

The Space of Possibilities: Political Economies of Technology Innovation in Sub-Saharan Africa

Christopher Csikszentmihalyi¹, Jude Mukundane², Gemma F. Rodrigues³, Daniel Mwesigwa⁴,
Michelle Kasprzak⁵

^{1,2,3,5} Madeira-ITI, ²Instituto Superior Técnico – University of Lisbon, ⁵University of Porto, ⁴CIPESA
^{1,2,3,5} Funchal, Portugal ⁴Kampala, Uganda

¹csik@m-iti.org, ^{2,3,5}{first.last}@m-iti.org, ⁴daniel@cipesa.org

ABSTRACT

HCI researchers work within spaces of possibility for potential designs of technology. New methods (for example, user centrism); expected types of interaction (user with device); and potential applications (urban navigation) can extend the boundaries of these possibilities. However, structural and systemic factors can also foreclose them. A recent wide and shallow survey of over 116 individuals involved in technology development across 26 countries in sub-Saharan Africa reveals how factors of political economy significantly impact upon technological possibilities. Monopolies, international power dynamics, race, and access to capital open or constrain technological possibilities at least as much as device-centric or user-focused constraints do. Though their thrust may have been anticipated by reference to political economic trends, the structural constraints we found were underestimated by technologists even a decade ago. We discuss the implications for technology development in Africa and beyond.

Author Keywords

Sub-Saharan Africa; Africa; HCI4D; M4D; postcolonial

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; K.4.2 Social Issues

INTRODUCTION

HCI researchers labor to generate new knowledge. Much of this work is conducted with the implicit or explicit expectation their research might inform the design of future systems, or expand the space of technical possibilities. Branches of the CHI community look to influence industry [7,24], activists [19,21], cultural applications [27,43], or development projects [30,38], among other areas, and recently much attention has been focused on maker and

hacker spaces [5,28] as sites for the democratization of technology and its application.

This expectation of influencing future systems is immanent in much HCI work but it is also often unarticulated, with “very little direct guidance in the HCI literature for how to envision a future or, more importantly, forecast multiple futures and critique implications for creating technologies that will be relevant a decade or more from now” [29].

In this paper, we seek to demonstrate the importance to prediction of researching usability within a broader, ecosystems approach, which may also concern itself with such factors as history, political economy, race, class, or infrastructural constraints, among others.

We begin by revisiting an ICT-/HCI-/M- 4D debate that did not adequately take into account broader ecosystems. The debate, which took place in the context of sub-Saharan Africa around 2006-2010, revolved around whether technologists should concentrate on more available telephony standards of SMS/USSD, or rather develop for the internet, which was growing in popularity. While our example is anchored in HCI4D, it is not primarily concerned with technology for development but rather with contrasting perspectives of usability versus ecosystem. Later, we describe our recent survey of current ecosystems in the region, and how they help to determine what technologies have become possible. Finally, we contextualize this within larger political economic trends and considerations.

ICT POSSIBILITIES IN THE FIRST DECADE OF THE TWENTY-FIRST CENTURY

Around 2006-2010, technologists and analysts debated the best way to deploy information and communications technology (ICT) in Africa [1,12,44]. ICT was “an attractive element of any strategy to meet development challenges,” because “It can be tailored to meet a variety of diverse challenges and need not be ‘purpose built.’ The same network, server, and peripheral devices (such as PCs or cell phones) can help support distance education and remote health delivery and connect rural communities to global markets” [45].

A co-founder of iHub (the first and most famous African hub, in Nairobi) posed the central question in 2009 as: “should [we] be providing internet protocol (IP) services first, rather than SMS [?] If cost is the single most important factor for

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.

CHI 2018, April 21–26, 2018, Montreal, QC, Canada © 2018 Copyright is held by the owner/author(s). ACM ISBN 978-1-4503-5620-6/18/04. <https://doi.org/10.1145/3173574.3173880>

This work is licensed under a Creative Commons Attribution International 4.0 License.



any mobile service aimed at ordinary Africans, then what will it take to move the ball from the SMS court to the IP court?” [12].

The arguments for SMS included that it was ubiquitous and available for anyone with a phone. The arguments against it included the limitations of 160 characters and the “richer experiences” available on the open internet, which might “remove barriers to information often faced by resource-constrained users” [11].

HCI researchers at the time typically focused primarily on questions of usability, whether of SMS/USSD or internet platforms. For example, researchers prioritizing internet access wrote, “we need to understand and design for mobile-only access; otherwise many will remain excluded from the internet for the most trivial of reasons” [16]. While usability was considered a major constraint, the accompanying assumption was that the internet for users would resemble the internet researchers had access to at that time. As we will see, the internet that is accessible in Africa is increasingly different from the open and neutral internet most technologists envisioned in 2010.

Of studies from this period, one survey of ‘mobile for development’ (M4D) projects, while focusing mostly on usability [11], did presciently put its finger on another key analytical question: “What does the project require from [telephony] manufacturers or operators?” This necessary, dependent relationship with telcos remains a major determinant of what has become possible in the ensuing decade. While the 2008 survey did more than most to anticipate infrastructural concerns, it nonetheless underestimated how politics may also intervene. For example, it describes the Zimbabwean Freedom Fone project as working “with all phones with voice and SMS as the lowest-common denominator,” and as not requiring “operator cooperation.” From the user/device standpoint that may have appeared true, but that very project was later blocked by mobile operators after coming under pressure from the government [53].

IT TAKES AN ECOSYSTEM

The user/device/service emphasis that informs many HCI discussions of technology can miss “essential aspects of aesthetics, justice, and change,” and contrasts with infrastructural approaches that may yield a “more ecological understanding” [46]. Users and their devices exist within a broader ecosystem of services, networks, and infrastructure, which codetermine technological possibilities: a political economy of technology and its development.

The 2006-2010 debate on the best way to approach ICT4D in sub-Saharan Africa remains unsettled. Internet has spread dramatically if unevenly throughout the African continent. Cost, lack of relevance, literacy challenges, limited electrical grids, poor rural telecommunications service, and other issues (including usability) have led to much lower usage rates than perhaps expected, especially outside urban areas.

Meanwhile a number of SMS and USSD applications have had success [9,20,47]; while they are by no means ubiquitous, they have high rates of access and interaction among the general population, and they have spread more equitably than internet-based systems. By way of example: Mobile payment systems using USSD, such as M-Pesa or mobile operator credit top-ups, have seen massive adoption. The USSD-based Ugandan Birth Registry [61] has facilitated birth certificates for over three million newborns since its launch in 2011. SMS and USSD based MomConnect registered 700,000 users in South Africa in 2014, its first year of operation [62]. UNICEF’s SMS-based U-Report has been launched in 21 African countries, with over 4.6 million registered users worldwide.

The spread of SMS and USSD systems has nonetheless been heavily constrained by the difficulty of launching and maintaining systems that depend upon mobile operators. Indeed, a majority of successful programs are launched by development organizations with the cooperation of the national government. It is difficult to understate the importance of these types of organizations on the continent, “formidable institutions that are [also] ‘governing’ Africa from afar: the transnational financial institutions (World Bank, IMF, foreign banks) and development agencies (USAID, UNDP, UNHCR, etc.), as well as the churches, missions, and so-called non-governmental organizations” [13].

This sort of ‘development’ is a major industry in many parts of Africa: direct aid is 5% of the GDP in Uganda, accounting for as much as 42% of the government budget in 2006 [63,64]. It is often viewed with ambivalence: one Nigerian angel investor based in London we interviewed told us, “The aid industry is too big to fail, and the biggest benefactors are the grantors and trusts, because for every \$10k granted there is an apparent \$40k lurking in the woodlands. The industry exists for white people to create jobs for themselves and perpetuate the trade.” Irrespective of merit, the development industry is an inescapable part of local technology sector ecosystems, setting tacit priorities and determining narratives within local tech communities—and internationally in fields like ICT4D and M4D. The advantages of working with these agencies, often in tandem with national governments, in order to deploy accessible ICT services imbricates much local innovation into an international development narrative that is largely set in the West.

Moving past development aid, the goal for most regions is also to have an ecosystem of local technologists developing local services, with some insight into local opportunities and risks. Local funders would help technologists to scale and distribute their work. These technology activities have always existed, though they often get little mention. “[W]hat has been lacking in the development discussion regarding Africa is a view that recasts Africa as a variegated site of innovation (not humanitarian desperation)” [32]. However, until recently, African nations have not been generally

recognized as hotbeds of ICT innovation, and local institutions like universities and the finance industry have not been seen as capable of providing adequate launchpads for tech startups.

Over the last decade, that perception has been changing. There are now over 200 ‘tech hubs’ across the continent. Hubs are seen as a crucible for new technologies—primarily apps—that would be locally and socially relevant. Attention to tech financing has been growing, startups launching, and products making it to market, generally centered on a few regions dubbed with recognizable monikers like Silicon Savannah, Silicon Cape, or Silicon Lagoon.

SURVEY ON SOCIAL TECHNOLOGY ECOSYSTEMS

We will now present the findings of a commissioned survey we conducted for three U.K. foundations on the ecosystems of ‘social technology’ – systems designed for social good applications – in sub-Saharan Africa. In the pages that follow, we paint a ‘broad brush’ picture of the ecosystems for technology innovation in sub-Saharan Africa, highlighting those ecosystem characteristics we found 1) to set the parameters of technology possibility and 2) to be present in multiple national contexts. These include the arrival and spread of tech hubs; interactions with Silicon Valley models of innovation; the outsize influence of telcos; the advent of social media bundles and absence of net neutrality; and implicit bias against Africans and racism in funding. Each of these ecosystem elements enclosed or expanded the ‘space of possibilities’ for technologists in significant ways.

Our concentration in the survey on social good was part of the commission, but aligned with our team’s experiences as activist technologists. A recent United Nations (UN) report describes the need for reorienting technology development toward more socially inclusive systems, as while contemporary technologies help us individually, they appear to be increasing inequality and poverty in many parts of the world:

Dominant innovation trajectories fail to include significant numbers of people from the benefits of social and technical change, and these are disproportionately poorer and more socially disadvantaged groups, including rural inhabitants and women... [There is a need to] re-orientate and redirect innovation trajectories in ways that enable more inclusive, socially just and environmentally benign patterns of socioeconomic development [59].

Social technology is not limited to Africa or the Global South; this reorientation is necessary everywhere. Examples of social technology include anti-corruption systems for citizens to report bribes; communications platforms for refugees on the move; and systems that help farmers to plan the right crop. Our survey was primarily focused on ICTs, though many of its findings may apply more broadly. It also tended to focus on accessible systems for which the user is the ultimate beneficiary, as opposed to institutional systems for professionals or organizations.

Method

Our survey was synthesized through a combination of desk research, participant observation, and semi-structured interviews. Our team of eight interviewers and researchers, anchored in a technical research center in Portugal, included social technology founders, academics, a telecommunications engineer, and a technology journalist. The team was equal by gender, with three of the team from Africa, two from North America, and the remaining three from Europe. Interviews were conducted both live in Africa and via telecommunications, and took place from December 2016 until May 2017.

From our initial desk research, we built lists of dozens of potential interview subjects involved in social tech ecosystems in sub-Saharan Africa. These subjects were contacted via email, LinkedIn, or phone, with initial higher response rates in some (mostly anglophone) countries than others. During these interviews, we solicited further nominations, and proactively sought interviews with members of the ecosystems who proved harder to reach, such as investors and regulators. Altogether, we conducted 116 interviews from 29 countries in French, English, and Portuguese. 38 subjects were female, 78 male.

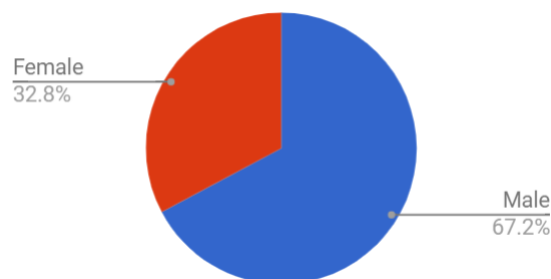


Figure 1: Interviewees by gender

More interviews were conducted in countries with strong tech ecosystems, like Kenya and Nigeria. Countries like Mozambique with less robust ecosystems had lower response rates, and lusophone and francophone interviewees generally described lower activity, looking to anglophone countries for inspiration.

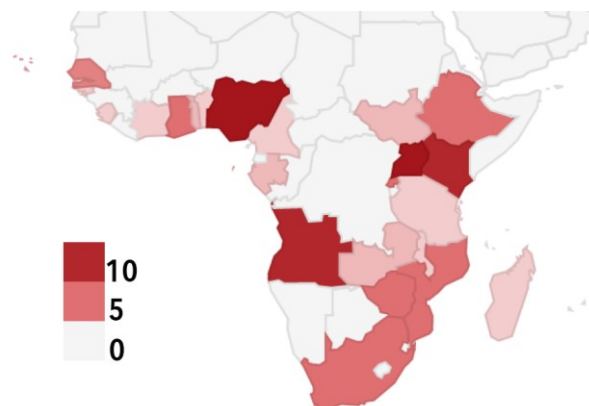


Figure 2: Interviewees by country

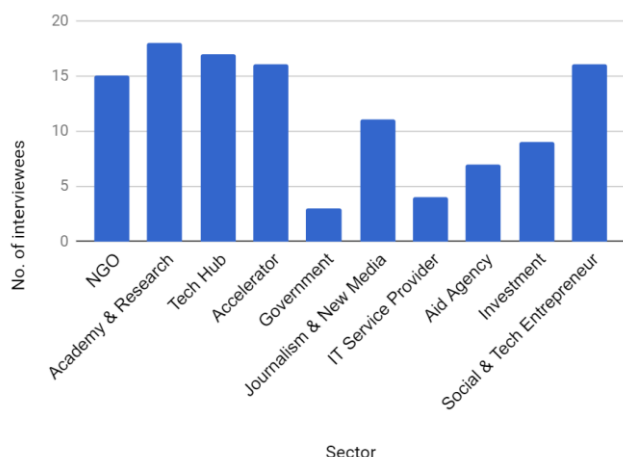


Figure 3: Interviewees by sector

With regard to theoretical orientation, we draw inspiration from several contemporary postcolonial Africanist scholars to guide our exploration of political economics in sub-Saharan African technology innovation. We are concerned not just with broad power dynamics between the West and sub-Saharan Africa but also how these extend to and mix with local interactions between tech entrepreneurs and investors, technologists and telcos, users and their communities, governments and citizens. Our thinking has been especially stimulated by observations that Africa is increasingly a site where “the practical workings of neoliberalism have been tried and tested [...]—thence to be exported to Euro-America” [8].

Finally, though sub-Saharan Africa is home to about 900 million people in the more than 45 states in, with over 1500 languages between them, “we can meaningfully speak about Africa. We can do this without needing definitively to establish an African ‘essence’, a *differentia specifica*, that renders the continent a single entity” [18]. Both within and without the continent, for example, Africa is a market, a trading zone, a union, and its countries are subject to significant and ongoing international (sometimes consensual) pressure, ranging from missionary organizations to the World Bank and the IMF, often under the continental moniker, e.g. “African hubs.” It is also important to note here that Africa has a millennia-long history of global entanglement, whose processes have only accelerated. Let us now describe some hallmarks of social tech ecosystems in this region

Hubs

The last ten years of technology culture in sub-Saharan Africa might well be called ‘the decade of the hub.’ No other African technology entity has so successfully captured the imagination, either locally or in the international press, nor

seen such a concerted push from powerful organizations like the World Bank. By 2016, there were 155 hubs in sub-Saharan Africa, according to the Bank [58], and some estimate the number to be over 200 at this point¹.

In 2014, researcher Nicolas Friederici reported from a working group that sought to define some of the common characteristics of hubs they had studied in Africa, Asia, and Europe [14]. According to Friederici, hubs are:

- Communal – a shared working environment
- Self-organizing and adaptive – driven bottom-up by the needs of innovators and entrepreneurs
- Innovating, enabling innovators – a service entity enables the creation of other enterprises
- Melting pots for heterogeneous knowledge – welcoming practitioners from tech, business, design etc.
- Local outposts of a higher cause – promoting Silicon Valley (or other international) techniques

While these hubs have been hailed for demonstrating lower failure rates than U.S. startups after which they are largely modeled [23], the absence of failure should not automatically imply success. There has been a burst of funding for tech hubs that largely keeps them from closing shop, even while being tasked with creating a particular type of tech ecosystem *de novo*, a task so great that success is elusive. Their existence in the middle of strong forces and expectations perhaps explains the pressure on hubs we heard about repeatedly. As the ‘re-pat’ co-founder and CEO of one of Ghana’s most active independent tech hubs described it: “It’s like we’re the bank, school, parent, brother, and psychologist. We’ve had a couple of [staff] people suffer from mental health issues because of the stress.”

While hubs may aspire to, and have much in common with the startup culture cultivated in Silicon Valley, the expectations for each are different. Startups in Silicon Valley are innovating for a rich ecosystem with ‘thick’ public investment, often ‘hacking’ around established systems and infrastructure to provide services for a sub-economy. For example, Uber allows for cheaper and more convenient access to taxi services in part through bypassing government and incumbent structures. In Africa, though, the cost and technology requirements of using ICT services are accessible mostly to the affluent, and labor is cheap, so it would be difficult to develop an Uber-like service that would offer cheaper or more convenient alternatives. Innovation for the masses pushes hubs and their young entrepreneurs toward areas such as health, agriculture, and financial technology – areas that have no clear models from Silicon Valley, and where prior public investment has generally been much lower.

Malawi, Kianda Hub in Angola, ActivSpaces in Cameroon, Hypercube in Zimbabwe, CITIC in Senegal and others.

¹ Hubs whose personnel we interviewed include Bongo Hive in Zambia, iHub in Kenya, Hive Colab in Uganda, M-Hub in

Interviews revealed that the greatest similarity between hubs is in their core aspiration: all sought to promote business and enterprise formation, usually around technology. From this starting point many paths diverge: hubs vary significantly in how they choose their mandate and seek to achieve their goals.

As important as hubs have become, it is critical to recognize that no single type of institution can provide an ecosystem for technology development [35]. This survey found that where hubs have led to the creation of successful projects, it was generally because other aspects of the ecosystem were working well. Where enterprises generated by hubs have been less successful, this was often because their progress was obstructed by the weakness of a key ecosystem enabler, for example, regulation, trained labor, or technical infrastructure. This echoes the broader thesis of the World Bank Digital Dividends [56] report, which concluded that “the full benefits of the information and communications transformation will not be realized unless countries continue to improve their business environment, invest in people’s education and health, and promote good governance.”

A key characteristic of hubs in sub-Saharan Africa is that they have generally been very consciously introduced and embraced as embassies of Silicon Valley entrepreneurial culture [4]. A hub might offer training in ‘lean startup’ approaches to business and tech enthusiasts; their design often seeks to imitate the fun and designerly offices of tech ‘unicorns’ like Facebook and Google, with bright colors, foosball tables, and beanbag chairs. The combination of technique, aesthetics, and worldview most hubs seek to promote is, to put it simply, an ideology. For proponents like the World Bank, the hope is that this enculturation will create a more mobile and internationalized workforce that can better interface with global trends.

LEARNING THE WRONG LESSONS

Two obvious problems arise from this approach. First, the right way to innovate technology in Silicon Valley is not necessarily the right way to do so in the Rift Valley. Teams working in hubs often learn the wrong lesson; perhaps the most significant waste of innovation energy has been the concentration on smartphone apps since the introduction of the iPhone a decade ago. Hubs have spawned successive waves of poorly-adapted pitches for smartphone apps in countries where habits and access to smartphones and data are completely different from American or European markets. These waves have crashed against the rocks of market realities.

A local business culture outside a hub may be quite different from the one forged inside. This disjuncture between Silicon Valley and local culture and conditions means that work in hubs has often conflated the aspirational with the delusional, for example by training young people for the wrong ecosystem and opportunities.

As one Nigerian tech executive now in the U.K. put it: ‘Hubs are making promises they can’t keep’. A U.K.-based scholar of media and communications cultures in southern Africa described her concern that hubs in Zambia “are giving young people too much hope, and maybe the wrong kind of hope....the truth is there is a dearth of other opportunities.” These observers worry that the structural impediments to succeeding are not being highlighted nearly as much as success stories from other ecosystems which may be unreproducible.

One U.K.-trained, ‘re-pat’ computer science professor in Zimbabwe looked at the reproduction of Silicon Valley applications this way: “Sometimes I worry that the software industry in Africa is just stuck in eternal mimicry. Which I don’t think works.” For him, imitation fails in two ways: First, imitation is a losing game if you’re slow to it. Inundated with examples of successful apps from other parts of the world, hub innovators often reproduce local versions of products (Ebay, Uber) that fail to gain traction. “It works technically, but the guys are doing it 10 years too late.”

Second, he says, imitation fails because one can imitate the product, but not necessarily the user: “[W]hen you are diffusing and transferring technologies, you are also diffusing different cultural practices, because the technologies are not value neutral or ideologically neutral. And the people who write software tend to be the people who do not appreciate the social side of technology.”

One former in-house hub researcher and current open technology advocate in Kenya thinks it is time for hubs to start defining themselves better, with more reference to the specifics of their country: “It’s going to be very interesting to see with all these hubs, how much is it that the local community gets agency to explore, experiment and figure out the place of technology to help solve their problems. Or is it going to be, ‘Come learn how to make apps and go ye forth!’?”

Hubs encourage and house a range of economic activity, not only social tech. Some teams might design games, others create applications for tourists. As economic activity this makes sense, and resembles common Silicon Valley strategy. But the urban, affluent bubble in which most African tech hubs exist can negatively impact social technology initiatives. Many projects marketed (or confused by media or donors) as ‘social tech’ projects only serve local elites, at times privatizing what in a more equitable approach would be a public resource. Over the course of the research, our team began to refer to social technology products developed in an affluent hub bubble as ‘*bourgeois-apps*’. Hallmarks of a bourgeois-app include: a) smartphone apps or unsubsidized SMS systems for the rural or poor, when such data usage is mostly restricted to urbanites with surplus income b) appealing to values or situations that are primarily urban, such as food delivery or anonymous house cleaning services c) simply replaying a recent trend in Silicon Valley without reference to local economics or preferences d)

appealing to values more common among aid workers or recently returned diasporans.

One example is SafeBoda, a company in Kampala, Uganda that trains ‘boda boda’ (motorcycle taxi) drivers in safety, provides them with two helmets, and mediates between customers and drivers with an app. Lauded in major Western media from CNN to MIT Tech Review, SafeBoda won an UK-based prize intended for “inspiring uses of digital technology for social good,” and received investment from the Global Innovation Fund, which aims to “improve the lives and opportunities of millions of people in the developing world.” SafeBoda’s website features a closeup of an upscale cafe table with a new smart phone running its app next to a cappuccino, a *mise en scène* beyond the means of most boda commuters. Its co-founders are European (Oxford and Louvain trained) development economists [65].

Boda safety is a pressing societal issue in Uganda, as is road safety throughout most of Africa. Over half of the many cases of trauma at the central hospital in Kampala stem from road traffic injuries, with motorcycles contributing 21-58%. “Low protective gear use, lack of regulation and weak traffic law enforcement contribute to [sic] unsafe nature of commercial motorcycles” [22]. But while this problem affects all of Kampala’s residents equally, SafeBoda’s app-based approach, borrowed from Uber, is unlikely to attract many customers save development workers or those from very elite backgrounds.

Most boda riders have few other transport options to make critical appointments, and ride of necessity. The ability to pay for traffic safety, like the ability to run a smartphone with a full internet data package—not to mention the taste for cappuccino—all correlate with disposable income. But perhaps more importantly, while using SafeBoda may improve road safety for the elite who can afford it, the innovation does little to improve safety in general. A similar investment in ICT for traffic police, infrastructure, public campaigns, or an ICT transport service with different affordances and values would bring more equitable benefits.

SafeBoda and similar bourgeois-apps follow the dominant innovation trajectory described earlier, failing to include significant numbers of people in the benefits of technological change. From the perspective of the user/device/service these technologies appear to provide a good, but viewed in a greater ecosystem, they primarily provide individual advantage. They are selfish rather than civic.

We are not arguing that there is an onus on every tech product in Africa to concentrate on users at the bottom of the economic pyramid, nor trying to vilify this particular and not unusual startup. Rather we argue that importation of Western technology tropes (like Uber) and their libertarian values may be diverting creativity toward a group of users (those with smartphones and internet bundles, who can afford particular calculations around safety) that might be too small a market to even succeed. Western tropes may be

overwhelming approaches more appropriate for the local economy or that might yield more equitably distributed benefits. Western observers and gatekeepers routinely misunderstand and reward such projects as providing a social good simply because they address a social problem, even as their benefits only accrue for elite users. This validates and reinforces the cycle.

Whether discussing hubs themselves or the products of hubs, it is clear that Western financial, cultural, and other expectations largely shape the narrative about what a hub should be, what technologies seem appropriate for development and funding, and what is ‘cool’ to work on. Hubs have created a schism with prior local technical and business practices, importing models that are not in sync with the local technical, educational, or financial ecosystem. Frictions and loss between expected and actual outcomes ensue [4].

Telcos & Platforms

The second ecosystem element we found impacting upon the space of possibilities for African tech innovation was the internet, and more recently mobile telephony. The dynamics of availability vary in sub-Saharan Africa [17], but the internet has, since its popular spread since the early twenty-first century, been less available to rural users, women, and those at the bottom of the pyramid.

Earlier we described the debate centered around those who felt it wise to design with technologies that were widespread to large numbers of users in Africa – like SMS or USSD [10,42,51] – or if doing so would strand Africans with inferior technologies. Better, many thought, to assume the spread of Internet and eventually smartphones. These arguments were often grounded on misleading reports issued by ministries and organizations like GSMA and ITU. For example, through the 2000s a steady stream of articles touted large rates of growth in mobile ‘penetration’ [57]. These rates were largely exaggerated due to multiple SIM card purchases [17]. Similarly, in 2013, InformaUK predicted that by 2018, Africa would have in excess of 800,000,000 mobile broadband subscriptions [54], a number close to 100% of its current population. The most recent report by the Uganda Communications Commission lists 6.5% of their (relatively well-connected) citizens reporting having used the Internet in the prior three months [55].

Smartphone availability has indeed gone up [17], but large differences between rural and urban users, literacy issues, and prohibitively expensive data mean that few users outside the urban wealthy use smartphones with internet ‘always on’ [52]. The applicability of SMS and USSD has not declined significantly in rural areas throughout most of the continent, or for the urban poor. The hypothesis that internet access would eventually approach accessibility has proven invalid. However, two other aspects of network and telco availability further complicate possibilities: the difficulty of scaling novel technologies with SMS and USSD, and the rise of ‘social bundles’ (which we cover later).

SMS & USSD: dancing with monopolies

For mobile phone ICTs without internet, two technologies have stood out: SMS and USSD. SMS is the original texting protocol, available since 1992 and to 80% of the world's mobile phone users. USSD (Unstructured Supplementary Service Data) can encompass more sophisticated, menu-based, two-way dialogues than SMS. It is commonly used by telcos as a way to interact with users, for instance to 'top up' credits with scratch cards.

Both systems are used extensively, but it is typically the telcos, development agencies, and large businesses that have access to these technologies, in contrast to apps or other software with more egalitarian possibilities for development and distribution. A service using USSD or SMS *at scale* typically requires direct collaboration with a user's telecommunications carrier; third party aggregators also exist but they add considerable expense, so using them is usually uncompetitive [31].

Telco partnerships are difficult, however—an issue that is rarely addressed fully in research pilots [2,6,25,26,36,37,40,41,48,49]. In fact only two or three of our dozens of interviewees reported positive stories about relationships between telcos and social technology startup initiatives.

Our survey yielded stories of hubs taken over by telcos; telcos offering free internet to hubs in exchange for all IP generated in the hub; one interviewee gave an example of a telco-sponsored hackathon where the telco launched an identical project to the prizewinners a few months later. As one tech hub executive based in Ghana put it:

The telcos are a bit like charlatans. They do their own competitions, and if you win, you cede all intellectual property rights in your idea over to them. Also, the app can only be made available on their platform. Another example: I had to walk away from a £180,000 deal with [telco name] to provide [hub name] with free internet because they wanted subsequent rights to everything that came out of the hub.

Most of the people we spoke with described telcos running roughshod over entrepreneurs and creating their own terms of engagement. As one social tech innovator specializing in agricultural services in Kenya and beyond put it: "No telco wants an outside company or partners to be big; they want to own everything." And because of their power, telcos can and do consistently try to own everything.

A venture capitalist in Kenya explained that partnering with a telco – which is generally necessary to scale a project – means sharing revenue with them at ratios of 70/30 or 80/20 in the telco's favor: "This doesn't make for a very sustainable financial ecosystem especially for services aimed at those with little or no money." This has led local investors to suggest avoiding startups that rely on partnering with a telco in order to scale: "I would be very hesitant to invest in a fintech company that had to integrate with [a telco] as their primary distribution channel" [31].

The Kenyan social tech founder working in agriculture we interviewed received development funding at key stages in her initiative and has created a successful SMS-based system. Nonetheless, her relationship with her partnering telco has been complicated: "[A]t first we wanted to be '[mobile] network agnostic'. But no one wanted to partner with us. In the end, we entered into an exclusive partnership with [the largest telco], who took on marketing for us." The successful partnership has not, however, been enough for the telco. In a move similar to others that were described by many sources in other situations and countries, the telco recently launched a nearly identical service. The innovator isn't too concerned: "They don't have the agricultural knowledge or community ties; we're just sitting back and waiting to watch them fail..."

The telco barrier to sustainable SMS and USSD innovation is nearly impermeable to local innovators.

Social bundles 'WTF'

In recent years telcos have negotiated with the top Californian platforms to offer significantly less expensive, prepaid 'social bundles,' which allow mobile phone subscribers cheaper access to WhatsApp, Twitter, and Facebook (marketed as 'WTF bundles'), or other combinations of social media, than to the open internet [15]. The bundles give users access to the most popular social media, but block the rest of the internet or give a warning and charge much more for external links. Many users think of Facebook and WhatsApp almost interchangeably with the internet. As one digital activist in Zimbabwe estimated, "70% of internet usage is WhatsApp. A lot of people think WhatsApp is the internet."

From the perspective of an innovator, mobile (or tethered) software that requires access to a server will be inaccessible for a user on one of these bundles. One Egyptian fintech co-founder working in Uganda expressed his frustration with being forced to use Facebook rather than open internet standards: "You're competing inside a system that has been gamed! Everybody is being forced, pushed to build bots and services for the Facebook messenger platform. It's like being forced to abet corruption." He noted that Facebook makes arbitrary changes to its interface and APIs, and discontinues functionalities that companies and community-based organizations build their work around.

We have demonstrated how, given the current trajectories for both low (SMS and USSD) and high (internet) bandwidth data, local technologists in sub-Saharan Africa are unable to launch a sustainable new system or product without either having to enter a difficult or impossible relationship with a telco, or using a proprietary and limiting platform. Systems that have been proposed in CHI and alternative arenas based on these technologies [3,6,25,26,36,37,40,41,48,49] carry, in most of sub-Saharan Africa, an implementation burden to release or maintain *at scale* that often eclipses usability constraints. The debate from the first decade of this century about whether SMS or IP would be more empowering has no

winner: both approaches are accessible primarily to the most powerful actors.

Technology funding

Our interviews surfaced another major impediment to technical possibilities for local innovators: capitalization. We heard similar stories across countries of the difficulty of securing financing for technology initiatives, and occasional remarks about race. Our interviews revealed the mismatches between the goal of a Silicon Valley style capitalization and local conditions.

One major Paris-based impact investor active across West Africa described their hesitation to fund technology, as models for adoption and growth are often less clear than for conventional businesses. Other investors spoke about investments in real estate, the music business, or structural debt as more predictably profitable. In relatively active local investment markets like Nigeria and East Africa, local funding exists but at rates that would be considered extortionary in Silicon Valley. Local banks are not geared toward supporting entrepreneurs in any of the countries where interviews were conducted. High interest rates, inflexible repayment schedules, demands for rapid repayment and demands for 150-200% collateral were typical. As a small loan fund manager offering ‘patient capital’ via an accelerator in Rwanda said, “Time and again I’ve seen good SMEs being given terrible terms by the banks, terms that required payment too soon, and then the banks just came and took all their collateral. I’ve seen very good business ideas fail in this way.” Social technology entrepreneurs are generally not in a position to put forward collateral, let alone at such high rates. As a hub co-founder in Ghana highlighted, “No banks will give loans to startups, because you can’t get a loan without collateral.”

Foreign funding is increasing; in East Africa 80% of disclosed investment in 2015-2016 was from outside Africa [31]. Local initiatives, however, often seem illegible to foreign capital. A UK-based Nigerian technology executive explained that there is “an increasing demand internationally ... [foreign investors] are beginning to take Africa very seriously, but then they don’t have a process to do due diligence on the startups they want to invest in. People are struggling to find who to collaborate with locally to make these things happen.”

If this foreign finance does come—either through commercial capital or development funding—one last filter prevents many possibilities. This is the racial aspect of such funding, which has major implications for what systems may be built and by whom.

A recent report by Village Capital notes that “In East Africa, where the majority of early stage investors are foreign, investors tend to rely even more on in-group bias. Ninety percent of disclosed investments in 2015 and 2016 went to startups with one or more European or North American founder.” It goes on to point out that “In 2015, 75% of the

funding in Kenya was provided to only two startups (Angaza and M-Kopa), and 98% of the funding in Tanzania went to just one company (Off Grid Electric).” All of these companies have foreign, all-white founders [31].

This report is notable in its careful exploration of why local black African entrepreneurs are passed over; it coins the gentle term “pattern recognition” to describe a combination of racism, classism, and other forms of implicit bias. Regardless, it is clear that the benefits of foreign tech funding to the tech ecosystem are offset significantly by its tremendous Western bias. Rather than a chance for local economic empowerment and technological democratization, technology development is becoming a stage for Western actors to make profits. As a former PS Minister of ICT for an East African country concluded, “When people think of [technology] investors, they think of foreigners. We need to decolonize.”

DISCUSSION

While this paper has focused on many of the systemic challenges that act as constraints upon technology innovation in sub-Saharan Africa, it is not meant to be a negative portrayal of the potential for African tech development. As can be seen in the examples of hubs, finance, and the policies of telcos, it is exceedingly difficult for a local technologist in Africa to move an idea to users.

The innovators we interviewed were thoughtful and inspired, and informed us of the many challenges and contradictions in the ecosystem. It is worth noting that while many of our interviewees were aware of these hindrances, their focus was not on addressing hindrances per se, but rather designing solutions and finding support to circumvent them — improvisation colloquially known in Southern Africa as ‘making a plan,’ in francophone countries as ‘Système D,’ in Swahili as ‘Jua Kali,’ and in South Asia as ‘Jugaad’ [39]. This adds extra steps to their already challenging paths, but at the same time hones a form of creativity that could well be a wellspring for global innovation.

The historian of technology Clapperton Mavhunga warns against authors who “have nothing to write about Africa that resides in the domain of technology and innovation except how the technological innovations of others have victimized them. That, or how Africans are ‘reacting’ to incoming technologies, or how such technologies are impacting them, is all they write about” [34].

In this section we wish to complicate our portrayal of negative conditions in the African social tech ecosystem with reference to postcolonial writing on Africa, technology, and globalism. Despite systemic forces foreclosing possibilities, the technologists we spoke with in our interviews have a great deal of agency. Indeed, Africa is home to many diverse creative technical cultures and approaches to innovation, influenced but not defeated by globalism.

Finally, we will recount how many observers of Africa have pointed out that it is not, as is often constructed, the ‘last

frontier’ for technology and modernism but rather a bellwether for the planet, a site of such neoliberal excess that designers and technologists everywhere should be watching it carefully.

Systemic forces and Agency

It is easy to find enormous pressures imposed upon African governments and systems from forces outside the continent. 500 years of war by Europe on Africa, called slavery, followed by direct and indirect colonialism, hot proxies of the Cold War, the mortifying ‘structural adjustments’ of the 1990s, and now the neocolonialism of hubs and race-based financing all point to a continent that receives too much of the wrong attention. At the same time, African citizens are not passive in these processes, nor are the technologists we interviewed.

Mavhunga offers an example of this sort of agency when describing what are typically called ‘proxy wars’ in the West, but in Africa called wars of independence. Giving the example of Zimbabwean independence fighters who, like their counterparts in other African countries, traveled to the USSR, Czechoslovakia, North Korea, and China to train in guerilla tactics, he writes:

This, I suggest, is how the North became a weapon of the South... There were moments in such encounters when countries of the North projected themselves as ‘superpowers’ fighting a Cold War. Meanwhile, in the eyes of Africans, they were merely sources of guns, military training, and communist ideology – tools with which to liberate power for themselves...

One might see the guerrilla as a boundary object, a kind of weaponized body at the intersection of two designers (his own organization and the communist countries training him), a vehicle through which those two designers used each other [33].

Such a case of ‘two designers’ is probably at play in the spread of hubs and the appeal of Silicon Valley style innovation. In many instances, our interviews suggested that hubs were seen as a key to employment, more open for women and girls than the local Computer Science department, and a way to bypass conservative education.

Globalization and summoning

Mavhunga also describes how many misread Africa as a space of ‘impact’ for technologies, rather than a continent filled with active participants in their use and framing:

This behavior of incoming things in local hands does not necessarily represent the far-reaching tentacles of globalization; in fact, it also involves Africans themselves initiating the movements... they are actively constructing transnational networks through their own mobilities in the world -- or those of their goods... It is within this global engagement that Africa has provincialized or tamed not just the cell phone and, more recently, revolutionized its applications [34].

Perhaps the clearest example of the revolutionized applications of the mobile phone that Mavhunga refers to would be M-Pesa, the massive over-the-phone payment system that is regularly touted as an example of Africa’s

digital renaissance. Cited as a product of the Kenyan telco Safaricom, M-Pesa is in fact a complicated amalgam of transnational production. It was a product of UK-based Vodacom, funded by UK’s DFID, developed in the UK by a solutions company, and then rolled out in Kenya with monopoly privileges for many years. M-Pesa routed 28bn USD in 2015 alone annually [60].

While M-Pesa was not built in Africa, it is built on the practice that was common throughout the continent: users transferring phone credit. User A would purchase credits, then use a telco-provided USSD service to transfer these credits to another subscriber, User B, who could then resell the credits in exchange for cash to others (User C) in their community. As novelist Binyavanga Wainaina wrote in 2007, the year of M-Pesa’s launch, “Now there is a pilot project in Kenya, the first in the world, to transfer money, Western Union style, to anybody with a cellphone. It is exciting, yes, but then people have been sending money to each other in Kenya for years. Send minutes to someone, and they can resell them for cash” [50].

In this case, Mavhunga’s thesis exactly describes how African user innovation of informal cashless transfer techniques inspired the UK production of M-Pesa, in order to in turn capture these users. We have yet to see the long-term implications of the financialization of so many citizens of the continent, or the large-scale extraction of wealth into Vodacom’s hands of what used to be distributed informal commerce.

Whence goes Africa

Some HCI readers might doubt the relevance of Maoist liberation fighters to their work. Africa is often portrayed as “remote, exceptional and characterized as lacking to some degree or other the proper properties held by the ‘international community’ or ‘globalization’” [18]. We will now attempt to demonstrate how the survey described in this paper might be relevant beyond the scope of one continent.

We have shown that debates around ICT possibilities from the late 2000s failed to anticipate some of the most serious factors bounding possibilities in the late 2010s. This in itself is not surprising; indeed, it would be far more surprising if the debates had successfully predicted the next decade. What is of note is that many of the factors are defined by themes—unequal globalization, multinational extraction and corporate capture, monopolies or oligopolies, transnational capital and racism—that are not only part and parcel of neocolonialism but consistent features of neoliberalism as well.

Most discussions of the variable future of technology from the late 2000s did not tend to cover these issues. Indeed, the dialogs tended to imagine more unrestricted freedoms and increased capabilities arising from both mobile networks and the internet, or even anticipated that competition between SMS and TCP/IP would primarily yield benefits for consumers [12]. No one can fault observers for failing to

grasp the specifics of the technological future, yet it does seem clear that the history of Africa, and its relationship to globalism and extraction, should have informed some of the speculation. As anthropologists [8] summarize:

In recent decades, capital, with its stress on flexibility, liquidity, and deregulation, has yet again found untapped bounty in former colonies, where postcolonial states, anxious to garner disposable income and often in desperate need of ‘hard’ foreign currency, have opened themselves up to business; specifically, to corporations that have little compunction in pressuring ruling regimes to offer them tax incentives, to relax environmental controls, to remove wage restrictions and worker protections, to limit liability and discourage union activities, even to allow them to enclave themselves—in short, to bow to the tenets of laissez-faire at their most extreme, their most sovereign [8].

It is then easy to see that, in this neoliberal game park, large social media companies would of course move to create WTF bundles with local African telcos to extend their monopolies. And that those telcos would move to quash incipient competition. “Africa is extreme not exceptional: it manifests the most radical instances of a generic aspect of contemporary globalization – that is, neoliberal reform.” [18]. Ten years ago, tech innovators should have been able to recognize that in addition to ensuring usability, they would also do well to decentralize, avoid corporate capture, and embrace other techniques to ensure their ICTs provided users more and lasting capabilities and freedoms.

The Comaroffs among others have noted that Africa, rather than being ‘undeveloped’ and behind, may actually be an indicator of global trends, the effects of which may take longer to detect in the West. “What if it is the global south... that affords privileged insight into the workings of the world at large? ... It is the south that often is the first to feel the effects of world-historical forces, the south in which radically new assemblages of capital and labor are taking shape, thus to prefigure the future of the global north” [8]. Indeed, while this paper was in review the USA Federal Communications Commission voted to end ‘net neutrality’ provisions.

African trade has always been an important part of globalization and technology, from the sugar triangle and the slave trade that settled the new world and built European capitals, to the rubber tires of the first automobiles and the ivory keys of jazz pianos. “Africa and globalization are co-produced” [18].

We can, then, learn from the fact that technologists were having a debate ten years ago, mostly about usability, that failed to anticipate key ways in which technical possibilities would be foreclosed. By failing to consider historic, macroeconomic, and social trends, they assumed that technology would inevitably create new opportunities and freedoms. It has, but at the same time utterly predictable forces of monopoly capture and neoliberal financialization constrained possibilities in ways that were a direct, imaginable vector from the past, but nonetheless largely

undiscussed. These constraints lock all but the most powerful actors out of the distribution of new technologies. This capture is not unique to the African context, and has many implications for the design, analysis, and prediction of new systems.

ACKNOWLEDGMENTS

Our team would foremost like to thank the many people we interviewed throughout this process, whose patience and generosity were a blessing. The European Commission, ARDITI – Agência Regional para o Desenvolvimento e Tecnologia under the scope of the project M1420-09-5369-FSE-000001 – PhD Studentship, LARSYS, and M-ITI made the analysis possible. Elise Leclerc and Cristiano Gianollo diligently conducted and transcribed our Francophone and Lusophone interviews. Billy Dann and Loren Treisman were excellent sounding posts during the research phase of this project. We also thank our thoughtful reviewers, who pushed us to clarify and refine our arguments.

REFERENCES

1. Mary Alexander. 2009. Google’s SMS internet for Uganda. *Brand South Africa*. Retrieved September 19, 2017 from <https://www.brandsouthafrica.com/investments-immigration/africanews/googles-sms-internet-for-uganda>
2. Aris Alissandrakis and Marcelo Milrad. 2013. Designing interactive mobile services to promote civic participation in northern Uganda. *ICT for Anti-Corruption, Democracy And Education in East Africa*: 53–65.
3. Aris Alissandrakis and Marcelo Milrad. 2013. Designing interactive mobile services to promote civic participation in northern Uganda. Retrieved June 7, 2017 from <http://www.diva-portal.org/smash/record.jsf?pid=diva2:743728>
4. Seyram Avle, Silvia Lindtner, and Kaiton Williams. 2017. How Methods Make Designers. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (CHI ’17), 472–483. <https://doi.org/10.1145/3025453.3025864>
5. Jeffrey Bardzell, Shaowen Bardzell, and Austin Toombs. 2014. “Now That’s Definitely a Proper Hack”: Self-made Tools in Hackerspaces. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI ’14), 473–476. <https://doi.org/10.1145/2556288.2557221>
6. Victor de Boer, Pieter De Leenheer, Anna Bon, Nana Baah Gyan, Chris van Aart, Christophe Guéret, Wendelien Tuyp, Stephane Boyera, Mary Allen, and Hans Akkermans. 2012. RadioMarché: distributed voice-and web-interfaced market information systems under rural conditions. In *International Conference on Advanced Information Systems Engineering*, 518–532.

- Retrieved June 21, 2017 from http://link.springer.com/chapter/10.1007/978-3-642-31095-9_34
7. Leonardo Bonanni, Matthew Hockenberry, David Zwarg, Chris Csikszentmihalyi, and Hiroshi Ishii. 2010. Small Business Applications of Sourcemap: A Web Tool for Sustainable Design and Supply Chain Transparency. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '10), 937–946. <https://doi.org/10.1145/1753326.1753465>
 8. Jean Comaroff. 2012. *Theory from the South: or, How Euro-America is evolving toward Africa*. Paradigm Publishers, Boulder, Colo. ; London.
 9. Matthew Cummins. 2012. *Uganda's Experience with Real Time Monitoring: mTrac and U-Report*. Social Science Research Network, Rochester, NY. Retrieved September 19, 2017 from <https://papers.ssrn.com/abstract=2573256>
 10. Catalina M. Danis, Jason B. Ellis, Wendy A. Kellogg, Hajo van Beijma, Bas Hoefman, Steven D. Daniels, and Jan-Willem Loggers. 2010. Mobile phones for health education in the developing world: SMS as a user interface. In *Proceedings of the First ACM Symposium on Computing for Development*, 13. Retrieved September 18, 2017 from <http://dl.acm.org/citation.cfm?id=1926197>
 11. Jonathan Donner, Katrin Verclas, and Kentaro Toyama. 2008. Reflections on MobileActive08 and the M4D Landscape.
 12. Erik Hersman. 2009. Should we be Building SMS or Internet Services for Africa? *WhiteAfrican*. Retrieved September 19, 2017 from <http://whiteafrican.com/2009/08/25/should-we-be-building-sms-or-internet-services-for-africa/>
 13. James Ferguson. 2006. *Global Shadows: Africa in the Neoliberal World Order*. Duke University Press.
 14. Nicolas Friederici. 2014. What is a tech innovation hub anyway? *The Connectivity, Inclusion, and Inequality Group*. Retrieved May 12, 2017 from <http://cii.oii.ox.ac.uk/2014/09/16/what-is-a-tech-innovation-hub-anyway/>
 15. Alison Gillwald, Chenai Chair, Ariel Futter, KweKu Koranteng, Fola Odufuwa, and John Walubengo. 2016. MUCH ADO ABOUT NOTHING? *Research ICT Africa*. Retrieved September 19, 2017 from https://www.researchictafrica.net/publications/Other_publications/2016_RIA_Zero-Rating_Policy_Paper_-_Much_ado_about_nothing.pdf
 16. Shikoh Gitau, Gary Marsden, and Jonathan Donner. 2010. After access: challenges facing mobile-only internet users in the developing world. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2603–2606. Retrieved September 17, 2017 from <http://dl.acm.org/citation.cfm?id=1753720>
 17. GSMA Intelligence. 2016. *Global Mobile Trends*. GSMA. Retrieved September 18, 2017 from <https://www.gsmainelligence.com/research/?file=357f1541c77358e61787fac35259dc92&download>
 18. Graham Harrison. 2010. *Neoliberal Africa: The Impact of Global Social Engineering*. Zed Books, London ; New York.
 19. Edward A. Hirsch. 2004. Speakeasy : mobile telephony for community networking and civic engagement in an immigrant community. Massachusetts Institute of Technology. Retrieved September 19, 2017 from <http://dspace.mit.edu/handle/1721.1/17822>
 20. Nick Hughes and Susie Lonie. 2007. M-PESA: mobile money for the “unbanked” turning cellphones into 24-hour tellers in Kenya. *Innovations* 2, 1–2: 63–81.
 21. Lilly C. Irani and M. Six Silberman. 2013. Turkopticon: Interrupting Worker Invisibility in Amazon Mechanical Turk. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '13), 611–620. <https://doi.org/10.1145/2470654.2470742>
 22. L. H. Kamulegeya, M. Kizito, R. Nassali, S. Bagayana, and A. E. Elobu. 2015. The scourge of head injury among commercial motorcycle riders in Kampala; a preventable clinical and public health menace. *African Health Sciences* 15, 3: 1016–1022. <https://doi.org/10.4314/ahs.v15i3.41>
 23. Tim Kelly and Rachel Firestone. 2016. How Tech Hubs are helping to Drive Economic Growth in Africa. Retrieved September 11, 2017 from <https://openknowledge.worldbank.org/handle/10986/23645>
 24. Aylin Koca, Evangelos Karapanos, and Aarnout Brombacher. 2009. “Broken Expectations” from a Global Business Perspective. In *CHI '09 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '09), 4267–4272. <https://doi.org/10.1145/1520340.1520651>
 25. Arun Kumar, Sheetal K. Agarwal, and Priyanka Manwani. 2010. The spoken web application framework: user generated content and service creation through low-end mobiles. In *Proceedings of the 2010 International Cross Disciplinary Conference on Web Accessibility (W4A)*, 2. Retrieved June 8, 2017 from <http://dl.acm.org/citation.cfm?id=1805990>
 26. Neha Kumar and Richard J. Anderson. 2015. Mobile Phones for Maternal Health in Rural India. 427–436. <https://doi.org/10.1145/2702123.2702258>

27. Vilma Lehtinen and Lassi Liikkanen. 2012. The Meanings of Music Sharing in Tween Life. In *CHI '12 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '12), 1907–1912. <https://doi.org/10.1145/2212776.2223727>
28. Silvia Lindtner, Shaowen Bardzell, and Jeffrey Bardzell. 2016. Reconstituting the Utopian Vision of Making: HCI After Technosolutionism. 1390–1402. <https://doi.org/10.1145/2858036.2858506>
29. Jennifer Mankoff, Jennifer A. Rode, and Haakon Faste. 2013. Looking past yesterday's tomorrow: using futures studies methods to extend the research horizon. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1629–1638. Retrieved September 17, 2017 from <http://dl.acm.org/citation.cfm?id=2466216>
30. Gary Marsden. 2007. Doing HCI Differently – Stories from the Developing World. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '07). <https://doi.org/10.1145/1240624.2180966>
31. Heather Strachan Matranga, Bidisha Bhattacharyya, and Ross Baird. 2017. *BREAKING THE PATTERN: Getting Digital Financial Services Entrepreneurs to Scale in India and East Africa*. Village Capital. Retrieved from http://vilcap.com/wp-content/uploads/2017/06/VC_Breaking_the_Pattern.pdf
32. Clapperton Mavhunga. 2011. Inertia and Development Approaches to Africa: Towards African Mobilities. *Thresholds*, 39: 79–82.
33. Clapperton Mavhunga. 2011. A plundering tiger with its deadly cubs? The USSR and China as Weapons in the Engineering of a “Zimbabwean Nation,” 1945–2009. In *Entangled Geographies: Empire and Technopolitics in the Global Cold War*. MIT Press.
34. Clapperton Chakanetsa Mavhunga. 2014. *Transient workspaces: technologies of everyday innovation in Zimbabwe*. The MIT Press, Cambridge, Massachusetts.
35. Mariana Mazzucato. 2013. *The entrepreneurial state: debunking public vs. private sector myths*. Anthem Press, London.
36. Neil Patel, Deepti Chittamuru, Anupam Jain, Paresh Dave, and Tapan S. Parikh. 2010. Avaaj otalo: a field study of an interactive voice forum for small farmers in rural india. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 733–742. Retrieved June 7, 2017 from <http://dl.acm.org/citation.cfm?id=1753434>
37. Neil Patel, Scott R. Klemmer, and Tapan S. Parikh. 2011. An asymmetric communications platform for knowledge sharing with low-end mobile phones. In *Proceedings of the 24th annual ACM symposium adjunct on User interface software and technology*, 87–88. Retrieved June 7, 2017 from <http://dl.acm.org/citation.cfm?id=2046436>
38. Anicia N. Peters, Heike Winschiers-Theophilus, Nicola J. Bidwell, Arun Kumar, Daniel O. Ochieng, Fatoumata Camara, and Susan M. Dray. 2014. Community Centered Collaborative HCI Design / Research in Developing Countries. In *CHI '14 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '14), 1143–1146. <https://doi.org/10.1145/2559206.2559212>
39. Kavita Philip, Lilly Irani, and Paul Dourish. 2012. Postcolonial Computing: A Tactical Survey. *Science, Technology, & Human Values* 37, 1: 3–29. <https://doi.org/10.1177/0162243910389594>
40. Agha Ali Raza, Farhan Ul Haq, Zain Tariq, Mansoor Pervaiz, Samia Razaq, Umar Saif, and Roni Rosenfeld. 2013. Job opportunities through entertainment: Virally spread speech-based services for low-literate users. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2803–2812.
41. Asreen Rostami, Valeriy Savinov, and Louise Barkhuus. 2015. Testing in the Field: Voice Based Interaction for Citizen Reporting in Uganda. 1061–1066. <https://doi.org/10.1145/2702613.2732893>
42. Emmanuel Rotimi, Oludele Awodele, and Olutayo Bamidele. 2007. SMS Banking Services: A 21st Century Innovation in Banking Technology. *Issues in Informing Science & Information Technology* 4. Retrieved September 18, 2017 from <https://pdfs.semanticscholar.org/210d/ba7fd0d5e6ab7941f05094faab63d460e685.pdf>
43. Phoebe Sengers and Chris Csikszentmihályi. 2003. HCI and the Arts: A Conflicted Convergence? In *CHI '03 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '03), 876–877. <https://doi.org/10.1145/765891.766044>
44. Javie Ssozi. SMS vs. Mobile Internet: Scaling the mobilephone | The African Timer. Retrieved September 19, 2017 from <https://jssozi.wordpress.com/2010/11/15/255/>
45. James B. Steinberg. 2001. Information Technology and Development: Beyond Either/Or. *Brookings*. Retrieved September 18, 2017 from <https://www.brookings.edu/articles/information-technology-and-development-beyond-either-or/>
46. SUSAN LEIGH STAR. 1999. The Ethnography of Infrastructure. *American Behavioral Scientist* 43, 3: 377–391. <https://doi.org/10.1177/00027649921955326>
47. UNICEF. 2013. *A PASSPORT TO PROTECTION*. Child Protection Section Programme Division -

- UNICEF. Retrieved September 19, 2017 from http://esem.org.mk/pdf/Najznachajni%20vesti/2013/4/UNICEF_BRHandbook_Web_single_pages.pdf
48. Aditya Vashistha, Edward Cutrell, Gaetano Borriello, and William Thies. 2015. Sangeet Swara: A Community-Moderated Voice Forum in Rural India. 417–426. <https://doi.org/10.1145/2702123.2702191>
 49. Aditya Vashistha and William Thies. 2012. IVR Junction: Building Scalable and Distributed Voice Forums in the Developing World. In *NSDR*. Retrieved June 7, 2017 from <https://www.usenix.org/system/files/conference/nsdr12/nsdr12-final4.pdf>
 50. Binyavanga Wainaina. 2007. Glory: The Soft Bigotry of Great Expectations. *Bidoun*, Technology / Issue 10: 48–52.
 51. Susan P. Wyche and Laura L. Murphy. 2012. Dead China-make phones off the grid: investigating and designing for mobile phone use in rural Africa. In *Proceedings of the Designing Interactive Systems Conference*, 186–195. Retrieved September 12, 2017 from <http://dl.acm.org/citation.cfm?id=2317985>
 52. Susan P. Wyche, Thomas N. Smyth, Marshini Chetty, Paul M. Aoki, and Rebecca E. Grinter. 2010. Deliberate interactions: characterizing technology use in Nairobi, Kenya. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 2593–2602. Retrieved September 17, 2017 from <http://dl.acm.org/citation.cfm?id=1753719>
 53. 2013. Econet and bulk SMS in Zimbabwe: Operator blocking “legit” bulk SMS? *Techzim*. Retrieved January 5, 2018 from <https://www.techzim.co.zw/2013/12/econet-gikko-in-fresh-bulk-sms-storm-legal-battle-looming/>
 54. 2014. *Africa Telecoms Outlook 2014*. Informa Telecom and Media. Retrieved September 19, 2017 from http://files.informatandm.com/uploads/2013/11/Africa_Telecoms_Outlook_Low_resolution.pdf
 55. 2015. *UCC Access and Usage Survey 2014 - Data dot UG*. Uganda Communications Commission. Retrieved April 4, 2017 from <http://catalog.data.ug/dataset/ucc-access-and-usage-survey-2014>
 56. 2016. *World Development Report 2016: Digital Dividends*. World Bank, Washington, D.C. Retrieved from <http://documents.worldbank.org/curated/en/896971468194972881/pdf/102725-PUB-Replacement-PUBLIC.pdf>
 57. 2016. *First Quarter Sector Statistics Report for the Financial Year 2015/2016 (JULY-SEPTEMBER 2015)*. Communications Authority of Kenya. Retrieved September 19, 2017 from <http://www.ca.go.ke/images/downloads/STATISTICS/Sector%20%20Statistics%20Report%20Q1%202015-16.pdf>
 58. 2016. Tech hubs and incubators in Africa. Retrieved from <http://pubdocs.worldbank.org/en/765531472059967675/AFC42460-081716.pdf>
 59. 2017. *New Innovation Approaches to Support the Implementation of the Sustainable Development Goals*. United Nations Conference on Trade and Development, New York and Geneva. Retrieved from <http://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=1775>
 60. 2017. *Safaricom Limited FY 2017 Results Presentation*. Safaricom Limited. Retrieved September 19, 2017 from https://www.safaricom.co.ke/images/Downloads/Resources_Downloads/FY16-17Presentation.pdf
 61. Uganda Mobile VRS. Retrieved September 19, 2017 from http://mobilevrs.co.ug/summary_statistics.php
 62. *MOMCONNECT: Launching a National Digital Health Program in South Africa*. United Nations Foundation, Washington, D.C. Retrieved August 8, 2018 from <http://www.unfoundation.org/assets/pdf/momconnect-case-study.pdf>
 63. Net official development assistance and official aid received (current US\$) | Data. Retrieved September 18, 2017 from <https://data.worldbank.org/indicator/DT.ODA.ALLD.CD>
 64. World Development Indicators - Google Public Data Explorer. Retrieved September 18, 2017 from https://www.google.pt/publicdata/explore?ds=d5bncppjof8f9_&met_y=ny_gdp_pc&idim=country:UGA:KEN:RWA&hl=en&dl=en#!ctype=l&strail=false&bs=d&nselm=h&met_y=ny_gnp_mktpp_cd&scale_y=lin&ind_y=false&rdim=region&idim=country:UGA:KEN:RWA&ifdim=region&hl=en_US&dl=en&ind=false
 65. SafeBoda. *Crunchbase*. Retrieved January 7, 2018 from <https://www.crunchbase.com/organization/safeboda>