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Impacts and Challenges for Developing Countries

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CHAPTER 5 “IMPACTS AND CHALLENGES FOR DEVELOPING COUNTRIES”

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INTRODUCTION

As illustrated in the first three chapters of this book, the influence of mobile ICT on urban mobility systems (including travel behaviors, mobility services, and public policies) has been the focus of increasing research. Yet, a closer look at the academic literature that analyzes such issues reveals that most of said research focuses, whether explicitly or implicitly, on the mobility systems of developed countries.

Over recent decades researchers have analyzed mobility in the cities of the developing world from a wide range of angles, including the rapid rise of individual motorization (Kenworthy, 2017; Kenworthy, 2011), the prevalence of, and challenges to, non-motorized transport (Pendakur, 2011; Khisty, 2003), the role of informal public transport as a ‘gap filler’ (Cervero and Golub, 2011; Cervero and Golub, 2007) or as a complement to public transit in ‘hybrid transport systems’ (Salazar Ferro et al., 2013), the institutional and governance challenges (Sclar and Touber, 2011), etc.

Moreover, as documented by Pfaff (2010), the role of mobile ICT in bridging and connecting what is conceptualized as ‘North’ and ‘South’ has lately emerged as a growing theme of research in the field of mobile phone geographies. Some of the early analyses have focused on the possible impact of the mobile phone on economic and educational development, others on its role in enterprise development or industrial change. Sectoral analyses of the impact of mobile ICT in developing countries have covered the development of financial services (Duncombe and Boateng, 2009) and of agricultural extension programs (Aker, 2011). The influence of the mobile phone on livelihood or healthcare delivery in developing countries has also recently been the object of systematic analyses (Agarwal et al., 2015; Duncombe, 2014).

Yet as illustrated by their absence from the World Bank’s report on Information and Communications for Development (2012), the specific influence of mobile phones on transport in general and on urban mobility in particular in the developing world, has long remained unexplored. It is our view, however, that there has lately been a rise in the awareness of this issue and that the related body of literature is bound to keep growing accordingly.

Acknowledging the disparities in the situations of urban mobility in developing world cities, this chapter draws on a dedicated literature review to analyze the specific opportunities and challenges of mobile ICT for urban mobility systems that are characterized by rapid changes in travel demand, a lack of synchronization with other urban subsystems and the existence of substantial populations in poverty (Gakenheimer and Dimitriou, 2011). Beyond the literature dealing with cities in major emerging economies, e.g. China and India, insights will also be gained from African and South-East Asian cities.

The chapter is divided into three parts. The first considers recent trends in smartphone ownership and travel behavior in cities of the developing world. The second focuses on recent trends in the development of mobile ICT-enabled services in these cities. And finally, the third part explores the specific challenges and opportunities of mobile phones for the organization and regulation of urban mobility systems in the developing world.

1. RECENT TRENDS IN SMARTPHONE OWNERSHIP AND TRAVEL BEHAVIOR IN DEVELOPING COUNTRIES

1.1 Smartphone ownership and Internet access

Access to, and use of, the Internet (fixed and mobile) and the smartphone have grown rapidly in recent years worldwide. However, differences remain between developed and developing countries (Poushter, 2016; Sridhar, 2014). Differences also remain between developing countries, as the economic conditions that govern the development of digital infrastructures and household equipment levels vary widely across the developing world.

In 2015, 37% of adults in developing countries owned a smartphone (up from just 21% in 2013), compared with 68% in industrialized countries (Poushter, 2016). It is in the poorest countries (Tanzania, Uganda and Ethiopia) that smartphone possession is the lowest (less than 11% in 2015).

Internet use is more widespread in developed than in developing countries, where just over half of adults (54%, as compared with 87% of adults in developed countries) used the Internet in 2015 (Poushter, 2016). Nevertheless, the situation is changing rapidly: the proportion of Internet users increased by ten points between 2013 and 2015 in developing countries. This is partly due to the spread of the smartphone, which in many developing countries has become the tool through which people access the Internet (Middleton et al., 2014, Napoli and Obar, 2014).

In both developed and developing economies, people aged 18-34 have the highest rate of smartphone ownership (Poushter, 2016). They are also the most intensive users of the Internet. Gender differences, sometimes significant, also exist in a number of developing countries (Poushter, 2016). In several African countries men are more likely to have access to the Internet. Smartphone ownership is, moreover, more frequent among males in many countries like Mexico, Nigeria or Ghana (Poushter, 2016).

In both developed and developing countries, the smartphone is not just a tool for Internet access. Its dissemination stimulates the production of new services and in particular services that are both geared to local contexts and personalized, in all areas of daily life, e.g. work, health, education, transport, commerce, social relations. For example, the M-Pesa mobile service has provided thousands of Kenyans and Tanzanians with access to a micro-finance and money transfer system (Barret et al., 2015). In the sphere of mobility in particular, many service innovations are emerging in developing countries with the spread of the smartphone.

1.2 Travel behavior

It is difficult to compare urban mobility patterns in developing countries with those in developed countries, because of the lack of international statistics and also the wide gaps that exist because of different social, economic and political conditions (Dimitriou and Gakenheimer, 2011). Nevertheless, various studies have shown that mobility in the cities of developing countries is characterized by much lower motorization rates, less private car use and a higher proportion of walking, public transport, and notably informal transport. The latter, which fills the gaps in public transport provision (Cervero and Golub, 2011; Cervero and Golub, 2007), takes extraordinarily varied forms from one city to another, and meets the day-to-day mobility needs of millions of people (Lesteven and Boutueil, 2018; Paget-Seekins and Tironi, 2016; Phun and Yai 2016; Behrens et al., 2015; Sengers and Raven, 2014). However, paratransit has long been negatively perceived by local authorities on grounds of safety, pollution and congestion (Kumar et al., 2016; Sengers and Raven, 2014), which has led to attempts at formalization in some cities in Latin America (Paget-Seekins and Tironi, 2016; Golub et al., 2009) or Africa (Venter, 2013; Schalekamp and Behrens, 2010).

In developed countries, household car ownership has been on the decline for some years (the so-called peak car phenomenon), for complex reasons (economic, generational, cultural, but also related to anti-car policies as well as lifestyles, including the development of ICT, and to urban forms) that are still a subject of debate in the international literature (Bastian et al., 2016; Van Der Weger, 2015; Goodwin and Van Dender, 2013). Conversely, motorization and private car use are growing strongly in developing countries (Belgiawan et al.,

2014, Sperling and Salon, 2002), particularly in China (Wu et al. 2016, Yang et al., 2017), although levels remain well below those of developed countries (Cervero, 2013).

For the period 1995-2012, the motorization rate in cities recorded in the UITP (International Association for Public Transport) 'Mobility in Cities' database increased from 117 to 254 cars per 1,000 inhabitants in developing countries. Over the same period, motorization in the cities of developed countries recorded in the survey increased from 345 to 418 cars per 1,000 inhabitants, though the latter figure had not changed since 2001 (Haghshenas and Vaziri, 2012). With access to a car, households in developing countries increase their share of car journeys, to the detriment of motorized two-wheelers (Law et al., 2015) and public transport. The UITP study shows, again for the period 1995-2012, that the modal share of public transport (in motorized travel) fell from 35% to 24% in the cities of developing countries for which statistics could be obtained, against a rise from 34% to almost 40% in the cities of the developed countries described in the database, which however represents only a small fraction of the world's cities.

The growth of motorization rates tracks that of household income in developing countries. However, many other factors contribute to the success of the car and the specific mobility trajectories of the world's cities (Sperling and Salon, 2002). In fact, there are significant differences between cities with comparable economic levels (Dargay et al., 2007). In particular, public transport provision and urban form, notably the density and the degree of urban sprawl, both contribute to explaining the differences in household motorization rates and modal split (Ahmad and Oliveira, 2016; Dargay et al., 2007; Guerra, 2015; Roque and Masoumi, 2016; Shen et al., 2016). Urban sprawl does not necessarily increase motorization: in Mexico City, wealthy households prefer to live in the center and own one or more cars (Guerra, 2015). In addition, attitudes towards the car are important (Belgiawan et al., 2016, Van et al., 2014). Finally, while in developed countries the younger generations are obtaining their driving licenses later and using the car less compared with their predecessors, in particular because of the deterioration in economic conditions, and later entry into the labor market (Klein and Smart, 2017) and into parenthood (Garitapaki et al., 2016), this phenomenon is not observed in developing countries, where a car is seen as a factor of upward social mobility and a status symbol. A car also significantly increases the activities that can be undertaken (particularly access to jobs), as well as simplifying ordinary day-to-day tasks (Belgiawan et al., 2014).

These observations obviously raise the question of the ability of new smartphone-based mobility services to steer the cities of developing countries, with their fast-growing populations, towards mobility trajectories that are more in line with the environmental as well as social objectives of sustainable development (Poiani and Stead, 2015; Rode et al., 2017).

2. NEW (SMARTPHONE-ENABLED) MOBILITY SERVICES

2.1 The international ride-hailing revolution reaches the cities of developing countries

As described in Chapter 2 of this book, cities in developing countries have been part of the aggressive international development strategy of some of the world leaders in ride-hailing, in particular Uber.

Of the more than 700 cities around the world where the U.S. ride-hailing company Uber was present as of February 2018, close to 50% were cities in developing countries, including 165 in Central and South America (including 108 cities in Brazil, 19 in Colombia, 18 in Chile, 5 in Peru, 3 in Dominican Republic, 2 in Bolivia, 2 in Ecuador, 2 in Uruguay, 1 in Argentina, 1 in Costa Rica, 1 in Guatemala, 1 in Panama, 1 in Salvador, and 1 in Trinidad and Tobago.), 50 in Southeast Asia (including 24 cities in Indonesia, 11 in Malaysia, 5 in Thailand, 4 in Vietnam, 3 in the Philippines, 1 in Cambodia, 1 in Myanmar, and Singapore), 38 in South Asia (including 30 cities in India, 6 in Pakistan, 1 in Bangladesh and 1 in Sri Lanka), 15 in Africa (including 4 in South Africa, 2 in Egypt, 2 in Ghana, 2 in Kenya, 2 in Nigeria, 1 in Morocco (closed at the end of February 2018), 1 in Tanzania, and 1 in Uganda), 12 in the Middle-East (including 3 cities in Kazakhstan, 3

in Saudi Arabia, 1 in Azerbaijan, 1 in Bahrain, 1 in Jordan, 1 in Lebanon, 1 in Qatar, and 1 in U.A.E.), and 5 in East Asia (in Hong Kong and Macau, and 3 cities in Taiwan).¹

Similarly, Uber's Estonian competitor Taxify (founded in 2013), which was operating in 40 cities as of March 2018, was balanced in its presence between developed countries (21 cities across 15 countries, including 17 cities in Europe, 3 in Australia and 1 in Canada) and developing countries (19 cities across 12 countries, including 11 cities in Africa, 3 in the Middle-East, 3 in Mexico and 2 in Eastern Europe). As of March 2018, it was in competition with Uber in 31 cities and 22 countries (16 cities in developing countries, 15 cities in developed countries), which made it Uber's second biggest competitor in terms of numbers of countries after Brazil's Easy Taxi (see *infra*).

Growing purchasing power and mobile phone penetration (particularly smartphones) in developing countries prompted Uber to pursue development in a number of them, which in turn triggered the emergence of local competitors. Some of these home-grown competitors in developing countries seem to have capitalized for their development on a large domestic market (in the case of operators native to emerging market economies, e.g. Didi Chuxing in China, Ola in India, Yandex.Taxi in Russia, 99 in Brazil, and Go-Jek in Indonesia), whereas others have opted for larger scale development, be it with a regional focus (e.g. Careem in North Africa and the Middle-East, Grab in Southeast Asia) or internationally (Easy Taxi).

By means of a broad inventory of ride-hailing platforms and their cities of operation, we were able to identify in all some 2,500 cities around the world where at least one major ride-hailing platform (here defined as a platform with operations in 10 cities or more) was operating as of March 2018. Of these 2,500 cities, two thirds (~1,700 cities) were in developing countries and 55% (~1,400 cities) were in large emerging countries (including 600 in Brazil, ~450 in China, 102 in India, 117 in Indonesia, ~130 in Russia and 4 in South Africa).

2.2 Developing countries are breeding ride-hailing champions

2.2.1 Actors from large emerging economies have mostly remained focused on their domestic market

As of March 2018, some of the largest ride-hailing service providers were native to large emerging economies, namely Didi Chuxing in China, Ola (also known as Ola Cabs) in India, Yandex.Taxi in Russia, 99 (formerly known as 99Taxi) in Brazil, and GO-JEK in Indonesia.

As already mentioned in Chapter 2, Uber's Chinese competitor Didi Chuxing was founded in 2012 and by early 2018 was present in more than 450 cities in China, arranged more than 20 million trips per day, had received total funding of \$18.1bn, and had achieved a market valuation of \$56bn. Didi Chuxing has also become a funding partner in other ride-hailing providers, investing in its competitors from both the developed world (investing in Lyft in 2015 and in Uber in 2016, and taking a corporate minority interest in Taxify in 2017), and the developing world (investing in Ola in 2015 and in Grab in 2015 and again in 2017, investing in 99 in 2017 before acquiring it in 2018, and taking a corporate minority interest in Careem in 2017). Didi Chuxing also entered into a strategic alliance with Lyft in September 2015 to organize reciprocal roaming for their services in the U.S. and China (Lyft, 2015) – they were joined by Grab and Ola in December 2015 (Grab, 2015), but the roaming agreement came to an end in 2017. In August 2017, Didi Chuxing announced the signature of a strategic partnership with Taxify to support their development in Europe and Africa (Didi Chuxing, 2017a), just a week before announcing a strategic partnership with Careem to support their development in the Middle East and North Africa (Didi Chuxing, 2017b). Lastly, Didi Chuxing acquired Brazilian 99 in January 2018 with a view to expanding their market in Latin America (Didi Chuxing, 2018).

¹ Financial information in this chapter was all retrieved from CBInsights' website: <https://www.cbinsights.com/>. Operational information (e.g. on city counts) were retrieved from the company websites, including <https://www.uber.com/>; <https://www.olacabs.com/>; <https://99app.com/>; <https://www.grab.com/>; <https://www.careem.com/>; <https://taxify.eu/>; <http://www.easytaxi.com/>; <https://www.go-jek.com/>. For lack of detailed information on the company websites on the list of cities in which Didi Chuxing and Yandex.Taxi operated, ballpark figures (respectively 450 and 130 cities) were obtained and cross-checked using secondary sources.

Founded in 2010, the India-based company Ola was operating in 102 Indian cities as of February 2018 and also launched operations in 3 cities in Australia that same month. Ola received \$0.5bn in funding from Didi Chuxing in 2015. As of February 2018, it was in competition with Uber in 30 cities in India and in Melbourne, Perth and Sydney in Australia (with additional competition from Estonian Taxify in Melbourne and Sydney).

Founded in 2012, the Brazilian company 99 was operating in 586 cities in Brazil as of March 2018. It was in competition with Uber in 96 of these cities (making it Uber's largest competitor outside the U.S. in terms of numbers of cities), and with Brazil's Easy Taxi and Spain's Cabify in respectively 23 and 8 of them. After receiving \$0.1bn in funding from Didi Chuxing in January 2017, 99 was eventually acquired by the Chinese company in January 2018 (99, 2018; Didi Chuxing, 2018).

Based in Moscow, Russia, Yandex.Taxi was founded in 2011 as a full subsidiary of Yandex, a Russian conglomerate specializing in Internet-related products and services (including Russia's biggest Internet search engine). As of March 2018 it was operating e-hailing taxi services in approximately 130 cities in Russia and 30 more cities in neighboring countries. Pending the merger of their services in Russia, Kazakhstan, Azerbaijan, Armenia, Belarus, and Georgia into a new holding company (Yandex, 2017a and 2017b), Yandex.Taxi and Uber had competing operations in 16 cities in Russia – in which they were also in competition with Israel's Gett (present in 77 cities in Russia) – and 10 cities outside Russia.

Finally, the Indonesian company Go-Jek, founded in 2010, is a very specific case since it specializes in motorcycle ride-hailing services (*ojek* is the Indonesian word for a motorbike taxi). As of March 2018 it was operating in 51 cities, exclusively in Indonesia. It is widely acknowledged that in part of their market, such services are in direct competition with the more traditional ride-hailing services (i.e. four-wheel motorized vehicles). As of March 2018, Go-Jek was in competition with Uber in 21 cities and with Grab in 42 cities (with an overlap of 19 cities where all three operators were present).

Altogether, these five major home-grown ride-hailing service providers in large emerging economies have become domestic champions – with at best an embryonic international presence as of early 2018. Although they have developed in competition with Uber in the biggest cities on their home market, they have remained almost unchallenged in the second- and third-tier cities.

2.2.2 Some other actors from developing countries have opted for regional development strategies

Besides the leading home-grown operators in large emerging economies, a myriad other actors from developing countries are providing ride-sharing services to local markets. Two of them, however, have emerged as regional leaders, namely Careem (also known as Careem Networks) in the Middle East and North Africa, and Grab (formerly known as GrabTaxi) in Southeast Asia.

Careem was founded in Dubai in 2012 and as of March 2018 was operating in 75 cities exclusively in developing countries, including 44 cities in the Middle East (24 in Saudi Arabia, 6 in the United Arab Emirates, 4 in Jordan, 3 in Palestine, 2 in Qatar, and 1 in Bahrain, Lebanon, Iraq, Kuwait and Oman), 17 in Africa (14 in Egypt and 3 in Morocco), 13 in Pakistan and Istanbul in Turkey. It was in competition with Uber in 17 of these cities and with Easy Taxi in 6. Didi Chuxing took a corporate minority interest in Careem in 2017 as part of a strategic partnership to support the development of the platform in the Middle East and North Africa (Didi Chuxing, 2017b).

Grab was founded in Singapore in 2012 and as of February 2018 had gained a strong foothold in Southeast Asia, being present in 161 cities in the region, including 106 in Indonesia, 28 in Malaysia, 11 in Thailand, 8 in the Philippines, 5 in Vietnam, 1 in Cambodia, 1 in Myanmar, and in Singapore. It was in competition with Uber in 44 of these cities. After an initial investment in Grab in 2015, Didi Chuxing invested a further \$2bn in July 2017 with co-investor SoftBank Group. Uber later took a corporate minority interest in Grab in March 2018.

All in all, ride-hailing actors from developing countries play major roles in the worldwide competition between Uber and Didi Chuxing. Since Didi Chuxing managed to buy Uber out of all its operations in China in 2016, the Chinese company has endeavored to enter into competition with Uber on many of their international markets via a portfolio of strategic or capitalistic partnerships: with Taxify in Europe and Africa, with Ola in India and Australia, with 99 in Latin America, and with Careem in the Middle East and North Africa. Uber on the other hand managed to secure its operations in Russia by entering into a joint-venture agreement in late 2017 to merge operations with Yandex.Taxi in Russia and neighboring countries. The role Grab will play in this landscape is yet to be determined, as the Southeast Asian company holds an unequivocally dominant position in its native region while it both received significant funding from Didi Chuxing in 2017 and extended a corporate minority share to Uber in 2018.

2.2.3 Additional actors competing for the ride-hailing market of cities in developing countries

A home-grown Brazilian company founded in 2011, Easy Taxi is a unique case among ride-hailing providers from the developing world. Indeed, besides operating in the highly competitive Brazilian market (as of March 2018, it was in competition with Uber and 99 in 24 Brazilian cities and faced additional competition from Cabify in 6 of these cities), the company has expanded internationally and by March 2018 was operating in 108 cities in 29 developing world countries (including 85 cities in the Americas, 12 in Asia, 6 in the Middle East and 5 in Africa) and 8 cities in South Korea. Altogether, as of March 2018 it was in competition with Uber in 84 cities and 26 countries around the world, making it Uber's biggest competitor in terms of numbers of countries, and its second biggest competitor outside the U.S. borders in terms of numbers of cities, behind the Brazilian operator 99.

In addition to operators with a large domestic market and those with a big international presence, numerous platforms have developed to serve local markets, e.g. Snapp in Iran (10 cities as of March 2018), Ousta in Egypt (11 cities), Oga Taxi in Nigeria (3 cities), BiTaksi in Turkey (2 cities). There was little evidence as of early 2018 as to whether such locally focused actors would be able to survive the competition from larger or more international actors in their home markets and what role they would eventually play in the general competition for ride-hailing provision in cities in developing (and developed) countries. Box 1 illustrates the proliferation of ride-hailing services in developing world cities, focusing on Africa and using a systematic inventory of the most popular ride-hailing apps (with at least 10,000 downloads from iOS or Android app stores) in a selection of 20 large cities in African countries with well-established app-development activity.

Table 1. City count and funding of major ride-hailing services native to developing countries

Company name	Headquarters	Founded	City count	Total funding	Corporate investors from the ICT industry (from earliest to latest funding)
Didi Chuxing	Beijing, China	2012	~450	\$18.1bn	Sina Weibo, Tencent Holdings, Alibaba Group, Apple, Uber , Foxconn Technology Company
Ola	Bangalore, India	2010	105	\$3.8bn	Didi Chuxing , Tencent Holdings
Go-Jek	Jakarta, Indonesia	2010	51	\$1.75bn	Rakuten Ventures, Tencent Holdings, Samsung Ventures, Meituan-Dianping, JD.com, Google
99	Sao Paulo, Brazil	2012	586	\$0.84bn	Qualcomm Ventures, Didi Chuxing (corporate majority)
Yandex. Taxi	Moscow, Russia	2011	~160	n.a.	Yandex (parent)
Grab	Singapore	2012	161	\$4.64bn	Qunar, Didi Chuxing , Uber
Careem	Dubai, U.A.E.	2012	75	\$0.57bn ^(*)	Saudi Telecom Company Ventures, Didi Chuxing
Easy Taxi	Sao Paulo, Brazil	2011	~118	\$0.08bn	Rocket Internet, Latin America Internet Holding, Africa Internet Holding, iMENA, Moby Ventures, Holtzbrinck Ventures

^(*) Not including Didi Chuxing's investment in August 2017 (amount not disclosed).

Source: Author's own construction based on data from CBInsights as of March 2018

Box 1. The rise of ride-hailing apps in large African cities (1/2)

As of 2017, there were 1.3 billion people in Africa, 17% of the world population. More than half of world population growth by 2050 is expected to occur in Africa, meaning that the African population would have doubled and would represent 26% of the world population (UN, 2017). Africa is also set to be the region with the fastest urbanization rates in the coming decades. In 1990, one third of Africa's population was urban. By 2050, the figure is projected to reach 56%. As of 2017, 60% of the population was under 25 and 41% under 15.

Africa is a region experiencing massive change, not only in demography and urban development, but also in the adoption and use of mobile ICTs. As of late 2016, there were 420 million individual mobile subscribers in Sub-Saharan Africa, a penetration rate of 43% (27% in 2010). Mobile penetration in the region is likely to continue to grow faster than in any other region of the world. Smartphone connections in Sub-Saharan Africa doubled in just two years to account for 27% of mobile connections in the subcontinent in 2016. This rate could double again (to 54%) by 2020 (GSMA, 2017a). Mobile phone penetration in North Africa was already 67% in 2017, very close to the global average. Smartphone connections in the region accounted for 41% of mobile connections in 2017, and could reach 64% by 2020. Though more mature than Sub-Saharan Africa, North Africa remains a market with strong growth potential for mobile ICT in coming years (GSMA, 2017b).

As recent research has demonstrated, paratransit services – including all the intermediate transport modes between the private car and mass transit, whether formal or informal – play a major part in African urban mobility systems (Behrens et al., 2015). In particular, they are a key asset in providing access to demand segments that are not otherwise served, especially in a context of rapid demand growth (Cervero and Golub, 2011; Lesteven and Boutueil, 2018). ICT has brought many changes to the paratransit industry in Africa, one of which has been the rapid development of ride-hailing services (including ride-sourcing using for-hire vehicles and taxi e-hailing) (Boutueil and Lesteven, 2018). As of March 2018, Uber had operations in 15 African cities, Careem in 17, Taxify in 11, Easy Taxi in 5, Heetch in 1. Altogether, 30 African cities were hosting the operations of one or more international ride-hailing service providers.

Table 2. Main ride-hailing services operating in a selection of large African cities as of March 2018

App	Origin	Creation	Downloads (Android)	Cities (by pop. size)	Cairo, Egypt	Lagos, Nigeria	Luanda, Angola	Nairobi, Kenya	Algiers, Algeria	Dar es Salam, Tanzania	Johannesburg, S. Africa	Accra, Ghana	Abidjan, Côte d'Ivoire	Casablanca, Morocco	Kampala, Uganda	Dakar, Senegal	Harare, Zimbabwe	Ouagadougou, Burkina Faso	Yaoundé, Cameroon
					X	X	X	X	X	X	X	(†)	X	X	X	X	X	X	X
Uber	U.S.A.	2009	100,000,000 +		X	X	X	X	X	X	X	X	(†)	X					
Careem	U.A.E.	2012	10,000,000 +		X								X						
Easy Taxi	Brazil	2011	10,000,000 +		X	X	X												
Heetch	France	2013	1,000,000 +										X						
Taxify	Estonia	2013	1,000,000 +			X	X	X	X	X					X				
Little Cab (*)	Kenya	2016	100,000 +			X	X								X				
Mondo Ride (*)	Kenya	2016	100,000 +				X	X							X				
Saytaxi	Estonia	2013	100,000 +			X													
Yassir	Algeria	2017	100,000 +					X											
Baxi: The Taxi (**)	India	2015	50,000 +				X								X				
Oga Taxi	Nigeria	2014	50,000 +		X														
SafeBoda (**)	Uganda	2015	50,000 +												X				
Africab	C. d'Ivoire	2016	10,000 +						X				X			X			
Allo Taxi	Lebanon	2014	10,000 +				X			X									
MaraMoja	Kenya	2013	10,000 +				X												
Pewin Cabs	Kenya	2016	10,000 +				X												
PickmeApp	Algeria	2013	10,000 +					X											
TaxiJet	C. d'Ivoire	2015	10,000 +										X						
TaxiPixi	India	2012	10,000 +		X							X							
TemTem	Algeria	2017	10,000 +					X											
VotreChauffeur.ma	Morocco	2015	10,000 +											X					
Wesselni	Algeria	2017	10,000 +					X											
Yenko Taxi	Ghana	2017	10,000 +									X							
ZebraCabs	S. Africa	2008	10,000 +							X									

* Ride-hailing platform including moto-taxi services. ** Ride-hailing platform specializing in moto-taxi services. The 30 most populous agglomerations in Africa were initially considered; 10 of them were set aside to retain only one city per country; of the remaining 20 agglomerations, a further 5 were set aside on the basis of their low scores for the GSMA indicator "apps developed per mobile Internet user" for 2016 (<https://www.mobileconnectivityindex.com/>). Only apps with 10,000 downloads or more are inventoried. A bold **X** is used when the app is native to the country considered.

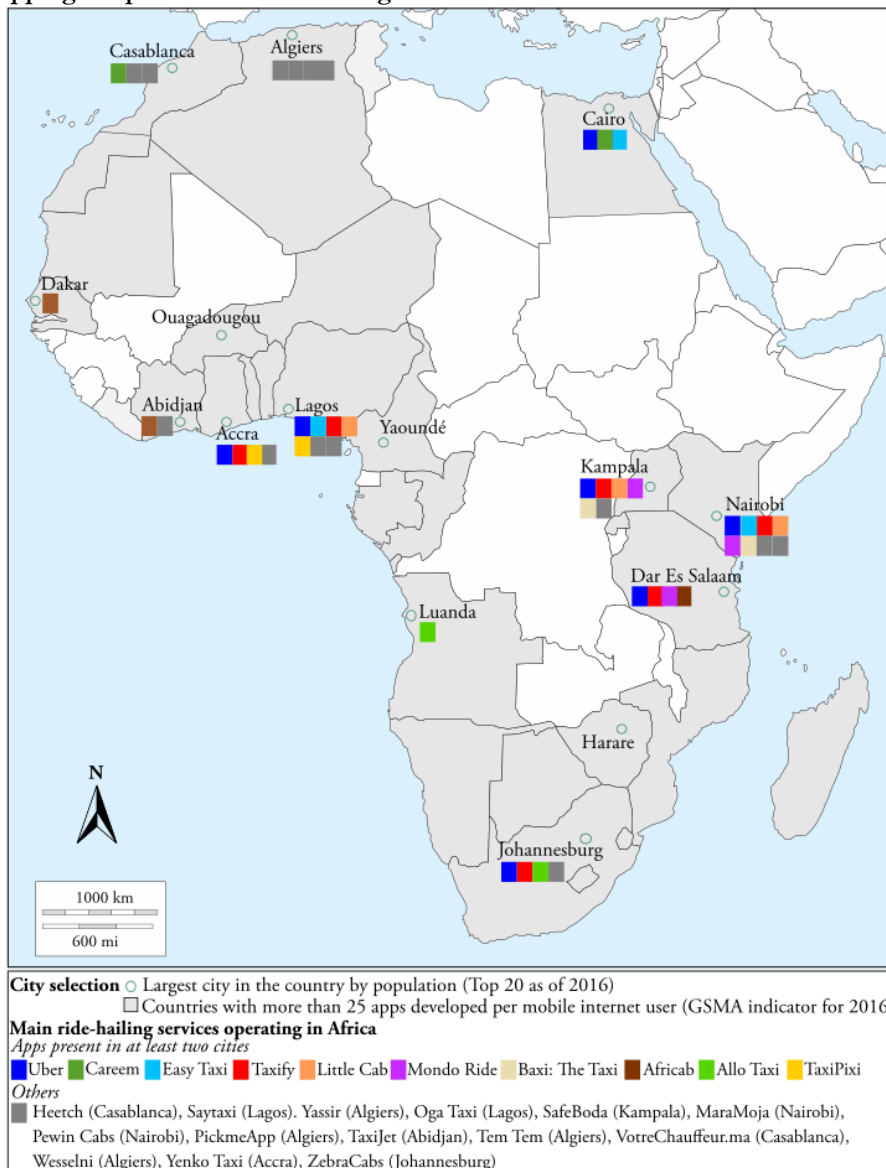
Source: Boutueil V. and Mornon C., unpublished data; download statistics from Google Play as of March 2018.

Box 1. The rise of ride-hailing apps in large African cities (2/2)

Table 2 presents an inventory of the main ride-hailing services (including ride-sourcing using for-hire vehicles and taxi e-hailing) operating in a selection of 15 of the largest cities in Africa. It reveals both the growing foothold of major international apps on the African continent (Uber, Careem, Easy Taxi, Heetch, Taxify) and the proliferation of locally-developed apps. Altogether 24 apps with over 10,000 downloads on Google Play (Android) were inventoried in the 15 cities as of March 2018. Several development patterns can be identified. Unlike major international players such as Uber, Easy Taxi and Taxify, which were present across the continent, several apps would seem to focus on a particular region – e.g. Careem on North Africa, Mondo Ride on East Africa – or even on their home country (12 of the 24 apps). Only the native apps Little Cab and Africab had opted for a wider range as of early 2018.

The three cities with the greatest number of ride-hailing services as of March 2018 were Nairobi (8), Lagos (7), and Kampala (6). At the other end of the spectrum, three of the selected cities hosted not even one significant ride-hailing service. Whether or not population is a factor remains to be analyzed, but it is noticeable that of all selected cities with fewer than 4 million inhabitants, only Dakar was host to one significant ride-hailing service. Two cities only seem to host apps that are home-grown in their country: Algiers (3) and Abidjan (2). Further research would be needed to uncover the reasons for these diverse situations of ride-hailing supply in major African cities. Explanatory factors could include socio-demographics, urban form, ICT situation, political aspects, safety, etc. A dynamic perspective would further be needed to uncover trends in the development strategies of ride-hailing services in the area.

Figure 1. Mapping the presence of ride-hailing services in a selection of African cities



Source: Boutueil V. and Mornon C., unpublished data.

2.3 Developing countries are pioneers in the diversification of ride-hailing formats and options

As they have adapted their services to local situations that were rather disparate in terms of demand, competition and regulation, major ride-hailing service providers have generally diversified their service portfolio to include, depending on local context, taxi e-hailing, ride-sourcing with licensed drivers, ride-sourcing with unlicensed drivers, ride-pooling (i.e. splitting of rides among two or more passengers), van-pooling, and even car-pooling in some cases (e.g. Didi Chuxing).

The founders of Go-Jek were pioneers when in 2010 they created the first large-scale ride-hailing platform originally dedicated to motorcycle rides. Other specialized platforms have since been launched, such as Baxi and Rapido (based in India, founded in 2015), SafeBoda (based in Uganda, founded in 2015) and iMoto (based in Bangladesh, founded in 2017), all rooted in cities where moto-taxi services were already thriving. In addition to these specialized platforms, many traditional ride-hailing service providers (i.e. based on four-wheel motorized vehicles) have included motorbike ride-hailing in their service portfolio over recent years. This includes major players such as Grab (a GrabBike service was launched in Vietnam as early as 2014), Uber (an UberMoto service was launched in several Asian cities in 2016, and may be launched in East Africa in the course of 2018), Ola (Ola Bike was launched in several Indian cities in 2016) and Taxify (TaxifyBoda was launched in Uganda in 2018), but also local competitors such as Mondo Ride or Little Cab (both included *boda-boda* services in their ride-hailing options in Kenya from 2016 and 2017 respectively). Interestingly, diversification from motorbike to traditional car-based ride-hailing has also occurred, e.g. when Go-Jek launched a Go-Car option in 2016 to better compete with Uber and Grab in Indonesian cities.

Home-grown ride-hailing service providers in developing countries have also been pioneers in diversifying their activities far beyond passenger transport services. Uber's diversification into the food delivery industry through Uber Eats (initially launched as UberFRESH in California in 2014, the platform got its own app in 2015 and was rebranded as UberEATS) has been documented in the literature, together with other "crowd-sourced" delivery services in developed countries (see, for example Carbone et al., 2017; Dablanc et al., 2017). Research on similar initiatives originating in developing countries has so far been very limited. Nonetheless, Go-Jek was a pioneer in goods transport crowd-sourcing in more ways than one: they launched Go-Food (instant food delivery) and Go-Mart (instant grocery deliveries) as early as 2015, then launched Go-Send (instant courier service), Go-Box (removals service) and Go-Med (prescription collection and delivery) in 2016, all integrated into the Go-Jek app and helping to diversify revenue streams for their motorcycle riders (Eskenazi and Boutueil, 2016). Go-Jek was also a pioneer in mobile services: they launched Go-Massage (massage service), Go-Clean (cleaning service) and Go-Glam (hair stylist and beauty care services) in 2015, then Go-Auto (car maintenance) in 2016. Unlike services related to the transport of goods, these offerings are integrated into a separate app developed by Go-Jek: Go-Life.

2.4 Developing countries were also pioneers in free-floating bike-sharing

As already described in Chapter 2, developing countries have also been pioneers in the development of new mobility services in the form of free-floating (i.e. station-less) bike-sharing. Chinese companies Ofo and Mobike (founded in 2014 and 2015 respectively, with more than \$2bn each in disclosed funding) have pursued aggressive international development strategies, launching smartphone-enabled free-floating bike-sharing services in Asia, Australia, Europe, and the U.S., in, respectively, more than 250 cities (in 21 countries, including China, India and Russia, and also Kazakhstan, Malaysia and Thailand) and more than 200 cities (in 13 countries) as of February 2018. The extent to which such services will contribute to the diversification of mobility options in a wide range of developing countries in the years to come remains unclear. It is also unclear whether the business and operational models of such innovative services are in fact sustainable. Nevertheless, such privately-supported services could provide an alternative to public bike-sharing schemes in countries or cities that lack appropriate funding.

3. CHALLENGES AND OPPORTUNITIES OF SMARTPHONES FOR URBAN MOBILITY POLICY-MAKING IN DEVELOPING ECONOMIES

3.1 Exacerbated challenges

The challenges facing urban mobility systems (and policy-makers) in developing countries as a result of the spread of smartphones are in many ways similar to those facing urban mobility systems in developed countries, though they may take different forms depending on local context.

The main challenge common to both categories of urban mobility systems lies in the integration of new (smartphone-enabled) mobility services into urban mobility systems and public space, which requires the establishment of a fair regulatory framework and the modernization of existing public transit services if all services are to compete on a level playing field. The rapid uptake of new (mobile ICT-enabled) mobility services in cities in developing countries tends to put pressure on established transport modes and in some instances disrupts existing markets (Schechtner and Hanson, 2016). On the one hand, these services may help to meet latent mobility demand (whether unexpressed, or expressed but unmet) and increase overall accessibility in cities where mobility supply – including infrastructure, services and vehicles – falls short of expectations. On the other hand, the effects of such services both in terms of inequality of access (among different categories of population) and in terms of traffic congestion, remain unclear. While similar issues arise in developed countries, the challenges to the urban mobility systems of developing countries tend to be exacerbated by accelerated population growth and urban sprawl in some developing world cities (Schechtner and Hanson, 2016).

Another challenge arising from the spread of smartphones that is common to cities in both developed and developing countries is the increasingly central role of data in the organization, management and supervision of new mobility services, which requires a transformation and diversification in the expertise and skillset demanded of policy-makers to leverage such data for planning and regulatory purposes. Given the existing challenges facing developing countries around institutional capacity building in the transport sector (see, for instance: Jarvis, 2017; Hidalgo and King, 2014; Dotson, 2011; Gogelia and Talvitie, 2011; Cervero and Golub, 2007), it can be anticipated that the development of the new expertise and skills needed for public policy-makers to keep pace with the rapid changes in the business and operational models of new mobility services, will not come without major effort. Moreover, the challenge of capacity building in developing countries is further exacerbated insofar as the innovations resulting from the spread of mobile ICT are bound to affect pre-existing mobility services, especially paratransit, which are massive sources of employment to low-skilled workers and where certain management skills may be lacking (Cervero and Golub, 2007). As prior attempts at transformation have shown in some contexts, the ability of public policy-makers to effectively engage such stakeholders often involves a process to support capacity building in the service providers (for the reform of the minibus taxi industry in South Africa, see: Schalekamp, 2017; Behrens and Schalekamp, 2010).

The third challenge facing urban mobility systems in developing countries as a result of the spread of the smartphone is very specific to those types of urban context where mobility services are more developed than private car ownership. While developed countries are faced with the challenge of leveraging the digital transformation and integration of transport services to make the transition to a conception of mobility as a service, developing countries are faced more with the challenge of enabling, or even facilitating, the digital transformation of already significant mobility services – including transit and paratransit, formal and informal services, etc. – on the grounds that this may open up alternative mobility pathways for developing world cities and in particular help resist the rapid rise in private car ownership and use (Boutueil and Lesteven, 2018; Sengers and Raven, 2014).

3.2 Amplified opportunities

On the other hand, it could be argued that the dissemination of mobile phones may offer greater opportunities to improve the performance of urban mobility systems in developing countries than in developed countries.

As in the case of cities in developed countries, the spread of the smartphone in the cities of the developing world has made possible the development of new mobility services including, but not limited to, ride-hailing in its many forms and free-floating bike-sharing. Technology-enabled services may play a role in increasing overall accessibility in such cities where mobility supply – including infrastructure, services and vehicles – tends to fall short of demand, even though public authorities may be concerned that the said services should not in fact be accessible to the whole population (e.g. for lack of adequate means – financial and practical – or adequate skills).

Moreover, the spread of mobile phones could offer policy-makers in developing countries various other kinds of opportunities beyond the development of new services. In particular, it could help them build up their knowledge and expertise relating to the mobility system and provide them with new tools to monitor and improve its performance.

3.2.1 Building up knowledge and expertise relating to the mobility system

Paratransit services have remained a major component of most urban mobility systems in developing countries. Because they were historically informal (and in many cases still are) and because not all of them operate along fixed routes or schedules, information about the service provided in a given city by the industry as a whole has been impossible to consolidate (e.g. in the form of network maps or planning tools for multi-leg journeys) (Klopp et al., 2014; Zegras et al., 2015). Paratransit users therefore have to rely on their own expertise or on the expertise of relatives to plan their journeys, which can be especially difficult in the case of one-off, multi-leg journeys (Zegras et al., 2015). Under these circumstances, it is probable that even public authorities would base their regulations on partial data complemented by experience and hearsay (Boutueil and Lesteven, 2018).

Digital Matatus was an initiative led by a team at Massachusetts Institute of Technology, University of Nairobi, Columbia University, and the consulting firm Groupshot. In 2014 it produced a consolidated overview of more than a hundred *matatu* (midi-bus) routes serving the city of Nairobi and has become the most famous of all paratransit mapping projects in developing countries around the world. This project demonstrated the possibility of using mobile phones to develop an open source database on non-traditional transit in an adapted version of GTFS (General Transit Feed Specifications) format. The expectation was that, on the basis of the data collected, new technology and services, e.g. transit routing apps, could in turn develop (Williams et al., 2015; Klopp et al., 2014).

Although it did not attract as much publicity, a project similar to Digital Matatus produced the first map of paratransit networks in Dhaka in 2013. It was led by a team from Massachusetts Institute of Technology, together with consulting firm Urban Launchpad and the NGO Kewkradong Bangladesh (Zegras et al., 2015). A survey of frequent transit users' perceptions of the new map revealed that, for a vast majority of interviewees, not only would the resulting map make it easier for them to navigate the transportation system, it would also increase the likelihood that they would take a different bus than usual and that they would visit a part of the city to which they had not previously travelled (Zegras et al., 2015).

Once the feasibility of smartphone-enabled mapping of transit and paratransit systems was established, other projects followed suit, including in Accra (Saddier et al., 2016), Mexico City (Sandoval-Almazan et al., 2017), Kampala (Ndibatya et al., 2017), Bogotá (Goldwyn and Vergel-Tovar, 2018), La Paz, Tunis, etc.

As in the case of prior attempts to transform the paratransit industry, real participation by a wide range of stakeholders (including communities, operators and local authorities) has proven key to their success, in terms of overall trust in the output, value added for the users, innovation opportunities for service providers

(e.g. through an open-data approach), and official endorsement (Williams et al., 2015). The latest developments in this area even leverage innovation labs and gaming approaches in order to foster participation by all parties and add value to public decision-making processes, as in Mexico City's Mapatón project (Sandoval-Almazan et al., 2017).

Beyond innovative approaches to mapping transit and paratransit services in cities in developing countries, smartphones may indirectly offer public policy-makers the opportunity to tap into the data collected by smartphone-enabled mobility services such as ride-hailing to build up their knowledge of their city's mobility system, including mobility patterns (admittedly confined to specific user groups), vehicle flows, peak hour traffic congestion, travel time reliability, road incident black spots, etc. An initiative like this was launched in 2016 in Manila, through a collaboration between ride-hailing service provider Grab, the Philippine Department of Transportation and Communications (DOTC) and the World Bank (Schechtner and Hanson, 2016). The actual outcome of this or similar initiatives remains yet to be documented.

3.2.2 Improving the level of service provided by public transit and paratransit services

With safety and reliability (including time reliability) being two of the major issues facing the users of paratransit services (Joewono and Kutoba, 2007), mobile phones offer promising prospects for improvement in the level of service provided by transit and paratransit services.

A number of smartphone- (or more generally, cellphone-) enabled solutions have been developed to provide transit and paratransit users with real-time information on traffic conditions, congestion and incidents. For instance, the Nairobi-based start-up Ma3Route, a spin-off of the Digital Matatus project, runs a crowd-sourced real-time information service that generates a feed for the benefit of *matatu* users through a light-data app, reporting on traffic conditions and accidents in three different languages. A partnership with the National Transport and Safety Authority and Nairobi City Council has further allowed for real-time reporting on bad driving behavior through the Ma3Route app (Boutueil and Lesteven, 2018). Other real-time information services have developed in various cities in developing countries, e.g. GoMetro app and USSD services in Cape Town, Durban and Johannesburg-Pretoria.

In Malaysia, the Land Public Transport Authority (SPAD) has incorporated Grab into their taxi development strategy, with a view to improving the taxi experience of citizens and tourists in Kuala Lumpur. Ride-hailing apps are thus envisaged as alternatives to quality requirements in the licensing process, with significant leverage to improve the service through citizen participation (driver rating, etc.) (Eskenazi and Boutueil, 2016). Similar initiatives have been developed in other parts of the world, e.g. BA Taxi, the Buenos Aires government's app to ensure safer taxi transport, but limited research has been done on these solutions.

4. TAKING A STEP BACK... AND EXAMINING OUTSTANDING ISSUES

Although they form a limited part of the academic literature looking at the effects of the smartphone on urban mobility systems, cities in developing countries are attracting increasing scholarly attention. Some rebalancing is still needed, though, if research is to account for the specific challenges and opportunities of the spread of smartphones for urban mobility systems in the developing world. The good news is that rebalancing is underway and the fact that such research may yield interesting lessons on the transformation of urban mobility systems in developed countries can only help to foster the process.

4.1. Global trends vs. local adaptations

The spread of mobile ICT in general and smartphones in particular is a global phenomenon that could see many developing countries leapfrogging to the type of technology and level of penetration observed in developed countries within just a few decades. Yet, the question of whether this process will yield similar outcomes in developing and developed countries in terms of the transformation of mobility behaviors,

services and policy-making, remains open for discussion. In building up research on the issues considered here, special precautions should be taken to refine the understanding of urban mobility systems in developing countries, and to acknowledge the *diversity* of local situations in terms of demographics, urban form, but also political stability, economic dynamism, regulatory capacity, ICT diffusion, etc.

In practice, the adaptation of technology-enabled solutions to the local contexts of cities in developing countries, taking into account such factors as the penetration of mobile Internet, the types of mobile phone used, the quality of Internet access, the cost of voice, text and data communications, the penetration of mobile payment, etc., seems to be a crucial challenge for their adoption on a large scale in the cities of developing economies (Boutueil and Lesteven, 2018). From a research perspective, examining to what extent and how technology-enabled solutions are indeed adapted to local situations, may bring useful insights for anticipating their effective potential to transform urban mobility systems in cities of developing economies around the world.

One example of adaptation to local context has been the development of USSD- and SMS-based services (for mobility-related information, booking, payment, etc.) instead of, or in addition to, mobile Internet and apps. Whether such low-tech (or low-cost technology) solutions are just a transitory palliative for lack of a better solution, or whether they provide significant advantages that are bound to endure and could be exploited in other contexts, remains to be assessed. In any case, low-cost technology solutions may offer major prospects for improving the level of service of transit and paratransit services for the many, in cities where cost (of devices, data, etc.) is still a sensitive issue.

4.2. Will smartphones help make urban mobility in developing countries smart?

More research is needed to explore the extent to which smartphones and other mobile technologies may help make mobility in the developing world “smart” or “smarter”, i.e. more focused on “usership” than ownership, more intermodal, more user-centric, etc. (Docherty et al., 2017). If we assume here that urban mobility systems can only be as “smart” as their stakeholders, it should be considered how the dissemination of smartphones may change how public policy-makers, service providers and citizens participate in the transformation of urban mobility systems.

On the regulation side of urban mobility systems, new research topics need to be explored in order to gather useful insights into the challenges and opportunities of mobile technologies for public policy-makers in cities of the developing world. These would include:

- the processes of capacity-building for the benefit of public policy-makers in relation with new technologies, new data, new services, etc.;
- the role, quality and relevance of smartphone-sourced data in public policy-making processes (Jerven and Johnston, 2015);
- the use of public consultation and citizen participation in decision-making processes (Sandoval-Almazan et al., 2017; Dotson, 2011), including planning processes (Kash and Hidalgo, 2014);
- the use of mobile technologies in various aspects of the regulation and monitoring of urban mobility systems (e.g. dynamic traffic regulation, safety regulation, taxation, licensing processes);
- collaborative approaches to the production, availability and analysis of mobility data.

On the supply side, further research is also needed on a wide range of topics relating to the transformative effects of mobile technologies on public transit and paratransit services, including with regards to:

- the specific features of service diversity, competition, hybridization, integration (or aggregation) in cities of the developing world;
- the role of smartphone-sourced data in monitoring and improving service performance and level of service;
- the processes of capacity-building for the benefit of transit or paratransit operators in relation with new technologies, new data, new services, etc.;

- the possibility of disruptive smartphone-based innovations in mobility creating social capital in urban communities (Suseno, 2018);
- the type of labor organization (i.e. employment model, wage structure, contractual relations, etc.) that smartphone-based mobility solutions will help promote (Boutueil and Lesteven, 2018);
- the possible empowerment of drivers through smartphone use (Eskenazi and Boutueil, 2016; Duncombe, 2014).

Finally, on the demand side, additional strands of research that need to be pursued to assess the transformative effects of mobile technologies on citizens in general, and transit and paratransit users in particular, would include:

- the effects on travel behavior of awareness of, better information on, and improved access to an extended range of mobility options (Zegras et al., 2015; Guillen et al., 2013);
- the processes of user participation in the production of the service and the optimization of its performance (Eskenazi and Boutueil, 2016);
- the contribution of smartphones to the creation of communities around particular services (Williams et al., 2015).

4.3. Will smartphones help make urban mobility in developing countries sustainable?

All the observations made in this chapter raise the question of whether smartphones and other mobile technologies will help put the cities of developing countries, whose populations are growing rapidly, on the track to mobility trajectories that are more in line with the environmental as well as social objectives of sustainable development.

Further research would be needed into the overall impacts of smartphone-enabled mobility services on inequalities of access in developing world cities. So far, concerns have indeed been voiced that some of these services (e.g. ride-hailing) would mostly serve the needs of a growing middle- and upper-class market in developing countries (Schechtner and Hanson, 2017). Moreover, further research is needed into the special nature, forms and impacts of the “digital divide” on access to mobility services in developing cities transitioning to technology-enabled mobility.

More research would also be needed into the potential direct and indirect contributions of smartphones and smartphone-enabled mobility solutions to sustainable development goals in general, and sustainable mobility transitions in particular. In particular, it has been suggested that mobile phone-based solutions could play a major role in modernizing paratransit services and maintaining their presence as an integral part of urban mobility systems, alongside transit services, in the decades to come (Boutueil and Lesteven, 2018; Sengers and Raven, 2014). Whether this opportunity will materialize and open up alternative mobility pathways for developing world cities by combating the rapid growth in private car ownership, remains an open question.

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