Chapter 22
Smart Mobility in Urban Africa: Geography of Diffusion, User Characteristics and Emerging Impacts of Digital Platform/app-Based Mobility Services

Ransford A. Acheampong

Abstract Smart, digital platforms or app-based mobility solutions are becoming common in global south cities. Over the last few years, major Transportation Network Companies (TNCs) have expanded their services into several African countries with unfolding disruptive consequences. The overarching aim of this chapter is to explore the geography of the diffusion of these new and emerging mobility services in Africa and their emerging socio-environmental impacts. Firstly, the chapter presents an inventory of and maps known app-based mobility services in Africa, to reveal, for the first time, the distribution of these ICT-mediated mobility solutions across the continent, and their key drivers. Secondly, drawing on a large sample survey conducted in two of Ghana's major urban centres (i.e., Accra and Kumasi), the chapter provides empirical insights into the emerging impacts of app-based on-demand mobility solutions focusing on internet-based ride-hailing. To this end, the following key questions are addressed: (a) who are the users (and non-users) of app-based ride-hailing and the reasons for doing so? (b) what are the associated travel behaviour impacts, in terms of mode substitution and ride-hailing trip characteristics? (c) What are the safety and security impacts from the perspective of passengers? Finally, the chapter reflects on the implications of app-based mobility services for creating sustainable transport and mobility futures in urban Africa.

Keywords Digital platform mobility · App-based mobility · Smart urban mobility · Ride-hailing · Travel behaviour · Sustainable futures

22.1 Introduction

Digital platforms or app-based mobility solutions are now a global phenomenon. Constituting one of the common expressions of the smart city development model

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and emerging platform urbanism, these new mobility solutions are leveraging advances in Information and Communication Technology (ICT) and associated digital technologies to transform the way we move in towns and cities.

Globally, the availability and widespread adoption of the internet and smartphones have enabled the delivery and adoption of ICT-mediated mobility solutions. Major Transportation Network Companies (TNCs), such as *Uber*, *Lyft* and *Bolt*, as well as other service providers, provide digital platforms deployed as smartphone applications with which users can meet their everyday mobility needs on-demand. Within the emerging paradigm of 'collaborative consumption' (Botsman and Rogers 2010) or 'sharing-economy' (see e.g., Sundararajan 2016) in which shared-use of resources and assets is promoted and encouraged as opposed to outright ownership, digital platforms enable users to access shared-mobility services such as car-sharing, bike-sharing and e-scooter-sharing (Shaheen and Cohen 2013). Other options, including ride-hailing (non-pooled), motorcycle-hailing and water taxis are also increasingly being offered through smartphone applications and other digital platforms.

ICT-mediated mobility solutions have emerged with disruptive consequences for cities and their transportation systems, triggering wider societal impacts that are not yet fully-understood (see e.g., Palm et al. 2021; Lucas 2019). They are radically transforming urban mobility and individual travel behaviours by providing flexible, on-demand alternatives to hitherto rigid conventional transport systems, such as taxis and public transport. A case in point is internet-based ride-hailing which is increasingly becoming a popular way of meeting various travel needs, including for social and recreational trips, as well as work journeys in cities globally (see e.g., Acheampong et al. 2020; Grahn et al. 2020; Lavieri and Bhat 2019; Pham et al. 2017). Evidence from the aforementioned studies shows that people prefer ride-hailing services because they are convenient to use; can be affordable compared with other options; and offer a much flexible alternative to individuals not wanting to use personal cars for trips, especially in busy urban centres where parking is limited.

In African cities, the disruptive consequences and societal implications of the on-going diffusion of ICT-mediated mobility solutions are even more profound. For example, minibuses and taxis (including cars, bicycles and motorcycles used as taxis) have long served the mobility needs of different groups of the growing urban populations of Africa (see e.g. Sietchiping et al. 2012; Ehebrecht et al. 2018). These conventional, mostly informal mobility systems have operated in very rigid ways, such as requiring passengers to board a taxi from a designated station/rank or walk to the nearest service route in order to hail one, such as what is known locally as 'dropping' in urban areas in Ghana. Thus, in most African cities, the arrival of TNCs, such as Uber and Bolt with their digital platforms often mark the introduction of flexible, on-demand, ICT-mediated mobility options.

While from the perspective of individual users TNCs and their ICT-mediated mobility solutions, such as ride-hailing are providing convenient, flexible and clean travel alternatives, from the point of view of other actors such as taxi businesses, the immediate impact has largely been negative. With existing transport governance regimes grappling with how to regulate the activities of TNCs and capture maximum public value (see e.g. Agyemang 2020; Papadopoulos and van Eck 2021), local taxi

businesses are struggling to compete, with profound implications for employment and livelihoods of the thousands of workers in the taxi industry**.** In some cases, local operators have sought to compete and reclaim their market share by digitizing their services through the adoption of platforms similar to those used by the major TNCs. A case in point is the recent digitization of '*Boda Boda'* (motorcycle and bicycle taxis) in urban Uganda and '*Okadas'* in Nigeria (see e.g. Doherty 2020; Ibrahim and Bize 2018).

This chapter investigates the diffusion and emerging impacts of digital platform mobility solutions in urban areas across the African continent. The research and approach are outlined as follows: Firstly, an inventory of ICT-mediated or app-based mobility solutions present across the continent as of the time of conducting this research was derived through a desk study. The inventorization involved searching the world-wide-web for any documented evidence of the presence of app-based mobility solutions including the popular ones provided by TNCs such as Uber and Bolt and relatively smaller, less-known local providers/platforms. The internet-based search was done on country-by-country basis, recording for each country the names of the providers/platform and the cities where they are present. The output is mapped to show the geography of the diffusion of the digital platform mobility solutions across the continent. Secondly, the chapter draws on survey data conducted in Accra and Kumasi, Ghana two largest urban centres on the adoption and use patterns of internet-based ride-hailing. Using the survey data, the chapter explores key questions including: (a) who are the users (and non-users) of app-based ride-hailing and the reasons for doing so? (b) what are the associated travel behaviour impacts, in terms of mode substitution and ride-hailing trip characteristics? (c) What are the safety and security impacts from the perspective of passengers? And (d) what are the implications of platform mobility services for sustainable transport and mobility futures in African cities?

The rest of the chapter is organized as follows. Following this introduction section, the second section will focus on the geography of the diffusion of app-based mobility solutions in cities across Africa and the factors underlying the observed distribution. Next, the chapter will present insights from the survey-based empirical studies from Ghana on user characteristics and travel behaviour impacts of the digital platform mobility solutions. The penultimate section will highlight and discuss the key insights of the findings with a particular focus on their implications for sustainable transport and mobility futures, followed by conclusions and directions for future research in Sect. 22.4.

22.2 Geography of the Diffusion of Digital Platform Mobility Solutions

The geographical distribution of TNCs providing app-based mobility solutions across the continent of Africa is mapped in Fig. 22.1 while Fig. 22.2 provides a summary

of the number of cities for each of the TNCs found through the desk study. As the visualization shows, digital platforms and their app-based mobility solutions are present across all of the continent's sub-regions. In total, the study found app-based mobility solutions in 95 major towns and cities in 29 countries across Africa.

There are two main categories of app-based mobility service providers. These are the major multinational TNCs (i.e., Bolt and Uber) and other local, relatively smaller app-based mobility service providers. Bolt (formerly Taxify), an Estonian-based TNC is by far the dominant app-based mobility provider on the continent of Africa. It operated in 75 out of the 95 cities represented in this study. Uber, the second largest TNC in terms of presence operated in 19 of the 95 countries represented.

The two major TNCs (Bolt and Uber) tend to be the sole app-based mobility providers in most of the cities where they operate. However, there are also instances where they compete in the same city. The study found that in 12 of the major cities represented, including Abuja (Nigeria), Accra (Ghana), Cape Town, Durban and Johannesburg (South Africa), Dar es salaam (Tanzania) and Kampala (Uganda), both Uber and Bolt were present. This means that Bolt operates exclusively in 59 of the cities compared to Uber that does so in only seven of the 95 cities represented in this study.

Furthermore, the desk study found that TNCs other than Bolt and/or Uber provided app-based mobility solutions in 17 of the cities represented in this study (Fig. 22.1b). The majority of this second category of TNCs were present in cities in East, North and Central Africa where none of the two major providers (i.e., Bolt and Uber) had any presence. One major exception is the *'Boda Boda'* app-based motorcycle-hailing service that competes with Uber in Kampala, Uganda.

The diffusion of app-based mobility solutions across Africa is largely an urban phenomenon. There are a number of reasons why this is the case. TNCs and their ICT-mediated mobility services are present in the most urbanized areas with higher population concentrations in the countries represented in this study. With the high population and economic activity concentrations, these locations are strategically chosen by TNCs to offer the critical mass of early adopters for the new mobility solutions. In addition, major urban areas tend to have the basic satellite-based mapped information that digital platforms require for drivers to be able to navigate in providing mobility services on-demand. Thus, usually, such services first become available in the capital city and subsequently spread to other large urban centres. For example, in Ghana, Uber started operating ride-hailing services around 2016, first in Accra, the capital and subsequently in other large urban areas, including Kumasi, the second largest city.

Aside from the large population concentrations as a key driver of the presence and diffusion of digital platform mobility solutions, the major cities represented in this study have the ICT infrastructure needed to support app-based mobility solutions. In recent years, the percentage of the African population using mobile phones and connected to mobile internet has been increasing steadily. Regarding mobile phone usage, a recent Pew Research Centre study on mobile phone ownership in six sub-Saharan African countries namely South Africa, Tanzania, Ghana, Kenya, Nigeria and Senegal found that large majorities of the population in these countries own

Country	City	Uber	Bolt/Taxify	Others
Algeria	Algiers			x
Angola	Luanda			x
Benin	Cotonou		x	
Botswana	Gaborone		x	
Congo, DRC	Kinshasa			x
Cote d'Ivoire	Abidjan	x		
Egypt	Alexandria	x		
	Zagizig	x		
	Cairo	x		
Ethiopia	Addis Ababa			x
Ghana	Kumasi	x	x	
	Accra	x	x	
	Cape Coast	x	x	
	Sekondi	x	x	
Kenya	Kakamega		x	
	Mombasa	x	x	
	Kisumu		x	
	Nakuru		x	
	Nyeri		x	
	Embu		x	
	Nairobi	x	x	
Libya	Tripoli			x
	Benghazi			x
Madagascar	Antananarivo			x
Malawi	Lilongwe			x
	Blantyre			x
Morocco	Fes	x		
Mozambique	Maputo			x
Namibia	Windhoek			x
Nigeria	Katsina		x	
	Owerri		x	
	Uyo		x	
	Calabar		x	
	Port Harcourt		x	
	Ibadan		x	
	Akure		x	
	Lagos	x		
	Ilorin		x	
	Kaduna		x	
	Abuja	x	x	
	Enugu		x	
	Benin City		x	
	Asaba		x	
	Awka		x	
	Kano		x	
	Bauchi		x	
	Jos		x	
	Maiduguri		x	
	Warri		x	
	Onitsha		x	
	Aba		x	

Country	City	Uber	Bolt/Taxify	Others
Rwanda	Ruhengeri		x	
Sierra				
Leone	Freetown		x	
Somalia	Mogadishu			x
South Africa	Cape Town	x	x	
	Port Elizabeth	x	x	
	Johannesburg	x	x	
	East London	x	x	
	Kimberley		x	
	Pretoria		x	
	Pietersburg (Polokwane)		x	
	Durban	x	x	
	Pietermaritzburg (Ulundi)		x	
	Damietta		x	
	Emalahleni		x	
	Grahamstown		x	
	Hurghada		x	
	Mansoura		x	
	Mbombela		x	
	Mthatha		x	
	Phuthaditjhaba		x	
	Potchefsroom		x	
	Queenstown		x	
	Rustenburg		x	
	Welkom		x	
	Thohoyandou		x	
	Canal Cities		x	
	Garden Route		x	
Sudan	Khartoum			x
	Port Sudan			x
Swaziland	Mbabane			x
Tanzania	Mwanza		x	
	Arusha		x	
	Dodoma		x	
	Dar es Salaam	x	x	
Tunisia	Tunis		x	
	Sousse		x	
Uganda	Gulu	x		
	Kampala		x	
Zambia	Lusaka			x
Zimbabwe	Harare			x

● App-based mobility present

Fig. 22.1 Distribution of TNCs and app-based mobility services in Africa

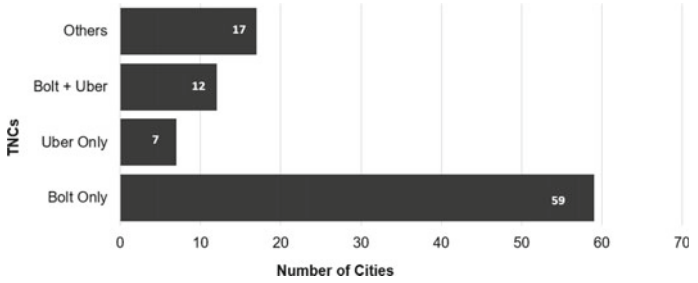

Fig. 22.2 Summary of TNCs presence across Africa

mobile phones. In South Africa, more than half (51%) owned a smartphone that can access the internet and apps while in countries such as Ghana, Senegal and Kenya, about one-third of the adults owned smartphones (Pew Research Centre 2018).

Furthermore, in Sub-Saharan Africa, it is estimated that some 120 million people, representing 13% percent of the continent's population were connected to mobile internet in 2014 (GSMA 2020). By 2019, this had increased to 270 million or 26% of the continent's population. In addition to actual mobile broadband connections, more of the populations are living within the footprint of mobile broadband networks in Africa, suggesting a huge potential for higher levels of internet access in the coming years. The GSMA estimates the usage gap—populations living in the footprint of a broadband network but who are not using mobile internet—to be 49% or 520 million as of 2019. The distribution of the app-based mobility solutions mapped in this study was found to mirror patterns of mobile broadband internet availability and access across Africa. For example, comparing the distribution of app-based mobility solutions with that of the Mobile Connectivity Index, this study found that the former were concentrated in areas that score higher on the latter.[1]

A third key driver of the adoption and diffusion of app-based mobility solutions is the unmet travel demand generated by a mix of historical policy and market failures in the transport and mobility domains. Major transportation problems, including urban congestion, unreliable public transport services and the existence of huge first-and-last-mile accessibility deficits typify many urban areas in Africa (see e.g. Sietchiping et al. 2012) and indeed those represented in this study where new app-based mobility solutions have taken off. TNCs and their app-based mobility solutions can therefore be seen as part of the wider portfolio of responses, mainly from the private sector, to meet the growing mismatch between travel demand and the supply of modern transport services in urban Africa. They are a manifestation of an unmet need and a market-driven, profit-oriented response by multinational TNCs to historical public sector failures to invest in modern transportation systems in rapidly urbanizing Africa.

[1] Mobile Connectivity Index combines a number of indicators including 3G coverage, mobile ownership and mobile app accessibility to map levels of ICT penetration and connectivity globally. More information can be found via this link: www.mobileconnectivityindex.com.

It is important to establish that the foregoing is not to argue that TNCs and their app-based mobility services are necessarily providing effective solutions to the prevailing urban mobility challenges in the cities they operate. Indeed, prior to the advent of TNCs, informal para-transit and various forms of traditional taxis, including car-based, motorcycles and bicycle taxis, provided and continue to provide the means by which the majority of the urban population in Africa move around and access opportunities in their cities. However, with the introduction of apps, these hitherto rigid conventional means of travel are now becoming more responsive to the travel needs of users, by offering flexible, convenient and affordable mobility on-demand. Even so, one could also argue that app-based mobility solutions are contributing to or even exacerbating some of the existing transport and mobility challenges in African cities. For example, instead of the more sustainable mobility alternatives such as bicycling, the large majority of the app-based mobility solutions available in the cities mapped in this study offer motorized options, with car-based mobility such as ride-hailing being the most common service provided.

There are also wider social equity issues associated with app-based mobility solutions. The ICT infrastructure and services required to enable people to access app-based mobility solutions are not available to and accessible by everyone. Regarding mobile internet connectivity, the GSMA (2020) estimate suggests that a large gender gap and rural–urban gap persist in mobile internet use in Africa, standing at 37% and 60%, respectively. Furthermore, mobile phone ownership in general and smartphone ownership in particular tend to be significantly higher among young, highly educated, high-income and male populations (Pew Research Centre 2018). Thus, within urban areas where these mobility services exist, the prevailing digital divide and its intersection with socio-demographic factors are major determinants of who can use these services. Indeed, TNCs are aware of these factors and configure their service coverages to respond to the existing potential demand. In Ghana, for example, previous research (see e.g. Acheampong et al. 2020) has shown that rid-hailing services provided by Uber and Bolt tend to be concentrated on University campuses and their immediate catchments and around the catchments of major commercial centres, such as malls with the goal of attracting the more tech-savvy and financially capable demographics in these areas. App-based mobility services also tend to serve major tourism districts in sub-Saharan Africa (see e.g. Park et al. 2021; Henama and Sifolo 2017).

The foregoing discussions suggest that, with the prevailing digital divide, app-based mobility solutions could not be meeting the mobility needs of the majority of Africa's poor and low-income urban populations unless fundamental gaps in access to ICT infrastructure and services are addressed. In the section that follows, issues around user characteristics, usage patterns and the associated travel behaviour and passenger safety and security in ride-hailing are discussed, drawing on two major survey-based studies conducted in Ghana.

22.3 Platform Mobility Services in Ghana: User Characteristics and Emerging Impacts

22.3.1 Overview of the Survey Data

In Ghana, internet-based ride-hailing was introduced in 2016 by Uber in Accra metropolitan area, the country's capital and largest conurbation. While Uber's main competitor is the major TNC Bolt, (formerly known as Taxify), there are a number of relatively smaller digital platform mobility service providers currently operating in the country's major urban centres. With the presence of TNCs offering new on-demand mobility services, a survey was conducted between May and August 2019 to explore the adoption and user characteristics of ride-hailing and the associated travel behaviour and safety and security impacts in Accra and Kumasi, Ghana's two major urban centres.

The original survey (see Acheampong et al. 2020; Acheampong 2021) covered a number of themes, including the respondents' socio-demographic characteristics; locality of residence; reasons for using internet-based ride-hailing and the associated mobility patterns; as well as their perception of safety and security in ride-hailing. The data collection involved online surveys, using various online and social media platforms, including direct emailing, Facebook, WhatsApp and LinkedIn. Field Assistants also conducted face-to-face surveys, using versions of the questionnaire hosted on Mobile Phones and Tablets, with the aim of targeting respondents who could not be reached online and/or self-complete the questionnaire. Ultimately a total of 1,188 valid responses from adults aged over 18 years were obtained. An estimated 65% of the respondents were attracted via the online platforms while the remaining 35% of responses were obtained through personal interviews. Of the total sample, a sub-sample of 548 individuals responded to the open-ended question below about their safety and security experiences and perceptions:

> Overall, do you consider internet-based ride-hailing services such as *Uber* and *Taxify/Bolt* as being safe and secure? Please state your view or experience regarding this…you may also identify if your view or experience applies specifically to any of the ride-hailing service providers in your city/metropolis. Please provide as much information as you possibly can.

An overview of the sample characteristics is presented in Table 22.1. In the sections that follow, broad insights from the survey data are presented with a particular focus on user characteristics, patterns of usage, travel mode substation behaviour in the context of ride-hailing and passenger's safety and security perceptions and experiences.

Table 22.1 Summary of characteristics of the survey respondents

City of residence	Accra: Kumasi	51%: 49%
Gender	Female: Male	48%:52%
Age-groups	18–24	18%
	25–39	53%
	40–54	26%
	55 +	3%
Coupling	Couple: Single: Divorced/Widowed	45%:53%:2%
Have children?	Yes: No	42%:58%
Children in school (KG-SHS)? (n = 497)	Yes: No	84%:16%
Education	Basic school (Primary + Junior High School)	16%
	Senior High School (SH)	12%
	Tertiary (undergraduate/Diploma)-currently enrolled	13%
	Tertiary (undergraduate/Diploma)-completed	34%
	Postgraduate (Master's degree or higher)	25%
Employment	Employed (Full-time)	50%
	Employed (Part-time)	18%
	Retired	1%
	Student (Full-time)	17%
	Unemployed	14%
Income (n = 812)	≤ GH¢1,050	55%
	GH¢1,051–2,000	19%
	GH¢2,001–3,000	10%
	GH¢3,001–4,000	5%
	GH¢4,001–5,000	4%
	≥ GH¢5,001	7%
Car Ownership/Use	I have a car	15%
	I DON'T have my own car, but there is at least one car in my household that I can use if it is available	22%
	None of the above applies to me (don't have a car)	63%
Driver's Licensure	Valid License: Learner, provisional: No	32%:5%:63%

22.3.2 Who is Using Ride-Hailing and Why?

Of the total sample, 59% had used ride-hailing, suggesting that nearly three out of five of the survey respondents were using this new form of mobility in the case study areas (Fig. 22.3a). For the seven-day period prior to completing the survey, 36, 30 and 14% of this sub-sample of respondents had used the app-based service for one, two and three days, respectively. About 5% of the respondents had used the available app-based mobility services every day of the week prior to taking the survey. The users included those who indicated being able to use the app to request a ride themselves (76%); those who had a ride for their reference trip booked by another person, but indicated that they were capable of doing so if they had to (21%) and those who were assisted by another person to use the app because they could not do so on their own (3%).

Furthermore, the survey data showed a generational, educational and income divide regarding who uses internet-based ride-hailing (Fig. 22.3b,c). A larger proportion of the users were 18–24 year-olds (25%) and 25–38 year-olds (66%) who were either currently in higher education and/or employed and earning relatively higher incomes. For example, among individuals with monthly earnings of ≤ GH¢1,050,

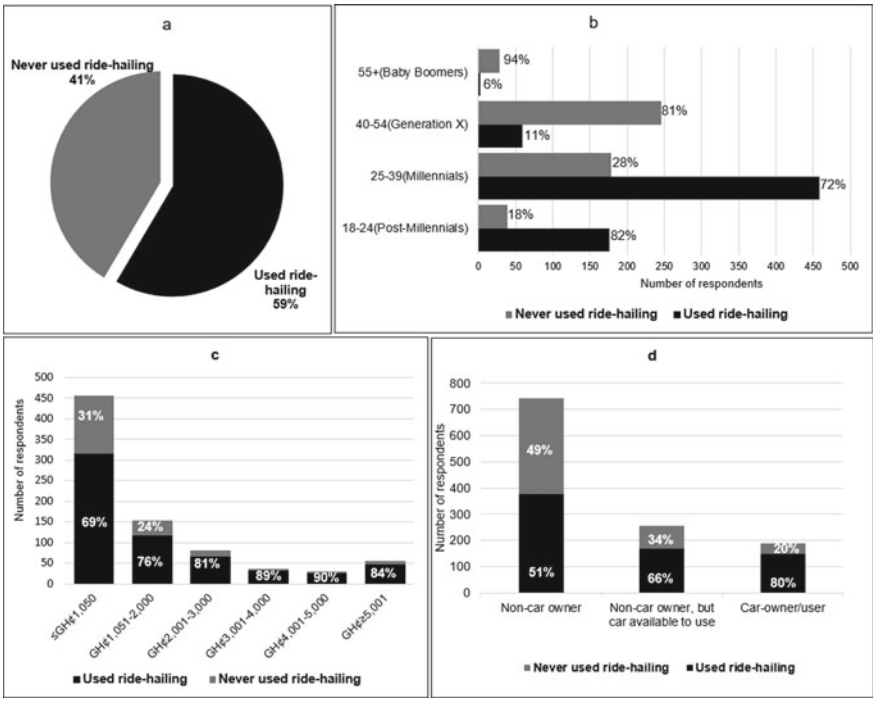

Fig. 22.3 Ride-hailing use: **a** in the total sample population **b** among four generational cohorts **c** among income-groups **d** among car owners/users and non-car owners

69% had used a ride-hailing service but among those with higher earnings (i.e. > GH¢1,050), at least 81% used a ride-hailing service. The proportion of ride-hailers was high for both car owners/users and non-car owners (Fig. 22.3d).

Individuals use app-based ride-hailing for their unique instrumental utilitarian and hedonic benefits. More than three quarters of all the reasons given by the respondents in the survey reflect these benefits, including ride-hailing being a convenient, cheaper, reliable, comfortable and quicker travel option, compared to other available public transport modes (Fig. 22.4). Indeed, the self-reported wait times between passengers requesting a ride and being picked up by the driver, demonstrate the time-saving benefits of using these on-demand mobility services. The majority of individual users reported having a vehicle available to them in less than five minutes (65%) and between 5 and 10 min (42%) of requesting one via an app. The waiting time for an additional 17% of all online vehicle requests were reported to have been met between 10 and 15 min. The respondents indicated additional reasons for using ride-hailing, including the need for privacy while travelling; difficulty in accessing public transport for the trips in question; and ride-hailing being perceived as 'classy' and 'hip' and 'trendy'.

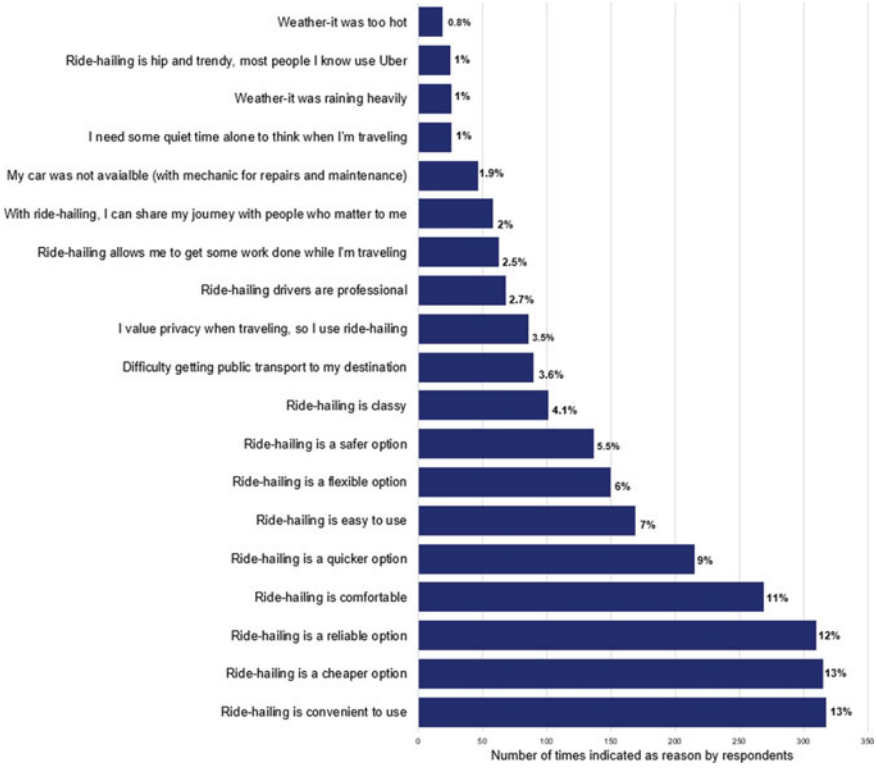

Fig. 22.4 Reasons for using a ride-hailing service for adult respondents' reference trip

22.3.3 What Are the Travel Behaviours Associated with Ride-Hailing?

The characteristics of the surveyed trips (Table 22.2) reveal a number of useful insights based on which the emerging travel behaviour impacts of ride-hailing can be assessed. Individuals ride-hailed to work and school (mainly university). Besides these core activities, 50% of all the ride-hailing trips could be classified as 'special occasion' journeys, such as booking the ride to attend social functions (e.g. weddings and parties); visiting friends and family and for religion-related journeys (e.g. church or mosque attendance). The remaining 9% of journeys involving ride-hailing were unknown as the respondents chose to not disclose the purpose of those trips. The self-reported in-vehicle travel times show that ride-hailing trips typically covered relatively shorter travel times and distances, with about 78% of the surveyed trips lasting between 10 and 30 min.

Furthermore, as the trip pattern analysis show (Fig. 22.5) a larger proportion of the ride-hailing journeys had a suburban location of origin and destination: For example, an estimated 70% and 64% of the ride-hailing trips originated from an outer-suburban locality in the Kumasi and Accra metropolitan areas, respectively. A significant proportion of the reference trips have the same zones of origins and destinations. This means that ride-hailing trips that started in a suburban location were more likely to be a suburban destinations. For example, 63% and 54% of the trips that originated in the outer-suburban zone in both metropolitan areas had destinations in the same zone. Typical suburban localities represented in the ride-hailing trip flow data included the public University Campuses in each of the study areas, and their relatively affluent catchment neighbourhoods. Most suburban areas are not adequately covered by conventional public transport (Trotro) and therefore experience high first-and-last-mile accessibility deficits in relation to public transport (Acheampong and Asabere 2022). Thus, by offering on-demand door-to-door mobility in these suburban locations, ride-hailing becomes a convenient and flexible alternative mode of transport, enabling users to overcome the existing public transport accessibility challenges.

The survey also explored vehicle occupancy and mode substitution behaviours in the presence of internet-based ride-hailing. The results show that a significant share of ride-hailing trips involved lone travel—single occupancy of the vehicle by the passenger, excluding the driver. This information is inferred from the self-reported vehicle occupancy at the trip origins and destinations. About 87% of the respondents indicated that there were zero passengers in the vehicle when it arrived to pick them, suggesting that they would have been the only passenger at the trip's origin.

Similarly, 85% of the respondents indicated that they were the only passenger in the vehicle at the trip's destination and that no other passengers boarded the vehicle during the entire journey of the ride-hailing trip in question. In order to understand the associated mode substitution effects, the survey respondents indicated which of the existing conventional modes they typically would have used for their reference journeys when the option to ride-hail was not available. The results show that in the

Table 22.2 Ride-hailing trip characteristics and travel behaviours

Trip purpose	Work and school-related	41%
	Special occasion	50%
	Undisclosed	9%
Journey start time	Early morning (between 5 and 7am)	7%
	Morning (between 7 and 9am)	19%
	Late morning (between 9 and 11am)	18%
	Early afternoon (between 12 noon and 2 pm)	18%
	Late afternoon (between 2 and 5 pm)	15%
	Evening (between 5 and 9 pm)	19%
	Late Evening (after 9 pm)	12%
Journey times (minutes)	About 10	12%
	10–15	16%
	15–20	23%
	20–25	13%
	25–30	14%
	30–60	18%
	60 +	4%
Vehicle occupancy (trip destination)	Zero	85%
	One person	8%
	Two persons	4%
	Three persons	2%
	Four persons	1%
Mode substitution	Public transport (Trotro)	36%
	Taxi (conventional)	51%
	Private car	10%
	Public transport (bus)	1%
	Walking	1%

absence of ride-hailing, 51%, 36% and 1% of the surveyed journeys would have been undertaken using conventional taxis, public transport (Trotro) and buses respectively (Table 22.2). An additional 10% of the journeys would have been completed using a private car in the absence of internet-based ride-hailing. Ride-hailing also replaced walking trips, although this was significantly lower, constituting only 1% of the reference trips.

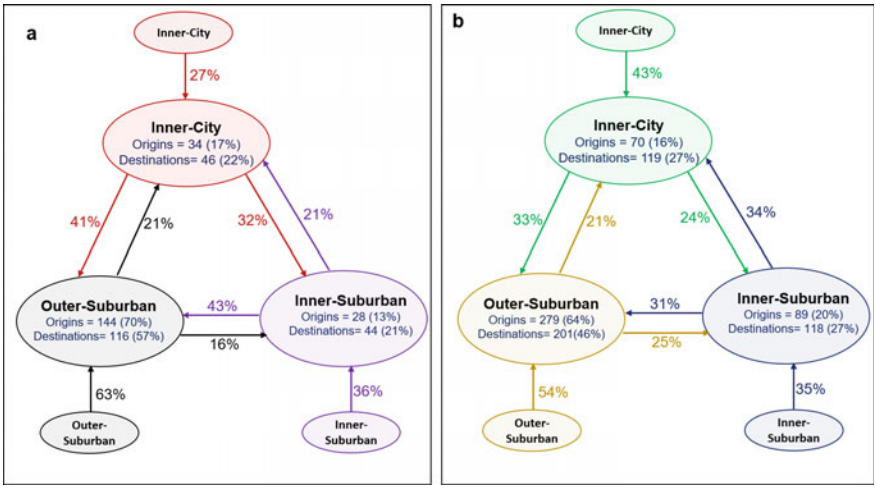

Fig. 22.5 Reference ride-hailing trips distributions among three broad zones in **a** Kumasi and **b** Accra

22.3.4 What Are the Emerging Safety and Security Impacts?

In addition to the travel behaviour changes explored in the previous sections, the presence of digital platform mobility services are triggering safety and security consequences in the study areas. While traditional traffic safety concerns and challenges persist with this new form of mobility, other safety and security challenges are emerging that are inherent in ride-hailing being ICT-mediated. As indicated in Sect. 22.3.1, the survey on safety and security elicited detailed qualitative responses from the respondents. This section outlines and discusses the key findings of the survey responses.[2]

The individual respondents perceived the issues of passenger safety and security regarding ride-hailing differently. Overall, the reported safety and security perceptions and experiences could be summarised along the continuum of responses that reflected internet-based ride-hailing being safe (48%, n = 236), somewhat safe and secure (24%, n = 132) and not at all safe and secure (25%, n = 137). As both individuals who have used ride-hailing before and those who had not as of the time of the survey expressed their views about the safety and security consequences of ride-hailing, the extent to which their responses differed are also examined.

The results show that among the former sub-group of respondents, more than half (54%) indicated that they felt safe, overall, in using internet-based ride-hailing. Within the latter sub-group of respondents, 41% perceived this new form of mobility as not being safe and secure. For this sub-group of respondents, it could be deduced from the information they provided that their safety and security perceptions have

[2] See Acheampong (2021) for a detailed analysis of the qualitative responses with the codes and emergent themes on which the discussion here is based.

been shaped largely by media reports and in some instances by the experiences of significant others such as friends and families.

A summary of the main factors influencing passenger safety and security that emerged from the qualitative data analysis is presented in Table 22.3.

Table 22.3 A summary of factors influencing passenger safety and security in ride-hailing based on the detailed qualitative survey responses

Factors	Influence on passenger safety and security (perceived and experienced)
Inbuilt app safety and security features: driver and vehicle identification and performance ratings	• Positive influence on safety and security as passengers see basic identification of the driver and vehicle via the ride-hailing app ahead of the trip. Higher safety and security perception by those who trust the apps' inbuilt identification system. Others believed that they asserted and ensured their safety through the instituted regulatory mechanism of reward and punishment, in the form of driver performance ratings • Some respondents, however, simply did not trust in the app's identification features in guaranteeing their safety and security for reasons including possible lapses in driver vetting and recruitment processes; susceptibility of apps to hacks; fears and anxiety about possible driver impersonations and identity swapping; and fake driver accounts
Inbuilt app safety and security features: trackability	• The apps' trackability function provided a number of safety and security benefits to passengers by making it possible to: share one's travel with significant others, such as family and friends to track in real time; alerting significant others to suspicious and potentially safety compromising behaviours during the trip; and track on-going trip on their own phones, so that any unexpected detours en-route by the driver could be detected and questioned
Inbuilt app safety and security features: traceability	• Traceability is both an 'in-trip' and 'after-trip' benefit that accrues from the app allowing passengers to be able to trace a vehicle and/or driver to recover personal belongings left onboard. Both traceability and trackability also improved safety through the notion of 'surveillance'— the belief that the driver is being monitored by someone or that someone is watching over both the driver and passenger

(continued)

Table 22.3 (continued)

Factors	Influence on passenger safety and security (perceived and experienced)
Possible exposure to malicious and criminal activities	• The risk of exposure to criminal activities while using ride-hailing services, such as robbery, kidnapping and sexual harassment were identified as causing major safety and security concerns. Most of the respondents had not been victims of such criminal activities, but their fears and concerns stemmed largely from news media reports on the subject of robbery and kidnaping around ride-hailing services
Privacy and lone travel	• On the one hand, some individuals seemed to derive a sense of safety and security from the privacy and lone travel in ride-hailing. On the other hand, they expressed fear that that lone travel and the privacy it affords could expose passengers to danger if they find themselves with a ride-hailing driver who has intentions of harming them
Emergency use	• Respondents also associated and experienced safety and security regarding internet-based ride-hailing in times of emergencies, such as ill-health. In a context where access to reliable ambulance services is extremely limited, ride-hailing services provide public value by becoming a rapid response alternative, to accessing health care, thereby contributing to saving lives
Driver behaviour	• Driver behaviours such as reckless driving and associated risk-taking behaviour, smartphone use while driving (e.g. for navigation) were identified by passengers as one of the major sources of their anxiety while using ride-hailing

It becomes clear from the summary that the platforms' inbuilt safety features had major implications for perceived and/or experienced safety and security in ride-hailing. Inbuilt features such as driver and vehicle identification and trackability and traceability functions of the ride-hailing apps contributed largely positively to passenger safety and security. At the same time, some of the responses reflected significant distrust in these inbuilt safety and security features, stemming mainly from lapses, including driver vetting and recruitment processes and the apps' susceptibility to hacks, leading to fake driver accounts, impersonation and identity swapping.

From the perspectives of the respondents, these app-related lapses were exposing passengers to malicious and criminal activities including armed robbery, kidnapping and sexual harassment. The overall view was that females in particular were more

at risk of exposure to these safety and security compromising situations in using internet-based mobility services. There were genuine concerns and fears about individuals who dabble in 'Sakawa'—a local term for illegal practices which combine internet-based fraud with African traditional rituals—leveraging ride-hailing platforms and posing as drivers of requested rides to target, kidnap and/or rob their rider victims. While the survey response captured these perceptions from the perspective of passengers, drivers are also exposed to criminal and malicious activities that leverage ride-hailing apps and vehicles.[3]

Moreover, the analysis found that safety and security considerations were partly responsible for the large proportion of lone-travel journeys in ride-hailing in the case study areas. On the one hand, some passengers preferred to travel alone in order to avoid the possibility of being exposed to risks and dangers associated with having to travel with complete strangers in a vehicle, as has long been the case with conventional taxis. Indeed, most of the respondents were not open to the option of pooled-rides that would mean having to share the same vehicle with other passengers, especially if the other passengers were going to be complete strangers. On the other hand, there were concerns that the perceived safety and security benefits of lone travel is only guaranteed as long as drivers of requested rides are genuine. To the extent that ride-hailing apps were susceptible to hacking and fake driver accounts, the risks to passenger safety and security remained even for the preferred option of lone passenger journeys.

22.4 Discussion and Policy Implications

Following global trends, digital platforms or app-based mobility services can now be found in several African countries, as revealed by the inventory and mapping of app-based mobility solutions that were found through the web-based desk study (see Fig. 22.1). As the analysis has shown, app-based mobility solutions are an urban phenomenon, with the available services concentrated mainly in the largest cities, mainly the national capitals in all cases, as well as other major urban centres. With the distribution of app-based mobility solutions mirroring mobile broadband internet availability, African countries that have seen investment and growth in the latter have also become fertile grounds for TNCs and other service providers to offer app-based mobility services.

The reverse holds true for countries that score low on the Mobile Connectivity Index. Thus, in the future, as smartphone penetration and broadband connectivity expands across the continent, as the trend already shows, service providers would seek to expand their markets to more countries. App-based mobility solutions are therefore expected to become more widespread in major towns and cities across the

[3] The gruesome murder of an Uber driver is reported by one of the major media outlets in Ghana here: https://www.myjoyonline.com/decapitated-man-was-an-uber-driver-and-headmaster-feyiase-assemblyman-reveals/?param=.

African continent. Moreover, app-based mobility solutions have emerged partly as a response to the unmet mobility and accessibility needs in Africa's rapidly growing cities, created by a mismatch between the ever-growing travel demands on the one hand, and the supply of affordable and efficient public transport services on the other hand.

The geography of diffusion observed at the country level is also a reflection of the digital divide within individual countries, whereby ICT diffusion favours the most urbanized areas, such as capital cities and other major towns and cities. Moreover, within these urban areas, we know that smartphone ownership and mobile broadband internet availability required to access the available app-based mobility services differ considerably among social groups. Indeed, as studies in some African countries have shown (see e.g., Pew Research Centre 2018) smartphones and mobile broad internet are accessible to younger, highly educated and/or individuals with relatively higher earnings. Access to the mobility services provided by digital platforms is therefore skewed toward this demographic who can afford smartphones and available mobile broadband internet. Indeed, the empirical evidence presented in this chapter support this assertion. Thus, within urban areas where these mobility services exist, the digital divide is a major determinant of who can have access to these new app-based mobility services. This also implies that the larger share of the urban population who are poor or earn low wages face significant barriers in using app-based mobility solutions in the areas where they are present.

These findings have implications for the wider equity impacts of app-based mobility solutions now and in the long-term. We know that the prevailing mobility challenges in urban Africa, to which TNCs are partly responding with their app-based mobility solutions, disproportionately affect low-income and poor households and individuals. This is because, while groups that are more affluent increasingly own personal vehicles and can also afford the car-based alternatives offered by digital platforms, the rest of the population must rely on public transport that is under-funded, inefficient, unsafe and offering low quality levels of service. Thus, app-based mobility solutions have not emerged to serve the mobility needs of the larger mass of the urban populations whose mobility needs are already not being adequately met. Instead, they appear, at least in the early years of their diffusion, to add to the pool of alternatives that is accessible to a rather narrow sub-group of the urban population—the affluent or the smartphone-owning, tech-savvy younger population.

This is expected, as like many other technical innovations, the diffusion of app-based mobility solutions, requires a niche market of a critical mass of early adopters, who tend to fit the aforementioned demographics. That said, given the nature and extent of mobility and accessibility challenges in Africa's major cities and urban areas, app-based mobility solutions would only become beneficial when they are able to serve the populations who are most affected by the prevailing urban transport and accessibility challenges. In practice, this would mean app-based mobility solutions expanding their service coverage geographically; providing ways by which both individuals who have access to broadband internet and those who do not can access available services on-demand; and becoming affordable.

A combination of market competition among service providers and public sector interventions and a regulatory response would be crucial to making app-based mobility solutions accessible to different social groups in urban Africa. While in many countries the landscape of app-based mobility solutions is dominated by major multinational TNCs such as Uber and Bolt, increasingly, new and relatively smaller players are emerging to rival the major players. In the process, app-based mobility services are expanding to a much wider population in some contexts. The recent adoption of digital platforms by *Boda Boda* motorcycle taxis in Uganda is a case in point. Prior to this, Uber, the major TNC operating in the country's capital, Kampala, catered to a rather narrow catchment population, targeting affluent neighbourhoods and central areas of the city. By adopting digital platforms similar to those used by Uber, *Boda Boda* informal transport service providers are now rivalling Uber in offering on-demand motorcycle taxi services. In the process, app-based mobility services have not only become available to a much wider population in the city through *Boda Boda*, but Uber is also responding by expanding their service coverage to areas which were hitherto not covered as a way of increasing their market share of users of these new mobility solutions.

While the emergence of competition among app-based mobility providers is inevitable, free market forces alone may not be enough in bringing about the changes and outcomes that we are starting to see in cities such as Kampala. Instead, governments should bring their outdated urban transport regulatory regimes in line with the emergence of digital platforms and the associated mobility services. Governments could also provide critical support by investing in the necessary digital infrastructure and platforms as a way of enabling existing informal public transport service providers to transition to and benefit from the emerging platform economy. Doing so would not only protect employment and livelihoods, but also yield wider public value by enabling the expansion of and access to app-based mobility solutions to meet the mobility needs of the urban population.

The presence of app-based mobility solutions also raises a number of implications for travel behaviour and the sustainability of urban transport and mobility in African cities. The available app-based mobility services identified through this study are dominantly car-based and/or other motorized forms of transport, such as app-based motorcycle taxis that are becoming common in countries such as Nigeria, Uganda and Kenya.

Furthermore, as the empirical findings from urban Ghana on the travel behaviours associated with ride-hailing found, they are characterised by low vehicle occupancy with a significant share of usage being for lone travel; and ride-hailing tends to be used for relatively short journeys in both urban and suburban localities. What is more, these single occupancy car-based journeys offered by ride-hailing services are replacing conventional alternatives such as taxis and public transport that are shared by several passengers. For example, of all the ride-hailing trips surveyed in Ghana's two major cities, Accra and Kumasi, 51 and 36% of them would in the past, before app-based mobility became available, have been undertaken by traditional taxis and public transport (Trotro) respectively. About 10% of the journeys would have been undertaken in a private car prior to ride-hailing becoming available. These

findings raise questions about the extent to which the presence of ride-hailing is really filling a gap in public transport supply. The substitution behaviours suggest that ride-hailing service providers are duplicating and even possibly undermining existing public transport provisions.

The above findings also suggest that the presence of ride-hailing is triggering travel behaviour changes that are not all positive or beneficial, especially from a sustainability point of view for reasons outlined as follows: Being ICT-mediated and offering mobility on-demand, app-based solutions such as ride-hailing are enabling access to car-based transport in ways that were not possible a few years ago in urban Africa. Indeed, as the evidence from the survey-based studies from Ghana has shown, while ride-hailing's impact on personal vehicle use is relatively lower, they appear to be replacing more public transport and conventional taxi trips, with most of the journeys involving a single passenger. In most cases, lone travel is mainly because service providers do not offer pooled or shared alternatives. Thus, the car-based options that app-based mobility solutions are enabling access to could be contributing to the already rising levels of motorization and car use in Africa's major cities. Moreover, at the time of this study, none of the TNCs offering car-based ride-hailing services across the continent offered cleaner energy alternatives such as electric vehicles. This also implies motorized forms of app-based mobility solutions could be exerting further negative impacts in terms of energy consumption and contributing to congestion as well as the emission of $C0_2$ and other pollutants.

Within the existing car-based on-demand mobility systems, providing and promoting ride-share and ride-pool options to users could contribute to reducing the overall impacts of pervasive car-based on-demand mobility services. More crucial to creating sustainable mobility futures in urban Africa is the urgent need for non-motorized alternatives to on-demand, app-based mobility alternatives. Now, car-based alternatives dominate the landscape of digital platform mobility services in Africa, but non-motorized alternatives are also becoming available, although this is happening on a much smaller scale in a few cities. A case in point is GURARIDE,[4] a new app-based shared-mobility service offering non-motorized alternatives including bicycles, e-bicycles and e-scooters in Kigali, Rwanda's capital. The diffusion of these non-motorized alternatives would be contingent on sustained investment in infrastructure such as protected bicycle lanes and overcoming the general negative public perceptions and attitudes towards bicycling and other forms of micro-mobility.

Finally, as this chapter has briefly indicated, the emergence of digital platform mobility solutions now raises new safety and security concerns, some of which go beyond the traditional considerations of traffic safety, such as preventing road accidents and fatalities. By nature, app-based mobility services mediate interactions between drivers and passengers via their digital platforms. User data is also generated and exchanged in the process. We already know that vulnerabilities in digital platforms could be exploited by persons with criminal intent, thereby exposing users to safety- and security- comprising situations with potentially serious consequences.

[4] https://cleantechnica.com/2020/09/14/rwandas-guraride-looks-to-jumpstart-africas-bike-share-micromobility-industry/.

Thus, as digital platforms offering mobility services become pervasive, measures to ensure public safety and security would also become critical.

22.5 Conclusion

Globally, new transport technologies and ICT-mediated mobility services are having significant impacts on urban transport and mobility. Africa is no exception in the diffusion and adoption of these ICT-enabled mobility solutions. In Africa, as this chapter has shown, digital platform/app-based mobility is an urban phenomenon, necessitated in part, by the ever-growing, yet unmet travel demand in general, and the need for flexible, convenient and fast on-demand mobility options in particular.

The evidence presented in this chapter has shown that while app-based mobility services present several benefits, they are also exerting wider socio-economic and environmental impacts that are not well understood yet. Their user population are mostly younger and/or relatively affluent, own smartphones and have access to mobile broadband internet. This implies that app-based mobility services are not necessarily enabling the larger mass of urban poor and low-income populations to meet their everyday mobility needs. Currently, the landscape of digital platform/app-based mobility services in urban Africa is dominated by car-based demand-responsive offerings, such as ride-hailing, that are used as substitutes for conventional public transport and taxis. Shorter travel distances in urban and suburban areas, as well as lone journeys also typify usage of these car-based on-demand mobility services.

Following current trends, it is inevitable that digital platform/app-based mobility solutions will become pervasive across urban Africa in the coming years. Responsive policy-making and governance will become ever more critical for capturing public value from them, by ensuring that their presence do not widen existing urban transport inequalities, increase motorization levels and car-dependence, and act as barriers to creating sustainable urban transport and mobility futures.

As a fairly recent phenomenon, our understanding of the impacts of app-based mobility solutions, especially in African cities is rather limited. There is therefore the need for research to deepen our understanding of how these new mobility solutions are changing travel behaviours and shaping accessibility outcomes; their implications for employment and livelihoods; the associated social equity and environmental sustainability impacts and emerging governance responses and models.

References

Acheampong RA (2021) Societal impacts of smart, digital platform mobility services—an empirical study and policy implications of passenger safety and security in ride-hailing. Case Stud Transp Policy 9(1):302–314

Acheampong RA, Asabere SB (2022) Urban expansion and differential accessibility by car and public transport in the Greater Kumasi city-region, Ghana—a geospatial modelling approach. J Transp Geogr 98:103257. https://doi.org/10.1016/j.jtrangeo.2021.103257
Acheampong RA, Siiba A, Okyere DK, Tuffour JP (2020) Mobility-on-demand: an empirical study of internet-based ride-hailing adoption factors, travel characteristics and mode substitution effects. Transp Res Part C Emerg Technol 115:102638
Agyemang E (2020) "Uber is here to stay": exploring the policy implications of the Uber-Local Taxis turf war in Accra, Ghana. Case Stud Transp Policy 8(1)
Botsman R, Rogers R (2010) What's mine is yours. The rise of collaborative consumption. arper Business, New York
Doherty J (2020) Motorcycle taxis, personhood, and the moral landscape of mobility. Geoforum. https://doi.org/10.1016/j.geoforum.2020.04.003
Ehebrecht D, Heinrichs D, Lenz B (2018) Motorcycle-taxis in sub-Saharan Africa: current knowledge, implications for the debate on "informal" transport and research needs. J Transp Geogr 69:242–256
Grahn R, Harper CD, Hendrickson C, Qian Z, Matthews HS (2020) Socioeconomic and usage characteristics of transportation network company (TNC) riders. Transportation 47(6):3047–3067
GSMA (2020) Mobile internet connectivity sub-saharan Africa factsheet. https://www.gsma.com/r/wp-content/uploads/2020/09/Mobile-Internet-Connectivity-SSA-Fact-Sheet.pdf Accessed April 10 2022
Henama US, Sifolo PPS (2017) Uber: the south africa experience. Afric J Hosp Tour Leis 6(2):1–10
Ibrahim B, Bize A (2018) Waiting together: the motorcycle taxi stand as Nairobi infrastructure. Africa Today 65(2):73–92. https://doi.org/10.2979/africatoday.65.2.06
Lavieri PS, Bhat CR (2019) Investigating objective and subjective factors influencing the adoption, frequency, and characteristics of ride-hailing trips. Transp Res Part C Emerg Technol 105:100–125
Lucas K (2019) A new evolution for transport-related social exclusion research? J Transp Geogr 81:102529
Papadopoulos S, van Eck S (2021) Disruptive technologies and taxi rides in South Africa: what is the 'Uber'Uproar about?. In: Global perspectives on legal challenges posed by ridesharing companies. Springer, Singapore, pp 199–229
Palm M, Farber S, Shalaby A, Young M (2021) Equity analysis and new mobility technologies: toward meaningful interventions. J Plan Lit 36(1):31–45
Park SY, Kim J, Pan B (2021) the influence of uber on the tourism industry in Sub-Saharan Africa. J Travel Res 60(7):1598–1611
Pew Research Center (2018) Internet connectivity seen as having positive impact on life in Sub-Saharan Africa. https://www.pewresearch.org/global/2018/10/09/majorities-in-sub-saharan-africa-own-mobile-phones-but-smartphone-adoption-is-modest/ Accessed April 10, 2022
Pham A, Dacosta I, Jacot-Guillarmod B, Huguenin K, Hajar T, Tramèr F, Hubaux JP (2017) Privateride: a privacy-enhanced ride-hailing service. Proc Privacy Enhanc Technol 2017(2):38–56
Shaheen SA, Cohen AP (2013) Carsharing and personal vehicle services: worldwide market developments and emerging trends. Int J Sustain Transp 7(1):5–34
Sietchiping R, Permezel MJ, Ngomsi C (2012) Transport and mobility in sub-Saharan African cities: an overview of practices, lessons and options for improvements. Cities 29(3):183–189
Sundararajan A (2016) The sharing economy: the end of employment and the rise of crowd-based capitalism. MIT Press, Cambridge

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