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Working Paper Series

Digital Platforms, ICT-Mediated Mobility Services and Emerging Smart Mobility Ecosystems in African Cities: Systematic Evidence Review of Impacts and Research Gaps

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PRISM Working Papers Series- An Introductory Note

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As an example: Acheampong, R.A., Boateng, F.G., Agyemang, E., & Hotor, D.E. (2025). Digital Platforms, ICT-Mediated Mobility Services and Emerging Smart Mobility Ecosystems in African Cities: Systematic Evidence Review of Impacts and Research Gaps. Partnership for Research on Informal and Shared Mobility (PRISM), New York (USA).

Abstract

In the last decade, the mobility ecosystems of major urban centres in Africa have evolved and become more complex with the introduction of new ICT-mediated, platform-enabled mobility solutions. Alongside conventional informal modes, the emergent ecosystems present both opportunities and challenges for meeting everyday mobility and accessibility needs while addressing urban sustainability imperatives. This paper takes stock of the wide-ranging disparate evidence regarding the diverse impacts of ICT-mediated mobility services on the continent. It identifies and critically examines the multifaceted sustainability impacts of the diffusion of ICT-mediated mobility solutions in African cities. The paper synthesizes the emerging empirical evidence and impacts in five themes, namely: user characteristics and equity implications; travel behaviour and sustainability; employment and livelihoods, safety and security; and governance and regulatory response. Across these thematic areas, the paper identifies areas where evidence is either limited or lacking, requiring future research. We argue that characterisation of the emergent ecosystems mainly in terms of conflicts and antagonistic relationships among actors is probably less useful and that future enquiry ought to shift focus to understanding how these ecosystems are evolving and generating potentially mutually beneficial benefits for all actors and stakeholders. The paper also highlights the need for research into how new mobility solutions interface with established informal modes and their combined impact on equitable mobility and accessibility. Finally, it emphasises the need for a better understanding of the emerging governance and regulatory responses and highlights the need for cross-country comparative studies and learning to identify and examine governance models and their relative effectiveness.

Key words: ICT, digital platforms, ride-hailing, motorcycle-hailing, governance, equity livelihoods, Africa

1 Introduction

Digital technologies are enabling the delivery of new solutions and shaping experiences and outcomes in cities globally. In the transport sector, platform-based, Information and Communication Technology (ICT)-mediated mobility services are increasingly being employed to provide flexible mobility options on-demand such as ride-hailing and motorcycle-hailing for passenger transport and urban freight. In the last decade, Africa has seen a significant growth in digital platform mobility solutions as major Transportation Network Companies (TNCs) such as Uber and Bolt and other local providers compete for the continent's largely unmet mobility demand (Carmody and Fortuin, 2019; Henama, 2020; Acheampong, 2022).

Even before the advent of digital platform mobility services, African cities have always exhibited diverse and complex transport and mobility ecosystems dominated by informal/popular[1] transport systems, including paratransit and motorcycles (see e.g. Sietchiping et al., 2012; Ehebrecht et al., 2018; Oteng-Ababio and Agyemang, 2012; 2015). With the advent of digital technologies and the mobility solutions they enable, these ecosystems are becoming ever more complex. The unfolding platformization of mobility services on the continent has resulted in the supply of new mobility options that are competing with and challenging the hegemony of traditional popular transport options (Henama and Sifolo, 2017; Carmody, & Fortuin, 2019; Rizk, 2021). New ICT-mediated mobility solutions are also radically transforming urban mobility and individual travel behaviours with sustainability consequences that are not fully understood (Giddy, 2019; Fenton et al., 2020; Giddy, 2020; Mostofi, 2022; Acheampong et al., 2023). At the same time, existing transport governance regimes have struggled to keep abreast of the disruptive presence of these mobility services with profound implications for employment and livelihoods and sustainable travel demand management in African cities (Pollio, 2019; Boateng et al., 2022; Porter and Omwega, 2022; Anwar et al., 2022).

This paper seeks to critically examine the multifaceted, social, economic and environmental impacts of the diffusion of ICT-mediated mobility solutions in African cities through a systematic review of the emerging research evidence. To this end, the paper identifies and documents the extant research on digital platforms and ICT-mediated mobility services in Africa. It systematically and critically analyses and synthesises the existing evidence of impact on travel behaviour, employment and livelihoods, safety and security, as well as governance and regulatory response. Ultimately, the paper identifies gaps in knowledge and outlines directions to advance knowledge in this emerging frontier of research.

[1] The terms 'informal' and 'popular' transportation are used interchangeably in this paper in line with Global Network for Popular Transportation definition as referring to "privately provided, publicly serving local transportation services and systems that emerge in nearly every city in the Global South" (see https://www.populartransport.net/#what)

2 Methodology

The overall approach of the systematic evidence review is summarised in Fig 1. We searched three main databases, namely Scopus, Web of Science and Google Scholar[2] to identify and screen for the relevant literature in line with the focus and objectives of the review, utilising a Boolean search strategy, which employed both "AND" and "OR" operators. The main search terms used were 'ride-hailing', 'ride-sourcing', 'e-hailing' and 'motorcycle-hailing'. These terms were combined with broader related terminologies including 'sharing economy', 'gig economy' and 'digital platforms'. Additional keywords, including 'mobility services', 'security', 'safety', and 'employment', 'livelihoods' were combined with the aforementioned to further narrow the scope of the search. Finally, geographic and location specific terms including 'Africa' and names of specific countries (e.g. Nigeria, Ghana, South Africa') were included in the search terms. The inclusion of names of specific countries to search for relevant papers was partly informed by an earlier study that had identified and mapped the geography of ride-hailing services across the continent of Africa (see Acheampong, 2022).

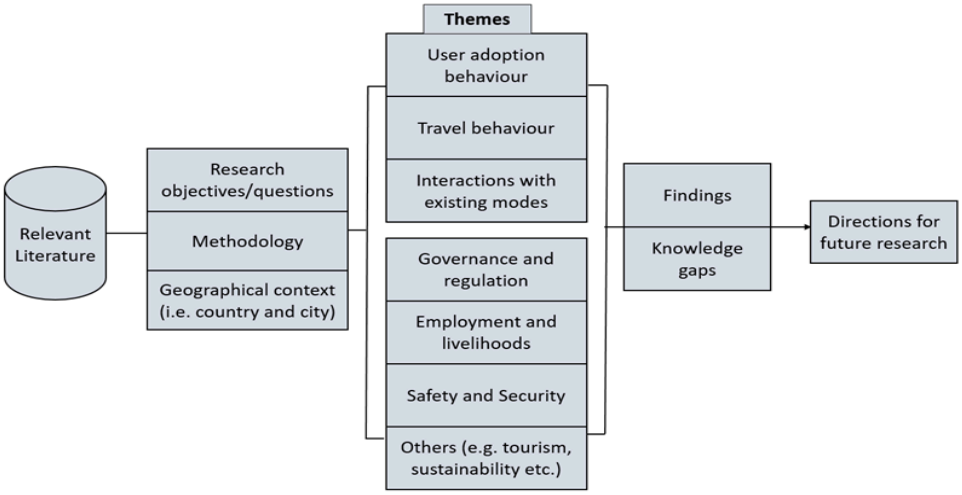

Fig 1: Systematic review schema

We searched the scientific publication databases mentioned above systematically using different combinations of the terms outlined above. The search focused on only papers published in the English Language. By limiting the search of relevant literature to Africa, the approach employed ensured that papers on the topic that did not focus on the continent were automatically excluded at the initial stages of literature identification. Most of the relevant papers appeared in all the databases searched. Therefore, as a first step we removed multiple records of the same paper. We then compiled and screened the resulting papers further for their relevance. Ultimately, we retained sixty publications for in-depth review. Out of the total of sixty, six of them were on the topic of ride-sharing or shared-mobility and focused on user adoption intentions. We included this set of papers because they conceptualised

[2] Google scholar alerts were set with the key words to ensure that relevant papers published after the initial search would be identified and included in the evidence review.

shared mobility as ICT-mediated services and elicited user adoption intentions to these mobility services. The remaining fifty-four papers all focused on existing digital platform mobility services, such as ride-hailing and motorcycle hailing. It is worth emphasising that the overall approach employed in the research search, screening and exclusion meant that statistics such as the total number of papers returned and the number excluded were not as useful as the number of relevant papers retained.

3 Results

We reviewed each paper to identify the research question/objectives addressed, methodology employed, as well as the geographical focus (i.e. country and city). In addition, we sought to identify themes covered by the papers. We started with an initial list of themes and expanded this list as additional ones emerged through the review. Ultimately, six themes were identified (Fig 2). In the sections that follow, we consolidate the six themes into five and synthesize the evidence under each of them.

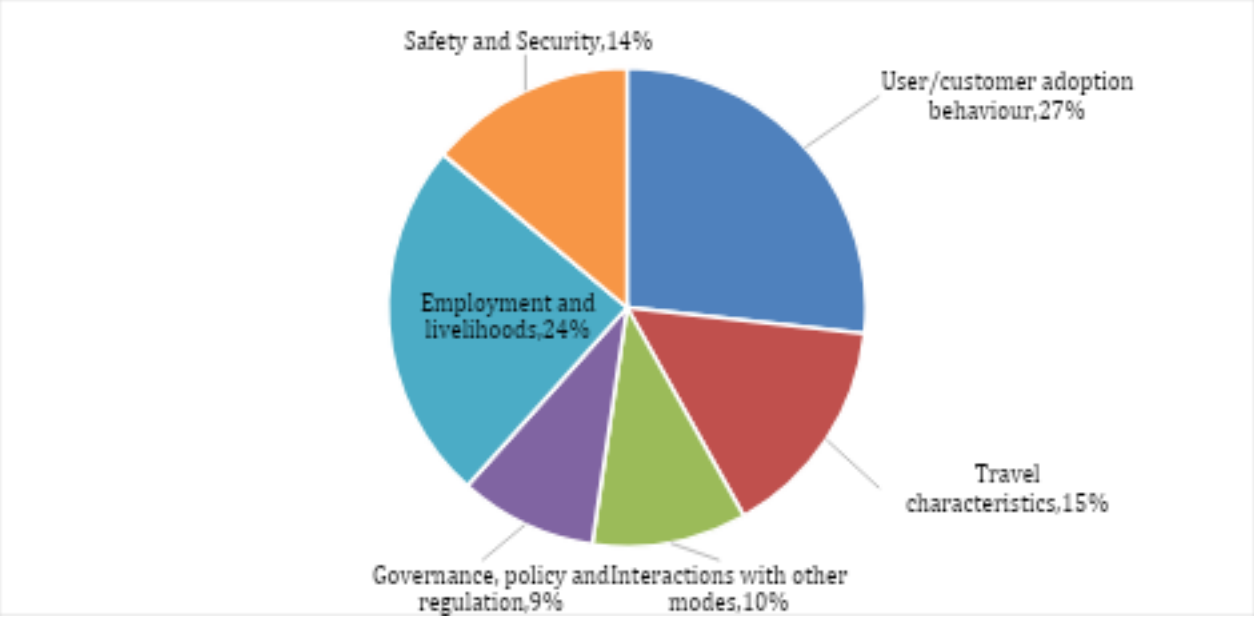

Fig 2: Themes covered in the existing literature (Nb: A paper can cover more than one theme. The chart therefore shows percentages based on the frequency of themes but not the total number of papers)

3.1 User characteristics and equity implications

As ICT-mediated mobility solutions are relatively new, and revolutionary particularly in the African context, a substantial body of the existing research has focused on understanding who the users are and the implications for equitable mobility and accessibility. Nearly all of the existing research examined user adoption behaviour in relation to car-based ride-hailing, such as those provided by TNCs including Uber and Bolt. Collectively, the evidence shows that users of these novel mobility services tend to be relatively younger and highly educated urban residents, who also earn relatively higher income than the

rest of the population. For example, Fenton et al., (2020) found that in Johannesburg, younger people whose mobility demands are not completely met by existing public transport options tend to use ride-hailing more. This finding is corroborated by empirical research from Cairo, Egypt (Mostofi et al., 2022); Lagos, Nigeria (Ajayi, 2020); Nairobi, Kenya (Delaunay, 2021); and Accra and Kumasi, Ghana (Acheampong et al., 2020; Agyemang and Yaro, 2023).

In addition to the broad demographic group of users identified above, a handful of the papers shed insights about the gender aspects of the adoption and usage of the car-based ITC-mediated mobility services they examined. Females were found to use ride-hailing more in Nairobi (Delaunay, 2021), Cairo (Mostofi et al., 2020) and Johannesburg (Giddy, 2020). These studies do not establish the reasons why this appears to be the case. Giddy (2020), based on survey evidence from Johannesburg, speculated that this may be due to some female respondents deriving a sense of safety from the safety and security features the Uber platform provided. There could be other reasons. Perhaps, in car-owning households, men tend to use the household vehicle more than women, implying that female members of the household could be using ride-hailing services instead to meet car-based mobility needs. That said, it is also worth noting that the insights from these studies ought to be understood and interpreted in recognition of some of the obvious limitations of survey-based studies, including sampling and response biases.

Besides socio-demographic factors, the literature also points to wider contextual factors that have influenced the adoption and use of digital platform mobility services. ICT-mediated transport solutions are an urban phenomenon, as the available mobility services are mainly concentrated in large cities and major urban centres in Africa (Acheampong, 2022). This urban presence also reflects the overall digital divide in countries where new mobility services are being provided: ICT infrastructure and internet availability, which are fundamental enablers of digital platform mobility services tend to be concentrated in primary cities such as national capitals and other major urban centres (Acheampong, 2022). Moreover, that huge mobility and accessibility gaps exist in African cities has been another important driver of the presence of major TNCs, both local and international, entering the transport ecosystem to provide on-demand mobility services. Thus, these new app-based mobility services have become available in the context of poor and inefficient public transport as well as the growing problems of unequal access (see e.g., Møller-Jensen et al., 2012; Melbye et al., 2015; Campbell et al., 2019) that typify most cities in Africa. Fenton et al., (2020) argue that in the context of historical legacies of segregation, sprawl and limited coverage of existing public transport in both low-density suburbs and high density townships of Johannesburg, ride-hailing services such as Uber and Bolt (formerly Taxify) have emerged to fill a unique mobility gap in a spatially unequal city. Delaunay (2021) argues that using ride-hailing is increasingly becoming a necessary alternative to access urban opportunities in a context where public transport is inefficient, and the majority of the population cannot afford to own a car. In urban Ghana, ride-hailing services have emerged as alternatives to existing conventional informal public transport services which are generally perceived as having inferior quality of service and lax safety standards (Acheampong et al., 2020).

The final strand of the literature on user adoption reveals some of the specific attributes of these new mobility services that influence adoption and use. The literature in this regard relates largely to car-based ride-hailing and show that the key determinants of user adoption include perceived advantages such as ride-hailing offering convenient, reliable, and quicker travel options compared to existing conventional public transport services (Boateng et al., 2019; Acheampong et al., 2020; Adenigbo, 2023). Consequently, a number of studies have found that users tend to be generally satisfied with these new digital platform mobility services (see e.g. Agyemang, 2020; Nyamekye, 2022; Ofori et al., 2022).

The evidence provided by user adoption behaviour studies raises a number of equity implications. Daramola and Etim (2022), argue that digital platforms lack affordances such as supporting native language contents, thereby limiting their accessibility to persons with minimal digital literacy. In a study that focused specifically on ride-hailing and people with disability in Accra, Ghana, Odame et al., (2023) show that ease, convenience, exclusive services and the friendly reception from Uber drivers remained the key attraction for the increasing trend in their patronage of such services. However, the relatively higher fares (compared to traditional public transport) associated with Uber services meant persons with disabilities cannot always afford to use them despite the obvious mobility and potential accessibility benefits. In addition, compared to public transport, the study showed that ride-hailing, being door-to-door and involving lone journeys provided fewer opportunities for social interaction to persons with disability. It thus seems that the benefits of app-based mobility solutions such as ride-hailing are skewed in favour of a narrow sub-group of the urban population who are relatively affluent, younger and tech-savvy (Acheampong, 2022).

3.2 Travel behaviour impacts: trip characteristics, inter-modal interactions and sustainability implications

We interrogated the literature to identify the overall impact on individuals' travel behaviours due to the presence of new digital platform mobility services. The first body of evidence relates to trip characteristics where the evidence found was largely in relation to trip purpose and distance associated with car-based ride-hailing. The second body of evidence found relates to how these new mobility services interfaced with other modes and questions around mode substitution and complementarities, elicited mainly through surveys.

3.2.1 Trip purpose, distance, and vehicle occupancy

Regarding trip purpose, the majority of the studies, which focused on car-based ride-hailing, reported that these services were used mainly for non-commute or non-work purposes (Giddy, 2019; Fenton et al., 2020; Giddy, 2020; Mostofi, 2022). Multiple studies conducted in cities in South Africa found that the majority of people used ride-hailing services, such as Uber, for leisure purposes (Giddy, 2019; Giddy, 2020; Fenton et al., 2020;). They show that ride-hailing was used mainly for going out at night (Fenton et al., 2020; Giddy 2020) and that a significant proportion of one of the studies indicated that they used Uber as an alternative to drinking and driving (Giddy, 2020). In a survey-based study conducted in Accra and Kumasi, Acheampong et al., (2020) found that more than half of trips made using ride-hailing were

for ‘special occasion’ purposes, including church attendance, going out at night and visiting friends and family.

Ride-hailing trips also involved work journeys, although the evidence is mixed in terms of proportions. For example, Acheampong et al., (2021) found in their study on Accra and Kumasi that while non-work trips were more, work journeys were also substantially high, constituting 41% of all journeys undertaken using ride-hailing over the five-day period immediately preceding the day participants were surveyed. In Nairobi, Delaunay (2021) found that people across different socio-economic groups used ride-hailing on a regular basis for work rather than non-work purposes. Other studies reported relatively lower proportions of work-related trips being associated with ride-hailing. For example, in Johannesburg, a much smaller proportion of individuals surveyed (19%) used ride-hailing for work (Giddy, 2019).

Only two studies provided some indication of the distance travelled for different purposes using ride-hailing. In Johannesburg, the majority of Uber users surveyed travelled relatively short distances (Giddy 2020). In their study conducted in Accra and Kumasi, Acheampong et al., (2020) found a significant proportion of ride-hailing journeys covered relatively shorter travel distance and times (i.e. below 30 min) and occurred mostly in inner and outer-suburban localities. Nearly 90% of all these short distance trips were also lone journeys, involving a single passenger from trip origin to destination.

3.2.2 Intermodal interactions: mode substitution and complementarities

Only a handful of the existing body of research has examined how ride-hailing interacts with existing conventional modes of transport, including conventional taxis, public transport, car and walking (Acheampong et al., 2020; Mostofi, 2020a; Mostofi et al., 2020b; Mostofi et al., 2020c; Mostofi , 2022). These studies examined how ride-hailing either competes with and substitutes or complements conventional forms of transport. Collectively, they show that the conventional taxi sector is the most affected with the presence of ride-hailing. In Cairo, it was found that about 33% of trips that would have been undertaken using a conventional taxi had switched to using ride-hailing instead (Mostofi, 2022). In Accra and Kumasi, Ghana, Acheampong et al (2020) found that ride-hailing use replaced 51% of conventional taxi journeys, implying that the latter competes and substitutes the former. The tendency for travellers to switch to ride-hailing from conventional taxis stems from the former’s door-to-door, flexible, convenience and affordability advantages over the latter.

Moreover, there was evidence of both competition/substitution and complementarity between car-based ride-hailing and public transport. An estimated 30% and 36% of surveyed trips in Cairo and Accra and Kumasi, respectively, that were undertaken by ride-hailing would have previously used existing public transport options (Acheampong et al., 2020; Mostofi ., 2022). In the case of Accra and Kumasi, this shows that ride-hailing could be taking passengers away from the minibuses (Trotros) that constitute informal public transport. The evidence from these studies also showed that ride-sourcing users also used existing public transport options more frequently, when the analysis examined individuals’ full day’s travel behaviour. To some extent, this can be considered a form of complementary interaction whereby the presence of ride-hailing simply increases the number of options available to individuals to meet their

everyday mobility needs. Complementarity, in this sense, is an outcome of mode choice decision-making at the individual level rather than as an outcome of a carefully planned multi-modal integration system.

Whether car-based ride-hailing replaced private cars was also one of the subjects explored by these studies. In Cairo Egypt, it was found that ride-hailing replaced 24% of private car journeys (Mostofi, 2022), while in Accra and Kumasi combined, the estimated replacement was only 10% (Acheampong et al., 2020). While these studies provide useful insights, they only represent a snapshot of peoples' substitution behaviour in the presence of ride-hailing because they are drawn from cross-sectional surveys. Thus, evidence of whether ride-hailing does replace car trips completely in the medium to long-term is lacking. It is more likely that ride-hailing has become supplementary to the private car as the evidence of use behaviour suggests that individuals who own a car also tend to use ride-hailing more.

The evidence about the interaction between ride-hailing and motorcycle taxis, formal buses and rail transport systems is lacking in the literature. Thus, we do not know whether and how ride-hailing, for example, complements and/or competes with these modes of transport in the same way that studies have captured these effects in relation to paratransit, conventional taxis and private cars in African cities.

Collectively, the evidence of travel behaviour impacts of car-based ride-hailing discussed above suggests that their wider sustainability (dis)benefits are mixed. By taking passengers away from public transport and conventional taxis, often driving without passengers (i.e. deadheading) while having only marginal effect on car use, it can be concluded that these new forms of mobility are further contributing to the travel-related negative impacts, including rising motorization, increasing Vehicle Miles Travelled (VMT), congestion, energy consumption and air pollution that typify many urban areas in Africa.

3.3 Employment and livelihoods

More than one in four young people in Africa–around 72 million–according to the International Labour Organization are inactive: not in employment, education or training. Two-thirds of them are women (ILO, 2024). On the flip side, advocates present ride-hailing not just as a mobility enabler, but also as an entrepreneurial platform for people to monetize their time, driving skills and private cars (Okyere-Manu, 2023), positioning the technology to help tackle unemployment. We, therefore, interrogated the literature to identify ride-hailing job creation impacts including on the life chances of women in Africa. We found a general concern in the literature about the accuracy of the number of paid jobs (being) created by ride-hailing in Africa. The problem has root in inadequate data disclosure by the technology companies and general challenges with data availability and quality in Africa (Agyemang, 2020; Boateng et al., 2022; Otieno et al., 2020. Nevertheless, some numbers have been reported in the literature. For instance, Anwar et al (2022) suggest that South Africa's Uber driver population stood at 13, 000 in 2019 while that of Kenya hovered around 5, 000 in 2017 (Otieno et al., 2020). According to Boateng et al (2022), some 3000 people in Ghana, as of 2016, worked as Uber driver-partners. Rizk (2021) claims that in Egypt more than 150,000 people were working on Uber's platform in 2017 as drivers.

Thus, the literature shows that ride-hailing creates or is creating paid work in Africa. The jobs, however, disproportionately benefit males (Wilmans and Rashied, 2021; Porter and Omwega, 2022; Boateng et al., 2022; Anwar et al 2023). For instance, females, according to Anwar et al (2023) comprise only 5% of Kenya's ride-hailing workforce and there were only seven registered female Uber drivers in the whole of Ghana as of 2017 according to Boateng et al (2022). The underrepresentation of females in Africa's ride-hailing sector is consistent with the general gender dynamics in the broader commercial passenger transport sector: The sector's direct economic opportunities disproportionately benefit males (Wilmans and Rashied, 2021; Porter and Omwega, 2022; Boateng et al., 2022; Anwar et al 2023). Thus, as noted by Porter and Omwega (2022): "Male identity and motor-mobility are deeply intertwined across much of the globe but nowhere is this relationship more strongly in evidence than in Africa. On the African continent, road transport work has always appeared, in essence, to be a masculinist domain; it is almost always men who are seen driving commercial vehicles, regulating loading activities in the lorry and bus parks (and now the motorcycle stages), undertaking roadside repairs, vulcanizing tyres, even serving fuel" (p. 55).

Job numbers and gender inequalities are not the only themes that feature in the employment and livelihoods research on ride-hailing in Africa. The studies also consider the quality and conditions of the jobs, with ride-hailing jobs widely described in the literature as being "exploitative", "precarious", "sleep-depriving" , "insecure" and "unstable" (Pollio, 2019; 2021; Otieno et al., 2020; Anwar et al., 2022; 2023; Boateng et al., 2022; 2023; Ribbans et al., 2022; Castel-Branco et al., 2023; Adongo et al., 2024) . Researchers have documented experiences from Ghana (Boateng et al., 2022); South Africa (Carmody and Fortuin, 2019; Pollio, 2019; 2021; Anwar et al., 2022; Ribbans et al., 2022); Kenya (Anwar et al., 2022; 2023; Castel-Branco et al., 2023; Lazzolino, 2023); Tanzania and Nigeria (Adongo et al., 2024) showing that ride-hailing workers in Africa operate under widespread and a wide-range of tedious conditions. The studies are replete but generally coalesce around low and insecure income, excessively long hours of work, exclusion from social protection, a representational gap and occupational health, and safety challenges (Carmody and Fortuin, 2019; Akorsu et al., 2022; Anwar et al., 2022; Akorsu, 2023; Adongo et al., 2024). The common occupational health and safety challenges reported in the literature include road traffic crashes, physical and mental stress with all kinds of body aches and pains, verbal assault, sexual harassment, and criminal attacks from riders (Carmody and Fortuin, 2019; Anwar et al., 2022; Akorsu et al., 2022; Akorsu, 2023; Adongo et al., 2024). The concerns about labor exploitation has roots in ride-hailing companies' insistence on classifying their drivers merely as "partner drivers" as opposed to "employees"–a tactic they also use in other parts of the world to profit from vehicles they do not own, and the labour of drivers they do not 'employ' (Carmody and Fortuin, 2019; Mpofu et al., 2020; Pollio, 2021; Boateng et al., 2022).

Aside the challenges internal to the practices of ride-hailing companies and labour relations in the ride-hailing industry generally, the literature shows that ride-hailing workers also face other challenges linked to their competition with existing transport workers for control over Africa's urban transport sector (Henama and Sifolo, 2017; Agyemang, 2020; Kaye-Essien, 2020). There have been documented

instances where these tensions–described as a “turf war” by Agyemang (2020)–have resulted in violent crashes (Henama and Sifolo, 2017; Marcano, 2019; Kaye-Essien, 2020; Ribbans et al., 2022). The many challenges ride-hailing drivers face have meant that they have been organizing across the continent, seeking representation and improved working conditions. As a result, worker mobilization is also increasingly becoming an important focus of ride-hailing research in Africa (Pollio, 2021; Akorsu et al., 2022; Lazzolino, 2023; Castel-Branco et al., 2023).

The final theme that features in the research on ride-hailing and employment and livelihoods in Africa is Covid-19. The pandemic generated interest among ride-hailing researchers across the continent including in Ghana (Dzisi et al., 2021); Kenya (Anwar et al., 2023); South Africa (Otieno et al., 2020). The overall tenor of the Covid-19 literature is that the socio-economic challenges ride-hailing workers face in Africa’s urban economies were greatly amplified during the pandemic (Otieno et al., 2020; Anwar et al., 2022; 2023).

3.4 Safety and security

Previous research has investigated safety and security passenger and driver perspectives. The evidence reflects both the subjective perceptions and experiences of these two broad groups across multiple urban contexts. In general, the findings suggest that some passengers found certain features of platform-mediated ride-hailing improved safety and security. These include real-time journey trackability, including the ability to share one’s trip with significant others; driver rating system, and driver and vehicle identification capabilities that the platforms provided (see e.g., Giddy, 2019; Acheampong et al., 2020).

Notwithstanding these, the evidence also points to significant safety and security risks associated with the use of ride-hailing services. Passenger safety perceptions and experiences are gendered, with females being more at risk than male passengers in ride-hailing vehicles (see e.g. Ajayi, 2020; Fenton et al., 2020; Duri, 2023; Adenigbo et al., 2023). Studies conducted in Lagos, Nigeria (Ajayi, 2020) and Johannesburg (Fenton et al., 2020) and Gauteng (Duri, 2023) found that females were more likely to perceive ride-hailing services such as Uber as less safe and secure than males. These studies attribute such perceptions to the frequent incidence of sexual violence, kidnapping or attempted kidnapping and robbery of which females were more likely victims than males. The studies, however, do not elicit and compare safety perceptions and experiences between ride-hailing and conventional popular transport options. It is therefore not exactly clear whether these safety and security issues are as prevalent with these other popular transport modes as they are with ride-hailing specifically.

Moreover, safety risks were experienced through driver behaviour, such as reckless driving, distractions by smartphone usage while driving. Drivers taking longer routes to charge higher fares and other unfair pricing practices that are considered intransparent by passengers also led to clashes between them and ride-hailing drivers (Acheampong 2022; Duri, 2023).

It however appears that safety perceptions and experiences are not the same across the same city. For example, in a survey study, Giddy (2019) reported that about 94% of the study participants in the city of

Johannesburg reported that they felt safe using Uber. In the same city, Fenton et al., (2020) and Giddy (2019), reported that while ride-hailing provides a safe alternative mobility, in some ways, new safety and security threats have emerged as a result of the presence of these novel mobility service. They explain that the safety and security experiences and perceptions are influenced by 'locatedness' and appear to be confined to specific parts of Johannesburg such as around train stations, bus stations and airports where conventional metered taxis have operated long before the advent of Uber. They explain that at these locations, safety risks were partly the result of violence instigated by conventional metered taxi drivers who find the likes of Uber a threat to their survival and in some cases have resorted to violent attacks that put both passengers and drivers at risk of harm.

Much of the existing literature on digital platform mobility services in Africa focus on car-based ride-hailing. More recent literature is starting to pick-up on the advent of app-based motorcycle-hailing services (Divall et al., 2021; Sitas et al., 2022; Sitas et al., 2022; Martin et al., 2023; Pollio et al., 2023). As Sitas et al., (2022), note, motorcycle taxis have long been essential to the mobility ecosystem of African cities and are increasingly being brought into digital platforms to serve commuting and on-demand logistics (freight and deliveries) needs. The emerging body of research we found mainly focused on countries in East Africa where the app-based motorcycle-hailing ecosystem appears to be evolving rapidly with many platforms and services, including MondoRide, SafeBoda, SafeMotos, YegoMoto, Vuba Vuba, Tigo Twende, as well as international competitors including Uber and Bolt (previously Taxify) present in countries such as Kenya, Rwanda, Tanzania and Uganda. Safety and security were found to be a recurring theme across most of these studies on app-based motorcycle-hailing. It appears that one of the main logics behind motorcycle platformization is that, it would bring about improvement in safety because signing up on platforms compels drivers to follow safety measures such as wearing helmets, obtaining driving license, complying with traffic rules, which in turn reduces the risk of accidents (Martin et al., 2023; Sitas et al., 2022). The motorcycle-hailing platforms also enable the driver identification and verification, passenger ratings and the enforcement of other quality assurance measures that are considered critical to safety and security. While the opportunities for road safety improvements are often claimed as one of the benefits of platformization in the motorcycle-hailing sector, we found very limited evidence on the actual impact.

3.5 Governance and regulations

Africa's commercial passenger transport sector is generally poorly regulated. We found, however, that across the otherwise diverse countries, the few existing regulatory frameworks seldom apply to ride-hailing. For instance, among other things, traditional taxi drivers in Ghana, according to Pasquali et al., (2022), Agyemang (2020) and Kufuor (2019), are required to acquire a commercial vehicle license and authorizations from the Ministry of Transport and relevant Metropolitan and Municipal District Assemblies before they can operate. Ride-hailing drivers do not fulfil any of these obligations. Second, taxis are also required to undergo a twice-a-year technical inspection by the Drivers Vehicles Licensing Authority (DVLA) while the private cars used for ride-hailing undergo such inspections only once in a year. Third, taxi drivers pay daily tolls to transport unions for the use of their taxi terminals. Fourth, taxi drivers further pay insurance twice a year as opposed to the annual fees characterizing private cars used

for ride-hailing (Kufuor, 2019: 20; Agyemang, 2020: 60; Pasquali et al 2022: 1744 – 1745). Taxi fares in Ghana are negotiated between the Ghana Private Road Transport Union (GPRTU), the Progressive Transport Union (PROTOA) and the Ghana Road Transport Coordinating Council (GRTCC) representing operators, on the one hand, and the government, at the other hand. The negotiated prices are supposed to take into account inflation while ride-hailing companies, on the other hand, set their own prices. Overall, the literature shows that the traditional taxi sector is burdened with a suit of regulatory requirements, all of which carry cost implications, generating concerns about unfair advantage (Kufuor, 2019; Agyemang, 2020: 60; Kaye-Essien, 2020). Meanwhile, ride-hailing drivers also frequently complain about inadequate labour protection regulations, creating room for exploitation by ride-hailing companies (Akorsu et al., 2022; Boateng et al., 2022; Akorsu, 2023). Consequently, operators have unionized into associations, including the Ghana Online Drivers Union (GODU), the Ghana Online Drivers Association (GODA), Online Drivers' Union, Ghana (ODUG), to name a few, to advocate for better working conditions and serve as the official mouthpiece in negotiating and collaborating with stakeholders such as the National Road Safety Authority and the Ghana Police Service to promote the safety of ride-hailing drivers (Akorsu et al., 2022).

The Ghanaian situation, however, is not an outlier. Researchers have documented similar experiences across the continent including in Egypt (Rizk, 2021); South Africa (Henama and Sifolo, 2017; Carmody and Fortuin, 2019) and Kenya (Omolo, 2024). Overall, the literature shows that the growth of ride-hailing in Africa has not been matched by a commensurate growth in governance and regulation. This, however, appears to be changing, with multiple systematic studies reporting that African governments are increasingly moving in to regulate ride-hailing. For instance, Pasquali et al (2022) accounts suggest that in January 2020, Ghana's Drivers Vehicles Licensing Authority (DVLA) issued some bylaws to control the activities of e-hailing platforms. Pasquali et al (2022) also reported that the Ministry of Transport and the Accra Metropolitan Assembly too are working on some regulations for ride-hailing. Egypt has passed the Ride Hailing Act of 2018 (Risk, 2021) while South Africa's Parliament has amended the country's National Land Transport Act of 2009 to capture ride-hailing (Carmody, & Fortuin, 2019). Omolo (2024) shows that Kenya's recently passed National Transport and Safety Authority (Transport Network Companies, Owners, Drivers and Passengers) Regulations (2022) regulates ride-hailing.

While a welcome change, there are some causes for concern. The processes leading to the development of Ghana's ride-hailing directives were highly non-consultative. Pasquali et al (2022) report that only the so-called "Big Three" ride-hailing companies in the country–Uber, Bolt and Yango–were consulted. The authors also reported that the regulations being developed by the Ministry of Transport and the Accra Metropolitan Assembly have inputs from only Uber (Pasquali et al., 2022: 1748). Risk (2021) have reported a similar experience from Egypt where the processes leading to the passage of the country's Ride Hailing Act of 2018 failed to include indigenous ride-hailing companies. Further, Omolo (2024) shows that these emerging efforts at regulating ride-hailing seldom extend to labour protections, which is surprising considering that worker exploitation is arguably the most documented sustainability concern about ride-hailing in Africa (Carmody and Fortuin, 2019; Mpofu et al., 2020; Pollio, 2021; Akorsu et al., 2022; Akorsu, 2023; Omolo, 2024). All these raise questions about the potential of emerging

regulatory efforts to adequately address the most pressing socio-political-economic realities of Africa's ride-hailing industry and commercial passenger transport sector generally.

4 Discussion of findings and research gaps

In this paper, we have systematically reviewed the emerging research evidence on digital platform mobility services in African cities with the goal to identify and examine the multifaceted sustainability impacts, covering the social, environmental and economic. The identified impact evidence has been synthesized around five main interrelated themes namely, user characteristics and equity implications; travel behaviour and sustainability, as well as employment and livelihoods. The rests are safety, security, governance, and regulatory response. Below, the key findings across these themes are outlined alongside the key research gaps that need addressing.

We found that the presence of novel digital platform mobility services are helping to address long-standing mobility and accessibility problems in urban Africa. However, their benefits are unequally distributed given that these mobility solutions tend to be exclusively urban and largely benefit a narrower sub-group of the urban population who are relatively affluent, younger and tech-savvy. The prevailing sharp digital divide even within Africa's major urban centres serves to further exclude the majority of their populations from using digital platform mobility services to meet their everyday accessibility and mobility needs. While the existing research provides some useful insights in relation to which groups benefit from the perspective of mobility, studies evaluating and quantifying city-wide accessibility impacts of digital platform mobility services across different socio-economic groups in African cities is non-existent. Thus, future research should address this gap. In doing so, we recommend the need to not focus exclusively on these novel services, and instead, by taking an ecosystem lens and recognising the multi-modality of journeys, evaluate and quantify the combined, perceived/experienced accessibility impacts of both digital platform-mediated services and (in)formal conventional modes of transport modes and their interactions. In particular further research examining the interactions between ride-hailing, on the one hand, and existing conventional options including formal buses motorcycle taxis and rail transport systems, on the other hand, are needed. Adopting the wider ecosystem approach would also yield useful insights in terms of identifying integration gaps and challenges between the new and old as well as pathways of integration within the evolving mobility ecosystem.

Another area of differential impacts for users is safety and security. As the evidence review found, significant safety and security risks have accompanied digital platform mobility services, such as car-based ride-hailing. Exposure and potential impacts of these risks are gendered, with females being more at risk than males as passengers in ride-hailing vehicles. We also found that ride-hailing drivers were also exposed to safety and security risk especially in contexts where drivers have become the target of criminal and violent attacks as part of the response by incumbent public transport service providers to the presence of digital platform mobility services. Further research is needed in terms of understanding the gendered safety and security risks posed by digitally-enabled mobility services as well as the practical measures needed to address them. Moreover, as the evidence review has shown, while the

opportunities for road safety improvements are often claimed as one of the benefits of platformization in the motorcycle-hailing sector, we found very limited evidence on the actual impact. Thus, more research is needed to examine and identify the claimed safety benefits of app-based motorcycle hailing.

Regarding the travel behaviours associated with digital platform mobility services and the associated wider sustainability (dis)benefits, we found mixed evidence. The evidence shows that ICT–mediated mobility solutions such as car-based ride-hailing are fossil-fuelled, tend to substitute relatively higher occupancy modes such as conventional informal public transport modes and instead encourage lone journeys while having marginal effect on private car ownership and use. To this end, one could argue that these new forms of mobility could be inducing travel behaviours that are not necessarily environmentally sustainable by contributing to rising motorization, congestion, energy consumption and air pollution that typify many urban areas in Africa. It is worth emphasising that research quantifying the environmental sustainability impacts of services such as car-based ride-hailing and motorcycle-hailing in terms of energy consumption, greenhouse gas emissions and air quality in African cities are non-existent. Instead, these impact areas are often inferred or implied from observed usage patterns and the overall contribution to motorization levels as more vehicles are purchased and registered for use as app-based taxis. This is one critical area where future research is needed.

The presence of digital platform mobility services is undoubtedly creating new avenues for employment and livelihoods. These employment opportunities, as the evidence review has shown, disproportionately benefit males, however. Moreover, jobs in this sector are widely considered as being “exploitative”, “precarious”, “sleep-depriving”, “insecure” and “unstable”. They also tend to be less sustainable and resilient to shocks, as seen for example, in the overall negative impact on workers in the sector during the Covid-19 pandemic. The employment market dynamics in the sector are deeply intertwined with governance and regulation. As the evidence has shown, the digital platform mobility sectors have seen fewer regulatory responses in the context of weak transport governance regimes in many African cities. While the industry has expanded rapidly in the last decade, and the accompanying disruption to labour and employment laws as well as existing transport governance regimes have become evident, governance and regulatory response continue to lag behind. Thus, governance and regulation are seen as critical areas where more research and policy action are required.

As governance and regulation are multifaceted with implications for all the themes identified in this review, we argue that research in this area needs refocusing and reframing. Fundamental to this generating new and up-to-date understanding of the evolution of mobility ecosystems in African cities is essential. For example, as the evidence review has shown, previous research has tended to characterize ecosystems in terms of violence, confrontations and contestations between actors, modes and services of the technologically-driven new and emerging on the one hand and the established and conventional on the other hand. While this was true at the early stages of the presences of TNCs, overtime, the ecosystem has evolved and changed. It would therefore be useful to deeply understand how this evolution has unfolded, the nature of the ecosystem and relationships over time and to discern if there are more mutually beneficial relationships as opposed to the hostile and violence dominated way of things at the initial stages. We argue that doing so could be helpful in terms of unlocking new

perspectives and identifying effective governance approaches and models. Cross-country comparative studies of the evolving ecosystems as well as emerging policy and governance responses are needed.

Across all the themes identified and discussed in this paper, the focus of research has been on car-based ride-hailing. As the results showed, the literature is lagging behind the growing platformization of other modes of transport in African cities, especially motorcycle-hailing. Consequently, evidence regarding the adoption and diffusion of motorcycle-hailing services, governance and regulatory response as well as the differential socio-economic and environmental sustainability impacts is lacking. Further research in this sector is needed.

Data emerges as an important crosscutting issue in transport and mobility more broadly but also in relation to platform mobility services more specifically. The existing body of evidence reviewed in this paper derived their findings mainly from survey studies. Thus, while they yield useful empirical insights they are also limited in a number of ways. These survey data come from cross-sectional population sample studies that are fraught with sampling and response biases. They also tend to be limited in terms of coverage due to resource constraints that prohibit large samples being obtained in statistically representative ways. This results in studies offering only partial and snapshot understanding of the various issues they set out to address. For example, earlier studies found that ride-hailing is used by a narrow sub-group of urban populations such as young adults in and around university campuses. While this was true at the initial stages of the diffusion of ride-hailing services, today, we know that the geographical coverage of these services have expanded across major cities in Africa. We would therefore expect the socio-demographics of users, usage patterns and any associated impacts to expand and evolve. Yet, these potential dynamics are not reflected in survey-based studies that have emerged over the last decade. Thus, more data that is comprehensive is critical in order to gain a comprehensive and better understanding of the scale of impacts of platform-enabled mobility in terms of both the opportunities they provide and the problems they generate. Such data can only be provided by the TNCs such as Uber and Bolt that offer the platform applications on which these mobility services run. At the moment, we do not know of a single TNC operating on the African continent that is providing data. Uber started sharing aggregated and anonymized trip and traffic conditions data through the UberMovement platform for cities that included a handful of cities in Africa. However, Uber appears to have removed this data-sharing platform and are no longer making data publicly available and accessible. The challenges with data sharing and access are inextricably linked to the wider lapses in governance and regulation of TNCs and digital platforms already highlighted in this paper. Therefore, the need for action-oriented research on platform data governance cannot be overemphasized.

5 Conclusion

In conclusion, this evidence review has illuminated the complex and multifaceted impacts of digital platform mobility services in African cities. While these services offer solutions to long-standing mobility challenges, their benefits are unevenly distributed, often excluding the majority due to the prevailing digital divide in African cities. Significant research gaps remain in quantifying city-wide accessibility impacts across socio-economic groups and understanding the intricate interactions within the evolving

mobility ecosystem, particularly between ride-hailing and conventional transport modes. Gendered safety and security risks associated with these platforms also warrant further investigation. Moreover, the environmental sustainability claims require rigorous empirical examination, as current evidence relies heavily on inferences from survey data obtained purposely to understand user characteristics and patterns of usage. The precarious nature of employment within this sector and the lagging governance and regulatory responses underscore the urgent need for more research and policy action. Future studies should prioritize comprehensive data collection, cross-country comparisons, and a deeper understanding of the evolving mobility ecosystems to inform effective and equitable governance frameworks for platform-enabled mobility in African cities.

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