropological versions of functionalism, one emphasizing the psychology of “the native” (Malinowski 1922) and the other the structure of “native society,” captured well in the work of Radcliffe-Brown (1952) and Claude Levi-Strauss ([1949] 1969). Whereas this paradigm was deployed to serve Europe’s imperialist and colonial project, the second decisive, albeit structuralist, turn (1950s to 1980s) was in service of anti-imperialist and decolonial projects. Its applicators imported the writings of Karl Marx ([1867] 1954) and V. I. Lenin (1917) and repositioned the African historical experience as a class struggle, with Marx as a tool for analysis and political action (e.g., Nyerere 1962; Senghor 1964). The third turn was the cultural or poststructuralist turn, which imported and tested the ideas of Michel Foucault, Judith Butler, Jacques Derrida, Gilles Deleuze, Walter Benjamin, and others, well captured in the work of Ann Stoler and Fred Cooper (1997), V. Y. Mudimbe (1988), Jean Comaroff and John L. Comaroff (1991), and Achille Mbembe (2001). Meanwhile, a fourth paradigm shift, the environmental turn, was relocating the analytic from the social and cultural to the environment, borrowing its concepts from American environmental history. Its leading lights were William Beinart (Beinart and Coates 1995), Jane Carruthers (1995), Fairhead and Leach (1996), and Terence Ranger (1999), among others.

The fifth turn, to which this project contributes, is the science, technology, and innovation turn, dominated at present by self-identified STS scholars who deploy Western-derived concepts to order African empirical evidence. Because their priority is to follow Western-derived



phenomena, and science, technology, and innovation as defined in Western societies, they do not devote energy to African meanings and practices to any significant temporal or nuanced extent. They do not necessarily intend to or have to, and we should appreciate what they bring to the conversation; their strengths positively help us understand the traveling Western artifact, idea, or expert. It is one optic we cannot do without, so that when we as black folk tell our stories, we better understand how the inbound forces that complicate our lives operate, from where they derive their motivations, and the ends to which resources extracted and freedoms and prosperities enjoyed at our expense are deployed. When meanings and practices of science, technology, and innovation derived from outside have become inextricable from who we are as Africans, we need explanatory allies, scholars who have dedicated immense energy and care to the workings of these inbound forces. The literature that has equipped us with this capacity to decode science, technology, and innovation in Africa is becoming quite impressive (e.g., Mitchell 2002; Storey 2008; Tilley 2011; Hecht 2012; Breckenridge 2014; Peterson 2014; Osseo-Asare 2014).

The point is not that the scholarship focusing on inbound things and versions of science, technology, and innovation is wrong; that way, we can constructively identify the shortfalls as opportunities for us to come into the conversation from a different optic. For a start, the scholarship mentioned earlier helps us understand the specific versions of (and traditions of thinking about) technology the scholars follow. The meticulous attention to these inbound versions of science, technology, and innovation leaves little, sometimes no room, for versions—let alone the very possibility of versions—that have local (pre- or non-European) origin. The inbound—besides that brought by European colonizers—was coming from sites of production marked by exclusions on the basis of race and gender. It was mostly produced by white males; and it was coming to make wealth, power, and prestige for them in Africa. It is not enough, however, to have an account of how these white technologies, this white science, unfolded in the hands of white agents at the expense of black victims. For those versions to speak to Africans as intellectual agents and as thinkers, creators, and doers of technology, a deep immersion in Africa's idioms and long histories is required, with its own vernacular registers and syntaxes that are only partially found in writing. Few scholars are ready yet to be both thoroughly immersed in STS idioms and empirical material on one hand and those emerging out of Africa on the other. In any case, most STS scholars are trained in methods that enable them to work within only colonial and postcolonial history and anthropology; it requires a vaster repertoire to undertake an intellectual history of technology.

Africa clearly needs histories and philosophies of technology, but which ones? Although there is now a large body of social science and humanities literature on technology design and use relating to the Global North, Africa is made conspicuous by its absence from the discussion. When it is included, it comes into the story only as a recipient of technology transfer from the North or as a victim of (Western and colonial) technology or its appropriators. That, or Africans, are portrayed as just *tinkering* (that horrible word!) and responding without initiative or inventing anything. *Tinkering* is such a horrible word because it refers to



a mender of what is already made, a trial and error person, a meddler, or, worse yet, a clumsy, unskilled worker. The chapters that follow seek to go well beyond that lazy narrative to propose people deeply engaged in intellection, firmly anchored in their own philosophies, and alert to the world around and beyond them as a source of things that they render technological.

The reduction of innovation to technological and commercial ventures—and technology to iconic objects and processes—is a recent interpretation of phenomena that used to embrace much wider historical, cultural, environmental, and political systems (L. Marx 2010; Godin 2014). Three elements are at the core of Western innovation today: novelty, invention, and making money. Until the mid-eighteenth century, imitation was positively viewed as selective borrowing and creative copying that substituted for imported goods and lowered costs of original products (Godin 2008a, 7–10). During Europe’s renaissance, imitation was invention (Wittkower 1965; Hathaway 1989). By 1750, originality had become invention, imitation mere copying.

Invention itself has a long history in Western society. It emerged out of the classical rhetorical arts as a guideline for the fine arts. By 1350, it referred to the discovery of knowledge or knowing, and two centuries later, it referred to makers and their artifacts. Hence, in the sixteenth and seventeenth centuries, invention was a *venatio* (hunt or search) for knowledge (Eamon 1994; Hadot 2004). From the seventeenth century onwards, with patent laws and the West’s consumer and industrial revolutions, invention referred to technology and luxuries. With the rise of the research laboratory, invention was conflated with machines, artifacts, devices, engines, and methods for “the relief of the human condition” (Francis Bacon, cited in Zagorin 2001, 390).

The term *innovation* itself emerged out of *novation*, a thirteenth-century legal term referring to the process of redrafting a contract to renew a debtor’s obligations. We love to be called *innovators* today, but until the nineteenth century a *novator* was a very distrusted person (Godin 2008a, 21–22). With the advent of the patents regime, imitation became theft (Macleod 1988; Hilaire-Pérez 2000). The technologization of innovation began in the 1860s, with economists increasingly seeing technology as a cause of economic growth, a spur to industrialization, social change, crisis, and revolution. Thus, from the 1920s to the 1930s, technology was seen as labor and capital saving and a sign of measurable efficiency; productivity became an indicator of technology usage (Stern 1927, 1937; Gilfillan 1935; Ogburn 1941, 1950).

The decoupling of innovation from invention and its attachment to technology gathered momentum in the 1930s and is often credited to Joseph Schumpeter, especially via his now famous statement: “Innovation is possible without anything we should identify as invention and invention does not necessarily induce innovation” (Schumpeter 1939, 84). However, as Godin (2008b) has decisively argued, the Austrian-American economist and political scientist’s notion of *technological innovation* was feeding off the literature of the 1920s to the 1930s. The concept is owed instead to Rupert Maclaurin (see 1949, 1953), who

increasingly pinned technological innovation to commercialized innovation. His writings posited that technological innovation starts in basic research, goes to applied research, then development, then production, and then diffusion (marketing, supply, distribution; Godin 2008b). Productivity becomes the measure of progress, technology the means to achieve it. Economy is summarized to *growth*, not *sustainability*; as resources dwindle, a postindustrial society beckons (Toffler 1970; Bell 1973; Gosh 2009, 2012, 2015).

The science policy model that emerged in the post-1945 period was a Maclaurinian one (Godin 2008a, 36) and illustrates the synergistic roles between theorists, research institutions, and governments. The most influential theorists of innovation have also been consultants for or employees of governments. They have advanced policies based on their theories, like “the knowledge-based economy,” “the information economy,” “the new economy,” and “national systems of innovation” (Godin 2009). Examples include researchers from the RAND Corporation in the United States (Hounshell 2000), the Science Policy Research Unit at Sussex, and Maastricht Economic Research Institute on Innovation and Technology (MERIT) in the Netherlands. Their models have been exported as templates to other countries through manuals, IMF and World Bank structural adjustment policies (SAPs), and bilateral trade agreements (Godin 2005). To cite one example, under the R&D-centric approach, two-thirds of R&D expenditures are devoted to the development of new technologies (Godin 2006). The Organization for Economic Cooperation and Development (OECD)’s methodological manual for measuring innovation, the Oslo Manual (OECD, 1991), as defined in the US Department of Commerce’s Charpie Report, is a perfect example of this technological and commercial reductionism in the concept of innovation (Godin 2008a).

Can Africa follow these models of STI given its specific conditions? When 80 percent of the budget of countries like Zimbabwe goes to civil service salaries? When the bigger share of Africa’s budget relies on IMF and World Bank balance of payments support? When countries thus have meager funds to invest in R&D and yet make it the centerpiece of their STI policies anyway? When since slavery the West has used Africa as a mere source of raw materials (including cheap labor) for its development, a market for its finished goods, and a dumping ground for its disused products? Moreover, how exactly does Africa trust STI advice from the same experts that have devised systems of innovation that relegate Africa to a receiver of Western-produced R&D and a source of unprocessed natural resources and agricultural products for the West and East’s industries?

### **African Science, Technology, Innovation, and Entrepreneurship: Snapshots**

This book locates Africans between their locally generated and inbound ideas, instruments, and practices. It places these two, endogenous and inbound, within cultures in which bench science was not the norm of knowledge production and bench science itself was an inbound system of inventing and for which local practice has not contributed too much to changing the lives of ordinary people. Bench science—especially R&D—remains an elitist,

university-centered practice, something taught in class in primary and secondary school and usually left there. It doesn't come home—to the village, to the streets. The dilemma of knowledge production in Africa centers on how its structures, practices, and concepts came to be informalized while inbound European ones were rendered formal. This was particularly the case with metalworking, pottery, beer brewing, agriculture, trade caravans, and hunting, for which modes of knowledge and knowing (science), ways and means (technology), and innovation (creativity, experimentation, and strategic deployments) are already well-known. These pursuits are sketched in figure 0.1.

From the time that humans began making tools in stone, bone, and wood, Africa has hosted different forms of *nzvimbo shandwa* (workshop or, as the French encapsulate, atelier). There were no spaces singly designated for science, technology, or innovation; in fact, one cannot separate one from the other. In *Transient Workspaces* (2014), I called them *schools* and showed how African children were educated within them through doing, through being *vadzidzi* (apprentices). Hence the hunt was a professoriate of forest knowledge; the ironsmith's blast furnace, the potter's workshop, and the weaver's loom were Africa's



**Figure 0.1**

Some sites where science, technology, innovation, and entrepreneurship have been practiced in Africa, from the earliest times to the present.

*Source:* Author.

apprenticeship and engineering schools or innovation/tech hubs, while the trade caravan and marketplace was and remains the African business school par excellence.

Research on longstanding trade practices and routes has exposed African innovations in marketing, transport, currency systems, and commodity exchange. Some of these narratives suggest that the idea of an *entrepreneur*—defined as a person who starts a business and is willing to risk loss in order to make money—is sometimes morally repugnant and ethically fraught in the African context. For example, how should we address entrepreneurship involving the hunting, capture, and force-marching of African men, women, and children as commodities, bound in shackles and talons, to the waiting slave ship and, on the other side of the Atlantic, turning them into Europe's—and America's—first machine of mass production on the plantation? This is the case of the *ogaranya* (wealthy men) among the Igbo of West Africa, not only prior to the abolition of the trade in Africans as slaves in 1807, but right into the second decade of the twentieth century—*ogaranya*, for example, men like Chief Igwebe Odum (Njoku 2008, 27–33). Mandinka *jula* (merchants), often celebrated for their risk-taking and overwhelming success, traded extensively in enslaved Africans at the Fatatenda and Wuli markets (Wright 1977). Throughout Africa, the practice of sacrificing the enslaved, kin, strangers, and their body parts to make a business thrive is well-known; there has existed the perception that sound business principles are not enough to stabilize and scale up a business. Colonialism was itself a start-up project in most countries: some ambitious individual obtained fraudulent concessions from African rulers; formed a company to exploit the concession; obtained a charter from the British, French, Portuguese, German, or Belgian government to occupy the land to safeguard its investment; and raised money on the European stock exchanges to undertake colonization, with the goal of paying the investment back by exploiting the land and its people (Agiri 1977, 3).

As repugnant as all these examples are, we should also note the trade practices and education for children of merchants to become merchants. It offers us a space from which to radically rethink the ideas of hubs, startups, and platforms that is now associated with the narrative of “how mobile technology is changing Africa.” Indeed, this long history of integrated production-transportation-marketing systems with information management and communication at its core is an invitation to think of science, technology (even engineering), innovation, and entrepreneurship more organically and over a long time frame.

Take the example of the trans-Saharan trade routes, the history of which stretches across millennia. The oasis was a marketplace, an important juncture and resting depot for traders. Commodities were transported on the desert highway by camels, all the caravans and routes passing by oases. Commoners were forbidden from participating personally in foreign trade, and rulers taxed all export commodities (Kapteijns and Spaulding 1982, 30). The reason for paying the tax was simple: “In whose country, by which road could one have traded?” Gifts were exchanged between rulers of lands along which trade routes passed and in which essential commodities were produced. This was done to secure the macroeconomic environment for entrepreneurship. Hence, as Kapteijns and Spaulding (1982, 32) have noted,

“Reciprocity gifts were the language of diplomacy and expressed both the nuances and fluctuations of political relations between the states.” Private traders were attached to the royal caravan and received protection, guides, and royally sponsored interstate exchange facilities—for a fee, of course. Foreign traders’ first port of call was the king’s court or the household compounds of the big traders, with enslaved people usually sold privately (La Rue 1984, 60). Where marketplaces did exist, the forest paths functioned frequently if not primarily as trading lanes linking together different regions and peoples (Handwerker 1980, 3). Bear in mind, however, that markets were not simply fixed places but mobile or itinerant—what I call *transient workspaces*—that depended entirely on reliable market information passed through merchants moving between source and market (Dalton 1978, 134).

The trans-Saharan trade route is a perfect example of a transient workspace in which the training and apprenticing of children occurred via doing and showing. This is hardly unique; in *Transient Workspaces* (2014) I gave the example of the hunt as a professoriate. Even today, African entrepreneurial training is on-the-job apprenticeship; it constitutes the bulk of expertise that drives the informal sector. In precolonial Sudan, for instance, an entire clan was composed of merchants. They exposed boys to mercantilism early in life—in hospitality, bargaining, desert-crossing survival skills, and caravan guiding—under an uncle or father, for example, among Darfu caravans (La Rue 1984, 62). In Arochukwu society (Nigeria), trading was a form of education, and children learned buying and selling processes early. A boy usually started with trade in lizards (*mgbere ngwere*) under his master, a successful merchant; by the age of ten, he began trading in tortoises (*mbe*), considered a higher commodity than lizards; by age thirteen, he graduated into trade in towels (*ákwá-mmiri*); by age sixteen, he participated as a warrior in local wars; at twenty-two, he entered training as a slave dealer (Njoku 2008, 35).

The tech talk about Africa today is populated with phrases like *start-up* and *financing*. Among the Mandinka of West Africa, two types of strangers coming into a *jula* community offer intriguing insight into start-ups long before 1500 and prior to European colonization. One was the *suruga*, a person who would come to a new village without means, submit to the care of a generous host through whom he became kin, gain access to trade on the host’s good name and account, and eventually marry within the family (Wright 1977, 35). Compare the *suruga* to the *samalan*, a much more independent chap who provided for himself, paid a fee for land use, did his own work, and paid his way through everything, including marrying locally and becoming *jula*.

In earlier times, Tuareg herders of the central Saharan oasis of Kawar exported thousands of tons of salt dug from salt pits a year. Theirs was the hub of an economic system consisting of a large area astride the desert and its southern periphery from 1700 until French colonial conquest in 1906. They were not capitalists but clansmen, with a system for regulating salt production. The salt pit was a site of technological innovation and knowledge process, as seen from salt-production techniques (evaporation of subsoil water), digging and extraction, equipment, and modes of commodity exchange on site (silent trade); hence, this could be

called an *integrated platform* combining production and selling. The two parties to the transaction (the producer/seller and the buyer) never came into contact with one another. One came, left a commodity, and returned to his position a short distance away. The other came, inspected the goods, and left what he considered fair exchange beside it, and disappeared. The first party returned and inspected the exchange. If he accepted it, he took the proffered goods with him, and the deal was done (Vikør 1982, 125). Every salt basin produced its own unique product, and each salt basin owner therefore labeled his own salt differently to enhance competitive advantage. To develop the pit, each had to secure credit lines from wealthier kin or the chief.

In general, European colonialism from 1885 to the late twentieth century killed, disrupted, or delegitimized these sites of innovation and entrepreneurship by displacing Africans from their lands, creating farms and game reserves out of them, subjecting them to forced or miserly paid labor, and forcing Africans into cash crop production. The example of early colonial southern Dahomey, a region that includes peoples of the Aja-Ewe and Yoruba groups, shows the danger of imports killing local modes of innovation. Before inbound goods, specialists performed spinning, weaving, tanning, dyeing, pottery, woodwork, calabash making, and salt making work, but in many cases cheap, less arduous imports supplanted these vibrant yet strenuous activities that demanded more labor for less output. The competition from imported salt, carried as far north as the Niger, caused abandonment of salt manufacture in many places. Sewing machines replaced hand sewing (Manning 1980). Kola nut, domesticated and grown among the Yoruba, became the critical ingredient in Coca Cola, but in addition from 1901 the British Administration urged the introduction of the crop into parts of Northern Nigeria to which the Yoruba had not already spread the crop to before the colonial partition (Agiri 1977, 4).

Rubber is another perfect example of the morally reprehensible aspects of capitalist entrepreneurship as imperialism. Abir, the largest rubber concession company in the Congo Free State founded with Belgian and British capital, created no long-lasting entrepreneurial structures, introduced no new technology, no new market relations, no new indigenous elite—it was just like King Leopold II: “a plundering and tribute-collecting empire of the crudest sort” (Harms 1983, 125). The Belgian monarch had colonized Congo as his personal property. With the colonial subjugation of the area complete in 1898, a brutal regime of forced rubber collection began. Men who did not bring in enough rubber were often imprisoned and put to work drying rubber, but because a man in prison was two rubber-collecting hands lost, some Abir agents took hostages instead, holding a man’s wife or close kin until he completed his quota, or thoroughly flogging someone with the *chicotte* (hippo-hide whip), or imprisoning the chief of any village that fell behind in his rubber deliveries. Others tied people to platforms facing the sun, burned them with gum copal, or simply cut off their ears, noses, and hands and mutilated their faces (Harms 1983, 134).

The last example of European entrepreneurship severely disadvantaging Africans is that of cotton, and here the story becomes a complex one of brutal colonial practice and Africans’ creative resilience in the face of it—that is, innovation in the face of virtually



insurmountable odds. People in different parts of Africa had grown or used wild cotton for clothing and other purposes before European colonization. The colonial authorities compelled Africans to grow cotton as a cash crop on a large scale. From 1911, the French in Chad, for example, forced Africans to grow cotton under supervision of their chiefs, who were stripped of their rank and turned into forced labor themselves if they refused. The authorities sent out local clerks—*boys-cotons*—to prescribe what and how much land to be set aside for cotton. The program was a staggering failure (Sturzinger 1983, 217). Initial attempts to execute a similar system in Mozambique had also come to nothing, prompting colonial power Portugal to issue a decree giving extensive power to concessionary companies to compel Africans to cultivate cotton. The decree still failed, despite putting eighty thousand Africans under forced labor. In 1938, Lisbon authorized that the full force of the state be placed at the disposal of the Cotton Board to squeeze more production out of Africans. The work day was extended, mandatory cultivation mercilessly enforced, and vast regions decreed “cotton zones.” The colonial administrators made regular inspections, chiefs harassed and threatened their own people, and those caught fleeing were publicly flogged or often sent to jail (Isaacman 1985).

Creative resilience is best illustrated in the story of cotton in Uganda, which also exposes the parasitic nature of the colonial state as a capitalist entrepreneur or enterprise. It is the story of Africans already growing cotton and then proposing to scale it up into a cash crop to be able to pay taxes and avoid punishment from British colonizers. The key figure was Samwiri Mukasa, a Muganda chief from 1897 to 1926, who approached the agent of the Uganda Company, Kristen Borup, with a proposal to turn cotton into a cash crop. Borup agreed, provided that Mukasa pay a surety in case his people refused to grow the crop. Mukasa pledged twenty square miles of land and 1,200 rupees as security and enthusiastically distributed cotton seeds. Thus began the Bulemezi cotton venture, which spread to other parts of Uganda. It is also how Chief Mukasa earned the name *Muleta Pamba* or introducer of cotton (Nayenga 1981).

Located on the Kenyan coastline, Lamu challenges the frequent argument that Europeans were able to conquer and govern because of their superior science and technology. By the first decades of the twentieth century, mangrove poles brought scores of dhows (locally made sail ships) southward each year from Arabia, Persia, and Somalia. Coastal people regarded mangroves as a resource free for the taking by anyone with the need or ambition to do so. In 1907, the new British colonial government stepped in; it declared all mangrove swamps crown land and granted concessions to private companies like Smith, Mackenzie & Co. and then to Indian merchants like Mulla Taibali, whom it taxed. Still, as Philip Curtin shows, the real entrepreneur was neither the colonial government nor the concessionaire but the foreign captains of the *jahazi* (dhows), who paid the private concessionaires for a specific number of poles to cut and hired local Africans to cut them and transport them to ocean-going vessels. This grassroots process was exceedingly difficult to supervise, and dhow captains simply bribed the right people and paid for just half the poles loaded, with one-third of

proceeds going to the owner of the boat and the rest to the crew. The *jahazi* captain depended on buyers based in Lamu, who stockpiled the poles until the bigger dhows arrived with the monsoons from Arabia, Persia, and Somalia (Curtin 1981). In essence, the knowledge and methods used to harvest mangrove poles was endogenous and a continuation of non-European practice: a kind of technological version of indirect rule wherein the colonizer, severely outnumbered by Africans, extracted resources through local idioms.

KwaZulu-Natal provides a different dimension and directionality of knowledge: of Africans and inbound things that they reassigned technological purpose. From 1845 to 1880, a period of increasing Euro-African contact in South Africa, Zulu *kolwa* (those who had converted to Christianity) partook of a series of initiatives representing one of the most successful integrations of inbound things to come out of Southern Africa. They turned the Christian mission into a platform upon which Africans staged many experiments, especially those of innovation and entrepreneurship. Congregational, Methodist, and Anglican converts had acquired “mission reserves” from the colonial administrator, and in these reserves, *kolwa* were allocated land. They took well to European tastes, adopting European clothing, looms and needles, sewing machines, and brick houses with iron roofs.

Contrary to the statements of scholars like Norman Etherington (1978, 1), the missionaries were not “prodding” these Zulu toward “progress”; the Zulu had dreams of their own and took bold risks to realize them. They were not just *kolwa* but Africans who came and located themselves at sites where better opportunities to acquire tools for realizing their futures existed. At a mission station called Mvoti, for example, one missionary in 1864 counted some forty-eight upright houses, twenty-two ploughs, fourteen wagons, and twenty spans of oxen. One Methodist minister, Daniel Msimang, owned two houses on an eighty-nine-acre plot at Edendale, plus the following moveable property: two ploughs, two wagons, thirty-six oxen, 260 goats, and twenty cows. Cattle were not *means* to wealth; they *were* wealth. Ploughs, oxen, and land were utilized to produce crops, oxen and wagons as transport for trading expeditions. Msimang’s community included thirteen farmers, eight men employed in teaching or ministering, six in transport or trade, ten skilled artisans, and three unskilled laborers. All their activities were profit-driven: growing cash crops like cotton (1847), sugar (1860), and manufacturing sugar.

This remark by one surprised missionary puts things in perspective:

Men with black skins who a few years ago were naked boys ... are now competing with the white man in manufacturing sugar in a steam mill of their own from canes of their own cultivation and without any superintendence in the work; the men have incurred rather heavy money liability in erecting the mill (about six hundred pounds) but I see no reason why with ordinary success they may not hope to clear themselves in a comparatively short space of time. (cited in Etherington 1978, 3)

However, the land upon which the Africans grew and processed sugar cane was inside the Locations and Mission Reserves, where freehold tenure did not exist, and magistrates refused to allow blacks to buy land elsewhere, and government did not provide credit lines to blacks.



By 1881, these Zulu entrepreneurs had become “afraid of sugar growing, because it takes so much capital” (Etherington 1978, 4).

The second type of entrepreneurship in this prerailway age was ox wagon transport. Zulu men had been raised and trained in cattle handling, and ox wagon transport was in high demand. Every driver dreamed of owning his own wagon and trading independently. As one American missionary noted:

You will find them with bundles of the skins of the wild cat or monkey, or blankets which they have probably purchased on credit, traveling through the length and breadth of this country and even those bordering it, bartering for hides, goats, sheep, young cattle, and then selling these to each other or to the white people. After a few years some will succeed in obtaining a few oxen and a cart or wagon, when they will engage in purchasing mealies and take to the towns for sale, or will draw sugar from the sugar estates to market, or perhaps transport merchandise from the Port to the upper districts, going sometimes as far as to the Dutch Republics or even to the Diamond fields or Goldfields five hundred miles distant. (cited in Etherington 1978, 6)

By 1850, Kolwa trading had begun spreading from the Natal settlements into the rest of Kwa-Zulu, and by 1870 it extended into much of tsetse-free Southern Africa, the furthest extent oxen could pull wagons without succumbing to the insect’s deadly bite.

The Zulu example is only a snapshot of trends set with the coming of Europeans, colonialism, and its legacies, which concentrated and specialized goods and services around specific nodes—namely, stores (urban factory-produced groceries, etc.); marketplaces (trading in goods produced in informalized activities); stock exchanges (formal sector trading); industrial sites/factories (European-originated methods and instruments of production; formal goods); farms and mines (owned by Europeans or whites and Western multinational corporations); and “native” reserves or communal lands (the majority of the people).

The interlocked narrative of innovation and entrepreneurship and the Euro-African encounter must also consider fully the role of Indian, Lebanese, and Jewish entrepreneurship in Africa. The Indian entrepreneurial presence in particular has been closely associated with both collaboration with and resistance movements against colonialism—in South Africa, Zimbabwe, Mozambique, Tanzania, Uganda, and Kenya in particular. Indians in Africa have always drawn their power from entrepreneurship, going into places where no other foreigners want to go, setting up shop in remote localities where few to no other businesses exist, buying out the competition and establishing a monopoly. Their unequalled gift is persuasion and bargaining: in Zimbabwe, we call them *buya tinapangana* (come, let’s talk); fixed price means nothing to them. Their competitive advantage lies in being the cheapest, sourcing cheap, and moving stock off the inventory quickly. They locate their home either in the backyard or upstairs, get as many of their kin from India as possible, and often keep their money with them. This is exactly what they did in the British colony of Uganda in the early twentieth century, specifically in the kingdom of Busoga, where they settled at the homes of traditional chiefs, bought local produce, and sold local goods from their stores. They became

middlemen, buying African-grown cotton cheaply and marketing it to ginneries at exorbitant prices, and not before long they established their own ginneries. This is the story of two tycoons, Nanjibhai K. Mehta and Muljibhai P. Madvani, two men who bargained down the farmers whom *Muleta Pamba* had inspired into pioneering commercial cotton production in Uganda (Nayenga 1981, 189). Just two ginneries out of the eleven in 1920s Busoga were European-owned—testimony to the Indians’ monopoly model, which I also observed in Limpopo province, South Africa, and grew up with in Zimbabwe—the Gulabs in Marondera, the Patels in Harare, and Narans of Bulawayo.

The final snapshot comes from the post-independence period leading to the present. Most African countries either adopted socialist-based policies or a pragmatic blend of socialism and capitalism to address economic growth/modernization and social welfare programs. In socialist countries, government controls either stymied or completely eliminated “individualistic” or “capitalistic” business, with countries nationalizing multinational companies, specifically in Mozambique. In others, like Zimbabwe, governments nationalized some big corporations into or maintained existing parastatals (state-owned companies), established black economic empowerment programs to create an indigenous entrepreneurial class, and actively promoted both cooperatives and private entrepreneurship. These government subsidy-heavy programs put a drain on budgets, and soon countries were knocking on the doors of the International Monetary Fund (IMF) and the World Bank. With this move came deregulation, economic liberalization, removal of socialist subsidies, and denationalization.

The consequence was that governments were compelled to pull out of business. I was in high school when the Zimbabwean government succumbed to the Bretton Woods institutions’ “bitter medicine” in 1990. I was at the University of Zimbabwe when its many biting consequences began setting in. We began to see parastatals that had run quite well, like the Dairy Marketing Board (DMB), the Cold Storage Commission, and Ziscosteel, becoming privatized. As students we took to the street weekly in 1993 to protest (unsuccessfully) the privatization of accommodation, food catering, and student tuition and living allowance (payout). We unsuccessfully tried through protests to convince the government that deregulation—which now turns out to have been pushed by the Republicans during the George H. W. Bush era—would result in the dumping of cheap imports and kill local industry. At the time, David Whitehead, Cone Textiles, and Darryn Textiles were thriving. By the time the IMF was finished, each one had shut down, swamped by cheap, secondhand clothing. The IMF also insisted on cutting the budgets of the government and companies, especially relegating the role of the state to facilitator, not active investor or entrepreneur, ending a tradition of state involvement in business dating back to long before and during the colonial moment. Companies that had relied on subsidies to continue producing goods deemed to be in the national interest and to sustain the trade balance were ruthlessly exposed. By 1997, thousands of workers had been laid off as part of the “rationalization” programs of the IMF.

*Rationalization* is a term that assumes that prior to the IMF and World Bank interventions, African countries that adopted such structural adjustment programs (SAPs) had been behaving irrationally. Yet countries like Zimbabwe achieved significant milestones during the pragmatic socialism phase of their postindependence moment. Zimbabwe leapt forward to become the country with the most literate population in Africa by the end of the 1990s and has hovered either at the top or thereabout since. That would have been impossible without free primary and secondary education and a vigorous payout and student loan system at universities. It was also an accomplishment based on a philosophy of African socialism, firmly rooted in communality, which mobilized rural communities to mold clay bricks, fire them, and cart them to school in lieu of school fees to build then nonexistent schools. I vividly recall molding these bricks to build the block that sits near the plantations at Chitungazuva Primary School, firing them, and, in typical African innovation school style, apprenticing in the arts of molding, placing the bricks on *hovhoni*/oven or kiln, loading the logs into the openings, sealing the walls of the kiln, pouring sand on top, then firing. These are the bricks that enabled us and our parents to meet government contributions—solicited from donors, mostly the Nordic countries that had fought with the then-guerrilla movement now turned government—halfway.

Zimbabwe also developed perhaps Africa's best postindependence healthcare system based on free primary healthcare—something which even the United States of America has never made available. It also embarked on “food-for-work” programs (which the elderly transliterated as *futuweki*), whereby whole villages were mobilized to provide labor for rehabilitating sand- and silt-clogged rivers and nasty dongas and to plant gum trees to serve as windbreaks in open grassland areas like Chihota in exchange for drought relief food. There was nothing “irrational” about these programs to require “rationalization.”

Finally, through its Grain Marketing Board (GMB), the government vigorously introduced an agricultural inputs scheme, whereby our parents would get deliveries of fertilizer and seed for the upcoming season on time. This program built on the industry of ordinary people, with children working in the fields with their parents, learning through doing, and utilizing the considerable family sizes of the black majority as the basic unit of mass production. The grain was sold to the GMB, which deducted its fertilizer and seed input costs and gave the farmers the rest. This inputs scheme also ended with IMF intervention. Food security in Zimbabwe was already threatened by the time the government embarked on its land-reform program.

The second part of this postcolonial snapshot relates to the contemporary period of information and communication technology (ICT)-based platforms, characterized by *imitation* (importing or transferring models that have worked well elsewhere and implementing them in Africa) and by the creation of synergies between inbound and locally invented modes of innovation and entrepreneurship. It is often overlooked that Africans—specifically the Rwandan entrepreneur-engineer Miko Rwayitare and his Telecel company—are the ones who first introduced the cell phone and subsequently mobile technology to Africa in 1986. Until

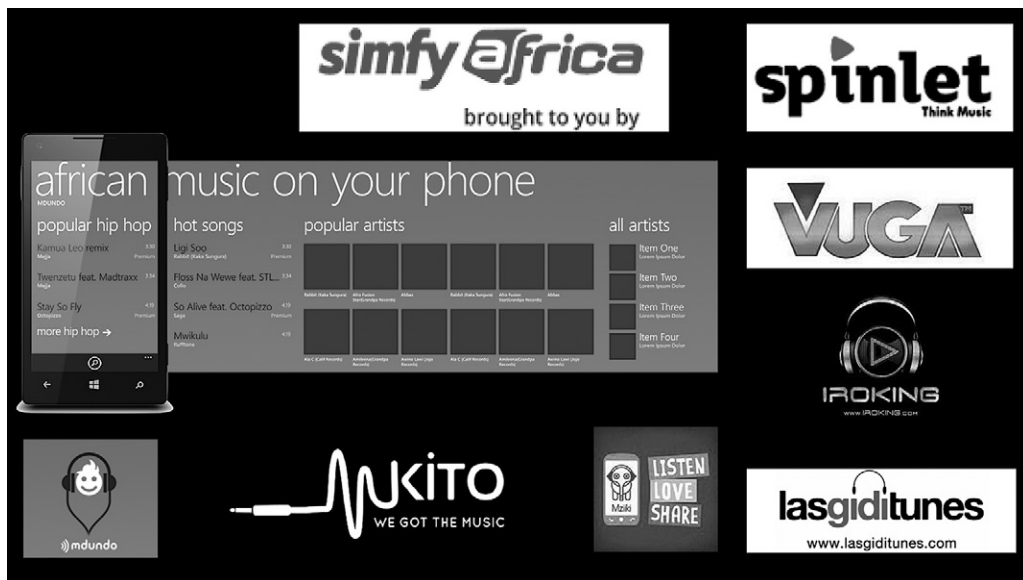
then, Africa had relied on fixed telecommunications first laid out in the colonial period for voice communication and on letters and telegraph for textual communication. Mobile also relied on satellite to transmit. As I see it, ICT is just a platform, a stage on which Africans are setting themselves up to create innovations. They are strategically deploying *things* (the mobile phone, computer, and Internet) to effect their dreams. Credit often unfairly goes to the gadget, as in *see how mobile technology is changing Africa*. Wrong! We should instead see *how Africans are changing mobile technology*. Ahead, I will discuss only examples in which Africans are changing this technology in a way that integrates the inbound and the locally generated as raw materials for creating something entirely new.

Although Rwayitare pioneered mobile telecommunications infrastructure, continent-wise, credit for digital mobile technology is owed to the political and strategic vision of the main protagonists behind Africa hosting the 2010 World Cup tournament. The most important figure was Thabo Mbeki, then South African president, with not-insignificant help from the persona and charm of Nelson Mandela. I was in Johannesburg when the news broke. The argument I heard Mbeki articulate on radio and television was that the World Cup event should be awarded to South Africa—the tip of the continent—so that the undersea cables could go round the furthest part of the continent and thus circumnavigate the entire continent. If the event was awarded to Egypt—the other bidder—the moment would be lost for good, because the rationale for such infrastructure development was to televise the games digitally in Europe and the Americas. The subsequent event led to laying undersea cables near Africa's shores, linking them with the Europe to India cables to connect the East Coast, and stretching from the West Coast to Brazil to link with Latin America and, by extension, North America. Often, we are caught up in the technical and financial aspects of the undertaking, completely ignoring the strategic deployment of the World Cup to obtain cyber infrastructure: the credit for Africa hosting the World Cup goes to Mbeki.

The effects of the new infrastructure were quite rapid. Two years after the World Cup, there were twenty-one innovation or tech hubs around the continent—spaces where research and development, entrepreneurship, and marketing that is heavily reliant on leveraging mobile technologies takes place. By September 2015, the figure had risen over five times to 117—and counting. Some of these hubs were created in 2010. Most of the bigger ones are concentrated in the cities of Tanzania, Ghana, Kenya, and Zambia and serve as incubators for start-ups. Perhaps the most ambitious of all is Botswana's first science and technology park, called Botswana Innovation Hub (BIH), an example of an integrated platform for scientific, technological, and indigenous knowledge-based innovation. BIH has five sectors: clean tech, ICT and ICT-enabled services, mining tech, biotech, and indigenous knowledge. BIH's biotech node explicitly seeks to undertake R&D and entrepreneurship in the testing and manufacture of indigenous natural products. The indigenous knowledge systems (IKS) sector focuses on local-level decision-making and cultural activities of rural communities. IKS has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities.

A second feature of the post-2010 era is the development of ICT- or app-based platforms that serve as spaces for conducting transactions. Here are a few examples. One is a multimedia platform for music streaming, which has opened up possibilities for African artists to reach new audiences, especially with the development of the smartphone. Among some of the most successful ones are Simfy Africa (South Africa); Spinlet, iRoking, Vuga, Orin, and Las Gidi Tunes (Nigeria); Mziiki and Mkito (Tanzania); and the Kenyan outfit Mdundo (Kenya) (figure 0.2). Their music inventory includes Afrobeat, gospel, dancehall, Fuji, highlife, hip-hop, hiplife, house, Jújú, Kwaito, reggae, R & B, and traditional genres. Many artists have over four hundred thousand subscribers. Spinlet, for example, invites such artists to upload music to the site and earn 90 percent of the revenue generated, with the company getting 10 percent. The payout per stream is currently about US\$0.038.

The second example is the social network app. Outside of Whatsapp, Twitter, Facebook, and LinkedIn, Africans are developing their own social networks. Most of them are still country-specific—for example, Mxit in South Africa—or limited to certain countries or just the diaspora; a few are continent-wide and connect Africa and its diaspora, such as African-zone and Yookos, the latter starting out as a Christ Embassy International platform before broadening. Some African Pentecostal churches use their church names—for example, the Kimbanguists in Congo and Tomitope Joshua's Emmanuel TV. They speak to the power of spirituality driving ICTs in Africa, which shows the marshalling of forms of social kinship



**Figure 0.2**

Music streaming platforms in Africa as of 2016.

Source: Author.

into a sustainable base of customers. Increasingly, villages and communities—platforms in their own way—are entering online platforms so that scattered members in the diaspora and the city can network. Some of this activity occurs on Facebook and Skype, but it is Whatsapp that has really driven this movement, at least in my village.

The most inspirational and urgently needed innovations derive from people who respect and thoroughly understand local modes of knowledge and build upon them. They are not just looking at the local as a problem that tech (i.e., the inbound) can solve but as a source of technologies that they can synergize with incoming materials to unleash opportunity from what people are already doing. Good examples of such synergy include eSoko, Rural eMarket, M-Shamba, iCow, and Hello Tractor. eSoko is an information and communication service for agricultural markets in Africa built by local developers and consulting staff in Accra, Ghana, as an ICT-response to preexisting and thriving farming; it offers services like market prices, weather forecasts, and growing tips and business strategies relating to product marketing, market monitoring, supplying, and sourcing. It also includes automatic and personalized SMS alerts, buy and sell offers, bulk SMS messaging, SMS polling, Android (operating system) surveys, and more. eSoko is the “e” in “electronic” affixed to Soko, kiSwahili for Market. Today, eSoko can be used anywhere with any mobile phone and is in use in Ghana, Kenya, Burkina Faso, Nigeria, Malawi, Zimbabwe, Benin, Madagascar, and Mozambique. iCow is a platform for dairy agricultural products lined up on a menu, the brainchild of a team of young Kenyan techpreneurs led by Su Kahumbu and Charles Kithika. It helps farmers to manage their cattle. What I found so impressive is that Su Kahumba is a woman who grew up on a farm and is using that knowledge not just to find a problem to be solved by ICT but as a rich knowledge base to add value to mobile phones and their possibilities. Rural eMarket is a multilingual app to affordably communicate commodity info about and enhance rural access to markets, including and especially in communities in which people didn’t go to or didn’t get far in school. It was developed in Madagascar in recognition of access to market being one of the biggest blockages for development—that is, the need to find the market and the right price for a product. M-Shamba is an interactive platform that also provides information (on production, harvesting, marketing, credit, weather, and climate) to farmers through the use of a mobile phone. Currently, four thousand rice farmers use the app in Kenya. Nigerian-based Hello Tractor is a social enterprise that addresses the shortage of rural draft power and labor shortages among rural farmers by creating a network of “smart tractor” owners from which farmers obtain tillage or tractors via SMS. The organization has designed innovative, low-cost smart tractors specifically suitable for small farmers, each equipped with various attachments so that owners can adjust them to suit specific crops and stages of production. Most helpfully in terms of trust and viability, a GPS antenna is attached to each tractor, allowing Hello Tractor to track the machine’s usage and collect data on its location, market trends, and uptake. These are innovations for Africa by Africans who thoroughly understand, emerged out of, and have faith in the working of African knowledge.

## Outline of the Book

Intellectual Africa is the subject of the nine chapters of this volume. Their task is not simply one of mobilizing Africans as “native informants” and African languages and orature as archive. One of the contributors to this volume made this critique two and half decades ago when responding to the way Henry Odera-Oruka (1983), Jan Vansina (1986), and V. Y. Mudimbe (1988) treated oral traditions. Cautioning against this colonial way of using African knowledge, D. A. Masolo urged us to move away from a tendency to reduce the producers, keepers, and purveyors of indigenous knowledge to the proverbial “native informant” of anthropology, who is “a mere resource material from whom the scholar extracts and constructs his mute knowledge.” Thus “the expert scholar” installs himself or herself “as the systematic thinker (lover of wisdom, scientist) who wades through the ignorance of his interlocutors in order to sift out episteme from *doxa*” (Masolo 1991, 1005; also Masolo 1994, 2003). The book signals a sense of urgency to do something other than simply mobilize African knowledge and lives as fodder for Western theory. As Ngugi wa Thiong’o (1985, 19) says: “Cultural control, as a means of economic and political control, is the most dominant factor during the neo-colonial phase of imperialism, and we as an African people must address ourselves to this if we are really serious about the liberation of the productive forces of African people.” It is no longer enough to be content with decolonization as the physical evacuation of the colonizer; Africa must vigorously seize itself with “decolonizing the mind” (wa Thiong’o 1986), to fight the colony within, the colony in us, the colony as us, to resurrect ourselves from the “cemetery of mind” (Marechera 1992).

It is therefore appropriate to start with Masolo, who in chapter 1 offers the inviting provocation that Africa’s indigenous knowledge systems have stagnated. There was a bright past indeed, but the light has dimmed; Africans have lost their self-image as innovators and are mere consumers. He wonders whether a reversal of “this culture of self-mortification” (treating ourselves as if we were dead) is possible, how, and against what obstacles. The most spectacular such example of self-mortification comes from the Nigerian scholar Abiola Irele (1983, 3; republished as Irele 1992), who said that the only future for Africa lies in turning toward and following Western culture and civilization: “It is of no practical significance now to us to be told that our forefathers constructed the Pyramids if today we can’t build and maintain by ourselves the roads and bridges we require to facilitate communication between ourselves, if we still have to depend on the alien to provide us for necessities of modern civilization, and if we can’t bring the required level of efficiency and imagination to the management of our environment.” Macien Towa (1971, 1979) is another prime mover of this view. Irele’s critics are justified in rejecting a total capitulation of African culture to Western values, because nobody can foretell what identity might emerge. They instead urge Africans to take all the positives they can get from outside, while maximizing the strengths of their own innovations (e.g., Gyekye 1997; Falola 2008; Wiredu 2000).



Masolo traces the problem of self-mortification to the informalization and trivialization of indigenous knowledge during the colonial moment and since then to something extracurricular to the “new and important” knowledge that Europeans introduced. The colonial school became the venue and source of knowledge, whereas home became simply a domestic space winnowed of any capacity to produce *true* knowledge. There were formed two worlds: one self-styling itself as the producer of secular, natural, or true knowledge (Western) while dismissing the other (the rest) as a world of myths, superstitions, and falsehoods. Those like Paulin Hountondji (1996) who saw myth as abstraction dismissed indigenous thought as philosophy on the basis that it was stagnant, communally produced, and anonymous, the antithesis of proper philosophy. As Masolo notes, Hountondji (2009a) no longer sees indigenous knowledge systems as stagnant and calls for accounting for change and continuity in African practices and modes of knowledge production. For his part, Masolo cites at least two poignant examples—the Maasai and their spear and Egyptian mummification—to illustrate what is scientific and technological about African systems of thought and practices and according to whom. Both are examples of myths and spirituality as abstractions and anchors, inspirations, drivers, and structures of scientific reason, illustrations of “the curiosity of the human mind” and the dynamism and adaptability of African modes of knowledge and material production.

I explore this interlocking of spirituality, communality, innovation, and knowledge production in chapter 2 on *chimurenga*, the arts of war derived from *Murenga*, or Mwari, god of *vedzimbahwe* (or “Shona” people) of Zimbabwe. I show that *chimurenga* is an innovative transformation of surroundings (caves, mountains, rivers, pools, valleys, forests, animals, and trees) into military assets and infrastructure, with or without physical modification. Previous studies reduce *chimurenga* to two historical events: the anticolonial wars of 1896–1897 and of the 1970s. Instead, I see *chimurenga* as a time-transcendent philosophy of security dating back to the migrations of *vedzimbahwe* from the North into Southern Africa. *Chimurenga* is one of many indigenous spaces from which to make critical interventions into the question of the scientific, the technological, and the innovative, from which African reasons and reasoning do not have to be true or false according to outsiders’ standards but must be valid on their own merits. I explore the creative labors relating specifically to biological and chemical warfare, which serve as exemplars of a spiritually anchored and inspired creativity. Through *chimurenga*, the everyday or day to day (*zuva nezuva*) becomes a vast *laboratory* (site of creative labors), with ordinary people (*vanhuwo zvavo*) as experimenters and intellectuals in ways specific to their needs and desires and ordinariness no longer equated with simpleton-hood but a normal state of things.

Shadreck Chirikure extends this conversation to African metallurgy in chapter 3, questioning why Africa should be tethered to a Western idea of a laboratory as a built-in space, which undergirds understandings of STI. Such Western-centric conception marginalizes other sites of knowledge production in regions of the Global South such as Africa. Chirikure



casts precolonial African “laboratories” as places of work, experimentation, and improvisation. Contrary to Western notions of the laboratory, Africa’s were not fixed-site installations but included various nodes from “the homestead to the forest, from the cultural to the natural, and from the living to the dead.” Chirikure shows that “sites of knowledge production were transient and never fixed on one point,” fluid not just spatially but also in their technical and symbolic practices. Metal- and pottery-making sites in particular were “laboratories without buildings.” Being temporary allows flexibility and experimentation in terms of furnace design and energy availability across different regions and time spans. With pottery, Chirikure proposes the idea of the homestead as a laboratory, involving the use of clay to form objects according to required shapes and heating them to high temperatures. This process removed water and increased strength. Metal-making was a male vocation, but pottery-making was exclusive to women and could be done indoors to ensure the right degree of heat or cold and the right air or wind conditions, thus preventing cracking. Collection, mixing, molding, drying, firing, and polishing are described in meticulous detail, with hints toward the taboos that governed practice.

Geri Augusto’s chapter 4 extends the conversation beyond the physical shores of Africa, emphasizing the role of enslaved Africans not only as STI transferors but also as innovators acting upon this carried knowledge, synthesizing it with knowledge found in the “New World” and creating something entirely new. Augusto points out that the growing literature does not treat the knowledge of enslaved Africans and their descendants as “an integral part of a truly globalized history of science and technology.” As she says, there must be room to treat human societies and knowledges as “coeval without having to be judged commensurate,” a “different history of science and technology, emphasizing what was creative, inventive, and put together differently.” The effort it takes the enslaved to rehumanize themselves after the slaver has relegated them to positions as nonhumans incapable of thought—and thus not technological but the technology themselves—is one of the most poignant examples of innovation in human existence. Thus, through what she calls *plants of bondage*, Augusto returns to enslavement and colonialism with a focus not merely on the sweat, blood, and tears of the enslaved and the colonized, but the enterprise and inventiveness that is required to keep “body and soul together” under circumstances that are supposed to rip one apart from the other. Indeed, one can extend this perspective to the present and turn upside down the negative portrait of Africa as riven with crises—disease, poverty, wars—and, wherever they exist, look at how people innovate survival.

Located in the present, Katrien Pype’s chapter 5 on Kinshasa speaks to that very dynamic. Like Mavhunga and Augusto, Pype draws her definitions of *innovation* from indigenous African words, in her case *kosikola*, “to innovate” in Lingala, the dominant language of ba Kinois, the inhabitants of Kinshasa, DR Congo’s capital. *Kosikola* also translates into “to choose” and “to deliver” from evil spirits, suggesting that innovation derives from the spirits; it is spiritual knowledge. Thus, “to know” is also *koyeba* or *kozala na mayele*, “to be with knowledge” or “wisdom” (hence smartness) derived from experience rather than formal schooling. *Kozala*

*na mayele* becomes a theoretical standpoint to challenge most studies casting smart cities as out of place in Africa and as outcomes of Western technology transfer and African use. On the contrary, there are other way of being smart that Western-centric scholarship does not cover. Thus, Pype proposes to approach “smartness” from below, as ba Kinois see it, and addresses their ways of being innovative and technological in this bustling Africa city. *Smartness* is the capability of one who is possessed by a *nkisi ndoki* (an ancestral or wandering spirit) and therefore a *ndoki*, one who practices not just witchcraft or *kunda* (sorcery), performing either malevolent magic (*kindoki kia dia*, usually by night) or benevolent magic (*kindoki kia lunda*, by day). Incoming things like motorcars, airplanes, kitchen robots, mobile phones, and computers, Pype shows, are all examples of what ba Kinois call *kindoki ya mindele* (“witchcraft of the white men”), distinct from *kindoki ya biso* (our witchcraft). The white man’s witchcraft is subjected successfully to “our witchcraft.”

The propensity of indigenous traditions to adapt to new circumstances so that they are part of the equation of everyday life today is illustrated clearly in Ron Eglash and Ellen K. Foster’s chapter 6. Although there are many makerspaces in America, Eglash and Foster focus on their African counterparts, which continue to multiply and gain popularity across the continent. They are locally and culturally situated, their fixer mentality deeply indigenous in its orientation, as opposed to simply aping European or American maker cultures. The authors cite Senegal’s Colobane market and the collective ethos deeply embedded in spirituality; “fixing” is a power given by God himself to the Senegalese people, according to one maker. Meanwhile, in Ghana, street vendors sell new wares while also fixing cell phones, printers, and other electronics with complex circuitry. “They learn their highly refined skills through attachments (or internships),” Eglash and Foster say, with the goal of owning their own shops. They creatively reuse what is otherwise waste: “They are simultaneously pulling the warp of innovation geared toward the future while also weaving in the weft of repair practices already deeply entrenched in their cultures.” In Lagos, the hackerspace WoeLab is now renowned worldwide for creating a 3-D printer out of e-waste, and in downtown Accra creative makers meet up and work on their projects in the shared tools, shared space called iSpace. These are just a few of several examples of Africa engaged in creative work at the interface between indigenous traditions and incoming (often invited) things and ideas. Eglash and Foster end where they began: by urging Africa to look into itself for inspiration instead of taking the easy road of importing other people’s cultural values.

In chapter 7, Toluwalogo Odumosu asks how, in spite of the self-disadvantaging legal framework Africa has imposed upon itself, Africa’s citizens are still able to make mobile technology African. “Can we recognize the African mobile as distinctly African? And if so, what is the nature of its sociotechnical assemblage?” he wonders. “What does it mean to examine how mobiles are being made African?” In answer, he says that Africans are not appropriating merely to use and throw away without adding anything, but are engaged in what he calls *constitutive appropriation*, wherein the act of appropriating is simultaneously one of constituting something into being. Besides the amazing point-of-use innovation that goes

hand-in-hand with mastery of the lingo and the artifacts and services it denotes, Odumosu speaks to the reality that in most parts of Africa no “wired” telephone infrastructure even existed to prelude the “wireless.” Thus, the celebration of Africa as having skipped wiring (technological leapfrogging) en route to wireless assumes this was a deliberate choice and is based on the privileging of the experiences of wealthy countries. Nigerian engineers were not simply “rolling out” universally operative systems but “determined that a fully functional *Nigerian* network has to take into account real users and their particular use practices.” Only after that could they engineer a Nigerian mobile. The lesson? “New challenges and practices *inspire new designs and innovative solutions* (overdimensioning) that are then folded into the upstream design process in tangible and substantial ways.”

Garrick E. Louis, Neda Nazemi, and Scott Remer mount a robust critique of Millennium Development Goals (MDG) and multiple other innovation and development programs that depend on official development assistance without accountability to Africans in chapter 8. Such foreign aid benefits Western think tanks, banks, NGOs, farmers, and transport companies, and, in the case of the United States, such foundations to “help” Africa are actually hygienic projects that help ex-presidents clean up their images in the eyes of the American people. Deploying what they call an *innovation for development* approach, the authors settle on a simplified definition of *innovation* as “the creation or enhancement of artifacts to improve the human condition.” Africa must establish an innovation strategy that “builds upon and leverages domestic capacity.” In that way, official development aid (ODA) could be synthesized with these local repertoires and resources to build an Africa-defined, Africa-driven, and Africa-benefiting strategy. The authors thus propose a two-part strategy for national development that prioritizes basic human needs (à la Maslow) as prerequisites for building capability for secondary and other higher-order needs. This commonsense approach holds that “it is not possible to sustain higher-order development processes like manufacturing without reliable basic services, such as water and sanitation.” Can’t we do both, one may ask? The danger lies in possibly stretching resources too thin and playing to Africa’s weaknesses, not its strengths, others say.

The authors make a powerful case for Africans not only as innovative originators of things from scratch. They seek to show the centrality of human needs—the basic ones any human being or living organism cannot do without—and the kind of means and ways Africans seek and deploy to meet these needs. It is here that the authors bring in innovation as strategic targeting of potentially resourceful things “out there” that can be deployed locally to answer these needs. The lazy or arrogant analyst may view such strategic targeting and deployment as merely “use” or even user innovation, when in fact, viewed from Africa, it constitutes a fecund scene of originality. In other words, the authors are saying that innovation developed outside Africa or by non-Africans can, in the innovative hands and minds of Africans (provided they are given the space), contribute to the betterment of living conditions and facilitate other forms of innovation in Africa by Africans. Another way of putting this is that when Africans speak of Marx, Maslow, Kuhn, or Einstein or use a smartphone, computer, or drone,

analysis misses the point when it only marvels at what these things are doing that makes them technological (problem-solving instruments) in their specific African contexts. Instead, the most important and beneficial question to consider both for Africans and outsiders looking in is this: What are Africans doing to, with, and through these things? This is a strategic targeting and deployment question. It has to be asked, especially as a means test for investing intellect, time, and money in Africa, and, more importantly, it is a question that Africans themselves need to ask whenever the continent's policymakers look outward for potential algorithms to address local problems.

Chux Daniels's chapter 9 closes the book with sobering reflections on official approaches to STI policies in Africa. How is it that an R&D-centric approach can be allowed to guide STI policy in a continent "in which empirical evidence shows that substantial innovation activities occur in the informal economy and significant indigenous knowledge resides in the traditional and rural settings?" Daniels asks. In doing so, he returns us to Masolo's exploration of the origins of the European colonizer's school as "true knowledge" and the homefront as an informalized, even knowledgeable space. He calls for a reconceptualization and expansion of STI to account for "the larger variety of innovative activity in Africa and to address social needs peculiar to the continent." This is an urgent task if the "basic needs" that chapter 8 maps are going to be met. Pan-continental bodies like the African Ministerial Council on Science and Technology (AMCOST) and the mother body, the African Union (AU), recognize the need for STI as a driver of development, but their borrowed definitions of STI are too narrow. How does one exclude street vendors in any narrative of innovation in Africa, for example, when they are a feature of every city on the continent? How can one possibly exclude Nollywood from Nigeria's innovation when it is the fastest-growing economic sector and industry? To illustrate just how Western-centric African measures of STI are, Kenya's M-Pesa is always cited as an example because it is "S&T-based, technology-driven, and prompts product innovation." As Daniels sees it, wherever possible, Africa must be willing to chart a different STI and development trajectory and devise its own measurement, rather than slavishly following the Oslo or Frascati manuals, which Latin American countries have left behind in favor of their own Bogota manual.

The reader is invited to explore what we believe is the beginning of a long walk to the freedom to think from a different place about concepts that we often take for granted and generate new meanings. We no longer look merely at proposing a new perspective to promote a new perception of Africa, but explore African self-perception as a compass from which to plot new futures—futures that are already happening. We just need to open our eyes to see them.