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How Huawei Succeeds in Africa: Training and Knowledge Transfers in Kenya and Nigeria

Henry Tugendhat



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CORRESPONDING AUTHOR:

Henry Tugendhat

Email: htugend1@jhu.edu

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ABSTRACT

**SAIS-CARI WORKING PAPER
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THIS PAPER TRACES KNOWLEDGE TRANSFERS related to Huawei’s investments in Africa. It does so by comparing Huawei’s activities in Kenya and Nigeria, and by comparing Huawei’s training practices with its main telecommunications competitors in the Original Equipment Manufacturing (OEM) sector. This paper argues that Huawei, like its competitors, treads a fine balance between training local engineers and keeping control of its intellectual property. Nevertheless, knowledge transfers have occurred, and new business opportunities, that stand as both a complement and a threat to Huawei’s future profits, have arisen in the region. This paper is based on fieldwork conducted in Kenya and Nigeria in June and July of 2018.

INTRODUCTION

TELECOMMUNICATIONS TECHNOLOGY IN AFRICA IS DOMINATED by Western and East Asian companies. None of these dominating firms have any interest in transferring knowledge or technology to African actors in such a way that would loosen their control of intellectual property. To do so would be tantamount to sacrificing profits. Although these telecommunications companies are multinational in nature, they are often deeply national in practice. Rarely are foreigners hired for top-management positions among the American, East Asian, and European telecommunications technology giants. Occasionally, a failing telecommunications company may be bought up by a foreign technology firm, but this is accompanied by a considerable amount of public debate, and sometimes legislation, regarding the national vulnerabilities involved.

Most research and development occurs in firm's home countries. In the case of equipment, it is much easier for technology firms to control their intellectual property since many poorer countries do not have the capacity to manufacture their own equipment. It is typically more difficult to prevent software development from falling outside of their control, but firms have found ways of protecting themselves here too. However, these multinational technology firms still need to sell their technologies to make profits. As part of these sales, foreign clients and staff need to have some level of understanding to be able to manage and operate the equipment and software. Economic development is a core priority for many African governments and, as a result, the bigger international telecommunications companies want to be seen transferring at least some knowledge or technology for the benefit of future generations in African countries. All of this requires a careful balance between what these firms teach, who they teach it to, and how they teach the elected material.

In the past decade Huawei has risen to be one of the most important telecommunications market "disruptors" in Africa. Although they are more famous in the West for the controversy over privacy and government control than their competitive products, in African markets they have become a household name. While Huawei still falls far short of the thousands of certified Cisco users, since their arrival on the continent in the early 2000s Huawei appears to be training more young people than other international firms such as Ericsson or Nokia. Be it university students, clients, subcontractors, or local Huawei employees, Huawei has invested heavily in training. Online news stories provide numerous examples of Huawei training centers and training courses in Africa.¹ But what difference, if any, do Huawei's training courses have with those offered by other international telecommunications technology firms? Is Huawei actually transferring any meaningful skills to the next generation of African engineers, technicians, software developers, and managers or is it all just window dressing? Lastly, are there any informal means by which knowledge and technology are transferred from Huawei to local actors?

All of these questions were the subject of my fieldwork conducted in June and July of 2018 in Kenya and Nigeria. As two of the most dynamic telecommunications markets in sub-Saharan Africa (SSA), these two countries offer a valuable case study of the future that many emerging market countries also hope to enjoy. My fieldwork included

41 interviews with staff and experts from Huawei, ZTE, Ericsson, Nokia Alcatel, Cisco, Independent Channel Partners, Kenyan and Nigerian University lecturers and students, IT managers from institutions that had purchased Huawei Technologies, World Bank project managers, and Information and Communications Technology (ICT) policy makers in the Kenyan and Nigerian governments (see Appendix A).²

BACKGROUND

RIVALRIES FOR AFRICAN MARKETS: HUAWEI AND ITS COMPETITORS

ALONG WITH DEPENDABLE ACCESS TO OPERATOR PROVIDED platforms, telecommunications still fundamentally depend on the underlying equipment and infrastructure. It is customer demand for internet and communication services that drive operators to buy more equipment from manufacturers such as Huawei, Ericsson, or Nokia-Alcatel to expand their networks in terms of capacity (e.g. number of users and geographic locations) and quality (e.g. 3G, 4G, or 5G). The companies who produce equipment and infrastructure are often referred to as Original Equipment Manufacturers (OEMs), while the operators are more informally referred to as ‘Telcos’ or ‘Carriers’ (e.g. Airtel, MTN, Orange, China Mobile, etc.). Nowadays, numerous OEMs focus on one particular sector within this value chain and a number of OEMs have become so successful that they are now multinational corporations.

OEMs will have similar names for their areas of business, but for the purposes of this paper, we will work with the definitions Huawei uses for its three key sectors: Consumer, Carrier, and Enterprise. Generally speaking, the production of phones, tablets, laptops, and everything else that individuals use to connect with telecommunications networks is referred to as the ‘Consumer Business’. The construction and management of the infrastructure, such as towers, base stations, cables, and the licensing on LTE devices, is referred to as the ‘Carrier Business’. Lastly, institutions with sensitive information, such as banks or government departments, may place a priority on using these forms of technology more privately. This may

Table 1: Original Equipment Manufacturers (OEMs) - Business Areas

Business Area	Defintion	Market Competitors
Consumer Business	Production of phones, tablets, laptops, etc.	Apple, Samsung, Tecno, Oppo
Carrier Business	Infrastructure construction and management, including towers, base stations, cables, and licensing on LTE devices.	Ericsson, Alcatel-Lucent, Siemens
Enterprise Business	Institutions with sensitive information using technology in a more private, client specific manner. For example, software solutions like Enterprise Instant Messaging (versus Consumer Instant Messaging).	Cisco and IBM

involve software solutions such as Enterprise Instant Messaging (as opposed to Consumer Instant Messaging), right up to the construction and management of their own servers, or data centers, for those able to afford it. This third area of the telecommunications market is referred to as the 'Enterprise Business'.

Huawei is one of the only firms involved in all three areas. Partly as a result of this enormous portfolio, Huawei is now estimated to represent 28 percent of revenues in the global telecom equipment market, making it the biggest such firm after it overtook Nokia in 2014 (See Table 2).

Table 2: Revenue as a Proportion of the Global Telecom Equipment Market's Share in 2018³

Company	Revenue as a Proportion of Global OEM Market
Huawei	28%
Other	26%
Nokia	17%
Ericsson	13%
ZTE	9%
Cisco	8%

However, one key difference between Huawei and its Western competitors is that Huawei has been awarded large lines of credit from the China Development Bank (CDB) and China EXIM Bank. The first CDB loan worth US\$ 10 billion was awarded to Huawei in December of 2004 and another US\$ 20 billion was awarded in 2009.⁴ These loans allowed Huawei to outcompete Western firms on price by offering vendor financing options (e.g. grace periods on repayments for equipment) and it also allowed Huawei to invest in R&D. In 2005, Huawei had already begun outcompeting Alcatel-Lucent in price and quality, leading one employee to say, "We won't die at the hands of Huawei; if we die, it will be at the hands of China Development Bank."⁵ Furthermore, according to the China-Africa Research Initiative database, there are 49 Huawei projects in 22 African countries that have received roughly US\$ 2.9 billion worth of loans from China's EXIM Bank since 2004.

ZTE was also the beneficiary of US\$ 15 billion in credit lines from the CDB.⁶ Since 2000 ZTE has also received roughly US\$ 3.9 billion from China's EXIM Bank for projects in 16 African countries. However, overall it has been far less successful than Huawei in Africa or internationally, in general. In Kenya, for instance, ZTE's presence was barely visible and in Nigeria, ZTE only competed in some common areas. ZTE's Lagos, Nigeria office only had roughly a dozen staff members, while Huawei's Lagos office is staffed by nearly 300 employees. Huawei is a company like no other in terms of scale

and success in international OEM markets. Figure 1 shows how significant each area of business has been to Huawei's revenues.

There is therefore more to be explained about how Huawei has become so successful overseas, and its investment in training is certainly one important factor. The following research will explain how and why training has played such an important role in Huawei's business strategy. However, for the purposes of this study, Huawei's 'consumer' business activities (e.g. mobile phones, laptops, etc.) will be bypassed since they do not share a training component in the same way that 'carrier' and 'enterprise' activities do in Kenya and Nigeria.

KENYAN AND NIGERIAN MARKETS IN CONTEXT

STANDING AT 45 PERCENT AS OF 2018, SSA REMAINS THE REGION with the lowest penetration rate of mobile phone subscribers (see Figure 2).⁷ Partly due to such low penetration rates, SSA is also the region with the greatest expectations of growth in the coming years. Other factors that contribute to optimistic growth forecasts in SSA include a relatively young demographic across most countries, and investments that have already been committed to by bigger operators in the region such as MTN and Airtel.⁸ Whether operators are local to the country, local to Africa, or from the rest of the world, almost all of them are working with Huawei in some capacity. Concrete figures were hard to come by because they depend on what type of technology, software, or service is sold by the OEM to the operator. However, during interviews with Safaricom and MTN representatives, the market leaders in Kenya and Nigeria respectively, both confirmed that Huawei was their biggest vendor. One MTN senior manager estimated that 55 percent of MTN Nigeria's revenue was derived from customers using their Huawei equipment, 25 percent from ZTE equipment, and 20 percent from Ericsson equipment.⁹

Figure 1: Huawei's Revenue by Business Segment 2012-2018 (in billion yuan)

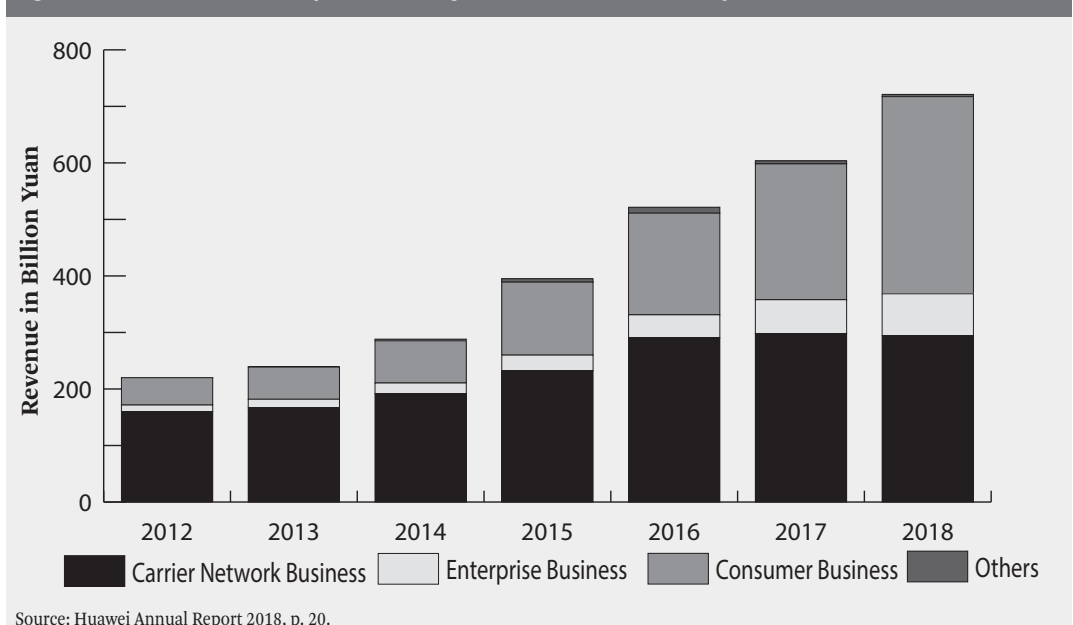


Figure 2: Proportion of Mobile Connections Compared to Regional Populations 2018

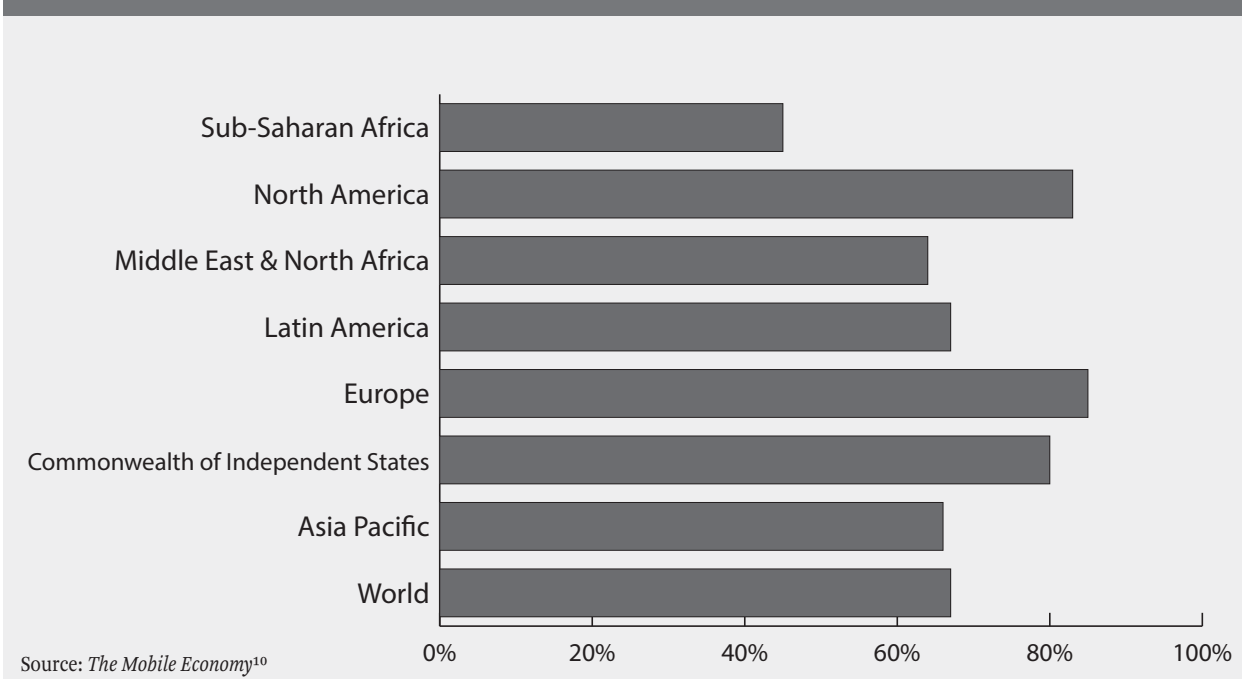
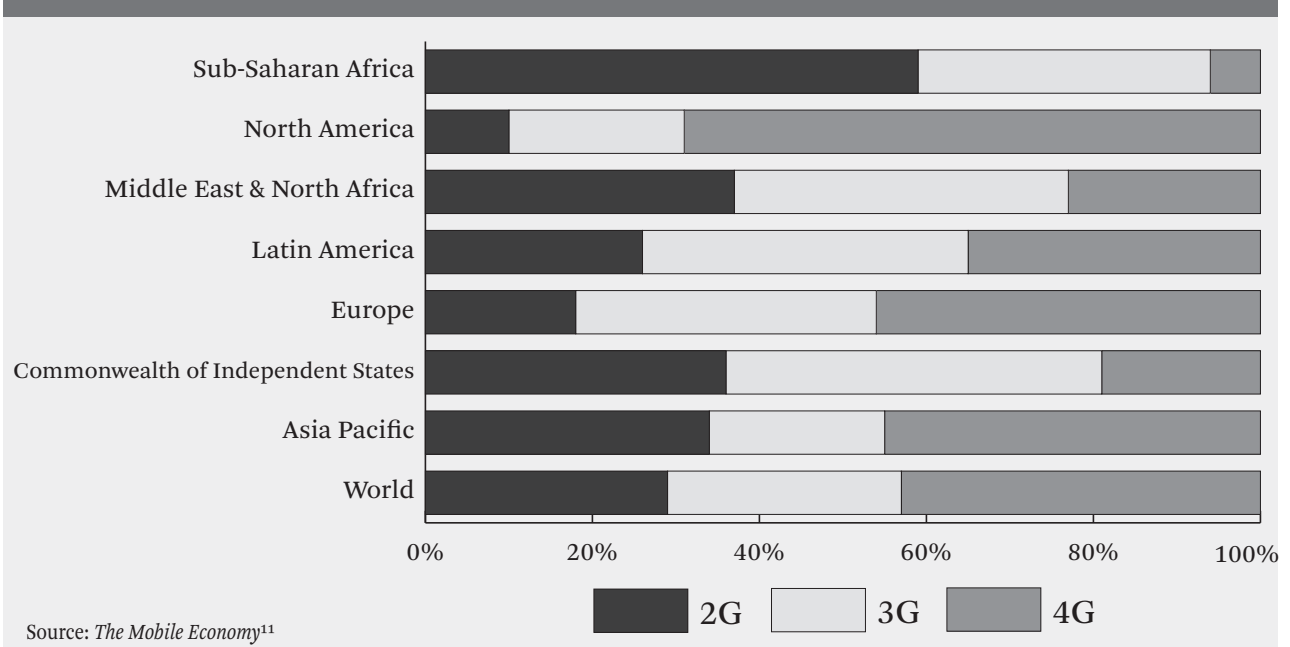


Figure 3: Proportions of Cellular Technology Used by Subscribers in 2018



Furthermore, SSA still has enormous growth potential in the deployment of 3G and 4G technologies. Figure 3 offers a breakdown of the proportion of cellular technology used in different world regions at the end of 2018.

The most striking observation about SSA from Figure 3 is how much potential there still is for 2G infrastructure to be replaced by 3G and 4G. While Kenya and Nigeria are ahead of the continental average in this regard, like many operators around the world theirs are still looking to expand 3G and 4G coverage. Moreover, in both

countries' urban areas, home-owners and businesses have also increased their demand for broadband internet and 'Over The Top' (OTT) services, which include streaming media services like Netflix.¹² In response and anticipation of this growth carriers are expanding their 3G and 4G LTE networks and broadband connections,

Table 3: Key Kenyan Operators

Operator	Ownership*	Market Share - Q4, 2018**	Market	Equipment Providers***
Safaricom	Government (35%) Vodacom Group (34.9%) Retail Investors (25%) Vodafone (5%)	62.4%	Mobile, fixed data services, internet, IT	Ericsson Huawei Nokia
Airtel	Bharti Airtel (100%)	23.4%	Mobile, internet, fixed data service	Ericsson Nokia
Telkom	Helios Investment Partners (60%) Government (40%)	9%	Fixed line, fixed wireless, internet, mobile	Ericsson Huawei ZTE

Source: *Fitch Solutions, *SSA Telecommunications Report, Q4 2019 - p. 41*. **Fitch Solutions, *SSA Telecommunications Report, Q4 2019 - p. 41-43*. ***Company names provided by industry insiders during fieldwork.

Table 4: Key Nigerian Operators

Operator	Ownership*	Market Share - Q4, 2018**	Market	Equipment Providers***
MTN	MTN Group (76%) Other investors (24%)	36.2%	Mobile (GSM 900/1800), fixed line, internet	Ericsson Huawei ZTE
Globacom	Mike Adenuga (100%)	27.5%	Fixed-line, mobile (GSM 900/1800), data, internet	Huawei Nokia ZTE
Airtel Nigeria	Bharti Airtel (79%) Other investors (21%)	26.3%	Mobile (GSM 900/1800)	Ericsson Huawei ZTE
9mobile (formerly Etisalat)	Emerging Markets Telecommunications Services (100%)	9.9%	Mobile (GSM 900/1800)	Ericsson Huawei Nokia
Ntel	Natcom (100%)	-	Fixed-line, data, internet	-
Nepskom	Eskom Enterprises (51%) State-Owned (49%)	-	Fixed-line, data, internet	-

Source: *Fitch Solutions, *SSA Telecommunications Report, Q4 2019 - p. 35*. **Fitch Solutions, *SSA Telecommunications Report, Q4 2019 - p. 31-32*. ***Company names provided by industry insiders during fieldwork.

which ultimately translates to increased business for OEMs. Kenya and Nigeria are at the forefront of Africa's drive to increase connectivity in 3G and 4G technologies.

Nigeria's operator market is a mixture of private international firms and private local firms. By contrast, Kenya's operator market has much more government involvement, most notably in Safaricom. In general, big international operator firms tend to have a preferred OEM. For example, the European company Vodafone, and its South African subsidiary Vodacom, are both committed Huawei customers. This tendency, in part, explains the burgeoning relationship between Huawei and Safaricom. In a similar vein, the South African operator MTN has traditionally been a big Ericsson customer across the continent (although this picture is shifting in Huawei's favor in MTN Nigeria).

TRAINING AS COMPETITION

HUAWEI TRAINING CENTERS

AS A RELATIVELY NEW ENTRANT TO BOTH AFRICAN and global markets, Huawei's success is impressive. What is less often recognized, however, is the role that training has played in Huawei's corporate strategy. Huawei's training centers operate like any other in the telecommunications industry. They are primarily aimed at customers and

Table 5: Huawei's Training Centers in Africa

City	Country	Year Established
Abuja	Nigeria	2004 ¹³
Cairo	Egypt	2005 ¹⁴
Tunis	Tunisia	2006 ¹⁵
Nairobi	Kenya	2008 ¹⁶ and 2017 ¹⁷
Johannesburg	South Africa	2008 ¹⁸
Luanda	Angola	2008 ¹⁹
Kinshasa	DRC	2012 ²⁰
Rabat	Morocco	2012 ²¹

channel partners who need to know how to install and operate Huawei's software and hardware. There are currently eight such training centers in Africa, all built between

2004 and 2017. Huawei's training of so many young engineers has fueled their growth in Kenyan and Nigerian markets.

Although Huawei Kenya representatives said they did not keep any digital records of who they trained at their Nairobi training center, they estimated training roughly 1,000 people in 2017.²² There are four lecturers at the Nairobi center, all of whom are Kenyans. While some interviewees in Kenya complained about language barriers during Huawei training courses taken back in 2007 and 2008, it is likely that language barriers are no longer a problem. Kenyan lecturers are periodically sent to China for up to two months at a time to learn about new software and hardware technologies at Huawei's Shenzhen campus.²³ As Nairobi is the training center for all of Huawei's East African operations, clients in other parts of East Africa either travel to Nairobi or to Huawei's Malaysia or Shenzhen campuses.²⁴ Huawei trains three main groups in its African centers: customers, subcontractors, and channel partners.²⁵

Table 6: Huawei's African Training Centers - Who do they teach?

Group	Defintion
Customers	Aimed at employees from the companies (e.g. carrier staff) in charge of overseeing the technologies they are buying from Huawei. This training is usually limited to no more than a week or two and there are plenty of equipment sales in which Huawei does not include training.
Subcontractors	Huawei holds managed services contracts with several operators – a growing area of business for all OEMs in Kenya and Nigeria. Huawei often subcontracts the bulk of this work to smaller local firms. For this, subcontractors need training on how to install and troubleshoot the equipment as well as health and safety principles.
Channel Partners	Channel partners are third party groups or individuals that market and sell products, services or technologies for a manufacturer or service provider via a partnering relationship. In the case of telecommunications in Africa, this involves local independent teams of engineers and technicians who traditionally sold on behalf of Cisco but are now increasingly working with Huawei as well. Whereas many had to pay for their own training in Cisco qualifications, Huawei invests in retraining them in Huawei's technologies and provides regular support to help them win contracts.

CUSTOMERS – CARRIER STAFF

FOR CARRIERS, THE TRAINING CENTERS FOCUS ON FAMILIARIZING carrier staff with the basics of Huawei equipment. Carrier employees in both Kenya and Nigeria said preliminary training often lasted between one and three weeks and was included in the cost of the equipment purchase. One Nigerian respondent said that if anything serious went wrong, they would pay Huawei engineers to resolve the issue. Eventually, in his case, the carrier decided to simply hire former Huawei employees to be on hand for any problems related to their Huawei equipment.²⁶ For more advanced training, carrier staff would have to pay extra, especially if going to Huawei's overseas campuses. However, carrier staff rarely pursue more advanced training due to the rise in managed services, as discussed in the next section.

Another common way carriers train their staff is by issuing requests for proposals (RFP) to training centers to bid on training contracts. For example, in June 2018, the Kenyan carrier Telkom issued an RFP to training institutions to educate eight to ten Telkom engineers in LTE technologies that included Huawei, ZTE, as well as other firms' equipment. A lecturer from an independent Kenyan training institution explained that the average rate was roughly US\$ 1,200 per week per person trained, but that Huawei's local training center would only bid if the contract exclusively involved Huawei technologies. However, even then, Huawei often does not bother to bid for these kinds of contracts. The lecturer suggested that Huawei did not consider the profits from such training courses to be great enough to divert their attention from equipment sales. In his words, "training is not really Huawei's calling."²⁷ Indeed, despite the 1,000 people reportedly trained at Huawei's training center in Nairobi in 2017, there are only four lecturers operating at the center. As an extension of Huawei's sales team, lecturers have to manage their time carefully to prioritize the sub-contractors who underpin their managed services contracts and their channel partners who find new clients for Huawei.

SUBCONTRACTORS – MANAGED SERVICES CONTRACTS

HAVING A GREATER FAMILIARITY WITH THE LOCAL POLITICAL exigencies on their industry and a personal experience with the opportunities for formation, local Kenyan and Nigerian staff members from the international telecommunications firms gave some of the most insightful interviews. They were able to connect the dots whereas international staff members from the home countries might have only been working in-country for two or three years. Many Nigerian and Kenyan experts in the field of telecommunications identified 'managed services' as one of the most important shifts in the industry over the past five years and a harbinger of knowledge spillovers to come. In essence, managed services are a form of outsourcing. While in the past operators used to do a project's planning, optimization, and maintenance themselves, since the decrease in profits around 2008 operators have hired OEMs to maintain the equipment for two- to three-year contracts. The OEMs, such as Huawei, in turn outsource the simpler tasks involved to small local firms. Those tasks include equipment installation, troubleshooting, and maintenance. In order for the whole operation to run smoothly, Huawei trains these subcontractors. However, Huawei also makes itself more vulnerable to having more experienced subcontractors take managed services contracts directly from the operators rather than having to depend on Huawei or other OEMs.

Managed services have become one of the most lucrative parts of the telecommunications business in Africa. Not only do OEMs profit from maintenance tasks but they are also in a position to propose any number of solutions to operators that involve buying more services or equipment. This is especially the case if an operator has equipment from several OEMs across its network but hires one OEM to provide all of its managed services. The OEM with the managed services contract

will usually propose solutions that involve discarding its competitors' technologies in favor of its own products. This shift towards managed services, however, has also caused carriers to train their employees less. Nowadays, carriers such as MTN will train the head of a team and then expect that team lead to teach junior staff.²⁸

CHANNEL PARTNERS – COMPETING WITH CISCO SYSTEMS FOR ENTERPRISE MARKETS

CISCO SYSTEMS HAS LONG BEEN THE GLOBAL MARKET leader in the field of 'Enterprise' technologies. Although Huawei competes in vastly more areas of telecommunications technology than Cisco Systems, 'Enterprise' technologies remain an important area of business for Huawei in Africa. In terms of routers and switches specifically, one respondent explained that in the local market Huawei still ranks second in sales after Cisco, and it is catching up fast.²⁹

Cisco and Huawei have very different approaches to training technicians. Cisco Systems' technologies are taught at university campuses and training centers across Africa and the world. These training courses are paid for by the universities or the technicians themselves. Having accreditation in Cisco technologies is a necessary step for young engineers to find employment and for experienced channel partners to win contracts related to the deployment of Cisco products. Once technicians and engineers have reached a certain level of expertise, they can either go off to work for firms that use those systems (e.g. an airline or a bank) or work as channel partners selling and installing the OEM's equipment for clients such as big firms and governments. Since Cisco's arrival in Kenya and Nigeria, this business model has worked as effectively as it does elsewhere around the world. Cisco has been able to profit from the learning materials and exams that technicians pay for to gain their certificates, then again from selling the equipment that these technicians buy for their new employers or sell on Cisco's behalf. By contrast, for at least the past five years, Huawei has targeted such technicians for subsidized training. In particular, Huawei reaches out to local partners that are Cisco qualified then subsidizes their training in Huawei technology and offers heavy discounts for the final exams needed for certification.³⁰ In this way, channel partners who were already selling Cisco technologies can now also present Huawei technologies as an option to the same client networks. According to one independent channel partner, since technicians are the main connection to clients, Huawei is very aggressive in courting technicians around Nairobi.³¹

A channel partner and two separate lecturers at higher education centers all suggested Huawei had the ability to re-train technicians who already knew Cisco because the technologies were so similar.³² They stressed that Huawei does everything that Cisco does, including cloud computing, wireless access points, security, servers, routers, switches, and servers. According to one interviewee, "The technology is often a barely veiled copy of Cisco. Even if you look at the Huawei website, you'll find the same technologies described in the same way with only slight adjustments to the vocabulary. And whereas Cisco's accreditation is CCIE (Cisco Certified Internetwork Expert), Huawei's is called HCIE (Huawei Certified Internetwork Expert)."³³ Another

"We train university students in the hope that they might become future customers, much like Cisco. We currently offer these training programs for free to universities...We intend for these qualifications to be equivalent to an employer backed certification that they might do as an elective or as part of their coursework, for example."

said that the technology was “borrowed, for want of a better word”.³⁴ To be sure, back in 2003 Cisco sued Huawei for copying its software to sell data traffic switches and routers and claimed that Huawei had plagiarized instructions, verbatim, from Cisco user manuals.³⁵ In the end, Cisco and Huawei settled out of court. Nevertheless these criticisms may have been significant when many Huawei products first emerged a decade or so ago, but the technologies are constantly evolving and Huawei is a company that has invested significantly in innovation since then. Huawei's leadership in the race to produce 5G hardware is a good example of this reality. The reason that Huawei is so competitive is now far beyond whether or not it copied its competitors' technologies but instead must take into consideration Huawei's business strategies including pricing, innovation, and of course investments in training.

Another key difference between Huawei and Cisco's relationships with their channel partners is that Huawei always provides a principal engineer from their own staff whereas Cisco does not. This means that when a team of channel partners prepares the cost and technical analyses for a client in order to win the contract, a locally based Huawei engineer will be dispatched to work with those channel partners on the client presentation. Thus, the technology is better explained by the engineer and tested by the engineer in the client's specific context, as a result giving the client more confidence in the proposal. This collaboration with Huawei can help the channel partner win more projects, whereas with Cisco projects channel partners are effectively on their own to win contracts. However, Huawei's direct involvement can also be a concern for some. One channel partner interviewed said that he had enjoyed a positive relationship working with both Cisco and Huawei. However, he said there were occasions when Huawei had been connected to a client via a partner, then bypassed the partner to work directly with the client, providing all the services that a channel partner would have otherwise covered: “I've heard of this happening twice. This happened with the partner that introduced Huawei to Safaricom. For this reason, some partners don't like Huawei. It's important for partners to be able to keep both parties at arm's length to maintain their position in the middle.”³⁶

Although Huawei has outcompeted rivals such as Ericsson and Nokia, Cisco remains the default company for 'enterprise' technologies. Huawei still has a way to go in developing their own 'enterprise' sector and training remains key to their strategy. Just from a cursory glance at five of Nairobi's biggest technology universities and training facilities, Cisco courses were still the most sought after by young engineers and students. Most employers still prioritize Cisco certifications above all else and all universities preparing their students for jobs in telecommunications offered some level of Cisco certification. By contrast, none of the universities in Kenya or Nigeria that I visited offered training towards Huawei certificates. To target those students, Huawei offers different forms of training opportunities that fall under their Corporate Social Responsibility umbrella (see following section).

Table 7: Huawei's Partnerships with Outside Institutions

Name	Defintion
Huawei Authorized Network Academy (HANA)	Located in local university campuses and run by the Carrier arm of Huawei.
Huawei Authorized Information and Network Academy (HAINA)	Located in local university campuses and run by the Enterprise arm of Huawei.
Huawei Authorized Learning Partner (HALP)	The status given to an independent training institution that is authorized to teach for Huawei certification, such as the African Advanced Level Telecommunications Institute (AFRALTI) in Nairobi.

THIRD PARTY TRAINING AND CORPORATE SOCIAL RESPONSIBILITY

TRAINING THE CUSTOMERS OF THE FUTURE

ASIDE FROM THEIR OWN TRAINING CENTERS, HUAWEI also has three forms of partnerships with outside institutions: Huawei Authorized Network Academy (HANA), Huawei Authorized Information and Network Academy (HAINA), and Huawei Authorized Learning Partner (HALP). The HANA and HAINA Labs, funded by Huawei, are aimed at incentivizing universities to promote certifications in Huawei technologies. As a Huawei spokesperson explained, “We train university students in the hope that they might become future customers, much like Cisco. We currently offer these training programs for free to universities, although the students may still pay a fee to their university as part of their tuition. We intend for these qualifications to be equivalent to an employer backed certification that they might do as an elective or as part of their coursework, for example.”³⁷

A HANA Lab was built at Strathmore University in Nairobi in 2013, but by my June 2018 visit it had already stopped functioning. During my visit to the lab every wall and chair was still covered in Huawei branding, with a new ‘HANA’ plaque still shining outside the front door. However, Ngugi, a young IT technician working in the room explained that it had only operated as a Huawei institution for barely more than a year. By the end of 2013, the academy’s teachers had moved out and onto other jobs but Ngugi did not know where they might have gone. He echoed the Huawei representative’s summary of the purpose of the institute but concluded that “it doesn’t seem to have worked.”³⁸ Instead, the Huawei center is now used as an IT support office for the university and occasionally used as a classroom.

In November 2016, Huawei established its second teaching lab at a Kenyan university – the HAINA Lab at the University of Nairobi. Just like Strathmore University, the University of Nairobi includes Cisco certification as part of many of its telecommunications-related curricula, but historically nothing on Huawei

Safaricom is the largest carrier in Kenya, with the Kenyan government operating as the majority shareholder. Huawei has very quickly established itself as Safaricom's most important OEM in the past ten years and their relationship has involved large contracts, such as software management for M-Pesa, the famous Kenyan mobile payment system that operates over GSM communications.

technologies. When I visited the center in June 2018, the HAINA Lab happened to be closed that afternoon. I was unable to verify whether this was because I had picked the wrong time, or because it had already suffered a similar fate to the HANA lab at Strathmore University. However, recent news articles about the University of Nairobi's HAINA lab suggest that it may be fully functioning and operational.³⁹

CORPORATE SOCIAL RESPONSIBILITY AND GOVERNMENT RELATIONS

LIKE MANY OF ITS WESTERN COMPETITORS, HUAWEI operates Corporate Social Responsibility (CSR) programs in Kenya and Nigeria. As an example, Huawei Kenya takes in roughly 20 students per year for the Presidential Digital Talent Program and trained 30 young people under the Digital Skills for Life Initiative in 2017. On the surface these may appear to be small contributions, but they still require a serious commitment of resources given that Huawei's Nairobi office only has around 300 full-time employees.⁴⁰

Huawei's senior director for public affairs was particularly forthcoming in talking about their many CSR activities and generously facilitated a survey that was sent out to former participants of Huawei's short-term training programs. The questionnaire was distributed to a mailing list outside of my control, so it is unclear who the questionnaire was sent to or whether participants were randomly selected. Overall there were 51 respondents, mainly consisting of former university students and recent high school graduates. Apart from students there were also two Huawei staff members and two customers who responded to the survey. Respondents had predominantly taken courses as part of the Seeds for the Future Program, the University of Nairobi's HAINA center, and AFRALTI. According to the survey, most students found the courses useful and interesting. Thirty percent of the respondents claimed to have implemented a project using the skills taught in the course they attended, even if they qualified implementation in vague ways. Certainly, Huawei's training staff will hope for their programs to be as useful to students as possible, especially for those who may go on to become future customers.

More importantly, CSR training is often primarily about networking for the participants and raising one's public profile for the company.⁴¹ A Kenyan engineer for Ericsson argued that Huawei's CSR programs appear to have achieved these very objectives, insofar as Huawei has some of the strongest government relations in the industry. In particular he pointed to the relationship that Huawei has successfully developed with Safaricom over the years.⁴² Safaricom is the largest carrier in Kenya, with the Kenyan government operating as the majority shareholder. Huawei has very quickly established itself as Safaricom's most important OEM in the past ten years and their relationship has involved large contracts, such as software management for M-Pesa, the famous Kenyan mobile payment system that operates over GSM communications.⁴³ Huawei was also subcontracted by Safaricom to supply and establish the CCTV camera systems over main roads in Nairobi and Mombasa in the wake of the country's recent terrorist attacks from Al-Shabab.⁴⁴ A representative of

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Kenya's investment authority went so far as to state that the relationship was so strong that, "Huawei has transformed Safaricom."⁴⁵

In Nigeria, Huawei's CSR programs have involved even more direct relationships with local government officials. In 2019, Huawei launched the ICT for Change program which trained 2,000 university students and 1,000 civil servants in their Abuja Training Centre. Local news articles published at the conclusion of the ICT for Change program highlighted praise by the Nigerian government for the training Huawei had provided to civil servants from over 100 Nigerian ministries, departments, and agencies.⁴⁶

Huawei also runs many other non-training related CSR programs in Africa that have raised their profile among African governments. For example, during the Ebola crisis, when employees from other international OEMs were leaving, Huawei staff were sent in to keep telecommunications networks running for emergency teams in the area.⁴⁷ Huawei also has a project in Kenya which builds smaller solar-powered towers for small rural and nomadic communities, including the Duse site in Isiolo county.⁴⁸ Similar examples exist among Huawei's competitors, but a cursory glance suggests that CSR projects have been a bigger part of Huawei's marketing strategy in Kenya and Nigeria than among Western OEMs and their commercial success with government contracts may be a testament to this.

HOW MUCH KNOWLEDGE TO SHARE WITH LOCALS IS AN ONGOING tension for all international OEMs. On the one hand, OEMs need to drive demand among customers and have well trained local staff members; on the other hand, OEMs do not want to lose control over their intellectual property. All of the major OEMs regularly train their staff on how to use and deploy the latest technologies coming out from their companies. However, Kenyan and Nigerian engineers working for Ericsson, Huawei, and Nokia all said that Research and Development within their respective firms occurred in their company's home countries.⁴⁹ Some of the Kenyan engineers interviewed even regarded this as "intentional".⁵⁰ Although some projects might sometimes be developed with the specificities of Kenya or Nigeria in mind, for which local employees would be needed, for the most part local engineers and technicians are only involved in sales, installation, and troubleshooting.

While capable use of the various companies' equipment is still an important and often highly technical skill, OEMs do not wish to give local engineers enough tools so that they might be able to set up their own competitive ventures. Since Kenya and Nigeria would struggle to manufacture much of the equipment produced by companies such as Huawei and Ericsson, in some sense OEMs are safe; however, software is a much more vulnerable area of intellectual property no matter where in the world OEMs are operating. OEMs might also not involve Kenyan and Nigerian engineers in the Research and Development process because they consider the staff in their home countries to have the highest human capital. International firms' search for ways to reduce expatriate staff has increased over the past eight years with the decrease

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in airtime and data revenues.⁵¹ Kenyan and Nigerian engineers come in as well-educated local labor able to manage sales and installations at the more technical end so that international OEMs can avoid paying for expatriate staff from their home countries.

SUCCESS AND FAILURE IN HUAWEI'S COOPERATION CENTERS

HUAWEI IS NO STRANGER TO KNOWLEDGE TRANSFER and collaborative learning. Like many Chinese technology companies, Huawei has established cooperative engagements with international market leaders around the world to learn and push the technological frontiers of their industry.⁵² In 2006 Huawei set up its first Joint Innovation Centre in Spain to work with Vodafone and has since gone on to establish roughly 35 more centers in China, Europe, North America, Latin America, Southeast Asia, and the Middle East.⁵³ In efforts to expand knowledge sharing Huawei has also established 14 Research and Development centers around the world, with the most recent built in Grenoble, France.⁵⁴ However, African countries have yet to benefit from either of these specific proactive knowledge collaborations.

Although relatively little compared to what has been built in more economically advanced parts of the world, Huawei has made tentative steps towards establishing similar centers in Africa. In 2016, Huawei was reported to have established a US\$ 6 million Joint Innovation Centre based out of the University of Lagos.⁵⁵ This would have been the first Huawei Joint Innovation center on the continent, and a spokesman for the company in Nairobi clarified that the project was managed under Huawei's Carrier wing.⁵⁶ The Centre's intention was to foster partnerships between Huawei engineers and engineers from local carriers. However, the center never materialized. During a site visit to where the center was supposed to be, a director at the University of Lagos confirmed that construction of the Joint Innovation Centre never began but said he did not know who to ask as to why.⁵⁷ Since then, Huawei was also reported to have opened two 'Open Labs' in Johannesburg and Cairo.⁵⁸ Huawei's Nairobi spokesman explained that these were intended to be operated by Huawei's Enterprise wing, with a view to developing software and hardware aimed at government and big business contracts.⁵⁹ Based on news articles, it seems as though the Johannesburg Open Lab was actually constructed, but the Cairo one may have met the same fate as Lagos' Joint Innovation Centre.⁶⁰ While opening these centers may still be an opportunity for Huawei to develop products in a more targeted way for local clients, they are also an opportunity for Huawei engineers to learn from market leaders. Learning from market leaders is perhaps the most obvious reason for why Huawei would focus their attention on cities with deeper human capital in the field of telecommunications, such as Madrid or Grenoble.

In both countries, OEM staff spoke of the recent swell in small local firms selling them services as part of managed services contracts. As outlined earlier, subcontractors' tasks can include erecting towers, cementing, transporting equipment, installing antennae, as well as software-based troubleshooting and network maintenance. Huawei Kenya estimated that in 2018 it was contracting out to roughly 2,200 such personnel, and in 2016 paid US\$ 40 million to local sub-contractors.

SILLOVERS FROM INTERNATIONAL FIRMS

I DEFINE 'SILLOVERS' AS THOSE MOMENTS WHERE EMPLOYEES take skills learned from working with international firms and later set up their own profitable enterprises independently; sometimes cutting the international firm out of the business in the process. Because spillovers are not among international firms' intended goals, I consider spillovers to be qualitatively different from 'knowledge transfers' and 'training'. In 2008, Ericsson was the first company to win a managed services contract in Nigeria. However, since that time Huawei has come to dominate all of the major operators in this business regardless of the technology involved. "If there's a problem with Ericsson radio equipment, it's still Huawei that fixes it" explained one operator.⁶¹ In Nigeria, Huawei now operates all of Airtel's and MTN's managed services contracts. As such, Huawei stands to lose the most if subcontractors cut them out as a result of unintended spillovers.

One of the most promising areas for spillovers to occur in Kenya and Nigeria's telecommunications sector is among subcontractors. In both countries, OEM staff spoke of the recent swell in small local firms selling them services as part of managed services contracts. As outlined earlier, subcontractors' tasks can include erecting towers, cementing, transporting equipment, installing antennae, as well as software-based troubleshooting and network maintenance.⁶² Huawei Kenya estimated that in 2018 it was contracting out to roughly 2,200 such personnel, and in 2016 paid US\$ 40 million to local sub-contractors.⁶³ In Nigeria, older construction firms like Interkel moved into the telecommunications sector as managed services contracts increased and new firms such as Hatfield emerged almost overnight in response to the new opportunities.⁶⁴

The concern among OEMs is that once subcontractors have been trained, they will side-step the OEMs to work directly for the carriers. A spokesperson for Huawei Kenya said that on occasion Safaricom had tried to hire subcontractors directly, cutting Huawei out, but after a fatality in 2017 Safaricom has been more cautious.⁶⁵ Nevertheless, a mid-level Nigerian engineer at Huawei's Lagos office predicted that these managed services contracts may leave Huawei as quickly as they came. He estimated that it could be just three to five years before subcontractors start to contract directly with the carriers in larger numbers.

The case of American Tower Corporation (ATC) is a prime example of direct contracting. Although ATC was already a successful international firm, it started its operations in Nigeria working as a subcontractor for Huawei.⁶⁶ The relationship began with Huawei winning all of Airtel's managed services contracts, then subcontracting out to ATC. After a period, however, ATC took over Airtel's "passive" managed services contracts such as landholdings, towers, and power generation for those towers. Meanwhile, Huawei has remained in control over Airtel's "active" managed services contracts concerning monitoring and troubleshooting equipment. For the time being, however, ATC remains an exception in terms of the massive amounts of capital they have mobilized to control those "passive" managed services contracts. Many of the

smaller local firms will be focused on the “active” managed services contracts and are able to build capacity precisely because they are being trained in best practices for maintenance operations, equipment installations, etc., by companies like Huawei and Ericsson.⁶⁷

INTERNATIONAL OEMs: STAFF TRAINING & TALENT RETENTION

HUAWEI AND ITS COMPETITORS ALSO CONTRIBUTE to knowledge transfer by hiring and training local staff. All interviewed Kenyan and Nigerian engineers who were permanent staff at Ericsson, Huawei, or Nokia said they had received regular training as part of their job. Huawei and Nokia engineers described a “70-20-10” training model in which 70 percent was on the job learning, 20 percent through e-learning, and 10 percent classroom-based training.⁶⁸ One former Huawei employee, who now works for Nokia, said that the training he received at Huawei was slightly more rigorous insofar as employees were obligated to take a technical exam for new skills every year, whereas at Nokia formal exams were merely encouraged.⁶⁹ He believed the rigorous testing was related to Huawei’s business model, which is based on hiring more recent graduates compared to other international OEMs. According to Huawei Kenya’s spokesperson, in 2016 65 Huawei employees left the company, of which 30 went to work for the government and 35 towards the private sector.⁷⁰

Like the subcontracted staff mentioned previously, Huawei and other firms have also trained full-time staff members who have then gone on to set up their own firms. For instance, Kilimall is an e-commerce company that was started by former Huawei Kenya employees from China. It was founded by Yang Tao who arrived in Nairobi in December 2012 to work for Huawei. Tao quit his job in 2014 to found Kilimall, taking other young Huawei colleagues with him.⁷¹ Kilimall began operations at a time when Amazon and Alibaba had not yet entered African markets and Jumia was only just beginning in Nigeria. The company remains headquartered in Kenya, but now also operates in Nigeria and Uganda, employing dozens of local technicians and sales representatives in each location. Similarly, a Kenyan engineer at Nokia said that he knew of several colleagues who had left the firm to set up their own IT companies, largely focused on software and app development.⁷² These areas were a common focus among young entrepreneurs in the telecommunications sector in both Kenya and Nigeria. It is a testament to the increased use of smartphones in the region and the related economic opportunities they bring. However, for both countries there remains a noticeable lack of manufacturing capabilities.

Some of the Kenyan and Nigerian employees interviewed said that trust was a barrier to promotion within their international firms.⁷³ They said it was difficult for local engineers to rise to the top jobs. Several Ericsson and Nokia engineers who used to work at Huawei said this was particularly the case at Huawei, as compared to their new employers. A more rigorous study would have to be carried out to see how corporate cultures differ between the international firms. However, Huawei’s Kenya office did have an example of one local engineer, John Tanui, who joined as a junior

Huawei and its competitors also contribute to knowledge transfer by hiring and training local staff. All interviewed Kenyan and Nigerian engineers who were permanent staff at Ericsson, Huawei, or Nokia said they had received regular training as part of their job. Huawei and Nokia engineers described a “70-20-10” training model in which 70 percent was on the job learning, 20 percent through e-learning, and 10 percent classroom-based training.

Lastly, the high salaries paid by international OEMs was cited as another barrier to knowledge transfer. An engineering professor at the University of Nairobi claimed that because their salaries would always be higher than local firms' salaries, their best graduates would ultimately rotate around companies like Cisco, Ericsson, Huawei, and Nokia, without ever going to work for the smaller, local operations where they might be able to help build local capacity.

staff member and rose to become Huawei Kenya's deputy CEO.⁷⁴ Tanui left Huawei in 2015 and went on to lead the Kenyan Government's flagship innovation development project, Konza Technopolis. It is hard to say whether Tanui is the exception that proves the rule or whether company culture has shifted since Huawei first arrived on the continent, but certainly it is possible for local staff to occupy senior positions that can then have positive spillover effects.

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LOCAL INNOVATIONS IN TELECOMMUNICATIONS

UNBEKNOWNST TO SOME, KENYA USED TO HAVE A NASCENT telecommunications manufacturing sector of its own. It was not on the scale of the industrial telecommunications leaders of today, but there were companies like Gil Gil that manufactured telephone handsets in the late 1990s and Jaminis Telecoms which produced routers.⁷⁸ Their main obstacles to grow further, or even survive, was that raw materials were expensive to import, local power supplies were unstable, and in the early 2000s strong competition from international OEMs came in.⁷⁹ A Nigerian government official said that there was once a similar company that produced handsets in Nigeria, but cited the same reasons for its demise.⁸⁰ For now, there are a handful of smaller firms in Kenya and Nigeria that produce simple inputs, like cables and steel needed for the construction of telecommunications towers, but nothing much more technical.⁸¹

The Kenyan and Nigerian governments have tried piecemeal incentives to spur industrial growth and knowledge transfers in the telecommunications sector where possible. In some cases, incentives have focused on trade barriers, such as the Nigerian policy banning the import of SIM cards and recharge cards so that they could be produced locally.⁸² Although a small step, this move has generally been regarded as a success over the past ten years. One Nigerian government official lamented that his government still allows foreign investors to repatriate 100 percent of their profits, and there are no concrete policies to enforce knowledge or technology transfers.⁸³ A representative from Kenya's investment authority said exactly the same thing, and both of them said it was because they were afraid that any sort of mandated local

Although Huawei would prefer not to foster new sources of competition, their enormous focus on training suggests a business strategy in which they see such investments as an indispensable component of long-term growth. Huawei would not have been able to establish such lasting relationships with the governments and biggest carriers in Kenya and Nigeria without hiring and training local staff on the scale that they have.

reinvestment might scare away investors.⁸⁴ The Nigerian official claimed that South Africa had a much better model in which it demanded foreign companies reinvest a percentage of their profits locally.⁸⁵ Ultimately, Kenyan and Nigerian leaders continue to shy away from the sorts of economic tools used by the Chinese government to channel investment and knowledge transfer in China.

To be sure, China's experiences are often unique and hard for other countries to replicate, but a few observations can be made of its experience in technology transfers. In the 1990s, Chinese authorities championed foreign direct investment (FDI) as a means of attracting foreign businesses to set up in China. The logic was that FDI would bring in needed capital, create jobs, and facilitate knowledge and technology transfers.⁸⁶ While the first two objectives were broadly met, by 2005 policymakers found that foreign firms and their governments were too keen to defend both the intellectual property and the international standards they had established, actively stymying prospects for knowledge and technology transfer.⁸⁷ No doubt, a number of African governments may feel the same way about China's hi-tech firms today. In response to this, since about 2006 Chinese authorities have made FDI conditional on forming joint ventures. In the first year, European Union FDI flows dropped from US\$ 7.9 billion in 2006 to US\$ 1.5 billion in 2007, but since then the results of this policy have appeared to pay off enormously for China's biggest firms.⁸⁸ Chinese authorities also increased investment in research and development, and encouraged national technology leaders to form more relationships overseas.⁸⁹ Huawei is just one of the international success stories that grew to its full potential in the wake of this change in policies, but there are others in fields such as bio-technology, car manufacturing, aerospace, and energy conservation.⁹⁰

The Nigerian government does not appear to be investing in any local research and development initiatives related to telecommunications. Despite the lack of investment, a grassroots technology cluster has emerged in Lagos that is colloquially referred to as Yaba valley.⁹¹ Yaba valley, like many other initiatives, is primarily focused on software development and does not appear to have the resources or ambition to foster manufacturing of telecommunications equipment. There are similar grassroots and local private sector initiatives in Kenya such as Chiramo's C4D Lab, iHub at Strathmore University, and Nailab. However, like in Nigeria, these are all primarily focused on software rather than manufacturing.

By contrast, the Kenyan government appears to be much more proactive in the research and development domain. Konza Technopolis is Kenya's flagship technology program and is currently managed by Huawei Kenya's former deputy CEO, John Tanui. The government's intention is for Konza Technopolis to operate as both a special economic zone and as a science and technology research park with universities and labs. It is being built in a town named Konza, 70 km southeast of Nairobi, with government funding and a loan secured from a private Italian bank. Konza Technopolis has also partnered with South Korea's Advanced Institute for Science and Technology and for now the university they intend to build in Konza is to be called the Kenyan Advanced Institute for Science and Technology. One of Konza Technopolis'

directors explained that as a special economic zone, “there will be incentives for firms that set up manufacturing or operations there, such as tax breaks. In particular we are trying to attract the research and development to set up a city like Daejeon in Korea. Many firms will want to access our markets with their technologies, and so this will be a space for them to innovate with local experts.”⁹² He said that enabling local telecommunications innovation and manufacturing was a core goal of the project.

However, in speaking to Kenyan engineers and technicians about the project, there was a mixture of hope and cynicism. Plans for Konza Technology City (as it was formerly known) were initially launched in 2008, with support from the World Bank’s International Finance Corporation and an approximately US\$ 14.8 billion investment.⁹³ Ground-breaking for the project began in January 2013, followed by another lull, and more recently there appeared to be a renewed enthusiasm for the project following the 2017 election.⁹⁴ Once again, though, reports from June 2019 suggest that the project is still struggling to attract outside investors to set up in a city that is only partially built. Whether or not it will stand to compete with similar Technology Zones in countries like Ethiopia and Rwanda remains to be seen.⁹⁵

More generally, some Kenyan engineers lamented about other issues on a more personal level, such as winning government scholarships to pursue further education but then never actually receiving the money or simply not knowing where a research department could apply for government research funds in the first place.⁹⁶ Although human capital in both Kenya and Nigeria is growing, thanks in part due to the increased presence of international OEMs, there is still a noticeable gap in terms of accompanying local government support. Furthermore, while both countries are already home to a number of industries in lower value products, it seems unlikely that they will reach the technological capacities of international telecommunications manufacturers without more concerted government support.

CONCLUSION

HUAWEI AND ITS COMPETITORS ARE NOT DOING BUSINESS in Africa for altruistic reasons, nor are they there out of purely political motivations as some headlines may suggest. Huawei is first and foremost seeking to expand markets, sales, and profits, just like any of its competitors. Although Huawei would prefer not to foster new sources of competition, their enormous focus on training suggests a business strategy in which they see such investments as an indispensable component of long-term growth. Huawei would not have been able to establish such lasting relationships with the governments and biggest carriers in Kenya and Nigeria without hiring and training local staff on the scale that they have. Furthermore, although China Development Bank and China EXIM Bank loans have certainly played a roll in Huawei’s pricing strategies, they alone cannot explain all of Huawei’s success or else other competitors, such as ZTE, would presumably have been just as successful in the region.

From Kenyan and Nigerian perspectives, much remains to be done to extract the knowledge and technology they seek to learn from Huawei, among other international

firms. Although Huawei trains local engineers, technicians, and sub-contractors to perform specific tasks, based on the fieldwork conducted for this research there was little to suggest that Kenyans or Nigerians will be sent to China to participate in the R&D process any time soon. The same can be said for Nokia, Ericsson, and Cisco for that matter as well. Kenya and Nigeria's ability to reach manufacturing capabilities in telecommunications will depend on a broad range of factors beyond the scope of this paper such as choices around tariffs, trade deals, special economic zones, free trade areas, the financing structures around power generation, and more. However, one preliminary step raised by both Kenyan and Nigerian government officials would be for their governments to start enforcing the local reinvestment of a portion of international OEM and Operator profits, similar to South Africa's policy. Their governments might also draw lessons from China's concerted move away from a liberal FDI-focused national innovation strategy, in favor of a strategy which is dependent on the creation of joint ventures where relevant.

In the meantime, however, the future of telecommunications in Africa remains bright. Connectivity is now growing faster in Africa than in any other continent in the world, and local jobs within that sector are growing too. There are obstacles in the form of structural inequalities and finances, but then there are also opportunities in terms of human capital that already exists in both countries. Kenya and Nigeria are two of the most exciting examples of how local engineers, technicians, and policy makers have begun to harness the opportunities presented by telecommunications' international market leaders. Although still small, there are some spillovers occurring, and OEMs have been some of the biggest influencers. It may be some time before we witness the establishment of a Kenyan or Nigerian OEM that can compete on Huawei's terms, but increased investment in the training of local talent must be the first step. ★

APPENDIX A: FIELDWORK INTERVIEWEE BREAKDOWN

Appendix A: Fieldwork Interviewees by Category

Interviewee Group	Citation Code	Number of Interviewees
OEM Staff	OEM	11
Carrier/Operator/Telco Employees	OP	5
Teaching Institution Staff & Students	TEA	9
Local Government Employees	LGOV	5
Local Telecom Firm Employees	LT	4
Miscellaneous Experts	MISC	4

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AUTHOR BIO

HENRY TUGENDHAT:

Henry Tugendhat is a fifth year PhD student at Johns Hopkins, SAIS, focusing on Chinese Telecommunications in Africa. He has conducted fieldwork in Kenya, Ghana, Ethiopia, Nigeria, and Zimbabwe on the nature of Chinese economic engagements in the continent. His research interests also cover the internationalization of middle-income country currencies and development finance more generally. Prior to his PhD, Henry worked as a Research Officer at the Institute of Development Studies (UK) for three years. He did his undergraduate degree in Chinese and Spanish at the University of Leeds and his MSc in Development Studies at SOAS (University of London). He speaks Chinese, French, Portuguese, and Spanish.

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SAIS China-Africa Research Initiative
1717 Massachusetts Avenue NW, Suite 733
Washington, DC 20036
www.sais-cari.org
Email: sais-cari@jhu.edu



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