# African Women, Technology and ICTs

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## Contents



**Abstract**

Technology has a lot to offer women in both their public and private lives. In view of this, the Strategic Development Goal (SDG) 5b seeks to utilize enabling technology, particularly information and communications technology, for the empowerment of women. Through a desk review, this chapter looked at the position of African women in the development, deployment, and utilization of technology in the broad sense with special focus on information and communication technology. Factors that inhibit women's full utilization of technology and some policy directives have also been enumerated in the chapter. Various interventions in the area of women and technologies have yielded results. African women are not only users of technology, but they are breaking through as developers in the technology space as well. In spite of infrastructural and socio-economic challenges, women in Africa are capable of harnessing the full potential of technology to improve their lives. They should therefore be perceived as such and be supported accordingly.

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## Introduction

The need to harness the full potential of technology, especially information and communication technologies (ICTs), to improve the situation of women has been explored for decades. Among the resolutions of the Beijing Declaration and Platform for Action at the Fourth World Conference on Women in 1995 was to provide equal access to science, technology, and information and communication markets (UN 1995; Brännström 2012). The president of the World Bank, Jim Yong Kim, wrote in his foreword to The World Development Report of 2016 that "new technologies allow women to participate more easily in the labor market" (World Bank 2016, p. xiii). In September 2015, the United Nations Sustainable Development Summit set the 2030 Agenda for Sustainable Development. This framework – which is composed of 17 Sustainable Development Goals (SDGs), 169 targets, and over 200 indicators – has some of its target on digital technology. It is stated in Agenda 2030 that the spread of information and communication technology and global interconnectedness has great potential to accelerate human progress, bridge the digital divide, and develop knowledge societies. Target 9.c of SDG 9, which is on infrastructure, industry, and innovation, commits the international community to "significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020." While SDG 5 aims to "achieve gender equality and empower all women and girls" by 2030, SDG 5b seeks to "enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women" (UN 2018 p. 07; UN n.d. para 12; ITU 2018 p. 01). The African Union has also declared the period 2010–2020 as the African Women's Decade to accelerate African women's development (Alozie and Akpan-Obong 2017). In the area of ICTs, the African Union also works with the United Nations International Telecommunication Union (ITU) "to create a global environment that empowers and encourages girls and young women to consider careers in the growing field of ICTs and enable a greater female participation in the ICT sector" (AU 2018, para 8). All the above statements, resolutions, goals, and initiatives indicate the commitment of the international and the African community to the full utilization of technology and ICT for improving the lot of women in Africa and beyond.

The digital divide should no more exist, because in Africa, women have the technology and ICT potential to excel in all aspects of their lives. Digital divide refers to the gap that exists between those who have access to new forms of information technology and those who do not have access. Such information technologies include computers, Internet connectivity, mobile telephony, and other related devices (Van Dijk 2006). Hilbert (2011) undertook a study to look at the digital divide from a gender perspective. According to the author, while some studies

claim that women are rather technophobic and that men are much better users of digital tools, others argue that women enthusiastically embrace digital communication. The ICT Facts and Figures report that was published by ITU in 2017 shows that while the Internet user gender gap has narrowed in most regions since 2013, the proportion of men using the Internet remains slightly higher than the proportion of women using the Internet in two thirds of countries worldwide. In 2017, the global Internet penetration rate for men stood at 50.9% compared to 44.9% for women. That means the proportion of men using the Internet is higher than the proportion of women using the Internet in two thirds of countries worldwide. In terms of gender, the report indicates that there is a strong link between gender parity in the enrollment ratio in tertiary education and gender parity in Internet use. The proportion of women using the Internet is 12% lower than the proportion of men using the Internet worldwide. The only region where a higher percentage of women than men are using the Internet is the Americas, where countries also score highly on gender parity in tertiary education. That is, in the Americas, the number of women using the Internet is higher than that of men. The ITU report further reveals that, though the gender gap has narrowed in most regions since 2013, it has widened in Africa.

In Africa, the proportion of women using the Internet is 25% lower than the proportion of men using the Internet. In least developed countries, only one out of seven women is using the Internet compared with one out of five men (ITU 2017). A current press release from ITU toward the 2019 "Girls in ICT Day" celebration indicates that the African region has the widest digital gender gap in the world with only 18.6% of women using the Internet, compared with 24.9% of men. Such results make the study that was undertaken by Hilbert (2011) more relevant today than ever before, to enable us harness the ICT potential that females in Africa have. The ITU has recognized this opportunity and potential hence the celebration of the "Girls in ICT Day," observed by the United Nations. ITU's press release for this year's celebration on April 25, 2019, was aimed at inspiring a new generation of girls to explore the exciting opportunities offered by a career in ICT. It is estimated that in 10 years' time, there will be more than two million technology jobs that cannot be filled due to lack of digital specialists. In view of this anticipated gap, girls and young women who learn coding, app development, and computer science will be well-placed for a successful career in the ICT sector with an edge in a competitive job market, be at the heart of the world's most exciting and fastest-growing industry; play an equal role in the creation, design, and implementation of the devices and platforms; and gain higher salaries and enhanced career mobility. The celebration of the event on the African continent, in Addis Ababa, Ethiopia, was also an indication of the recognition of the enormous potential for leveraging ICTs to drive economic growth and development and accelerate progress toward the 17 sustainable development goals (ITU 2019). This is very promising for the future because the dynamics are changing. Very recently, Bhandari (2019) undertook a study on "Gender inequality in mobile technology access: the role of economic and social development." The study expanded on the work of Hilbert (2011) by using a relatively broader sample of 51 countries from the ITU database. Bhandari notes that "For

about 20% of my sample of 51 countries, men actually have *less* access to mobile phones than women" (Pg. 679).

No matter their levels of education, income, or location, African women are making the best use of technological tools that are within their basic reach and ability – including home and workplace equipment to ease and speed up their work processes, mobile telephony to make phone calls for business transactions, mobile money services, engagement in distance learning programs, e-health services, basic Internet support on Facebook for connecting their rural markets to global markets, basic mechanized systems for increasing their agricultural productivity, and engagement in basic e-business transactions. The speed at which new technologies are defining the lifestyle of society and individuals in it makes it almost automatic for all to tap into the technology and ICT fever. The most dramatic revolution in the ICTs in Africa is mobile telephony with its mobile money services. No one is indeed left behind in this revolution of mobile telephony – male or female, the young and the old, the urban and the rural dweller, and the poor and the rich are all participating in this technological explosion for sending and receiving money, making remittances, or making payments either for business or for personal purposes. The utility of the financial transaction services of the mobile telephony in Africa alone has indeed cut across all divides including gender. Graham has noted that "the gap is *reversed* in mobile money accounts, where women outnumber men by about 22%. The same holds true in Malawi and Zambia: women's use of mobile banking services is outpacing men. . . . As these services grow and evolve, women's financial equality will improve (Graham 2018, para 9).

This chapter explores the state of African women in relation to technological and ICT development, deployment, and utilization. Through a desk review, the technological revolution and the ICT potential for women in Africa and related inhibiting factors have been discussed. Future policy directives for improving the state of African women's position in the ICT sector have also been recommended. Technology is simply used in this chapter to represent the application of scientific knowledge in inventing machinery and devices for providing practical solutions to all kinds of human activities. Technology is also perceived in this chapter as a tool, process, service, product, an activity, and a solution. In all these aspects of technology, African women are central and, therefore, cannot be left behind. ICTs on the other hand could be perceived as the branch of technology which provide scientific solutions to the production and management of information as well as its dissemination. Thus, ICTs include a range of "technologies that facilitate production, storage and exchange of information by electronic means" (Msoffe et al. 2018, p. 4). The technological revolution and ICT tools such as computers, cell phones, and the Internet services that come with it can no longer be perceived as a luxury or prestige but a utility for all categories of people including women in Africa.

The chapter comprises of four sections. The first section introduces the entire chapter with background information on international perspectives and initiatives on the issue of women and ICTs. The second section focuses on the technological revolution and the ICT potential for women in Africa. The section that follows discusses factors that affect women's full utilization of ICTs. Some policy directives

that could help address the inhibitions have also been recommended in the section. The final section provides concluding remarks on the chapter.

## The Technological Revolution and the ICT Potential for Women in Africa

Technology has shaped the development and direction of society for years. Technological advancements, coupled with the invention of key technologies for development, have led the industrial revolutions. The invention of the steam engine by Thomas Newcomen in 1712 brought about the first industrial technological revolution. The development of electric power and automatic operations led to the second technological revolution. As a result of this, iron, steel, decentralized engines, motion, bridges, railroads, skyscrapers, and the first car (in 1885) were all invented. The invention of the microchip in 1971 initiated the third technological revolution which is associated with the production of the computer. The computer has also brought about a massive revolution in the processes of work in corporate and home settings. Society is now faced with the fourth industrial revolution, which is guided by technological concepts and solutions that combine economy of scale with economy of scope. The technology for the fourth revolution seeks to integrate products and processes in a comprehensive network. It brings about collaboration between persons and machines (Dombrowski and Wagner 2014; Kim 2018; Carvalho et al. 2018). These developments have contributed to easing but also adding to the pressures on African women as they perform their household, occupational, and societal roles.

The technological revolution has impacted very strongly on the ICT landscape in the African subregion. ICT is critical for developing the information society, for alleviating socioeconomic exclusion and poverty, and for empowering disadvantaged groups including women in developing countries (Bisimwa et al. 2018). Technologists and development analysts have established that ICTs are critical tools for promoting the development of Africa (Csikszentmihalyi et al. 2018). In their most recent report on least developed countries (LDCs), which comprise the 47 nations that suffer from severe structural impediments to sustainable development, the International Telecommunication Union (ITU 2018) have noted that ICTs have enabled LDCs to tackle key development challenges in the areas of financial inclusion, poverty reduction, and health. It is further observed in the report that what the most successful mobile services and applications have in common is that they are basic (often using voice or text), affordable, and easy to use, require little bandwidth, work with plain cellphones, and work over second-generation (2G) networks. The broadband applications and services delivered through access to the Internet will provide more opportunities for people in developing communities. For instance, while telemedicine could help to compensate for a shortage of doctors, online learning could also fill in the gap for a shortage of teachers. By early 2017, 61% of the population in LDCs was covered by a mobile broadband signal, with the price of mobile broadband services reducing at a rapid rate. The ITU anticipates that

if recent growth rates hold, the LDCs will be on track to reach averages of 97% mobile broadband population coverage and Internet prices of less than 5% of monthly gross national income (GNI) per capita by the target date of 2020. This implies that some LDCs will have largely achieved the universality and affordability criteria by 2020. By the end of 2016, all LDCs had launched 3G mobile broadband networks, and a total of 26 LDCs had commercially deployed 4G long-term evolution (LTE) networks. These give an indication that the LDCs are on track to achieve SDG Target 9.c to make the Internet accessible and affordable by 2020. The 2018 report on the SDGs confirms that in 2015, medium-high- and high-technology sectors accounted for 44.7% of total manufacturing value added globally. The value added had reached 34.6% in developing economies (UN 2018). Internet use is however dependent on infrastructure, affordability, and development of human skills. The lack of the necessary skills and digital literacy could be a barrier to Internet use in many LDCs. So in connection with women, the ITU (2018) report indicates that the gender gap in the usage of the Internet is high and that efforts need to be made to bridge the gender gap in education, establish gender-friendly Internet access, provide training programs, and project the image of women and girls to empower them as critical partners in the digital economy (ITU 2018).

It is interesting to note that as far back as 2011, Hilbert undertook a study titled "Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics." In that study the Internet usage of men and women who were literate, actively working or studying, and who belonged to the top 25% income group was investigated. Hilbert concluded that the gender divide disappeared in most African countries for women "on equal footing" (women who were of similar characteristics as their male counterparts in terms of educational levels, economic and social status). The study further revealed that in the case of Kenya, the divide in Internet usage was reduced at 29.7% for both men and women, while women on an equal footing turned out to be more active mobile phone users (ratio of 90.0% men to 92.7% women). When placed on an equal footing, the ratio of women verses men turned around in favor of women for Internet usage in 4 of the 13 analyzed countries: Namibia, Ethiopia, Mozambique, and Senegal. Much as the study found that in South Africa, Benin, Botswana, Ghana, Uganda, and Cote d'Ivoire, men continued to use the Internet more, the relative difference diminished in the case of women who were on an equal footing with men. For example, in South Africa, the share of men online shrank to a difference of merely 5% for men and women on an equal footing. On the issue of mobile phone usage, apart from Senegal and Tanzania, women on an equal footing were found to embrace mobile telephony more than men. This implies that women welcome the use of digital tools when they are on equal footing. As to what engages both sexes online, the men revealed that they were much more enthusiastic about using the Internet for entertainment reasons than women (Hilbert 2011). So in situations where there is a fair assessment of women and men in the use of technology, women would not be found wanting. They will not be perceived as digital immigrants, that is, people who were born or existed before the high utilization of information and communication technologies. Rather, just as in Africa, there are male digital natives and immigrants, in the same way there

are female digital natives and immigrants on the continent. These results also hold after controlling for possible confounding factors. In addition to the household level of analysis, the study by Hilbert (2011) further revealed that gender disaggregation suggests that female mobile phone use has stronger positive associations with social welfare (caregiving) than if males alone use mobile phones.

An initial step in harnessing the power of technology toward the building of African women's capacities is to ensure that they have access to the most current digital tools – tools that are rapidly and perpetually evolving. For example, women use technological tools such as cars, blenders, washing machine, microwaves, juicers, and vacuum cleaners, among others, to help make life comfortable for the whole family. In communications, the woman uses the mobile phone for all kinds of assistance. There are instances of how technological tools have impacted on the lives of women across the African region in all sectors of the economy – in education, health, agriculture, business growth, increasing income levels, and participating in governance to obtain a voice in the public space as studied by Lepoutre and Oguntoye (2018), Masika and Bailur (2015), Kwapong (2010), and Etzo and Collender (2010). The mobile telephony technology alone has brought a huge revolution in the use of technology for the empowerment of African women. The technology is crucial in serving both men and women on the African continent in a very dramatic way. Mobile phones have been identified as the cheapest and quickest medium of communicating from virtually any location including even shantytowns and remote villages. Mobile money systems are contributing to transforming lives in Africa. This is evident in the fact that an estimated 277 million people in SSA signed up for a mobile money account in 2016 alone (Lepoutre and Oguntoye 2018; Masika and Bailur 2015; Etzo and Collender 2010).

In the case of using digital channels for education and training, the data shows clearly that women tend to make much better use of the existing opportunities than men (Hilbert 2011a). Women have utilized the opportunities in educational technologies to take online courses or software-based literacy programs (Wyche and Olson 2018). A research of 5000 respondents on gender differences in ICT provision in Bangladesh, Brazil, Chile, Ghana, and the Philippines revealed that tertiary education and the ability to use ICTs at home are significant factors for digital inclusion (Rashid 2016). A study in Ghana also revealed that distance learning programs that depend on educational technologies have contributed in widening access to tertiary education for women in Africa who otherwise would not have had the opportunity to overcome institutional, situational, cultural, and dispositional barriers to education (Kwapong 2007, 2010). In a study that was conducted among 246 women academics in 6 universities in South Western Nigeria, it was revealed that women in academia were using ICT facilities such as computers, printers, Internet, websites, photocopiers, and mobile phones for word processing, statistical analysis, browsing the Internet, accessing the search engines, electronic communications, and also in preparing their course materials (Olatokun 2007).

Economically, African women of all educational levels and groups have taken advantage of both formal and informal job opportunities that the technological revolution presents (Etzo and Collender 2010; Olatokun et al. 2017). Though

percentages may differ compared to their male counterparts, females are participants in the world of IT hardware and software designs and users in any way possible. Women entrepreneurs have utilized ICT resources such as mobile and online communication facilities to access worldwide e-business channels which operate 24 h and all year round. They use mobile phones to transfer monies for all kinds of business transactions. A large informal economy has also emerged to support the mobile sector, with people selling airtime, charging and fixing mobiles, and renting them out. Generally, mobile phones support women to save time and money; to increase and improve their work productivity and returns in the investments in their small-, medium-, and large-scale businesses; and also to maximize their household resources (Etzo and Collender 2010; Olatokun et al. 2017). The way Ghanaian traders utilize mobile phones for business is not different from their counterparts in other parts of the continent. The Ghanaian marketplace is set for both local and global engagement. It uses multiple local networks to move and circulate people, goods, and value. The business activities of women traders show that the mobile phone forms a critical part of their daily gendered lives. The device helps them to manage their livelihood and familial relations. It remains an integral part of their business communications and for building social capital (Kwami 2016).

Politically, African women have used ICTs to support their communities. The proliferation of media platforms such as radio, television, and online discussion forums in local languages has enabled meaningful participation in governance and made female voices heard. Women and men have used mobile phones to track and monitor elections to ensure transparency (Etzo and Collender 2010).

Culturally, the economic and political impact of technology on African women has improved their traditional status. By having access to formal education up to the higher level by distance learning, gaining some level of personal income through technology-based enterprises, and gaining a voice in governance as they participate in the various media platforms, there is a shift in the traditional gender status and roles for women who have suffered some form of discrimination over the years. That is women have expanded opportunities for making income that they can control and use as they find fit (Asongu and Nwachukwu 2018; Otte et al. 2018; Sekabira and Qaim 2017; Hilbert 2011).

Technology provides health solutions for African women in several ways. In Africa, women are confronted with critical and emergency lifesaving problem-solving situations every day. They need technology to help them arrive at the best health solution in their critical moments. Technology has been used to promote e-health services for women as well as men even in the remotest parts of the continent. The use of the mobile phones alone goes a long way toward timely healthcare delivery and also to improve access to healthcare information and services in low-resourced settings for women and men. A case in South Africa testifies to that. Mobile phones that have been used in poor, remote rural areas of South Africa have improved access to their healthcare and delivery for both females and males. Patients, nurses, doctors, and other healthcare providers stay in touch with each other and use the mobile device to provide health information (Watkins et al. 2018; Etzo and Collender 2010) and obtain cost-effective health services (Wyche and

Olson 2018). A research in rural South Africa revealed that some health workers and patients used their own mobile phones for healthcare, bearing the cost themselves. Patients also use their mobile phones to remind themselves to take medication or attend their clinic visits, and they appreciate receiving voice call reminders. Some patients and health workers accessed websites and used social media to gather health information. Doctors have developed their own informal mobile health solutions in response to their work needs and lack of resources due to their rurality (Watkins et al. 2018).

Agriculture is one sector where African women are dominant. Some of the major challenges that farmers face in accessing agricultural information are high costs, unreliable electricity, poor television signals, and illiteracy. In Tanzania, mobile phones have been used extensively to provide information for both female and male farmers (Msoffe et al. 2018). Radio remains the most widely used medium for disseminating information to rural audiences including women farmers across Africa (Kwapong 2005). Over 800 million radios have been estimated to be in sub-Saharan Africa. A study was conducted by Hudson et al. (2017) on food insecurity in sub-Saharan Africa to investigate strategies to provide information on innovative agricultural practices to smallholder farmers. In that study two participatory radio campaigns that used both listening groups and ICTs to engage African farmers in six African countries were assessed to find out how the participatory approach impacted on listenership, knowledge, and initial adoption of agricultural techniques and practices. As a result of the study, the program was found to be very useful for increasing awareness and adopting agricultural practices in sub-Saharan Africa.

Inarguably, African women are key agents of development. Thus, any limitation that holds them back could also hold back development as a whole. Just as they need equal access to all sectors of the economy such as education and health, they also need full access to the potential that technologies present. It is interesting to note that the very factors that could limit African women's access to the total benefits of development such as low levels of education, poor health, low income levels, and limited access to factors of production such as land and working capital could also influence their full utilization of technological resources. Considering the potential that technology presents to women in Africa, the continent cannot afford to deprive them of such a great resource. The benefits that society derives from technological solutions cut across all the sectors of development. As discussed earlier, in the education sector, ICT tools can provide women and men in Africa with access to lifelong learning as well as education and training by using distance and e-learning systems. Electronic health facilities enhance health care delivery for women as well as men. E-agriculture, e-commerce, and e-government are all ways by which opportunities for improved services are made accessible to both women and men of the African continent. Dlodlo (2009) has therefore noted that if we deprive women access to ICT tools, we do not only deprive them and their families of income, but we also reduce the skill levels of the nation, limit productivity, and prevent countries, especially developing nations, from being competitive in the global market. Information poverty alone could lead to low income in both rural and urban communities. Enhancing African women's increased access to technologies will help them to

transit from the perceived ICT sociological argument of women being *Cinderellas* to becoming ICT *Cyberellas* where they will become IT professionals, use and design computer technology programming, and work in virtual spaces as well (Alozie and Akpan-Obong 2017; Oreglia and Srinivasan 2016; Dlodlo 2009).

Kenya, for instance, has made great strides in bridging the gender digital divide. The country appears to have more females who are digital enterprise founders than any other country (20% of the worldwide total), including the United States (16%) (Bailur et al. 2018). Wyche and Olson (2018) undertook a qualitative study that focused on women in Kenya to explore their experiences with mobile phones. The study revealed that Kenya is one African country that is a leader in Internet use in which mobile Internet diffusion has outpaced PC-based Internet access. This is prevalent in mobile devices such as smartphones. The authors therefore anticipate that the mobile devices will possibly be the primary means by which new Internet users in rural African communities for instance will get online. For African women to make the best of these opportunities, the authors recommended that attention be paid to the provision of technical support for the women as they utilize the full potential of the devices (Wyche and Olson 2018; Wyche 2017).

## Emerging African Women IT Developers

A growing trend in the women in ICT space is the emerging interest of young African women in software development, coding, and other IT-related ventures, not satisfied to be only end users or consumers of ICTs. In his write-up on "Five powerful African women in technology you probably never heard of," Ekwealor (2016) has noted that:

> African women on the continent are doing amazing things in the technology sector. Most of them are slowly leveling the gender playing field and shifting tech from the traditional all-male domain to an equal opportunity sector. We are not there yet, but the work of many African women in tech is showing through, from initiating efforts to teach young girls codes to building spectacular technology-based businesses among other exploits. These days, there are as many female techpreneurs, web developers, graphic artists and everything as there are men and it is a very welcome development. The scary thing about this very progressive development is that some of these African superwomen are not in the limelight. Most shy away from press coverage for reasons ranging from modesty to personal reasons. And sometimes, there is just not enough press coverage. (para 1–4)

So the young African women are coming up. Though not highly publicized as the author has noted, they are working in their small corners with some of them taking baby steps and others taking giant steps in the IT sector. The beautiful thing also is that the women are not working in isolation. They are forming networks, organizations, groups, and associations to support themselves. A few of such groups are discussed below.

The Developers in Vogue team is set up to create a community of African women who have the passion to use technology to bring revolution into Africa and beyond.

They brand themselves as "next generation of African women in technology." The group seeks to work together to create opportunities in the IT industry for African women. As a result, some of them have been employed by Microsoft, financial institutions, and telecommunication companies.

The Developers in Vogue team organizes several activities such as Data Science Meetups, Graduate Training Program, Student Internship Program, Campus Ambassadors, Festivals, Boot Camps, and Introduce a Girl to STEM. The Data Science Meetups is a community that provides resources and opportunities for people to build careers in data science. They hold quarterly meetings to discuss issues such as data storytelling, digital security, and python programming. The group also provides a workspace for data scientists to network. They recruit female service personnel to work as software developers in their partner companies in Ghana (Developers in Vogue 2019).

African Women in Technology (AWIT) was created to connect, educate, and empower women who are determined to advance their technology careers. The network is a product of IBOM LLC which has served small business owners for more than 7 years. IBOM LLC is committed to creating a conducive environment for women to grow and become leaders in the technology sector. AWIT is set up to provide opportunities for women to develop themselves and become leaders in the IT sector. The group educates the African community by hosting the African Women in Technology events that take place on the continent (AWIT n.d.).

Andela is an IT company that builds distributed engineering teams with Africa's most talented software developers (Andela 2019). The company seeks to create an enabling environment for Africans to learn, innovate, and access the right tools. The organization is committed to driving change for women in technology (Kinya 2017). Out of 600 developers, nearly 30% of them are women who are based in Lagos, Nairobi, and Kampala. The Chief Strategy Officer, Wambui Kinya, has over 18 years' experience in digital, mobile marketing and technology consult. They focus on attracting and retaining top female talent. Andela has conducted all-female recruitment cycles and classes in Lagos, Nigeria. The female software developers of Andela are taken through technical leadership training. The company has observed that the female trainees have equal or better client satisfaction in comparison with their male counterparts when they are placed in international companies. Developers from Andela have had placement with companies like Microsoft and IBM. The company has a vision to train 100,000 elite developers in the next 10 years (Veselinovic 2016).

To reenforce the discussion in this section of the chapter, it is necessary to discuss a few of the individual African women who are working in the IT industry. Marian Tesfamichael is a Ghanaian Canadian who has trained as a coder. Marian holds a bachelor's degree in computer science and mathematics and has completed her graduate studies in information systems and design at the University of Toronto where she is also a web developer and data manager. Another role model in the industry is Ethel Cofie, a Ghanaian lady, who studied computer science from 1995 to 2001. She founded Women in Tech Africa and invested in technology to promote diversity in the computer programming industry to attract females in Africa to the IT

industry (Sene 2018). Nnenna Nwakanma, a Nigerian woman, is the African coordinator for the World Wide Web Foundation, the co-founder of Free Software and Open Source Foundation for Africa, and an Internet advocate for Africa with an online presence in social media. She provides support for Alliance for Affordable Internet. Nnenna seeks to increase the presence of Africa on the web and ensure that the voices of Africans are heard online. Rebecca Enonchong is a Cameroonian who has founded AppsTech which provides enterprise application solutions in over 50 countries around the globe. She is the co-founder of I/O Spaces in Maryland in the United States. Rebecca chairs the ActivSpaces which is a technology hub in Cameroon. They provide space for co-working and an incubator as well. Rebecca mentors startups in the IT industry which are based in Africa. Irene Charnley is a South African woman who served as executive director of the MTN Group. In 2007, it is reported that Irene left the MTN Group with over $150 million in stock. Irene is the founder and chief executive officer of Smile Telecoms, a mobile broadband operator that has markets in Nigeria, Tanzania, Uganda, and Democratic Republic of Congo (Ekwealor 2016; Sherrie 2018). These are remarkable accomplishments from African women that we can build on for the next generation, to enhance the presence of African women in the technology space.

## Inhibiting Factors and Future Policy Directives

There is no doubt that technologies present a great potential for women in Africa to contribute to and benefit from development. It is worth discussing some of the inhibitions to African women's full utilization of technologies and then exploring ways by which the inhibiting factors could be addressed (Uduji and Okolo-Obasi 2018; Porter et al. 2018; Leslie Steeves and Kwami 2017; Correa 2014).

It has been argued that women, not only in Africa but across the globe, are naturally too disadvantaged to benefit from the digital revolution because they are less tech-savvy and more technophobic since the technology has not been built for their needs and intuition (Wyche and Olson 2018). For instance, South Africa which has a population of more than 51 million, of which women constitute 51.3%, is underrepresented in terms of women in IT education and careers. Continuing education is very essential in the technology industry. And since time is a critical resource for African women, especially those who are nurturing, it could be challenging for them to find time to invest in continuing professional studies to update their knowledge in the ever-changing technology industry if a conscious effort is not made. In an online survey that was conducted by Pretorius et al. (2015), 87% of the South African women respondents said they found the information technology (IT) industry challenging but not chaotic. For 97% of the respondents, the industry was demanding and required constant education and time to keep up to date. Respondents of the study noted that in the IT industry, no day was ever the same; as clients got more technical, IT professionals had to find ways to keep up with the latest trend in the industry.

Socioeconomic and political factors influence African women's engagement in the technology arena. Csikszentmihalyi et al. (2018) studied 116 individuals from 26 sub-Saharan African countries who were involved in technology development. The study revealed that factors such as political economy had a significant impact on technological possibilities. Monopolies, international power dynamics, race, and access to capital were found to provide or restrict access to technological possibilities. The authors concluded that much as there had been a dramatic spread of the Internet on the African continent, the pace of access for women and rural communities had not been that high. They had been at the bottom of the pyramid. Olatokun et al. (2017) also found that the extent to which women participated in public online and offline communicative platforms was determined by the level of formal education, income, and participation in public life and governance. The position, perception, and the level of the authority of the mother, wife, daughter, or sister in the home, compared with that of the father, husband, son, and brother, could affect the extent to which one might have access to communication networks and platforms at the family level. It was also found in the study that the high cost of bandwidth could limit women's access to content and platforms that require high bandwidth and useful video and audio applications. The authors raised questions such as the following: (1) To what extent do interfaces and various applications consider the uniqueness and virtues of women in terms of structure, content, and values? (2) How are women able to project their voice and express themselves online or offline? (3) To what extent do women who are found to be emotional feel secure and safe in the media? (4) In terms of space, are they comfortable, free, and confident in the cyber space? (Olatokun et al. 2017). All these are questions that need to be addressed to ensure that women in Africa make the most out of emerging technologies.

Cultural issues also influence African women's full utilization of technologies. In a study of 500 young rural women's participation in an e-wallet program and modern agricultural input in Nigeria, it was found that cultural and traditional contexts such as beliefs, norms, and practices that breed discrimination determine women's participation. Men's ownership of property gives them control over all household equipment including ICT devices in the home. In societies that are deep-seated in traditional practices, the extent to which a woman can utilize and consume electricity in the home could be controlled by the male household head. It was thus recommended that special efforts needed to be made to gain the participation of unmarried girls, young women, and nursing mothers due to cultural, domestic, and childcare responsibilities that might be inhibiting their access and utilization (Hilbert 2011).

In spite of the fact that there have been some suggestions that women are technophobic and that men are better users of digital tools, there also exist arguments that women in Africa embrace technologies with enthusiasm. Studies have shown that women who are generally categorized as not being technology-friendly are increasingly overcoming their phobia. This applies not only to African women who reside in relatively well-endowed areas but also to those in underserved areas. This is indeed a good starting point for undertaking gender-specific policy interventions that promote e-learning, e-government, e-medicine, e-commerce, and all other

applications among African women in both urban and rural communities (Kwapong 2005, 2007, 2008, 2009, 2010). In an empirical test of these assertions, using data sets from 12 Latin American and 13 African countries from as far back as 2005–2008, Hilbert (2011) concluded that women emerge as more active users of digital tools than men if the factors affecting their access and usage of ICT tools are checked. The author noted that such findings make the so-called gender digital divide insignificant. Thus, technology becomes a great resource for addressing the issues of income, poverty, employment, education, and health among women in Africa.

Female IT professionals in Africa are attracted to the industry due to the intellectual stimulation, good salaries, flexible work schedule, job security, and job satisfaction offered. Studies have shown that the women who survive in the industry are those who have a passion for technology and analytical capabilities but not those who perceive it as a job. As a result, no matter the situation, African women can overcome the challenges in the IT industry if they have the passion to contribute to the introduction of varied skill sets into the entire IT industry be they the development of new hardware or software design and deployment (Pretorius et al. 2015). Efobi et al. (2018) have concluded that as a policy implication, while governments need to formulate and implement policies that boost ICT penetration, policy priorities should focus on how to improve women's access to fixed wireless broadband communication for Internet access and the mobile phone wireless communication, especially for women on the continent of Africa.

Considering the general issues that affect women's full utilization of technologies on the African continent, it is necessary to review policy direction to help increase African women's access to the massive resources that technologies offer. Some policies on ICTs, for instance, have been found to be silent on the interests of women in Africa, probably due to lack of political will or mere ignorance. If gender analysis is not done, policies in new technologies could ignore the needs, requirements, and aspirations of women in Africa. In other words, if gender issues are not consciously and strategically factored into policies on all kinds of technologies, it is not likely that women in Africa will make the most of the opportunities that the technology revolution and the information age present (Olatokun et al. 2017). In view of the multiple roles that African women play, such as family-focused and community-oriented engagements, as well as their businesses, corporate responsibilities, and other careers that they build, the special needs of the women cannot in anyway be ignored in any policy on technologies. Even though the government sets the overall national ICT policy, there is some merit in allocating considerable authority to regional and local authorities in setting priorities and approaches to empower rural women through the use of ICT (Kwapong 2008). Policies have to be directed at supporting the women of Africa to enhance, ease, and fast-track their numerous day-to-day engagements with technologies in both their private and public spaces and also to intensify their efforts as producers of new technologies (Chib 2010). In all of these, factors such as time, convenience, speed, space, and income should not be overlooked in the process of making technology policies gender-friendly on the African continent.

## Conclusion

This chapter has looked at the state of African women in relation to the technological revolution and its potential for them. The discussion in this chapter has revealed that technologies have a lot to offer the women of Africa. African women have the capacity to contribute to the development and deployment of technologies in general and ICT tools and resources, for instance. The women of Africa stand to gain much from opportunities that the technological revolution presents but have been limited by cultural, economic, and political factors. Wyche and Olson (2018) have noted that the future looks promising. There are efforts to enhance the digital infrastructures and to connect those who are not connected in Africa with technologies such as Google's Project Loon, which uses high-altitude balloons to create wireless networks; the Connectivity Lab of Facebook, which uses drones to provide Internet access; and the BRCK, a Kenyan-designed modem intended for use in rural areas. All that is needed is to push for stronger awareness and policies on the potential of the technological revolution for African women in the education, health, economic, agricultural, industrial, and all other sectors of development so that no gender inequality is created to the disadvantage of women on the continent (Otte et al. 2018). The women of Africa have the capacity to make the most of the technological revolution in terms of knowledge and skills. They are as capable as their male counterparts to overcome the challenges that they face in the process of developing, deploying, and utilizing new technologies. There is no excuse whatsoever.

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