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THINK PIECE

SHARED MOBILITY IN LOW- AND HIGH- INCOME REGIONS



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Abstract

Although shared and informal transport are not new concepts in low- and middle- income countries (LMICs), a variety of economic, environmental, and social forces are contributing to the growth of shared mobility in LMICs around the world. Shared mobility—the shared use of a vehicle, motorcycle, autorickshaw, minibus, scooter, bicycle, or other travel mode—is an innovative transportation strategy that enables users to have short-term access to a transportation mode. This paper documents key shared mobility and informal transport concepts, terms, and definitions around the world. The paper also discusses the state of shared, informal, and emerging mobility in LMICs and explores the potential similarities and differences between the adoption of these innovations in low-, middle-, and high-income economies. The paper concludes with a discussion of gaps in understanding and potential research needs to enhance collective understanding of shared mobility and informal transport in LMICs.

Introduction

Between 2015 and 2050, the world population is expected to increase by nearly 2.5 billion people with an estimated 97% of this increase occurring in low- and middle- income countries (LMICs) (Walker, 2016). According to United Nations estimates, by 2050, 68% of the world's population is expected to live in cities (United Nations, 2018). Increasing urbanization coupled with rising household wealth is also contributing to higher motorization rates in many parts of the world. Both rapid urbanization and motorization has the potential to contribute to climate change, while simultaneously making more people vulnerable to the impacts of climate change, such as natural disasters, severe weather events, droughts, and famine (United Nations, 2017). Some strategies that could help mitigate and reduce vehicle greenhouse gas (GHG) emissions include: reducing vehicle ownership and use, increasing vehicle occupancy, transitioning to low-carbon and zero emission propulsion systems, shifting to smaller form factors (e.g., automobile to a moped), and substituting trips with digital services (e.g., telework, telehealth).

In cities around the world, innovative and emerging transportation strategies are offering consumers more options to access mobility, goods, and services. Shared mobility—the shared use of a vehicle, auto rickshaw, minibus/bus, motorcycle, scooter, bicycle, or other travel mode—is a transportation strategy that enables users to have short-term access to a transportation mode. In the coming decades, the convergence of various transportation technologies, such as sharing, automation, and electrification have the potential to change how people travel and access goods and services. However, early evidence suggests that shared mobility could have mixed impacts on social, environmental, equity, and labor outcomes in a variety of contexts in both LMICs and high-income countries (HICs). These services are growing in many regions of the world, and consumers appear to be engaging in more complex multimodal behavior. On the demand side, rather than making decisions among modes, travelers are linking modes to optimize routing, travel time, and cost. In some cases, consumers are opting for goods and digital delivery in lieu of making a trip. Additionally, fare and digital information integration has the potential to enhance consumer convenience, increase transparency, and reduce friction in transferring between modes. On the supply side, shared mobility may offer new and flexible employment opportunities. However, the impacts of these strategies on incumbent services such as informal public transport, particularly in LMICs, are not well documented and in many cases more research is needed.

This paper provides an overview of shared and digital mobility in LMICs and explores similarities and differences between the adoption of these innovations in low-¹, middle- (also referred to as lower middle-)², and high-income³ countries. This paper is organized into six sections. The first describes the methodology used in this study. The following section provides key concepts, terms, and definitions. The third summarizes a state of the practice scan of shared mobility in LMICs. This is followed by the fourth section, which compares shared mobility and mobility integration strategies in low-, middle-, and high-income areas. The fifth section summarizes gaps in understanding and research needs. Finally, a summary of the findings is provided.

1. For the current 2022 fiscal year, low-income economies are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of \$1,045 or less in 2020.
2. Lower middle-income economies are those with a GNI per capita between \$1,046 and \$4,095
3. High-income economies are those with a GNI per capita of \$12,696 or more.

Methodology

The authors conducted a comprehensive literature review (i.e., market studies, governmental reports, academic research, conference proceedings, and other items) using a multi-method approach to researching shared and emerging transportation technologies in LMICs. This review was supplemented with an Internet search documenting historic, recent, and planned developments in LMICs. According to the World Bank LMICs include many economies in Africa, China, India, Latin America, the Middle East, and Southeast Asia (The World Bank, 2022). Given the exploratory nature of this research, differences in international terminology, language barriers, and the vast number of industry changes, it is possible that some examples and developments were inadvertently omitted. In addition to the literature review, the authors conducted more than 36 expert interviews with academics, mobility service providers, public sector representatives, and other subject matter experts and thought leaders between May and December 2021 as part of this VREF and a synergistic study conducted for The World Bank (Shaheen & Cohen, Forthcoming). Additionally, the authors hosted a virtual workshop with practitioners and thought leaders (n=18) representing the public and private sectors, non-governmental organizations, and academia in December 2021. The workshop fostered a lively dialogue about the state of shared mobility and informal public transport in LMICs, as well as research gaps. The workshop, expert interviews, and literature review provided a rich understanding of industry trends and developments, along with opportunities and challenges for on-demand mobility in LMICs.

Key Concepts, Terms, and Definitions

While sharing is not a new concept in LMICs, economic models and enabling technologies have emerged that make it easier for households in LMICs to share mobility resources, and in some cases earn additional income by employing underused transportation resources. In LMICs, these services can generally be classified into one of three categories. See Table 1 for terms and definitions.

- 1. Informal Transport:** Supplements public transit options through various form factors (e.g., minibuses, vans) that are usually low cost and imported from higher-income countries; typically operates without formal government approval, on a “full and go” system (i.e., where the operator waits until the vehicle is full before departing), and at the operator’s discretion; and is usually low tech (with the exception of e-Hail when it operates illicitly without government approval) (Kumar, Zimmerman, & Arroyo-Arroyo, 2021)
- 2. Fleet Sharing:** Provides travelers access to various types of shared vehicles or devices (e.g., bikesharing, carsharing) for short-term use
- 3. Ride and Delivery Services:**⁴ Offers travelers access to rides and deliveries provided by auto rickshaws, courier network services, e-Hail, motorcycles, pedicabs, taxis, and other vehicle drivers or device operators

However, as noted by Behrens et al. (2021), informal public transport and shared mobility options can be difficult to define due to similar and overlapping characteristics that lead to seemingly duplicative definitions. Behrens et al. (2021) attributed the following characteristics to each of the three mobility categories:

- 1. Informal Public Transport:** Services are provided by numerous informal or semi-formal organizations, services range from for-hire options to public transport, and a wide range of vehicle options are used (but most commonly a minibus).
- 2. Fleet Sharing (also referred to as sharing systems):** Registered carsharing members rent vehicles at lower cost than conventional car rentals (and the most common vehicle type is a sedan); service models including roundtrip, free-floating, peer-to-peer, and fractional ownership; bike and scooter sharing options operate through similar service models and are often enabled by smartphone platforms.
- 3. Ride and Delivery Services:** Services are smartphone enabled and apps allow for driver and passenger ratings, services operate along fixed-routes or on-demand to meet traveler pick-up and drop-off requests, vehicles are shared to reduce vehicle miles/kilometers traveled, rides can be pre-arranged, goods delivery operates in tandem with ride services, and fares are split among riders.

4. Behrens et al. (2021) do not have a term that encompasses all of the ride and delivery services discussed in this paper, so the common characteristics (as defined by Behrens et al. (2021)) for microtransit, ridesharing, ridesourcing, and ridesplitting are included.

Shared modes, in each of the categories, may be offered to consumers through one of three options: 1) Business-to-Business (B2B) services where a company owns or leases a fleet of vehicles to businesses and their employees and may use low-cost labor to enable valet services that deliver and pick-up vehicles for users; 2) Business-to-Consumer (B2C) services where a company owns or leases a fleet of vehicles to travelers; and 3) Peer-to-Peer (P2P) services where a marketplace, typically an online platform, facilitates carsharing transactions among vehicle owners and guest drivers in exchange for a transaction fee. Additionally, shared vehicles may be available for roundtrip and/or one-way trips. In the roundtrip model, a driver must pick-up and return a vehicle to the same location. With one-way systems, vehicles can be picked up and dropped off anywhere in the service area determined by the mobility provider and/or regulatory agency. Shared mobility, particularly shared micromobility, options can be available through different models including: 1) station-based (i.e., devices are returned to designated station); 2) dockless (i.e., devices are free floating and can be left anywhere within the service area, although there may be parking regulations, such as needing to be locked to something); and 3) hybrid (i.e., a device can be rented from a station but left anywhere within the service area and vice versa).

It is also important to note that public transport is a form of shared mobility. Public transport is discussed in the context of its relationship to and interactions with informal transport, fleet sharing, ride services, and delivery services. This paper discusses many of these key concepts and modes. Due to the vast number of modes, expansive geography, limited research documenting some services, challenges associated with language barriers, and the exploratory nature of this work, the authors were not able to review all of the modes in Table 1 with the same level of detail. Additionally, it should be noted that collecting information on digitally enabled shared mobility services was easier for the authors to collect than the informal sharing of vehicles, rides, and other transport services. This could inadvertently create the perception of a bias toward technology enabled services because the information on these services is generally more widely available. Additionally, some regions and countries have been studied more than others, which can create asymmetric levels of detail across regions. In many cases, more research is needed to document the history, state of the practice, and similarities and differences in shared mobility deployments across LMICs. Table 2 lists alternative names for the modes by regions listed in Table 1. For a complete list of terms, definitions, and alternative names please refer to the supplemental excel database.

Table 1. Existing and Emerging Shared Modes and Related Concepts

Category	Term	Definition
Informal Transport*	Informal Transport	Typically, an informal, unlicensed, or illegal for-hire private transport or taxicab operation. These modes can include various form factors (e.g., minibuses, rickshaws); service types (e.g., fixed-route, point-to-point); and business models (e.g., peer-to-peer, business-to-consumer).
Fleet Sharing	Bikesharing	A service that provides travelers on-demand, short-term access to a shared fleet of bicycles, usually for a fee. Bikesharing service providers may own, maintain, and provide charging (if applicable) for the bicycle fleet.
	Carsharing	A service that provides the traveler with on-demand, short-term access to a shared fleet of motor vehicles typically through a membership and the traveler pays a fee for use. Carsharing service providers usually own and maintain the vehicle fleet and provide insurance, gasoline/charging, and parking. The primary difference between carsharing services and traditional car rentals is that most carsharing programs bill in smaller increments (e.g., hourly or by the minute). Unlike car rentals, technology-enabled carsharing may offer virtual access without the need to exchange keys or interface with a fleet manager. Carsharing has the potential to be an attractive option for vehicle access where auto ownership can be cost prohibitive, particularly for many low- to middle- income households.
	Motorcycle and Moped Sharing	A service that provides the traveler on-demand, short-term access to a shared fleet of motorcycles and/or mopeds for a fee. Service providers typically own and maintain the vehicle fleet and provide insurance, gasoline/charging, and parking.
	Scooter Sharing	A service that provides the traveler on-demand, short-term access to a shared fleet of scooters for a fee. Scooter sharing service providers typically own, maintain, and provide fuel/charging (if applicable) for the scooter fleet. Service providers also may provide insurance.
	Shared Automated Vehicle	A service allowing automated vehicles to be shared among multiple users. Shared automated vehicles (SAVs) can be summoned on-demand or operate a fixed-route service.
	Shared Micromobility	A service that provides travelers with access to a low-speed mode on an as-needed basis. Shared micromobility services include bikesharing, moped and motorcycle sharing, and scooter sharing. Shared micromobility includes various service models and transportation modes that meet the diverse needs of travelers, such as station-based models (i.e., a device is picked-up from and returned to any station or kiosk) and dockless services (i.e., devices are picked up and returned to any location).
	Ride and Delivery Services	Auto Rickshaw
Courier Network Services (CNS)		A commercial for-hire delivery service for monetary compensation using an online application or platform (such as a website or smartphone app) to connect freight (e.g., packages, food, etc.) with couriers using their personal, rented, or leased vehicles, bicycles, or scooters.
e-Hail		Smartphone apps that supplement street hails by allowing on-demand hailing of taxis. e-Hail also is a service that can provide travelers with pre-arranged and/or on-demand access to a ride for a fee using a digitally enabled application or platform (e.g., smartphone apps) to connect travelers with drivers using their personal, rented, or leased motor vehicles.
Ferry		A boat or ship that transports passengers and goods over a body of water and typically a relatively short distance and as a regular service.
Microtransit		A technology-enabled transit service that typically uses shuttles or vans to provide pooled on-demand transportation with dynamic routing.
Pedicab		A for-hire ride service in which a cyclist transports traveler(s) on a tricycle with a passenger compartment.
Pooling (Ridesharing and Ridesourcing/TNCs)		The formal or informal sharing of rides between drivers and travelers with similar origin-destination pairings using mopeds, motorcycles, or motor vehicles. Riders may share some trip costs (e.g., fuel).

Category	Term	Definition
Ride and Delivery Services	Ridesharing (Carpooling and Vanpooling)	The formal or informal sharing of rides between drivers and passengers with similar origin-destination pairings, such as carpooling and vanpooling. Vanpooling consists of seven to 15 passengers who share the cost of a van and operating expenses and may share driving responsibility.
	Taxis	A service that provides the traveler with pre-arranged and/or on-demand access to a ride service in a motor vehicle or motorcycle for a fee for use. The latter is sometimes referred to as a motorcycle taxi. Travelers typically access this ride by scheduling trips in advance by street hail or a smartphone app.
	Transportation Network Company (TNC)	A service that provides a traveler with pre-arranged and/or on-demand access to a ride for a fee typically using a digitally enabled application or platform (e.g., smartphone apps) to connect travelers with drivers who use their personal, rented, or leased motor vehicles. Digitally enabled applications are typically used for booking, electronic payment, and ratings. This is known as a dual-sided market, as it represents both the supply and demand side of a ride service operating between privately owned vehicles/drivers and passengers via an app platform.

Source: Shaheen et al. (2020)

Table 2. Shared Mobility Alternative Names by Region

Category	Term	Higher-Income Countries	Africa	China	India	Latin America	Middle East	Southeast Asia
Informal Transport	Informal Public Transport	jitney, paratransit	aluger, amaphela, brush taxi, bush taxi, candogueiros, candongas, chapas, dala dala, danfos, gbakas, hilux, kombi taxi, matatu, molues, poda poda, sept-place, tanus-tanus, toca-toca, yasi	摩托出租车 (motorcycle taxi), 个体经营出租车 (self-employed taxi), 辅助客运系统 (paratransit system), 三轮车 (tricycle, including motorized tricycles and electric tricycles) 蹦蹦车 [“bouncy car” as a direct translation, but is a nickname of a motorized/ electric tricycle because it bounces a lot while operating on a bumpy road]	gramin seva, jeep, kaduka, maruti omni, sumos, vikram	almendrones, buseta, camonies, chicken bus, colectivo, combi, diablos rojos, gua gua, maquinas, microbus, por puestos, trolebus, trufis	camion, dabaabs, dolmus, grand taxi, lorries, marshrutka, monit sherut	bemos, jeepney, jingle bus, microlet

Category	Term	Higher-Income Countries	Africa	China	India	Latin America	Middle East	Southeast Asia
Fleet Sharing	Bikesharing	bike sharing, bike-sharing		共享单 (directly translated to "shared bike/bicycle", but officially referring to "bikesharing" and is mostly dockless), 公共自行 (public bike/bicycle, mostly referring to docked systems)				
	Carsharing	car sharing, car clubs, car-sharing, carshare, car share		共享汽车 (shared car, also referring to carsharing), 汽车共 (carsharing)				
	Motorcycle and Moped Sharing			共享摩托车 (shared motorcycle), 共享电动自行车 (shared electric bike, but most are mopeds)	scooty			
	Scooter Sharing	e-scooter sharing		共享电动滑板车 (shared electric scooter)				
Ride and Delivery Services	Auto Rickshaw		bajaj, cyclo-pousse, keke-marwa, kekeh, pousse-pousse, raksha, tuk-tuk	自动人力车 (auto rickshaw)	e-rickshaws, tom tom, toto, tuk tuk	ooco taxi	toktok	apes, baby taxis, becaks, cyclo, jumbos, remork-moto, samlaw, sam-lor, tuktuk
	Courier Network Services (CNS)	Courier Network Services, goods delivery		快递服务 (delivery service), 物流服务 (logistics services), 货物交付 (delivery of goods, goods delivery)				
	e-Hail		olando, keke napep, moto, okada, zemi john	叫车 (ride-hailing), 叫车服务 (ride-hailing service)	chakada, tata magic, mahindra gio	bici-taxi, carrito, colectivo taxis, conchos, directos, motoconchos, publico, tap tap		

Category	Term	Higher-Income Countries	Africa	China	India	Latin America	Middle East	Southeast Asia
Ride and Delivery Services	Ferry		pirougue	渡船 (ferry), 轮渡 (ferry, ferry service)		pangas	sambuq	dhoni, heua sa, heua wei, pirougue, slow boats
	Microtransit		bakassi, louage	微公交 (microtransit), 需求响应式公交 (demand-responsive bus)	bus on demand, force cruiser	colectivo, micros, pesero, taxi colectivo, willys		minibus
	Pedicab			三轮车 (tricycle, pedicab)	cycle rickshaw			
	Ridesharing	carpooling, vanpooling		拼车 (carpool), 共乘 (carpool), 拼车服务 (carpool service, carpooling)		carona, covoiturage		
	Shared Automated Vehicle (SAV)	SAV		共享自动驾驶汽车 (shared self-driving vehicle, shared automated vehicle)				
	Taxis		camiao, woro-woro	出租车 (taxi), 出租汽车 (taxi), 计程车 (taxi)	ta ta magic	tap tap	brousse, bush taxi, petit taxi	anggunas, motodop, o-jek, songthaew
	Transportation Network Company (TNC)	ridehailing, ridesourcing, TNC, Voiture de Transport avec Chauffeur, VTC		网约车 (ride-hailing / car-hailing), 网约车公司 (ride-hailing / car-hailing company), 网约车服务 (ride-hailing / car-hailing service)				

Mobility Integration Concepts

Informal public transport and shared mobility options are increasingly being integrated into app-based platforms that may offer trip planning, booking, integrated payment, bundled options, and other transportation and non-transportation services. Depending on the region, three common concepts are emerging. These concepts include:

- 1. Mobility on Demand (MOD):** MOD offers users access to mobility, goods, and services on demand by dispatching or using informal shared transportation services (e.g., auto rickshaws, jitneys); shared mobility; delivery services; and public transportation strategies through an integrated and connected multi-modal network. It is based on the principle that transportation is a commodity where modes have economic values that are distinguishable in terms of cost, journey time, wait time, number of connections, convenience, and other attributes. MOD emphasizes the commodification of passenger mobility, goods delivery, and transportation systems management. This concept is most common in North America.
- 2. Mobility as a Service (MaaS):** MaaS is an integrated mobility marketplace where travelers can access multiple transportation services over a single digital interface. A distinguishing MaaS characteristic is brokering travel with suppliers, repackaging, and reselling it as a bundled package. The primary emphasis of MaaS is passenger mobility (i.e., allowing travelers to seamlessly plan, book, and pay for a multimodal trip on a pay-as-you-go and/or subscription basis). This concept is most common in Europe.
- 3. Super Apps:** Super apps allow users to access several mobility, payment, retail, communications, and other services from a single digital interface. Common examples of super apps in LMICs include Gojek and Grab. Super apps are most common in Southeast Asia, although new platforms have begun emerging in other LMICs (e.g., Gozem in Africa).

State of the Practice Scan

Shared and informal modes have a longstanding history in a number of LMICs and regions such as: Africa, China, India, Latin America, the Middle East, and Southeast Asia. Table 3 through Table 5 provides examples of various shared mobility options in high-income areas (e.g., the U.S.) and LMIC. Generally, the vehicles used for informal public transport are individually owned. However, some fleet sharing and ride and delivery services employ devices (e.g., bikes and mopeds) and vehicle fleets owned by larger and/or multinational companies. The services listed in Table 4 and Table 5 distinguish different vehicle ownership models in three ways: 1) regular text – privately owned vehicle and device fleets, 2) italicized text - personally owned vehicles and devices, and 3) bold text - both privately and personally owned vehicles and devices. For a complete list of operational shared mobility options, please see the supplemental excel database. The subsections following the table discuss a brief history and current understanding of informal public transport, fleet sharing, and ride and delivery services available in each of these regions.

Table 3. Informal Public Transport Options in LMICs

Mode	High-Income Countries	Africa	China	India	Latin America	Middle East	Southeast Asia
Jitney		matatus, Swvl	-	auto rickshaw, chakada, cycle rickshaw, force cruiser, jeep, kaduka, mahindra gio, maruti omni, mini bus, tata magic, vikram	buseeta, chicken bus, colectivo, cam, fixed route taxi, gua gua, microbus, micros	camion, dabaabs, dalmus, grand taxi, lorries, marshurutka, monit sherut, sherut	bajas, beaks, jeepneys, minibuses, tuktuks

Table 4. Fleet Sharing Services in LMICs

Mode	Service Model	High-Income Countries	Africa	China	India	Latin America	Middle East	Southeast Asia
Bikesharing	Dockless			Meituan*				
	Station-Based	Bluebikes*, Capital Bikeshare*, Citi Bike*, Divvy*	-	Hellobike*	-	PBSC*	-	Linkbike*
Carsharing	Point-to-Point	Gig Car*, HyreCar†, Turo†, Zipcar*	Swvl*		Revv*, Zoomcar†		Zipcar*	Drivemate†, Moovby†
	Roundtrip	Getaround*	Komboa†, MINI Sharing†		Drivezy†, Hayr*, Myles*, Ola Drive*, VolerCars(), Zoomcar†	Loomute*	Ekar*, YOYO*	GoCar*, Haupcar*, HipCar†, Roadaz†
Moped and Motorcycle Sharing	Dockless	Revel*, Scoot*	-	-	Bounce*	-	-	-
Scooter Sharing	Dockless	Bird*, Lime*, Spin*	Bolt*	Hellobike*	-	-	-	-

*Indicates B2C model ()Indicates B2B model †Indicates P2P model Indicates personally owned vehicles and devices **Indicates both privately and personally owned vehicles and devices**

Table 5. Ride and Delivery Services in LMICs

Mode	High-Income Countries	Africa	China	India	Latin America	Middle East	Southeast Asia
e-Hail	Cabify [‡] , Flywheel ^{††} , Via ^{††}	Gokidok [‡] , Gozem[‡] , Little ^{††} , SafeBoda [‡] , Teliman ^{††} , Uber [‡] , ZayRide ^{††}	Caocao Mobility ^{††} , Didi [‡] , Meituan [‡] , T3 Mobility [‡] , Xiangdao [‡]	Ola ^{††} , Uber [‡]	99 ^{††} , Bajanda [‡] , Beat^{†††} , Cabify [‡] , Nekso [‡]	Bykea [‡] , Careem [‡] , Fyonka [‡] , Raye7 [‡] , YOYO ^{††}	Gojek [‡] , Grab [‡]
Goods Delivery	Caviar [‡] , Door Dash [‡] , Grubhub [‡] , Instacart [‡] , Kiwibot ^{††} , Postmates [‡]	Gokada^{††} , Gozem [‡] , SafeBoda [‡] , Tupuca [‡]	-	Tata ^{††} , Zyp ^{††}	Delivery Hero [‡] , iFood [‡] , Kiwi ^{††} , Mercadoni [‡] , Rappi [‡]	Careem ^{††} , Swvl ^{††}	Gojek [‡] , Grab [‡]
Pooling	Moovit [‡] , Scoop [‡] , Waze Carpool [‡]	GoVoiturage [‡] , Partagi, Jekalo [‡]		BlaBlaCar [‡] , Poolmycar [‡] , Quick Ride [‡] , sRide [‡]	inDriver [‡]	Darb [‡]	-
Transportation Network Company (TNC)	Lyft [‡] , Uber [‡]	Careem [‡] , Gozem[‡]	Didi [‡]	Ola ^{††} , Uber [‡]	Uber [‡]	Careem [‡]	Gojek [‡] , Grab [‡]

††Indicates B2C model †Indicates P2P model Indicates personally owned vehicles and devices **Indicates both privately and personally owned vehicles and devices**

Africa

Informal public transport is operating across Africa. Unlike public transport in HICs, informal transport (sometimes referred to as 'paratransit') typically offers dynamic services with flexible routing and pick-up times. It also includes a variety of form factors such as informal motorcycle taxis, autorickshaws, passenger vehicles, and larger minibuses (Egiegba Agbiboa, 2020). In Lagos, Nigeria, there are more than 200,000 okada (motorbike taxis) and the industry provides 500,000 jobs (Egiegba Agbiboa, 2020). Low start-up capital and maintenance costs, economic opportunity, and an entrepreneurial spirit has contributed to the growth of informal transport, and particularly those using smaller form factors (Egiegba Agbiboa, 2020) (Nebrija, Lindsay, & Gustale, 2022). Informal transport using larger form factors is also commonplace in many parts of Africa (Nebrija, Lindsay, & Gustale, 2022). In Kenya and parts of Nigeria, "matatus" (i.e., informal minibuses) comprise the vast majority of bus transport (Jensen & Scott, 2017). As of 2017, there were more than 53,000 matatu licenses issued, although some experts estimate that up to 100,000 licensed and unlicensed vehicles may be operating (Latif Dahir, 2019). In recent years, app-based platforms are creating new competition for matatus but could also improve their routing efficiency and help formalize an historically informal transport market. For example, Swvl blends aspects of informal transport and microtransit by using an app that uses algorithms to operate fixed- and demand-responsive minibus services (akin to more formal microtransit service in higher-income countries). Swvl operates in Nigeria and Kenya; they offer both intra and intercity services direct to travelers as well as service specifically for business clients. Swvl 'business' allows companies to book rides for their employees and monitor vehicle location and estimated arrival time (Swvl, 2021). However, high costs of driving, long hours, and low profit margins of informal transport sector operations have raised concerns by informal transport operators. Some of these concerns focus on e-Hail drivers and riders. In some cases, this has contributed to violence and vandalism against e-Hail passengers, drivers, and their vehicles. A few TNC operating headquarters in Africa have reported frequent vandalism and theft. Some African governments have made efforts to regulate both formal and informal transport modes (e.g., licensing and inspecting matatu vehicles in Kenya) to help address competition among different shared modes (Shaheen & Cohen, Forthcoming). Despite increased regulations, feelings of discontent between informal transport and e-Hail operators have led to conflicts. For example, in some instances, groups of drivers have organized to manage informal transport routes and "protect" them against competition from new modes (e.g., e-Hail).

There are also a number of fleet sharing services in Africa, such as carsharing and shared micromobility. In May 2015, Africa's first carsharing service called Locomute, launched in South Africa. Locomute offered roundtrip, one-way, and long-term carsharing and rental options in Johannesburg, Pretoria, Durban, and Cape Town (Roux, 2017). Other carsharing services operating in Africa include Komboa and MINI Sharing. Komboa is a peer-to-peer, roundtrip carsharing service operational in Nairobi, Kenya (Gakweli, 2020). As of October 2020, Komboa had 150 users. MINI Sharing is a roundtrip carsharing service that allows drivers to pick-up and drop-off vehicles from a privately owned fleet from apartment complexes in South Africa (TopAuto Staff Writer, 2021). In December 2018, Volkswagen launched a carsharing and e-Hail service, Move, in Rwanda. The service offered three vehicle options (Polo, Passat, Teramont), and Volkswagen covered the insurance, refueling, and maintenance operations (Volkswagen, n.d.). However, limited information about the success of the carsharing service is available (Bavier & Uwiringiyimana, 2019). In addition to carsharing, a limited number of information technology (IT)-based bikesharing programs are operational in Kenya and Morocco (Medina Bike Marrakech 2021; Zheng 2018; Shaheen & Cohen, Forthcoming). Currently, Bolt, a dockless scooter sharing service, is the only operational shared micromobility service in Africa, which is located in Tunisia (Ikoba, 2020). Limited shared micromobility availability is partially due to the lack of dedicated infrastructure and perceptions that cycling is for the poor (Mwanza, 2018; Shaheen & Cohen, Forthcoming).

Africa also has more than 60 ride and delivery services operating in 33 countries using a variety of form factors such as: auto rickshaws, motorcycle taxis, private for-hire vehicles, vehicle taxis, and e-Hail. In Africa, the majority of these shared ride and delivery services tend to use motorcycles and more traditional booking methods such as phone calls and messaging apps (e.g., Whatsapp). There also has been the emergence of some tech-enabled ride and delivery services; however, these tend to represent a relatively small percentage of the market, particularly outside of larger metropolitan areas (Fatima Arroyo-Arroyo, unpublished data, May 2022). For example, Bolt (previously Taxify), which launched in Africa in 2013 and operates in Nigeria and South Africa, claimed 2.4 million active riders as of September 2018. As of May 2021, Careem – a subsidiary of Uber – operates in more than 100 cities and 13 countries across North Africa and the Middle East (Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Morocco, Pakistan, Palestine, Qatar, Saudi Arabia, United Arab Emirates [UAE]). The technologies that enable ride services (e.g., e-Hail platforms) can offer unique opportunities for local mobility companies to tailor their services to meet local needs. For example, Little Cab – an e-Hail taxi app – operates in Kenya similarly to the global Uber platform. However, Little Cab meets local needs through novel features including: 1) multiple payment options (including cash, credit card, bank account, and M-Pesa [a mobile payment option]); 2) taxi meter fare estimates when a destination is entered into the app; and 3) the ability for riders to play radio stations through the smartphone app. Another e-Hail platform, Tirhal, operates in Sudan and offers the option for female riders to request female drivers. Similarly, the success of SafeBoda – a Super App that launched in 2017 and offers e-Hail services in Nigeria and Uganda, informal transport options, goods delivery, and financial services – has been credited to its locally tailored services (Kene-Okafor, 2021). Localized strategies include working directly with boda boda (i.e., motorcycle) drivers and providing resources, such as driver training and protective equipment (Bronson, 2021). As of April 2021, SafeBoda had completed approximately 1 billion rides in one market: Ibadan, Nigeria (Kene-Okafor, 2021). Other ride services, such as Partagi (which operates in Tunisia), allows drivers and riders to ride match based on a variety of personal preferences (e.g., gender, smoking, music, air conditioning, etc.). However, increased transportation and shared mobility regulations have

Use of Uncrewed Aircraft Systems (UAS)/Drones in Africa

In Africa, drones have been used for medical and humanitarian use cases in Rwanda and Ghana since 2016 and 2019, respectively (Toor, 2016; de Leon, 2019). In Rwanda and Ghana, Zipline – a drone service – has flown more than 1.8 million miles to airdrop medical supplies and ferry viral tests from more than 1,000 medical facilities, replacing the need for face-to-face contact. As of Summer 2020, Zipline had made 30,600 medical supply deliveries in Africa since the start of the COVID-19 pandemic (i.e., March 2020). In addition to delivering medical supplies, the company is transporting virus test samples from remote parts of Ghana that do not have testing facilities to laboratories in more populated parts of the country. The Zipline service is also being used to expand access to medical care for patients unable to travel due to COVID-19 quarantines, including delivering cancer drugs to patients in remote villages who are unable to travel to oncology centers. In areas with limited road infrastructure, drones have reduced the transport time to access medical supplies and testing facilities.

led to new challenges or exacerbated existing ones. For example, anecdotal evidence from shared mobility operators in Africa have revealed corrupt practices, such as paying off inspectors to allow vehicles that do not meet regulations to continue to operate.

Shared mobility options (e.g., carsharing, e-Hail) may be made available through new platforms. For example, Gozem is a smartphone app and transportation service that blends characteristics of MOD and MaaS in the Francophone West and Central Africa (Benin, Cameroon, Gabon, Togo). What makes Gozem particularly unique is that it integrates a number of mobility, delivery, e-commerce, and payment services (i.e., vertical integration). Gozem users can employ the app to: 1) dispatch a variety of mobility services (e.g., motorcycles/mopeds, auto rickshaws, taxis); 2) deliver cargo; 3) order groceries, household items, and durable goods; and 4) pay for goods and services using a digital wallet. As of March 2021, Gozem was available in Benin, Burkina Faso, Cameroon, Ivory Coast, Gabon, Mali, Senegal, and Togo (Kene-Okafor, 2020). It should be noted, however, that fare payment in Africa remains largely cash based with a limited number of electronic and smartcard-based systems being deployed in cities such as Cape Town, Kigali, Lagos, and Maputo (Arroyo-Arroyo, van Ryneveld, Finn, Greenwood, & Coetzee, 2021). In other parts of Africa using mobile money (e.g., a bank account with a mobile phone company) offers travelers alternative payment options for transportation (Arroyo-Arroyo, van Ryneveld, Finn, Greenwood, & Coetzee, 2021).

China

There is limited information on informal transport in China. However, information on other shared modes is available. Bikesharing was one of the initial fleet sharing services to launch in China in 2007. By 2015, Ofo and Mobike, two dockless bikesharing companies, improved upon previous bikesharing challenges and made the service available through Global Positioning System (GPS)-enabled apps (Huang, 2018). Ofo bikes cost approximately 1 CNY (\$0.15 US) per ride and Mobikes cost 1.5 CNY (\$0.21 US) for every 30 minutes. As Ofo and Mobike's popularity grew, other bikesharing operators (e.g., Bluegogo, Xiamong Bike) entered the market. However, by 2018, Ofo and Mobike were two of the few remaining bikesharing operators. A number of bikesharing operators faced financial challenges, and Ofo and Mobike were some of the few that continued to operate following acquisitions by larger technology companies (Huang, 2018). Bikesharing served over 360 Chinese cities by the end of 2020, and as of April 2021, the largest bikesharing operators in China are Hellobike and Meituan (previously Mobike, which was bought out and rebranded by Meituan in December 2020) (Jiang, Song, Xuan, & Lu, 2020; Whelan, 2021; Feng & Ye, 2020). Hellobike also operates the only moped sharing service available in China. The mopeds can be rented monthly and cost 200 CNY (\$31 US). Recently, local Chinese governments have introduced policies and infrastructure projects to support shared micromobility, which may increase its future adoption (Ma, 2020). Future adoption may need to be supported by regulations, such as key performance indicators for operators, defining parking restrictions and regulations, providing safe infrastructure, and standardizing technologies (e.g., platforms, data collection) (Jiang, Song, Xuan, & Lu, 2020). In addition to shared micromobility, carsharing services are available in China. CC Clubs launched roundtrip carsharing in China in 2010 (Song & Schmitz, 2017). By 2017, CC Club fleet sizes were as large as 30,000 vehicles and average yearly growth rates were over 200% (Song & Schmitz, 2017). By 2020, there were over 120 carsharing operators with over 4 million active monthly users in China (Yicai, 2021; Statista, 2022). The Chinese government may play an important role increasing shared mobility availability. For example, local Chinese governments have supported carsharing by offering free carsharing parking spaces at government facility parking lots and subsidizing operations. In 2016, the Shanghai government set a goal for carsharing fleets to have 6,000 parking spots, fleets of 20,000 electric vehicles, and 30,000 electric vehicle charging poles (Song & Schmitz, 2017).

Delivery and ride services also have experienced growth in China. By Winter 2019, there were 460 million Chinese food delivery consumers (Daxue Consulting, 2020). As of February 2022, Ele.me and Meituan were the two largest food delivery companies in China. Following consumer access to e-commerce options in China, ride services became available in 2012 with Didi e-Hail ride services. As of Winter 2021, the largest five TNCs operating in China (in order of greatest market share) were: 1) DiDi (with over 75% of TNC rides), 2) T3 Mobility, 3) Caocao Mobility, 4) Meituan, and 5) Xiangdao (Grant, 2021). As of 2020, ride services had grown to 360 million registered users and 30 million registered drivers (Daxue Consulting, 2020). Nevertheless, some ride and delivery services encounter a number of regulatory challenges. In September 2021, the Chinese Ministry of Transport and other government agencies began investigating alleged non-compliant behavior from multiple e-Hail providers including: 1) recruiting unapproved drivers and vehicles, 2) issues with data sharing (e.g., lack of access to data), 3) unfair competition with taxis, and 4) labor-related issues with drivers (Kharpal, 2021; Liao, 2019).

India

A number of informal transport modes operate in India. These modes are organized in **Table 6** and classified by capacity: low (one to three riders), medium (four to nine riders), and high (10 or more riders). Note that the designated vehicle capacity may deviate from the average capacity carried.

Table 6. Informal Transportation Modes in India

Capacity	Mode	Description	Vehicle Capacity (number of passenger)	Average Capacity (number of passenger)	Route Length (average kilometers)	Trip Length (average kilometers)	Operating Area
Low	Auto Rickshaw	A three-wheeled vehicle with a designed seating capacity of three passengers	3	9,5	12	6	Urban
	Cycle Rickshaw	A tricycle running on pedal power; generally carries two passengers at a time	3	9,5	12	6	Semi-Urban
Medium	Chakada	A three-wheeled vehicle comprising a motorcycle chassis retrofitted with a rear trailer; carries up to 20 passengers (according to drivers)	10	14	15	24	Semi-Urban
	Jeep	A four-wheeled vehicle, usually with open sides/rear; operates well in rugged topography	10	14	30-32	22-33	Semi-Urban
	Mahindra Gio	A four-wheeled passenger cab with open sides and a seating capacity of 6 passengers	6	8	12	6	Urban
	Maruti Omni	A typical urban four-wheeled van	7	12	35	30	Semi-Urban
	Tata Magic	A four-wheeled, van-like vehicle with a designed seating capacity of 7 passengers	7	13	15-20	6-10	Urban

Capacity	Mode	Description	Vehicle Capacity (number of passenger)	Average Capacity (number of passenger)	Route Length (average kilometers)	Trip Length (average kilometers)	Operating Area
Medium	Vikram	A three-wheeled auto rickshaw/ tempo-like vehicle	6	14	15-20	6-10	Urban
High	Force Cruiser	A large four-wheeled vehicle with a designed seating capacity of 13 passengers	13	-	40	27	Semi-Urban
	Kaduka	A locally manufactured four-wheeled vehicle that runs on diesel generator sets (generally used for irrigation purposes) and has a rear passenger trailer made of wooden planks, and carries up to 20-25 passengers per trip (according to drivers)	20	30	10	8	Semi-Urban
	Mini Bus	A small bus with a seating capacity of 20 passengers	20	30	45	14	Urban

Source: Kumar et al. (2016)

Carsharing services are also available in India. In India, carsharing programs tend to cost approximately 70INR per hour (\$1 US equivalent) for roundtrip service and 5 to 7INR (\$0.07 to \$0.09 US) per minute for one-way service. Some carsharing operators have developed long-term subscriptions and partnerships with automakers that blend aspects of a vehicle lease and carsharing. For example, Revv offers a 12-month minimum subscription and charges a monthly fee, which includes vehicle registration and insurance. Subscribers have the option of extending their subscription up to 48 months, purchasing the vehicle, or returning it to Revv. In addition to carsharing, a number of service providers offer both station-based and dockless bike and moped sharing in India. Some of these services allow users to pause a trip for a small fee to make multiple stops without being charged time while the device is not ridden. These services generally cost 3 to 6INR per kilometer (km) (\$0.04 to 0.08/km US), including fuel and a helmet. Some charge an additional per minute fee for about the same cost. One service, Bounce loop, offers P2P moped sharing that allows moped owners to rent their mopeds to other users for a fee.

Other shared mobility options include e-Hail, which is largely offered by Ola and Uber. Ola offers a variety of form factors, including auto rickshaws, motorcycle taxis, and vehicles (sedans and sport utility vehicles). An Ola ride can be booked on the service's mobile app or website. Ola also offers Ola Bike, a motorcycle taxi version of its service for as little as 1INR per four km (\$0.01/km US). Both Ola and Uber offer shared-ride options, known as Ola Share and UberPool, respectively. However, Indian carpooling services currently operate in a legal grey space. Transport departments have not given

licenses to carpooling firms and platforms, but the agencies have also not taken actions against them as carpooling can help achieve local goals (e.g., reducing vehicle emissions and congestion) (Mathew Philip, 2021). Regulations may need to be clarified to support select modes and travel behaviors.

In India, Kochi One is an app-based platform that integrates auto rickshaws, micromobility, and formal and informal public transport services onto a single trip planning and fare payment platform. In Kochi the Axis Bank Kochi App provides Kochi metro customers with the ability to plan, book, and pay for public transit tickets using a smartphone trip planner linked to a Kochi fare card. Because the smartcard is linked to the app, unbanked users have the ability to load cash onto the smartcard and still use the application. Travelers also can use the smartcard without having to use the smartphone app.

Latin America

Multiple informal transport modes are available in Latin America. **Table 7** summarizes the commonly found informal modes. The description column provides the general characteristics of these services, although they may vary by region and operator. Please note that the intended capacity denotes the passenger capacity for operation in locations with stricter regulations, such as the United States. However, when operating in Latin America, the average capacity may deviate from the intended capacity.

Table 7. Informal Transportation Modes in Latin America

Intended Capacity (persons)	Term	Alternative Name(s)	Description
6-12	Colectivo	almendrones	A van or small bus that transports passengers along a fixed route
10-20	Cam	-	A truck that runs similar routes to public transit buses and operates within and between cities These are typically more affordable, but less safe, than public transit options
12-32	Fixed Route Taxi	taxi ruta fija, trufis	A minibus that operates along a fixed-route from cities to smaller, surrounding towns
	Gua Gua	guaguas	A minibus that operates between cities
	Micros	combi, micros, por pouestos, trolebus	A converted minibus that operates along a fixed route
66-90	Buseta	-	A privately owned bus that operates along fixed route, these are typically more expensive than chicken buses
	Chicken Bus	diablos rojos,	A converted (and typically painted) school bus that operates a long a fixed route
	Microbus	-	A bus similar to a chicken bus but makes less stops

Bikesharing first arrived in Brazil and Chile in 2008, and expanded to Ecuador, Mexico, Uruguay, and Venezuela by 2018 (Van den Steen, Smart and sustainable, the bike sharing boom in Latin America, 2018). In 2017, PBSC, a global bikesharing company, implemented bikesharing systems throughout Brazil that included total a fleet size of 8,000 bikes and 680 stations (PBSC Urban Solutions, 2017). In 2019, there were 92 bikesharing systems operating in 11 Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Paraguay, Peru, Venezuela) (Binatti, Batalha, & Decastro, 2020). Despite bikesharing’s presence, scooter sharing remains limited in Latin America. In 2019, U.S.-based scooter sharing company Lime expanded to four cities across Argentina, Brazil, and Peru (Toll, 2019). However, within six months, Lime ended its Latin America operations (Latin America Business Stories, 2020). Also in 2019, Grow offered shared micromobility rentals of over 135,000 devices across six Latin America countries (Brazil, Chile, Colombia, Mexico, Peru, Uruguay) (Intelligent Transport, 2019). Shortly after initial shared micromobility services became available, the 2009 launch of Zazacar in Brazil made carsharing a mobility option (Olhar Digital Writer, 2019). In 2012, Carrot launched in Mexico (Movmi, 2018). In 2019, Awto carsharing was available in Argentina and offered two Nissan models to customers – the Kicks and March vehicle models. Carsharing users had the option to rent by the minute, hour, or day (i.e.,

the equivalent of a five-hour rental). The hourly rental rates in 2019 were 570 pesos (approximately \$27.72 US) and 440 pesos (roughly \$21.39 US) for the Kicks and March, respectively (Bland, 2019).

There are also numerous ride and delivery services operating in Latin America including: 99, Beat, Cabify, and Nekso. Drivers for some services use personal vehicles (e.g., Cabify), while others drive vehicles from company owned fleets (e.g., 99). There are also e-Hail options exclusively for females (e.g., Femi Taxi, Lady Driver, Uelas). In 2017, Lady Driver had 8,000 drivers and 100,000 riders in Sao Paulo, Brazil, with plans to expand into Rio. In the same year, FemiTaxi (also in Brazil) had over 1,000 drivers and 20,000 monthly riders (Haupt, 2017). According to several sources, the growth of e-Hail services focused on women's needs evolved in response to high rates of sexual harassment on public transportation (Haupt, 2017; Fontaine, 2021).

Middle East

There is limited information on informal transport modes that operate in the Middle East. Modes that have been identified include dabaabs in Yemen (i.e., minivans that operate along a fixed-route) and dolmus in Türkiye (i.e., 12 passenger capacity minivans that operate along a fixed-route). Türkiye is also an epicenter of robust carsharing activity. In Istanbul, Mobilizm, YOYO, and Zipcar offer carsharing for varying lengths of time, ranging from hourly to monthly. For example, YOYO offers annual memberships starting at 69 TRY (\$8 US). The service includes fuel and starts at 33 TRY (approximately \$5 US) per hour and 0.50 TRY per kilometer (approximately \$0.06 US). They also offer one-way service for an additional fee, as well as an optional valet service for dropping-off and picking-up a vehicle. In contrast, the majority of shared micromobility activity to date has been located in the UAE. The country has a number of operational bike and scooter sharing programs, mostly in Abu Dhabi and Dubai. Memberships typically range from \$20 AED per day to \$420 AED per year (\$5.50 US per day to \$114 US annually). Some services charge approximately \$3 AED to unlock (\$0.81 US) and \$0.59 to \$1 AED per minute to use (\$0.16 to \$0.27 US per minute).

The Middle East also has a number of for-hire ride services such as: Bykea, Careem, Fyonka, Raye7, Swvl, and YOYO. In Saudi Arabia, women comprise 80% of Careem's customers and are part of the country's Women to Drive Movement (i.e., a movement to legalize women driving in Saudi Arabia, where it was previously outlawed) (The Economist, 2017). The company also operates Careem Now, a food delivery service in Bahrain, Iraq, Jordan, Pakistan, Saudi Arabia, and the UAE. In select locations (e.g., UAE), Careem users also can request grocery and sundry deliveries (Godinho, 2020). In addition to services using personal vehicles, a number of services use higher-occupancy minibuses (i.e., typically eight to 16 passengers). For example, Swvl operates a service similar to microtransit operations in North America. Swvl claims this service is up to 70% less expensive than e-Hail and had a network of more than 200 routes in Alexandria and Cairo, Egypt in 2018 (Nsehe, 2018). Other similar services include Uber Bus and Careem Bus in Egypt and Saudi Arabia. Uber Bus trips in Cairo range between 15 EGP and 50 EGP (approximately \$1 to \$3 US) depending on the trip length (Uber Technologies, Inc., 2021). Uber also has partnered with NileTaxi to offer water taxis in Egypt. Users can specify a pick-up and drop-off location in the Uber app by placing their origin and destination pin on the Nile River and selecting 'Request UberBoat' (Egypt Independent, 2017). In the Middle East, pooled rides can face regulatory challenges. For example, in the UAE, pooling is generally illegal unless it is arranged using the Ministry of Transport app, known as "Darb" (DARB, 2021). The Roads and Transport Authority has previously suspended the issuance of Sharekni permits, which allowed drivers to offer pooled rides (Yousuf, 2018) (Shahbandari, 2018). In the first six months of 2018, more than 2,000 drivers were fined for illegally transporting passengers in their private vehicles in Abu Dhabi (Al Serkal, 2018). This offense carries a penalty of 24 black points. A driver with more than 24 black points can have their license suspended (Policy Bazaar, 2021).

Southeast Asia

A number of informal transport services operate in Southeast Asia including: bajas, beaks, jeepneys, minibuses, and tuktuks. With the exception of tuktuks, these modes typically operate along a fixed route. However, a few operators offer door-to-door service. Due to the smaller vehicle size, these informal modes can typically operate in areas where larger public transit vehicles are too large to navigate. Research has found that the areas of Southeast Asia with the least amount of road capacity per capita and poor road hierarchy tend to have the largest variety of informal transportation options (vehicle type and seating capacities) (Cervero, 2007).

Carsharing is also common in Southeast Asia. A few notable B2C programs include HipCar in Indonesia, GoCar in Malaysia, and Haupcar in Thailand. A number of these programs, such as HipCar and Haupcar, allow drivers to reserve

motorcycles. Various service providers also offer P2P services, such as Moovby and Roadaz in Malaysia and Drivemate in Thailand. As of 2018, there were 22 million carsharing users in Asia. However, shared micromobility options are less prevalent in Southeast Asia. As of February 2022, the only shared micromobility service available in Southeast Asia is Linkbike in Penang, Malaysia. The first 30-minute Linkbike ride is free, and each subsequent hour is 1 Malaysian ringgit (RM) (\$0.24 US). There are pricing plans that cost 3 RM (\$0.72 US) for one day, 4 RM (\$0.96 US) for two days, 5 RM (\$1.20 US) for five days, 10 RM (\$2.39 US) for 10 days, and 30 RM (\$7.17 US) for one year.

In Southeast Asia, Grab and Gojek are the primary e-Hail service providers. At present, Grab operates in eight countries where it also offers GrabFood and GrabExpress, food delivery and courier delivery services, respectively (Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam) (Dillet, 2021). In Singapore, Grab also has launched GrabPet with drivers that are trained to handle and welcome animals in their vehicles. Grab also has multinational partnerships with Careem and JapanTaxi, allowing their users to book rides on these platforms when traveling to Japan and the Middle East (Tariq, 2019). Gojek operates in seven countries and, as of May 2018, the service claimed more than one million drivers (Gojek Engineering, 2018). Grab also integrates a variety of: 1) shared mobility services (e.g., e-Hail, pooling, auto rickshaws, bikesharing, shuttles); 2) food options, parcel, and grocery delivery; and 3) a digital wallet. Other similar “super” apps include PayTM in India, Careem in the Middle East, and WeChat in China. Gojek, which primarily operates in Indonesia, the Philippines, Singapore, Thailand, and Vietnam, integrates shared mobility, parcel and food delivery, moving services, telemedicine, streaming video, mobile payment, and business services into a single platform. The service claims to have 190 million downloads since 2015, more than two million drivers, and 900,000 merchant partners. In 2020, Gojek also launched GoTransit, which integrates trip planning with public transport in Jakarta (Nebrija, Lindsay, & Gustale, 2022) (Kai, 2020). Pooling services are not as prolific as e-Hail services in Southeast Asia. For example, in 2015, Grab debuted its “Hitch” service. Hitch facilitated P2P ridesharing (or carpooling), allowing drivers to set their route and passengers going the same way to determine if they wanted to join the ride. In this case, passengers pay to reimburse their drivers actual costs of sharing a ride, such as fuel and maintenance. However, the service does not currently appear to be operational.

Comparison of Low-/Middle- and High-Income Countries

Shared mobility services, availability, characteristics, use cases, and impacts were compared between LMICs and HICs. While there are many shared mobility similarities across the regions, differences also exist. The following section summarizes similarities and differences that were identified.

Similarities

Despite these differences, shared mobility has some similarities between low-/middle- and high-income regions. These similarities include:

- **Trip Planning and Fare Payment Integration:** Stakeholders in low-/middle- and high-income areas are interested in integrating trip planning and fare payment into a single platform, even though some differences may occur in how they are deployed (e.g., MOD, MaaS, and Super Apps).
- **Gender Issues and Safety:** In both HICs and LMICs women may face many similar challenges regarding their personal safety.
- **Employment and Labor:** The growth of shared mobility is impacting labor in similar ways (e.g., changing existing roles, creating new employment opportunities, contributing to downward wage pressure for taxis) in both HICs and LMICs.

Trip Planning and Fare Payment Integration: A key similarity between shared mobility in HICs and LMICs is the desire to integrate trip planning and fare payment onto a single digital platform. These platforms can include MaaS, MOD, and super apps. App-based platforms may be able to promote sustainable mobility (e.g., low-emission modes and/or pooling) through gamification and incentives (Shaheen & Cohen, Forthcoming). Gamification is the use of game theory and game mechanics in an app context to engage smartphone users to employ the app in a particular way. The use of leaderboards, badges, levels, progress bars, and points are examples of gamified applications meant to encourage and/or discourage particular user behaviors. Incentives also can be employed to provide a payment or concession to a mobile app user to encourage app use, retention, or other type of behavior, such as riding public transport (Shaheen, Cohen and Zohdy, et al. 2016).

Gender Issues and Safety: In both HICs and LMICs, many females may face a variety of similar safety concerns. In both HICs and LMICs, concerns about harassment, sexual assault, and other forms of violence have been widely documented in the news. In the U.S., women are three times more likely than men to be concerned for their safety on shared transportation modes (Shermansong, et al., 2022). Research has identified similar concerns in LMICs. For example, in Mexico City, 75% of women rely on public transit and nine out of 10 women have experienced sexual harassment on public transit (Fontaine, 2021). This has led women to alter their travel behavior by taking alternate routes that may be longer, more expensive, and less convenient. In a variety of regions of the world, shared mobility services and features are being developed to address these concerns (e.g., the ability to request a female driver, app-based emergency call buttons, etc.). Additionally, shared mobility may not meet the needs of women even though they tend to be the primary household caregivers in many cultural contexts (e.g., not having car seats available in shared vehicles, a lack of family/bundled pricing for informal transport rides). These requirements will need to be addressed to enhance safety and better meet the mobility needs of women.

Employment and Labor: Shared mobility is changing traditional labor roles, creating new employment opportunities, and disrupting incumbent industries in both HICs and LMICs. For example, shared mobility is contributing to employment growth in some transportation sectors (e.g., increased e-Hail driver demand), but it may also be disrupting existing employment where demand for other services may be declining (e.g., taxis) (Mourdoukoutas, 2017). This dynamic also exists in LMICs where informal transport can undercut formal modes by offering lower wages to drivers and lower costs to users (Latif Dahir, 2019).

Differences

Shared mobility’s evolution, integration, operations, and infrastructure availability differ across LMICs and higher-income regions. These differences are summarized in **Table 8**.

Table 8. Differences in Low-/Moderate- and High-Income Countries

Topic Area	Low- and Middle- Income Countries		High-Income Countries	
	Difference	Description	Difference	Description
Shared Mobility Evolution	Non-technology Enabled Modes	Rich history of informal sharing has, in some cases, evolved into more formal and technology-enabled sharing	Backend Technology	Typically, technology (e.g., apps, algorithms) has been used to scale shared mobility from the outset
Mobility Integration	Emphasis on Super Apps	Super apps are being developed to integrate mobility options and other non-transportation services (e.g., retail, entertainment, banking, communications, etc.).	Emphasis on MOD and MaaS	MOD and MaaS are used as platforms for shared mobility access. These services tend to focus on mobility, goods delivery, and integrated pay for these services.
Shared Mobility Service Providers	Smaller, More Localized Organizations Greater Emphasis on Smaller Motorized Form Factors More Varied Regulation of e-Hail Services	Shared mobility options are generally provided by smaller and often local or national providers. Additionally, in LMICs shared mobility providers tend to emphasize smaller motorized form factors (e.g., auto-rickshaws, motorcycle taxis/TNCs, etc.) rather than vehicular modes. Additionally, in LMICs, the regulation of e-Hail services can vary considerably, which can contribute to services operating in legally gray areas.	Larger Corporations More Formal Regulation of e-Hail Services	Services are typically provided by larger, multinational companies often funded through venture capital. In HICs, shared mobility providers tend to avoid smaller motorized form factors such as autorickshaws and motorcycle taxis/TNCs). Additionally, in HICs, e-Hail services are generally regulated with consumer and labor protections (e.g., minimum wage standards, insurance requirements, etc.)
Personal Vehicle Ownership	Higher Cost, Less Accessible	High costs may prohibit personal vehicle ownership, but shared mobility may offer access to shared vehicle use (e.g., carsharing, e-Hail/TNCs, etc.).	More Accessible	Personal vehicles may be more affordable (in comparison to vehicle ownership in LMICs). In this context, shared mobility may act as a substitute for personal vehicle use.
Infrastructure	Funding and Improvements Needed	Existing infrastructure to support shared mobility (e.g., micromobility infrastructure, electric charging, etc.) may not be available or well maintained.	Available	Shared mobility infrastructure (e.g., safe locations for shared micromobility devices to be operated and charged) are relatively more readily available and well maintained, particularly in urban areas.

Shared Mobility Evolution: The evolution of shared mobility and user adoption seems to vary across LMICs and HICs. In HICs, shared mobility has scaled in recent decades almost exclusively with app-based services, algorithms, or other consumer-facing and/or back-end enabling technologies (Shaheen & Cohen, Forthcoming). In LMICs, shared mobility options tend to more frequently evolve from existing modes that historically have not been technologically enabled (e.g., taxis, rickshaws, etc.). Low-tech strategies such as exchanging car keys for carsharing and using coins for shared micromobility rentals have the potential to expand shared mobility to digitally impoverished and unbanked households (Shaheen, Sperling, & Wagner, 1998). These low-tech strategies also present an opportunity to expand shared mobility into more rural areas of LMICs where data access and smartphone penetration may lag behind urbanized megaregions.

Mobility Integration: Shared mobility is also evolving across different regions. In North America, consumers are assigning economic values to transportation services and making mobility decisions (including the decision not to travel and choosing instead having a good or service delivered) based on cost, travel and wait time, number of connections, convenience, and other attributes — a concept commonly referred to as MOD or mobility on demand (Shaheen, et al., 2020). In Europe, services allowing travelers to access bundled mobility services are becoming more popular — a concept known as MaaS or mobility as a service (Shaheen, et al., 2020). There are a variety of factors that could promote the adoption of MaaS in HICs and contribute to the lack of their adoption in LMICs. It is generally believed that the strong role of public transport and the lack of public-private partnerships in many European contexts has been a key enabler of MaaS.

In a number of LMICs, super apps that allows users to access several mobility, payment, retail, communications, and other services from a single digital interface are also becoming more ubiquitous (Shaheen & Cohen, Forthcoming). A key difference between MOD/MaaS and super apps is that the latter often integrates non-mobility services such as retail, communications, and financial services. The integration of mobility, delivery, and non-mobility services including financial also could raise different types of antitrust and other concerns about fair competition and consumer choice (Matthew Daus, unpublished data, May 2022).

Shared Mobility Service Providers: In addition to integration differences, shared mobility providers tend to differ between upper-income countries and LMICs. In upper-income countries, shared mobility providers tend to be large, international companies. However, shared mobility options in many LMICs tend to be provided by fewer multinational conglomerates (Mahendra, 2016). For example, the Africa region has a large number of relatively small shared mobility service providers. This could be due to various reasons such as: language barriers, cultural differences, concerns about foreign profiteering, and variations in governance that may make it more difficult for regional and multinational platforms to operate (Page, 2021; Shaaban, 2020; Valente, Patrus, & Cordova Guimaraes, 2019). Thus, regulatory approaches may be different based on small versus multinational operators. There are seems to be differences in form factors. In HICs, smaller motorized form factors (e.g., autorickshaws and motorcycle taxis/TNCs) are practically non-existent where in many LMICs smaller motorized form factors are quite common. This is likely due to safety regulations that may prohibit smaller motorized form factors on public roads in HICs as well as greater concerns about safety and liability associated with passengers riding on a motorcycle taxi, for example.

With respect to e-Hail, regulation can vary widely between HICs and LMICs. In HICs, specific aspects of e-Hail operation such as minimum wage standards, insurance requirements, and taxation are generally regulated allowing e-Hail to be legally defined and operate. However, in LMICs regulatory frameworks surrounding e-Hail may be inadequate or vague. Due to the lack of clear regulation concerning their operation, licensing, and taxation, e-Hail can sometimes operate in legally gray areas. Where regulations do exist, they often vary more widely across countries (Daus, 2018).

Personal Vehicle Ownership: While private vehicle use and auto ownership tend to be status symbols in both low-/middle- and high-income countries, shared mobility may have different impacts on motorization. In high-income nations where per capita incomes and motorization rates are higher, shared mobility options can offer alternative options to reduce personal vehicle ownership and use. In contrast, households in LMICs may face barriers greater to ownership such as lower household incomes and higher vehicle costs (e.g., due to import taxes). In this context, shared mobility could be a gateway to motorization through services such as e-Hail, pooling, and carsharing (Mahendra, 2016).

Infrastructure: Shared mobility and informal public transport availability may also be limited by infrastructure availability. LMICs may lack the infrastructure and funding necessary to support shared mobility, and in particular, electric modes that require charging infrastructure (Sustainable Mobility for All, 2021).

Gaps in Understanding and Potential Research Needs

The literature review, expert interviews, and virtual workshop helped identify research needs related to shared mobility and informal public transport in LMICs. Broadly, these research gaps can be categorized into eight categories including: 1) the built environment; 2) travel behavior and environmental impacts; 3) culture considerations and social equity; 4) economic and labor impacts; 5) business models and financing; 6) other policy issues including safety, infrastructure, pricing, and others; and 8) comparative research. The gaps in understanding and research needs classified under these categories are summarized in **Table 9**.

Table 9. Gaps in Understanding and Research Needs

Category	Research Need	Description
Built Environment	Shared Mobility Operations	Different shared mobility and informal public transport opportunities and challenges may exist across different built environments.
	Travel Changes	Travel behavior changes (e.g., choosing to bike to work) may vary based on different built environment, spatial, and temporal characteristics.
Travel Behavior and Environmental Impacts	Documentation	At present, shared mobility and informal transport travel behavior and environmental impacts in LMICs are not well documented and understood.
	Public Transit Impacts	Understanding of shared mobility and informal public transport public transit (e.g., ridership operations) impacts are limited.
Cultural Considerations and Social Equity	Cultural Perceptions	A greater understanding of how cultural perceptions and societal norms (e.g., social status of personal vehicle ownership) impact shared mobility and informal public transport use is needed.
	Accessibility and Access Policies	Further information is needed to better understand how shared mobility and informal transport can improve equity for minorities and resource access, as well as supportive policies and regulations.
Economic and Labor Impacts	Changes	Improved documentation and understanding are needed on how shared mobility and informal public transport alter employment, wage, and gross domestic product.
	Trends	An understanding of how macroeconomic and transportation trends (e.g., automation) may alter lower-income areas may be necessary to help them adequately prepare.
Business Models and Financing	Business Models	More research is needed to understand how shared mobility is disrupting incumbent industries, creating new business models, and impacting labor.
	App-based Business Models	Research is needed to understand the potential impacts app-based business models.
	Form Factors	Research is needed to understand similarities and differences in the size, shape, and other physical characteristics of different vehicle and device types, including similarities and differences across countries, regions, and cultures.
	Financing and Public-Private Partnerships	More research is needed to understand the various financing options to support emerging shared mobility services in LMICs, as well as the potential role public-private partnerships can play in expanding enabling infrastructure (e.g., charging, micromobility, etc.) and bridging spatial and temporal gaps in the transportation network.

Category	Research Need	Description
Public Policy	Governance	Research is needed to understand public sector processes, interactions, laws, norms, and other characteristics that can support, impede, or otherwise influence the adoption of shared mobility in informal transport in LMICs. Additional research also could help identify lessons learned and emerging practices for regulating shared modes (including informal transport) in LMICs.
	Safety	A number of safety concerns exist (e.g., lack of adequate infrastructure) and research is needed to understand how to address them.
	Pricing	Different strategies (e.g., congestion pricing) can help manage transportation demand, but it is unclear how these policies may be implemented in LMICs.
Comparative Research	Definitions and Governance	There is a need to study shared mobility terms and definitions, and the role of different governance structures on both the supply and demand sides of the shared mobility in various LMICs and regions.
	Low- and Middle-Income Countries	More research is needed that compares LMICs on various topic areas (e.g., comparative impact studies, diffusion/evolution of shared mobility, labor, equity, etc.).
	Regional Variations	More research is needed that explores comparative similarities and differences between regions (including HICs and LMICs) to understand variations in comparative impacts, the potential for shared mobility to impact motorization trajectories, diffusion strategies, labor, equity, etc.). Additionally, more research is needed to estimate the mode share and prevalence of different types of shared modes (including formal, informal, tech-enabled, and non-tech-enabled) across HIC and LMIC regions.

Because levels of urbanization and the built environment vary considerably across nations and regions of the globe, there is a lack of understanding about the opportunities and challenges for shared mobility and informal transport in different built environment contexts (e.g., urban, rural, etc.). There is also a need to understand how the travel behavior and impacts of shared mobility and informal transport vary based on the built environment, urban form, and other spatial and temporal characteristics.

In addition to the built environment, there is a need to understand the travel behavior and environmental impacts of shared mobility and informal transport in LMICs. More research is needed to understand the impacts of shared and informal services on mode choice, mode shift, vehicle occupancy, VKT, and GHG emissions in LMICs. There is also a need to understand in LMICs if shared mobility complements or competes with public and informal transport, and if it encourages or discourages vehicle use and private vehicle ownership.

Social, cultural, and language barriers could inhibit a user's comfort with using shared mobility (e.g., neighborhood crime, poorly targeted marketing, lack of multi-lingual support). As such, there is a need to understand how cultural considerations impact perceptions and use of shared services, barriers to access, and strategies to expand equitable access to these services. With respect to social equity, more research is needed to understand how shared mobility and informal transport can support mobility for women and vulnerable populations; access to jobs, healthcare, and other critical services; policies that support and inhibit equitable access to shared mobility and informal transport; and strategies for overcoming challenges associated with service affordability, banking access, and digital poverty.

There also exist a number of gaps in understanding associated with the economy impacts of shared mobility in LMICs. The impacts of shared mobility and informal transport on employment (i.e., job creation), wages (i.e., wealth generation), and gross domestic product growth are not well understood or documented. For example, it is not well understood whether for-hire vehicle drivers, couriers, operations staff, and back-office operations are creating new jobs, disrupting incumbent sectors, creating new opportunities for employment, and/or creating downward wage pressure. More research may also be needed to help LMICs prepare for economic and other trends that could disrupt shared mobility and

informal transport, such as electrification and automation. Whether LMICs are able to leap frog HICs with these emerging technologies remains to be seen.

Additionally, more research is needed to understand both app-based and shared mobility business models including their impacts on labor and the economy. Research is also needed to understand the various form factors (e.g., size, shape, and other physical characteristics of different vehicle and device types) including similarities and differences across countries, regions, and cultures. Research on financing and public-private partnership models could also help scale and replicate successful deployments in LMICs and create new opportunities for enabling infrastructure (e.g., active transportation, electric, and digital).

There are also a number of gaps in understanding and a need to conduct research on a variety of cross-cutting policy issues such as governance, safety, infrastructure, pricing, and others. For example, research is needed to understand public sector processes, interactions, laws, norms, and other characteristics that can support, impede, or otherwise influence the adoption of shared mobility in informal transport in LMICs. Additionally, a variety of safety challenges exist such as road safety, lack of infrastructure for active transportation, and other infrastructure such as lighting and safe waiting areas that could impact the personal safety of shared mobility and informal transport users. More research is needed to understand many of these safety challenges, identify infrastructure gaps (e.g., lack of curbs, bike lanes, charging, digital infrastructure, etc.), and strategies to address these gaps. There is also a need to understand the role of pricing (e.g., road use charges, congestion pricing, etc.) can play to help manage transportation demand and shift travelers to more sustainable travel options.

Finally, comparative research examining shared mobility in LMICs and HICs is limited. In some cases, research in some LMICs and/or specific modes is quite robust whereas in many cases research is very limited. For these reasons, there is a need to study shared mobility terms and definitions across different LMICs and regions. There is also a need to conduct comparative research on different governance structures on both the supply and demand sides of the shared mobility in various LMICs and regions. Comparative research is also needed to understand how the growth, evolution, and diffusion of shared mobility may be similar and different across regions and cultural contexts. Additionally, comparative research could help identify potential labor, equity, and other challenges, and potential strategies to help overcome these challenges.

Conclusion

Shared mobility is not a new concept in LMICs. Many LMICs include a variety of shared services, including informal transport, fleet sharing, and ride and delivery services. Informal transport supplements the mobility ecosystem through various form factors (e.g., minibuses, vans), typically operates without formal government approval, and is usually low tech (with the exception of e-Hail when it operates illicitly without government approval). Fleet sharing, such as car, bike, and scooter sharing provide travelers access to these services for short-term use. Ride and delivery provide travelers access to rides and consumers access to goods transported by taxis, e-Hail, motorcycles, auto rickshaws, pedicabs, and other vehicle drivers or device operators.

Although mobility is rapidly evolving in many regions of the world, shared mobility and app-based platforms in LMICs may be evolving differently in a number of ways. In some cases, LMICs are “leap frogging” (or bypassing prior evolutionary states) high-income countries in the features offered in these integrated mobility platforms. In Africa and Asia, the emergence of super apps offers consumers all-in-one mobile platforms for a variety of transportation and shopping options and payment services. Research has shown that shared mobility in HICs tend to be underused by lower income households. While research on the demographics of shared mobility users in LMICs is quite limited, shared mobility could offer access to private vehicle use (e.g., e-Hail, pooling, and carsharing) that would otherwise be unaffordable for many households in LMICs).

Broadly, shared mobility has not been well researched or documented in many LMICs. More research is needed to understand variations across regions, nations, and built environments. How these regions are defined (e.g., geographically, motorization rates, etc.) may impact both anecdotal observations and analytics findings. As additional information is gathered on shared mobility in LMICs, this data can be used to enhance the understanding of travel behavior and environmental impacts of these services; highlight opportunities and challenges; and identify use cases for implementation. Because the adoption and user behavior of these services may be influenced by social, equity, and cultural considerations, more travel behavior and sociological research is needed. There is also a need to understand the impacts of these services on labor and developing economies in order to maximize the potential economic benefits and mitigate potential concerns (e.g., downward wage pressure, competition with existing services, etc.). Cross-cutting policy research can also aid in the sustainable and equitable adoption and scaling of shared mobility and informal transport.

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