CAMBRIDGE
UNIVERSITY PRESS

RESEARCH ARTICLE

Deployment of digital technologies in African cities: emerging issues and policy recommendations for local governments

Leandry Jieutsa[1] 🄳 , Irina Gbaguidi[2], Wijdane Nadifi[3] and Shin Koseki[1]

[1]UNESCO Chair in Urban Landscape, Montreal University, Montreal, Canada
[2]École urbaine, Sciences Po, Paris, France
[3]DSA Architecture et risques majeurs, ENSA Paris-Belleville, Paris, France
Corresponding author: Leandry Jieutsa; Email: leandry.junior.jieutsa.nkuidje@umontreal.ca

Abstract

The deployment of digital technologies in African cities, beyond improving service delivery, raises issues of digital inclusion, digital rights, and increasing spatial and social inequalities. As part of the African Cities Lab Summit 2023, we conducted a workshop with 20 multidisciplinary participants to explore issues related to the deployment of digital technologies in African cities. This research is a policy paper that addresses these issues and provides policy recommendations for local governments. It emphasizes the importance of inclusive digital infrastructure, regulations safeguarding vulnerable sectors, and governance ensuring citizens' rights in the digital transformation. Focusing on transparency, equity, and collaboration with communities, local governments play a vital role in fostering inclusive digital transformation, essential for equitable and rights-centric smart cities in Africa.

Policy Significance Statement

In this paper, we delve into critical issues that transcend the mere enhancement of service delivery through digital technologies, encompassing broader concerns such as digital inclusion, digital rights, and the exacerbation of spatial and social inequalities. Our workshop addressed key aspects such as digital infrastructure, the digital divide affecting vulnerable populations, the disruptive nature of digital services, and the ethical implications of facial recognition technologies on human rights within African urban contexts. The societal implications of the digital transformation in African cities cannot be overstated, and this article not only highlights these challenges but also provides actionable recommendations for local governments to navigate and harness the opportunities presented by digitalization while safeguarding the rights and well-being of their citizens. The research findings and recommendations presented herein hold significant relevance for policymakers, urban planners, and scholars interested in the intersection of technology, society, and governance in the African context.

---

1. Introduction

An increasing number of revolutionary technologies have emerged and disrupted the urban dynamics in African cities. Indeed, the increasingly important deployment of digital technologies in rapidly growing African cities is bringing major changes to the urban fabric and the provision of urban services, while

Check for updates

reshaping interactions between the various urban players (Ciriminna et al., 2021). What is considered The Fourth Industrial Revolution is bringing about profound and rapid changes in urban systems and people (Hoosain et al., 2020). Recent advances in digital technologies from the Internet of things (IoT), artificial intelligence (AI) big data, and 5G are rapidly transforming city societies in Africa and advancing the capabilities of local governments to deliver services in the digital world (Kennedy et al., 2015).

Whether it is a sensor of various kinds, online delivery services, mobility services, facial recognition technologies (FRTs), and many others, all of which occupy an important place in African urban systems propelled by the IoT, improved connectivity, AI, and, above all, mobile banking. Indeed, the ever-increasing deployment of digital technologies in African cities is transforming spatial, social, and economic systems while at the same time reshaping urban governance systems (Odendaal, 2020).

However, the deployment of digital technologies in African cities raises major issues that need to be addressed, so that digital technology does not become a vector for increasing inequalities and excluding the most vulnerable. Indeed, the negative effects of digital technologies in cities are very little studied, especially with regard to inequalities and the new forms of exclusion and marginalization that they generate, and which need to be the subject of more research (Woods, 2020; Luusua et al., 2022).

The issues of digital divide, digital rights, inequality, and exclusion of the most vulnerable are becoming more acute in cities, with digital technology becoming increasingly present. The ever-increasing role of technology in cities generates new social issues that are difficult to understand (Calvo, 2020), deepens some of the existing inequalities, creates new ones, and benefits the most fortunate while punishing the poor (O'Neil, 2017; Courmont and Le Galès, 2019).

As cities are the support most of these trends, local governments play a central role in protecting residents' rights from potentially harmful practices that arise from business activities (United Nations, 2011). Indeed, the deployment of digital technologies in African cities poses the need to frame how they should be regulated and managed, the values and principles that should guide their use, and the role of local governments in ensuring that digital technologies are developed in an inclusive manner for the well-being of all.

This paper summarizes the discussions held by young researchers at the African Cities Lab Summit 2023 (ACL, 2023). As part of this summit, young researchers met for a workshop lasting for an hour and a half on the impact of digital technology deployment in African cities.

The aim was to analyze the impacts and societal challenges posed by the deployment of digital technologies in African cities in a local and global context, and then to formulate recommendations for local governments.

This paper captures the essence of the workshop's discussions. It is divided into three main sections. The first one presents the methodology. The second one presents the societal impacts of deploying digital technologies in African cities, from the perspective of digital infrastructure, digital inclusion of vulnerable groups, digital services in mobility, and FRTs. The third section provides recommendations to address the identified issues.

2. Methodology

This paper presents findings from a workshop titled "Deployment of Technologies in African Cities: Emerging Issues and Policy Recommendations for Local Governments," held during the African Cities Lab Summit 2023 on May 24, 2023, for a total duration of 90 min. Led by the author, the workshop audience comprised 20 participants of various profiles (researchers in technology and human sciences, students, engineers, urban planners, architects, etc.) from different universities, as listed in Table 1. The workshop stemmed from the call for communication within the summit framework. The workshop methodology consisted of three steps, as illustrated in Figure 1.

2.1. Step 1: literature review

The initial stage involved identifying pertinent topics by conducting a literature review that examined the impact of digital technologies on African urban regions.

Table 1. *List of participants in the workshop*

Participants	Profile	Institution	Country
1	Urban planner and PhD student	Montreal University	Canada
2	Researcher in Artificial Intelligence and cities	Center of Urban Systems	Morocco
3	Student in IT	Mohammed VI Polytechnic University (UM6P)	Morocco
4	Architect	Win Studio Archi, École Nationale Supérieure d'Architecture de Paris-Belleville	France
5	Urban planner	Infranum, Science-Po	Ivory-Coast
6	Assistant professor	Moulay Ismail Meknès University	Morocco
7	Student in urban planning	Institut National d'Aménagement et d'Urbanisme (INAU)	Morocco
8	Student in data science	Mohammed VI Polytechnic University (UM6P)	Morocco
9	Student in IT	Mohammed VI Polytechnic University (UM6P)	Morocco
10	PhD student in Machine Learning	Mohammed VI Polytechnic University (UM6P)	Morocco
11	Researcher in smart city	Mohammed VI Polytechnic University (UM6P)	Morocco
12	Architect	Freelance	Cameroon
13	Student in architecture	Mohammed VI Polytechnic University (UM6P)	Morocco
14	Engineer and CEO	ghm-labs	Morocco
15	Student in data science	Mohammed VI Polytechnic University (UM6P)	Morocco
16	Researcher in smart city	Hassan II University	Morocco
17	Researcher in urban systems	Mohammed VI Polytechnic University (UM6P)	Morocco
18	Urban planner	/	Morocco
19	Geographer and researcher in territorial management	Center of Urban Systems	Morocco
20	Researcher in data science	Hassan II University	Morocco

This literature review employed the Web of Science database because of its comprehensive and reputable collection of scholarly contributions. The search query involved combining key concepts: technology-related terms like "digital technology" and "smart technology," terms associated with African cities such as "African cities," and social impact-related terms like "social issues" and "social impacts."

The query structure employed the Boolean operator "AND" to interconnect the three core concepts and "OR" to encompass research articles. The actual query on Web of Science was as follows: TITLE-ABS-KEY (["Digital technology" OR "smart technology"] AND ["African cities"] AND ["social issues" OR "social impacts"]).

The search on the Web of Science database initially yielded 110 articles, of which 93 remained after excluding reviews, conference reviews, and letters. Additionally, gray literature, including press articles, books, reports, and working papers, was explored to ensure a comprehensive viewpoint, encompassing both French and English language resources.
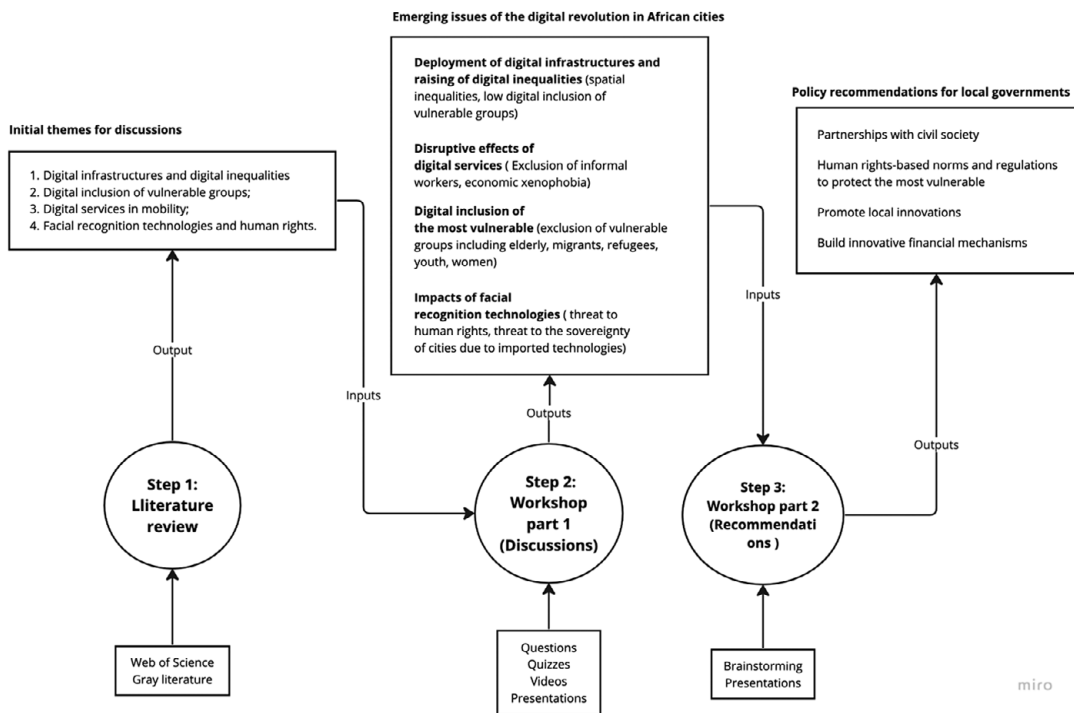
Figure 1. *Workshop structure and framework (Source: Author).*

From this exploratory process, 33 documents were selected for review, based on their direct relevance and articulation regarding the impact of digital technologies in African Cities. The analysis was conducted in April 2023. This rigorous review has identified four primary themes.

- Digital infrastructure and inequalities
- Digital inclusion of vulnerable groups;
- Digital services in mobility;
- FRTs and human rights.

2.2. Step 2: discussions

From the identified themes, the author has prepared an interactive presentation consisting of quizzes, videos, open questions, photos, and texts as listed in Tables 2 and 3. This part of the workshop lasted for 60 min. As the presentation progressed, the participants were encouraged to interact and contribute to the discussions via their smartphones through the ahaslide[1] platform. Figure 2 shows some of the answers that were collected through the platform during the workshop. This interaction allowed participants to contribute to the presentation prepared by the author through answers to quizzes, contributions on various themes, answers to open questions, and so forth. Participants could also react verbally by raising their hands to elaborate on a response given through the platform or share a thought. This interaction enriched the themes identified by the author, with ideas, experiences, perspectives, questions, and issues.

---

[1] https://ahaslides.com/.

Table 2. *List of questions and quizzes used for the first part of the workshop*

Number	Question	Type of question
Question 1	What is digital infrastructure for you?	Open-ended question
Question 2	A vulnerable group is? (Option1: Is more exposed to exclusion with the current digital revolution; Option 2: Is located in an area exposed to natural risks; Option 3: Has specific characteristics causing a higher risk of falling into poverty)	Quiz (pick answer)
Question 3	Can these groups be categorized as vulnerable? The elderly, Women, At-risk children and youth, Refugees, The mentally and physically disabled, Illiterate people and local language speakers.	Quiz (pick answer)
Question 4	What urban services in your city do you think could be affected by emerging technologies?	Open-ended question

Table 3. *List of videos used for the first part of the workshop*

Number	Title of the vidéo	Source
Video 1	L'enquête du 20H : tous reconnus en un clic !	https://www.facebook.com/infofrance2/videos/1389908305082602/
Video 2	Nanjira Sambuli: Governance, Technology, & Africa	https://www.youtube.com/watch?v=SxgrwTeOlnM
Video 3	South Africa Anti-Uber Protest: Metered taxi drivers accuse Uber drivers of 'killing business'	https://www.dailymotion.com/video/x6ga7ql
Video 4	Nnenna Nwakanma : Artificial Intelligence, Youth, and the Digital Divide in Africa	https://www.youtube.com/watch?v=Mpg79gNfRK0

Figure 2. Some of the responses to questions 2 and 4 collected during the workshop (Source: Authors).

2.3. Step 3: recommendations

The present section was allotted a duration of 30 min for the purpose of devising recommendations in response to the concerns brought up in the initial segment. Each participant was separately asked to pen their suggestions on post-it notes, in alignment with the predetermined themes, and subsequently present them to the remaining participants for further discussion. Table 4 provides the number of participants who

Table 4. *Repartition of participants' contributions according to each theme*

Themes	Number of participants who made recommendations
Digital infrastructures and digital inequalities	7
Digital inclusion of vulnerable groups	10
Digital services in mobility	4
Facial recognition technologies and human rights	8

a) First part of the workshop during the interactive presentation on digital infrastructure

b) Second part of the workshop during the brainstorming to formulate recommendations

c) Second part of the workshop, a participant is discussing a recommendation formulated

d) Family picture at the end of the workshop with the participants

Figure 3. *Pictures illustrating the progress of the different stages of the workshop (Source: Authors).*

made contributions based on each theme, with these recommendations specifically targeting local government bodies. Figure 3 depicts the various stages of the workshop through photographic representations. The images capture the different steps of the workshop in a visually compelling manner. The photographs are arranged in a sequential order, showcasing the progression of the workshop from start to finish. This visual representation makes it easier to understand the different stages of the workshop and grasp the overall process.

3. Societal impacts of the deployment of digital technologies in African cities

3.1. *Digital infrastructure and digital inequalities*

The deployment of digital technologies in cities relies strongly on digital infrastructure. Indeed, to connect devices and people across the African continent, it is necessary to deploy and secure, qualitative, and affordable digital infrastructure.

Digital infrastructure includes network infrastructure (backbone, wired infrastructure, datacenters, etc.), which allows objects and devices to be connected to each other. Their efficiency and speed enable the use of advanced technologies such as IoT and all connected devices (sensors) that report measurements, provide alerts, and allow remote actions to be taken.

Although the digital infrastructure in Africa is increasing rapidly, closing the digital gap with the rest of the world (Abdychev et al., 2020), with the fiber optic network growing from 278,056 km in 2009 to 1 million kilometer in June 2019 (Traoré et al., 2022), and the deployment of various types of sensors in African cities, a significant gap remains, with around 900 million people lacking access to the Internet (UN-Habitat, 2021). This leads to digital inequalities such as the digital divide, which goes beyond simple Internet access and use to encompass the outcomes linked to Internet use by different social groups in a given territory (Alzouma, 2005; Gilbert, 2010; Robinson et al., 2020b; Ferreira et al., 2021).

This digital divide represents a significant human and economic loss for cities and territories in Africa, and research has shown that the number of Internet users positively affects the inclusive growth of economies (Abdychev et al., 2020; Ndubuisi et al., 2021; Kouladoum, 2023), which can be characterized as both spatial and socioeconomic (Nijman and Wei, 2020). Indeed, the deployment of digital infrastructure reproduces spatial inequalities, thus enriching the multiscale spatial divide between cities and peripheries, metropolises and secondary cities, cities, and rural areas, as well as developed and less developed countries (Ramalingam, 2016; UNESCO, 2016; Otioma et al., 2019).

In the city and rural areas, the infrastructure gap accentuates the divisions between urban and rural areas due to low or non-existent digital infrastructure coverage (Sagna, 2006; UN-Habitat, 2021). In most African countries, the deployment of digital infrastructure is closely linked to the deployment of basic infrastructure, such as water and electricity distribution networks. As a result, hard-to-reach or sparsely populated rural areas are poorly served by these infrastructures, and populations are unable to access digital services. This is also explained by the low profitability of infrastructure deployment in these areas for telecommunications companies deploying infrastructure. The socioeconomic profile of these populations (lower class) explains this observation, as they are unable to afford such Internet services, which are still too expensive for the poorest sections of the population (Vodoz, 2010).

Consequently, migration from rural to urban areas is increasing. Another consequence is the loss of economic opportunities for rural dwellers, and the difficulty of access to quality education or any digital-related services enjoyed by urban dwellers (Aruleba and Jere, 2022).

At the city level, the spatial divide is widened by the deployment of digital infrastructure, with weak or absent connectivity in certain outlying districts and informal settlements (Otioma et al., 2019; UN-Habitat, 2021). Governance of digital infrastructure projects may be one of the reasons for this disparity. Indeed, in most African countries, telecommunications companies that belong to the private sector deploy digital infrastructures (de Feydeau et al., 2022).

These private companies are guided primarily by the quest for profitability, and will primarily deploy their services in areas where populations are in a position to access them financially. Service providers tend to focus on those who can afford to pay for their services, accentuating disparities between areas and neighborhoods.

This spatial divide has a strong impact on the digital inclusion of vulnerable groups, who find it harder to access digital services and related economic opportunities in urban areas. The digital divide to which population groups are concentrated in precarious neighborhoods is subject to a feedback loop effect, where the infrastructure deficit condemns them to live in these affordable spaces but limits the economic opportunities offered by digital infrastructures (Ramalingam, 2016). In reference to the Matthew effect, vulnerable groups in neighborhoods with poor digital infrastructure are increasingly excluded from advantaged classes, widening the gap between the rich and poor (Tewathia et al., 2020).

This brings us to another aspect of the spatial divide linked to digital infrastructure: gentrification. Digital technology is increasingly being linked to gentrification (Hovik et al., 2022). By concentrating mainly on city centers, the risk for African cities is that the deployment of digital infrastructure will lead to gentrification, making city centers less accessible to the lower classes, who will retreat to the less served but more affordable outskirts (Tveten, 2018).

Another element arising from a lack of digital infrastructure is the accentuation of social inequalities and social exclusion. The Covid-19 pandemic has demonstrated the damaging consequences of poor quality or non-existent internet, particularly in the education sector, causing many children to be excluded from school (Radoine et al., 2022). For example, school closures in Kenya have affected 18 million children (Radoine et al., 2022). The lack of infrastructure also affects the distribution of essential urban services. New technologies are a great way to innovate the distribution of essential urban services in Africa, but the majority of innovative digital solutions require a quality infrastructure network. Poorly served areas, although the most concerning by these solutions, are unfortunately the most excluded because they are poorly served.

3.2. *Digital inclusion of vulnerable groups*

The digital revolution like several other revolutions before it has created winners and losers (Ramalingam, 2016). Although the rapid deployment of technologies has created opportunities for many vulnerable groups, this digital revolution has also brought about unequal access to technologies (Ndoya and Asongu, 2022). The increasing deployment of digital technologies in cities places additional pressure on vulnerable groups that are most exposed to the negative impacts of the digital transformation of cities (UN-Habitat, 2021). These groups include the elderly, women, at-risk children and youth, refugees, mentally and physically disabled, illiterate people, and local language speakers.

Therefore, in increasingly connected and digital cities, the issue of digital inclusion is emerging as essential (Livingstone and Helsper, 2007; Robinson et al., 2020a; Mubarak and Suomi, 2022; Radoine et al., 2022). Digital inclusion is a term that goes beyond mere provision of digital technology. This emphasizes the importance of providing technologies with the aim of benefiting the targeted population by meeting their requirements and needs. Digital inclusion reinforces the relevance, affordability, and sustainability of digital technologies, leading users to expand their skills and knowledge, and therefore empowering them within the Information Society (IS) (Pitula and Radhakrishnan, 2007; UN-Habitat, 2021; Kanobe et al., 2022).

Another phenomenon occurring simultaneously with the digital revolution is the aging of the population. Older people are particularly anxious about digital technologies and find it difficult to integrate them fully into the booming digital ecosystem (Kanobe et al., 2022; Mubarak and Suomi, 2022). For instance, studies have shown that up to 27% of the older urban population lacks Internet connectivity (UN-Habitat, 2021). In addition, the significant digital divide and, more spherically, the lack of digital skills and literacy among the elderly contributes to the digital exclusion of this population group (Bothma et al., 2022; Mubarak and Suomi, 2022). Consequently, they are excluded from basic services and social connections (Kanobe et al., 2022). Indeed, in cities undergoing digital transformation, the elderly struggle to independently access several urban services. This includes healthcare, administrative services, mobility services, and so on. Already very vulnerable by their state of health and low economic status, the digital transformation of cities further exacerbates the vulnerability of the elderly.

Another vulnerable group worth mentioning is women, as they are at a disadvantage when it comes to using digital technologies: there were 250 million fewer women online than men worldwide. In Africa, the exclusion of women is more prevalent, as only 27% of women use the internet, while 38% of men use it (Kanobe et al., 2022). This implies a lack of exposure to opportunities online for women, not only because of the lack of access to the Internet, but also because of the limited knowledge they have to navigate the digital world; an increasing number of jobs require a certain level of knowledge of technologies, which can lead to women (with a lack of digital literacy) having less choice when it comes to choosing their career path.

The digital gap can also be explicitly perceived within the youth; 70% of African youth do not have access to digital technologies (Livingstone and Helsper, 2007). Their exposure to digital technologies is strictly related to whether their schools, communities they live in, and/or families can afford to provide said technologies (Kanobe et al., 2022). The COVID-19 crisis, for example, has shown the important role of digital technologies in young people's access to education and the job market (Radoine et al., 2022). Digital exclusion is further reinforced by the difficulty for this group to access information, learn new skill sets, and benefit from recreation and social networking, raising the question of inadequate infrastructure and the affordability of these digital technologies.

People with special needs also suffer from digital exclusion, and according to the World Health Organization, only 5–15% of this group has basic access to assistive technologies, which concerns people with special needs from the Global South. Unfortunately, the lack of access to technology increases the social isolation and marginalization of this group, leading them to miss opportunities to participate in various digital activities in society. Recent technology is progressively becoming integral to modern life for improved quality of life. Therefore, it is imperative that people with special needs learn how to adopt computer technologies to be part of the IS.

Digital exclusion also affects urban refugees; refugees are forced to migrate to foreign countries in which they may not get equal rights, priority, and attention as compared to national citizens. It is obvious that refugees equally require access to and use of the Internet and technology for navigation and communication among themselves and with their relatives and friends. Mobile technology plays a crucial role in saving refugees' lives during their travel to countries to settle as well as in their integration thereafter (Abujarour, 2018). It plays a key role in promoting social inclusion, because it allows refugees to participate in society and regain control over their lives. Technological tools can be of great use for communicating with refugees to minimize language barriers during settlement.

In general, Internet and digital technologies play a significant role in reaching equity, innovation, and economic development. It is crucial to allow wider access to these technologies by closing the digital gap for vulnerable groups in order to ensure a better quality of life.

3.3. The disruptive effect of digital services: the e-hailing services

The advent of digital service platforms for housing or mobility, such as Airbnb and Uber, has provided a new shape to service provision in many African cities but has also highlighted the exclusionary power that new digital technologies can have on the most vulnerable.

For example, e-hailing services are booming in several African cities. It is about sourcing for a taxi or other forms of urban mobility using a computer or mobile device (Bah, 2016; Contreras and Paz, 2018; Weru and Mugo, 2020). Uber was the first digital taxi app to be launched in many African cities (South Africa in 2013, Nigeria in 2014, Ghana in 2016, etc.), and due to its disruptive effect (Elbanna, 2017), many other applications followed, and ride-hailing apps have even expanded to motorbikes and buses, such as Kenya, and transformed the way people commute in cities (Weru and Mugo, 2020).

These services have facilitated mobility in cities and created jobs for many people (Henama and Sifolo, 2017). However, despite this positive aspect, the advent of e-hailing service platforms like Uber has brought about negative consequences such as unfair competition and threatened the livelihoods of traditional taxis, especially in the context of legal vacuum, to regulate the practice (Contreras and Paz, 2018; Agyemang, 2020; Odendaal, 2020; Ojekere, 2022).

Indeed, these services have faced strong tensions, anger, resistance, violence, and contestations through existing conventional taxis in several African cities (Mwaura, 2016). For instance, Uber drivers have faced different forms of violence. In Casablanca, Morocco, the Uber service withdrew in 2017 in the face of strong protests from taxi drivers, who saw themselves losing their livelihood to this giant. Similar protests have also been observed in South Africa, Ghana, and Kenya, with the corollary being the fear of conventional taxis that their activities would disappear following increasingly significant declines in revenue (Henama and Sifolo, 2017). This is also the case in Cameroon with the platform Yango, which was suspended in February 2023, following the grumbling of taxi drivers (Edjo, 2023).

By democratizing taxi services, these e-hailing service platforms threaten the income of conventional taxis whose drivers come from vulnerable social groups (low levels of education and income); hence, this economic xenophobia (Henama and Sifolo, 2017). Despite the positive boost to the efficiency of urban services, this technology, like many others, removes the right to the city (Lefebvre, 1968) from its vulnerable workforce by empowering and privatizing urban services that are part of an economic and social value chain on which this segment of the population strongly depends (Willis, 2019). For Courmont and Le Galès (2019), many of the questions raised by the new mobility services platforms stem from the indifference of computer codes to the norms laid down by the institutions that govern these spaces (Courmont and Le Galès, 2019).

Therefore, the digital transformation of urban services raises issues of exclusion of vulnerable groups such as taxi drivers, street vendors, or street workers, who have very few options for professional retraining in the event of the loss of their activities. Another issue is the sovereignty of cities and territories over the transformation of urban services, particularly when it poses complex social issues that a purely technological approach cannot respond to (Alzouma, 2005; Odendaal, 2020; Woods, 2020; Boateng et al., 2022).

3.4. FRTs and human rights

Data governance is a major issue in the deployment of digital technology in cities. This raises ethical, security, and privacy issues to which citizens are sensitive. Indeed, according to a study conducted by Ipsos in (2019), two out of three citizens worldwide are distrustful of the use of their personal data.

Personal data refer to information relating to a natural person in terms of identity, health data, places frequented, or any other form of information that enables that person to be identified (Li and Saxunová, 2020). These data can be collected at any time using technologies such as IoT, and then quickly processed in large amounts using AI. Although it can be used to optimize urban service provision, the use of this data nonetheless raises important societal issues (Tshiani and Tanner, 2021).

In African cities, one technology in particular is increasingly present in public spaces and is fed by personal data: FRT. This is a digital surveillance technology that matches a photograph of a person's face to a database containing the person's image, name, and other records already in the database. This technology uses biometric data along with other available information to provide precise and accurate information about a person and his/her behavior (Sarabdeen, 2022).

FRTs are used in African cities for law enforcement, to improve urban security, and to reduce crime. Several African governments have implemented these technologies in their respective cities. The city of Nairobi, for example, has installed around 1,800 high-definition cameras in the city since 2014 (Jili, 2022), and Kampala Police invested $126 million in 2019 in closed-circuit televisions in the Ugandan capital (Biryabarema, 2019).

Privacy is a fundamental right that includes data privacy (Sarabdeen, 2022). By collecting and using personal information, FRTs violate citizens' privacy and personal data (Loideain, 2017; Naranjo, 2020). This technology also lacks transparency in its use, as the data of individuals are taken randomly in public spaces and without concern. Furthermore, the algorithms used to analyze and process the photos and information collected were opaque.

Beyond privacy, the use of these technologies also threatens human rights, reducing individual freedoms and leading to discrimination (Naranjo, 2020; Dauvergne, 2022; Laganà, 2022). In oppressive political regimes, FRTs are used to track activists, protestors, and politicians as in Uganda (Kafeero, 2020), one of the worst countries in the world for excessive and invasive use of FRTs (Bischoff, 2021). This practice violates human rights and threatens democratic freedoms (Naranjo, 2020). This raises the need for a framework or even prohibition of this practice, as mentioned by the UN Special Rapporteur on Freedom of Association and Assembly in his 2019 report presented to the UN General Assembly (Human Rights Council, 2019).

The sovereignty of the cities and territories that deploy this technology is also called into question, because the FRTs used in African cities are imported, mainly from China (Jili, 2023). The adoption of this

technology in Africa is closely linked to Huawei's Safe Cities Project (Dauvergne, 2022; Jili, 2022), which consists of IP-based cameras with Wi-Fi backhaul installed across major grids of the city and connected to a command center, complete with video analytics (Huawei, 2019). In the absence of local technical capacity and technology, African cities do not have control over these technologies or the ability to perform maintenance or absolute control over the data.

The human rights violations posed by these technologies raise the issue of the right to the city (Lefebvre, 1968). Indeed, these disruptive technologies restrict freedom and raise the issue of the right smart city in increasingly digital cities (Willis, 2019). This highlights the issue of digital rights, which are interpreted as existing human rights that need to be protected in the context of digital technologies (UN-Habitat, 2022). In view of the discriminatory, intrusive and oppressive character, and so forth that these technologies can have on citizens while threatening universal fundamental rights, the right to have digital rights in cities emerges (Calzada, 2021).

With the ever-increasing deployment of technologies in African cities, including FRTs, the question of privacy protection has increased (Makulilo, 2016). Privacy is recognized as a constitutional right in many African countries and 36 states on the continent have data protection laws, 16 of which have ratified the African Union Convention on Cyber Security and Personal Data Protection, known as the Malabo Convention (Lovells, 2023). Countries such as Ghana, with its Data Protection Act (Act 843); South Africa, with its Protection of Personal Information Act; and many others, protect the privacy of their citizens (Bryant, 2021). However, the rapid development of technologies in cities requires rapid adaptation of regulatory tools and governance mechanisms.

4. Policy recommendations for local governments

The deployment of digital technologies in African cities raises many societal issues, and it is important to consider people centered on smart cities. The digital transformation of African cities must not increase disparities or create new inequalities, from the establishment of digital infrastructure to the inclusion of vulnerable groups. Local governments are at the heart of the inclusive territorial transformation process in Africa. As part of the workshop "Deployment of technologies in African cities: emerging issues and policy recommendations for local governments" organized as part of the African Cities Lab Summit 2023, the participants and the author made the following recommendations for local governments.

4.1. Prioritize inclusive digital infrastructure for equitable citywide access and local innovation

As digital infrastructures are at the heart of the digital transformation of African cities, local governments must ensure that they are put in place in such a way as to guarantee inclusive access to digital services for all citizens. This is through innovative financing mechanisms that ensure the universal coverage of territories, particularly in peripheral areas and informal settlements. Local governments must, therefore, establish public–private partnerships and social contracts with the private sector and social actors that guarantee an inclusive deployment of digital technologies while guaranteeing economic profitability and social well-being. To guarantee the technological sovereignty of African cities, local governments must implement policies and strategies to allow the accessibility and adaptability of digital infrastructures and technologies by focusing on local innovation. The aim is to promote local innovation ecosystems to boost the production of low-cost technologies adapted to the local context in terms of use and language. By creating digital innovation ecosystems at the local level, local governments can ensure affordable, context-specific digital transformation that meets the needs of citizens while ensuring economic and social development.

4.2. Ensure digital transformation that protects vulnerable urban sectors via inclusive regulations and citizen-centered governance

With regard to technologies that impact access to services such as mobility, housing, social services, and other urban services involving sensitive socioeconomic strata, local governments must be proactive in putting in place policies and regulations that guarantee that the digital transformation of urban services by

private actors protects actors in the sector rather than threatening or even eliminating their sources of income. By partnering with trade unions, associations, and other civil society organizations, African city governments must implement norms and regulations based on the social context to protect vulnerable sectors. It is a question of setting up a new social contract that defines inclusive conditions and frameworks for the deployment of technologies that affect sensitive social strata in urban areas. Therefore, these disruptive technologies must be implemented through inclusive governance approaches that give more weight to citizens by putting them at the center of the process. By relying on civil society, local governments must be at the forefront of the deployment of all urban technologies to limit their negative externalities and ensure that they protect the most vulnerable. They must also build capacity and set up monitoring offices with civil society to assess technologies developed by the private sector before their deployment in the urban landscape to limit their negative impacts.

4.3. Protect citizen rights in cities' digital transformation through inclusive governance and transparent regulations

Technologies deployed in urban areas must preserve citizens' human rights. FRTs, for example, pose serious challenges to individual freedom. The protection of personal data and the privacy of citizens must be at the heart of the digital transformation of territories in Africa, and local governments must ensure that digital technologies do not infringe upon human rights. Inspired by the cities' coalition for the digital rights model (UN-Habitat, 2022), local governments must put in place standards and regulations to oversee the deployment of emerging technologies from a people-centered smart cities perspective. The governance of these technologies in urban areas must be done in an inclusive manner by ensuring transparency in the development and use of technologies and the participation and engagement of communities to ensure that technologies serve their needs by integrating issues of equity, diversity, and inclusion. Local governments must also collaborate with civil society actors to assess, monitor, and monitor the evolution of urban technologies to avoid undermining individual freedoms, privacy, and other fundamental human rights. They must also acquire the necessary capacities and put digital public goods and infrastructure in place to ensure that the transformation of territories takes place in an inclusive manner.

5. Conclusion

This paper demonstrates how the deployment of digital technologies in African cities generates societal issues that local governments must address. Indeed, the deployment of digital technologies in African cities threatens individual freedom and human rights, strengthens disparities, and excludes vulnerable groups, as well as social and spatial inequalities. Local governments play an important role in inclusive digital transformation of territories to ensure that no space is left behind. Transparency, equity, inclusion, collaboration, and commitment of local communities must be at the center of all approaches to the deployment of technologies in African cities.

It is therefore necessary to examine what are the rationalities and stakeholders of the future "smart city" for better inclusion (Luque-Ayala and Marvin, 2015). In this sense, multi-actor and multi-scale governance is an essential first step to ensuring that the deployment of digital technologies in cities guarantees digital inclusion by limiting the digital divide while preserving digital rights (UN-Habitat, 2022). In addition, the governance of African cities in the digital age must consider the social elements of the digital transformation of territories, namely, the impact on the quality of life, work, and interactions of citizens. AI, IoT, Big Data, 5G, and so forth. Essential points must be considered from the beginning, namely the consequences of the technologies used in society and the institutional mechanisms to be put in place to limit them as much as possible.

The recommendations in this study are formulated in the context of a workshop with random participants, which limits its scope and extent. In particular, the workshop had duration constraints. To extend the scope of the results of this study, future research should map the practices of African cities in response to the issues identified in this study and discuss the measures put in place to address these issues.

References

Abdychev A, **Cangul M**, **Diouf MA**, **Esham N**, **Gupta PK**, **Li Y**, **Mitra P**, **Miyajima K**, **Ongley K**, **Ouattara F**, **Ouedraogo R**, **Sharma P**, **Fernando SF**, **Tapsoba SJ and Woldemichael MT** (2020) Digitalization in Sub-Saharan Africa. In *Sub-Saharan Africa Regional Economic Outlook*. Washington: International Monetary Fund. African Dept. Available at https://www.elibrary.imf.org/display/book/9781513536835/ch03.xml.

Abujarour S'A (2018) Digital Integration: The Role of ICT in Social Inclusion of Refugees in Germany. Available at https://www.researchgate.net/publication/329423548.

Agyemang E (2020) Uber is here to stay": Exploring the policy implications of the Uber-local taxis turf war in Accra, Ghana. *Case Studies on Transport Policy 8*(1), 59–66. https://doi.org/10.1016/j.cstp.2019.12.005.

Alzouma G (2005) Myths of digital technology in Africa: Leapfrogging development? *Global Media and Communication 1*(3), 339–356. https://doi.org/10.1177/1742766505058128.

Aruleba K and Jere N (2022) Exploring digital transforming challenges in rural areas of South Africa through a systematic review of empirical studies. *Scientific African 16*, 1–13. https://doi.org/10.1016/j.sciaf.2022.e01190.

Bah YM (2016) Teenage Pregnancy: Teenage Mothers' Experiences and Perspectives: A Qualitative study. *Journal of Health, Medicine and Nursing 29*, 118–136. https://iiste.org/Journals/index.php/JHMN/article/download/32668/33559.

Biryabarema E (2019) Uganda's Cash-Strapped Cops Spend $126 Million on CCTV from Huawei. Reuters. Available at https://www.reuters.com/article/us-uganda-crime-idUSKCN1V50RF.

Bischoff P (2021) Facial Recognition Technology (FRT): 100 Countries Analyzed. Comparitech.

Boateng FG, **Appau S and Baako KT** (2022) The rise of 'smart' solutions in Africa: A review of the socio-environmental cost of the transportation and employment benefits of ride-hailing technology in Ghana. *Humanities and Social Sciences Communications 9*(1), 1–11. https://doi.org/10.1057/s41599-022-01258-6.

Bothma E, **du Plessis A**, **Erasmus M**, **Hoffman J**, **van Rensburg JTJ**, **Ntombela N**, **Oduaran C**, **Roos V**, **Segalo P**, **van der Vaart L and van Greunen D** (2022) Age-inclusive ICT innovation for service delivery in South Africa. In RoosV and Hoffman J (eds.), *Age-Inclusive ICT Innovation for Service Delivery in South Africa*. Vanderbijlpark: Springer International Publishing. https://doi.org/10.1007/978-3-030-94606-7.

Bryant J (2021) Africa in the information age: Challenges, opportunities, and strategies for data protection and digital rights. *Stanford Law Review 389*(2), 24.

Calvo P (2020) The ethics of Smart City (EoSC): Moral implications of hyperconnectivity, algorithmization and the datafication of urban digital society. *Ethics and Information Technology 22*(2), 141–149. https://doi.org/10.1007/s10676-019-09523-0.

Calzada I (2021) The right to have digital rights in smart cities. *Sustainability (Switzerland) 13*(20), 1–28. https://doi.org/10.3390/su132011438.

Ciriminna C, **Jaligot R**, **Ginisty K and Rudaz F** (2021) *The Use of Digital Technology in the Context of West African Cities.*

Contreras SD and Paz A (2018) The effects of ride-hailing companies on the taxicab industry in Las Vegas, Nevada. *Transportation Research Part A: Policy and Practice 115*, 63–70. https://doi.org/10.1016/j.tra.2017.11.008.

Courmont A and Le Galès P (2019) *Gouverner la Ville numérique. La Vie des idées*. Paris: Presses Universitaires de France.

Dauvergne P (2022) Facial recognition technology for policing and surveillance in the global south: A call for bans. *Third World Quarterly 43*(9), 2325–2335. https://doi.org/10.1080/01436597.2022.2080654.

de Feydeau A, **Menski M and Perry S** (2022) *Africa's Digital Infrastructure Transformation.* Available at https://www.whitecase.com/insight-our-thinking/africas-digital-infrastructure-transformation.

Edjo M (2023) VTC: Booming Services Despite an Unprepared AFRICAN market. Available at https://www.agenceecofin.com/entreprendre/0205-107913-vtc-des-services-en-plein-essor-malgre-un-marche-africain-peu-prepare.

Elbanna A (2017) Re-Imagining the Disruptive Innovation Theory in the Digital Platforms Era Position Paper.

Ferreira D, **Vale M**, **Miguel Carmo R**, **Encalada-Abarca L and Marcolin C** (2021) The three levels of the urban digital divide: Bridging issues of coverage, usage and its outcomes in VGI platforms. *Geoforum 124*, 195–206. https://doi.org/10.1016/j.geoforum.2021.05.002.

Gilbert M (2010) Theorizing digital and URBAN inequalities. *Information, Communication & Society 13*(7), 1000–1018. https://doi.org/10.1080/1369118X.2010.499954.

Henama US and Sifolo PPS (2017) Uber: The South Africa experience. *DOAJ: Directory of Open Access Journals*, 1–10. https://doaj.org/article/dfb4f32333d6410fb0323bcc0962b017.

Hoosain MS, **Paul BS and Ramakrishna S** (2020) The impact of 4ir digital technologies and circular thinking on the united nations sustainable development goals. *Sustainability (Switzerland) 12*(23), 1–16. https://doi.org/10.3390/su122310143.

Hovik S, **Giannoumis GA**, **Reichborn-Kjennerud K**, **Ruano JM**, **Mcshane I and Legard S** (2022) Comparing Participatory Channels in Urban Development.

Huawei (2019) Transforming Bonifacio Global City into a Safe City with Huawei. Available at https://e.huawei.com/topic/leading-new-ict-ua/safe-city-case.html.

Human Rights Council (2019) Rights to freedom of peaceful assembly and of association, report of the special rapporteur on the rights to freedom of peaceful assembly and of association. In *A Concise Encyclopedia of the United Nations*, In https://digitallibrary.un.org/record/1298881?ln=en, Vol. *08114*, pp. 189–197. https://doi.org/10.1163/ej.9789004180048.i-962.150.

Jili B (2022) Africa: Regulate surveillance technologies and personal data. *Nature 607*(7919), 445–448. https://doi.org/10.1038/d41586-022-01949-9.

Jili B (2023) Surveillance tech in Africa stirs security concerns – Africa Center. Africa Center for Strategic Studies. https://africacenter.org/spotlight/surveillance-technology-in-africa-security-concerns/.

Kafeero S (2020) *Uganda Is Using Huawei's Facial Recognition Tech to Crack Down on Dissent after Anti-Government Protests.* Quartz. https://qz.com/africa/1938976/uganda-uses-chinas-huawei-facial-recognition-to-snare-protesters.

Kanobe F, **Ademolu Ajigini O**, **Ssebuggwawo D**, **Alexandra Nantogo B**, **Mukosi E and Moyane L** (2022) An Assessment of Digital Inclusion among Vulnerable Persons in Developing Economies.

Kennedy D, **Sing N**, **Gross P and Essop N** (2015) Africa is Ready to Leapfrog the Competition through Smart Cities Technology.

Kouladoum JC (2023) Digital infrastructural development and inclusive growth in sub-Saharan Africa. *Journal of Social and Economic Development* 1–25. https://doi.org/10.1007/s40847-023-00240-5.

Laganà M (2022) Facial Recognition and Human Rights in Europe. Human Rights Pulse. Available at https://www.humanrightspulse.com/mastercontentblog/facial-recognition-and-human-rights-in-europe.

Lefebvre H (1968) *The Right to the City.* Available at https://theanarchistlibrary.org/library/henri-lefebvre-right-to-the-city.lt.pdf.

Li Y and Saxunová D (2020) A perspective on categorizing personal and sensitive data and the analysis of practical protection regulations. *Procedia Computer Science 170*, 1110–1115. https://doi.org/10.1016/j.procs.2020.03.060.

Livingstone S and Helsper E (2007) Gradations in digital inclusion: Children, young people and the digital divide. *New Media and Society 9*(4), 671–696. https://doi.org/10.1177/1461444807080335.

Loideain NN (2017) Cape Town as a smart and safe city: Implications for governance and data privacy. *International Data Privacy Law 7*(4), 314–334. https://doi.org/10.1093/idpl/ipx018.

Lovells H (2023) Recent Developments in African Data Protection Laws Outlook for 2023. Available at https://www.engage.hoganlovells.com/knowledgeservices/news/recent-developments-in-african-data-protection-laws-outlook-for-2023.

Luque-Ayala A and Marvin S (2015) Developing a critical understanding of smart urbanism? *Urban Studies 52*(12), 2105–2116. https://doi.org/10.1177/0042098015577319.

Luusua A, **Ylipulli J**, **Foth M and Aurigi A** (2022) Urban AI: Understanding the emerging role of artificial intelligence in smart cities. *AI and Society 38*(3), 1039–1044. https://doi.org/10.1007/s00146-022-01537-5.

Makulilo A (2016) "A Person Is a Person through Other Persons"—A Critical Analysis of Privacy and Culture in Africa. *Beijing Law Review 07*. 192–204. https://doi.org/10.4236/blr.2016.73020.

Mubarak F and Suomi R (2022) Elderly forgotten? Digital exclusion in the information age and the rising Grey digital divide. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing 59*, 1–7. https://doi.org/10.1177/00469580221096272.

Mwaura G (2016) Uber: The Beauty and Wrath of Disruptive Technologies in Africa. The New Times. Available at https://www.newtimes.co.rw/article/128159/Opinions/uber-the-beauty-and-wrath-of-disruptive-technologies-in-africa.

Naranjo D (2020) Your Face Rings a Bell: How Facial Recognition Poses a Threat for Human Rights. Available at https://repository.gchumanrights.org/bitstream/handle/20.500.11825/1621/5.GlobalCampus2020_Europe.pdf?sequence=4&isAllowed=y.

Ndoya H and Asongu SA (2022) Digital divide, globalization and income inequality in sub-Saharan African countries: Analysing cross-country heterogeneity. *Social Responsibility Journal 20*(1), 1–19. https://ssrn.com/abstract=4233249. https://doi.org/10.1108/SRJ-07-2022-0277.

Ndubuisi G, **Otioma C and Tetteh GK** (2021) Digital infrastructure and employment in services: Evidence from sub-Saharan African countries. *Telecommunications Policy 45*(8), 1–9. https://doi.org/10.1016/j.telpol.2021.102153.

Nijman J and Wei YD (2020) Urban inequalities in the 21st century economy. *Applied Geography 117*, 1–8. https://doi.org/10.1016/j.apgeog.2020.102188.

O'Neil C (2017) *Weapons of Math Destruction*. Harlow, England: Penguin Books.

Odendaal N (2020) Platform urbanism and hybrid places in African cities. In *Shaping Smart for Better Cities: Rethinking and Shaping Relationships between Urban Space and Digital Technologies*. Elsevier, pp. 203–219. https://doi.org/10.1016/B978-0-12-818636-7.00018-4

Ojekere S, Ojo O, and Mkpandiok D (2022) Sustainable e-hailing mobility services in Nigerian cities: Issues and policy direction. *Research Square (Research Square)*, 1–10.

Otioma C, **Madureira AM and Martinez J** (2019) Spatial analysis of urban digital divide in Kigali, Rwanda. *GeoJournal 84*(3), 719–741. https://doi.org/10.1007/s10708-018-9882-3.

Pitula K and Radhakrishnan T (2007) LNCS 4554 - A conceptual model of inclusive technology for information access by the rural sector - Bibleaves. In *LNCS*, Vol. *4554*. https://bibleaves-stage.library.illinois.edu/catalog/ACDC_C27417.

Radoine H, **Sietchiping R**, **Yakubu H**, **Jieutsa L**, **Karani S**, **Owuor S and Benaomar K** (2022) Promoting Digital Inclusion in African Cities and Regions: Policy Frameworks for Digital Resiliency in Education for a Better COVID-19 Recovery. Available at https://www.itu.int/itu-d/sites/connect2recover/wp-content/uploads/sites/31/2022/11/C2R_RC_6_Promoting-digital-inclusion-in-African-cities-and-regions-221122-1.pdf.

Ramalingam Ben, Hernandez, & Kevin. (2016). The multiple forms of digital inequality. In *World Social Science Report, 2016: Challenging Inequalities; Pathways to a Just World*. Available at www.worldbank.org/en/publication/wdr2016 (accessed April 2023).

Robinson L, **Ragnedda M and Schulz J** (2020a) Digital inequalities: Contextualizing problems and solutions. *Journal of Information, Communication and Ethics in Society 18*(3), 323–327. https://doi.org/10.1108/JICES-05-2020-0064.

Robinson L, **Schulz J**, **Dunn HS**, **Casilli AA**, **Tubaro P**, **Carvath R**, **Chen W**, **Wiest JB**, **Dodel M**, **Stern MJ**, **Ball C**, **Huang K-T**, **Blank G**, **Ragnedda M**, **Ono H**, **Hogan B**, **Mesch GS**, **Cotten SR**, **Kretchmer SB**, **Hale TM**, **Drabowicz T**, **Yan P**, **Wellman B**, **Harper M-G**, **Quan-Haase A, and Khilnani A** (2020b) Digital inequalities 3.0: Emergent inequalities in the information age. *First Monday 2020*, *25*(7). https://doi.org/10.5210/fm.v25i7.10844.

Sagna O (2006) La lutte contre la fracture numérique en Afrique : Aller au-delà de l'accès aux infrastructures. *Hermes 45*(2), 15. https://doi.org/10.4267/2042/24030.

Sarabdeen J (2022) Protection of the rights of the individual when using facial recognition technology. *Heliyon 8*(3), e09086. https://doi.org/10.1016/j.heliyon.2022.e09086.

Tewathia N, **Kamath A and Ilavarasan PV** (2020) Social inequalities, fundamental inequities, and recurring of the digital divide: Insights from India. *Technology in Society 61*, 1–11. ISSN 0160-791X. https://doi.org/10.1016/j.techsoc.2020.101251.

Traoré B, **Yawson F**, **Floyd R and Mittal V** (2022) Promoting Innovation and Digital Transformation in the Infrastructure Technology in Africa.

Tshiani V and Tanner M (2021) South' Africa's quest for smart cities: Privacy concerns of digital natives of Cape Town. *South Africa 9*(1), 14–23.

Tveten J (2018) Municipal Broadband: Urban Savior Or Gentrification's Wrecking Ball? Available at https://www.Fastcompany.Com/40567009/Municipal-Broadband-Urban-Savior-or-Gentrifications-Wrecking-Ball; https://www.fastcompany.com/40567009/municipal-broadband-urban-savior-or-gentrifications-wrecking-ball.

UNESCO (2016) *World Social Science Report 2016: Challenging Inequalities: Pathways to a Just World*. Paris: United Nations Educational, Scientific and Cultural Organization (UNESCO).

UN-Habitat (2021) Addressing Digital Divide. Nairobi. Available at https://unhabitat.org/programme/legacy/people-centered-smart-cities/addressing-the-digital-divide.

UN-Habitat (2022) Mainstreaming Human Rights in the Digital Transformation of Cities – A Guide for Local Governments. Available at https://unhabitat.org/mainstreaming-human-rights-in-the-digital-transformation-of-cities-a-guide-for-local-governements.

United Nations (2011) Guiding Principles on Business and Human Rights. Available at https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf.

Vodoz L (2010) *Fracture numérique, fracture sociale : aux frontières de l'intégration et de l'exclusion. SociologieS.* https://doi.org/10.4000/sociologies.3333.

Weru B and Mugo J (2020) *Ride Hailing Survey: Usage of App-Based Mobility Services in Nairobi, Kenya GIZ TraCS | Advancing Climate Strategies in Rapidly Motorising Countries Prepared by PARS Research.* Available at www.changing-transport.org.

Willis KS (2019) Whose right to the smart city? In *The Right to the Smart City*. Emerald Publishing Limited eBooks, pp. 27–41. https://doi.org/10.1108/978-1-78769-139-120191002.

Woods O (2020) Subverting the logics of "smartness" in Singapore: Smart eldercare and parallel regimes of sustainability. *Sustainable Cities and Society 53*, 101940. https://doi.org/10.1016/j.scs.2019.101940.