LUTP

LEADERS IN URBAN TRANSPORT PLANNING

MOBILITY-AS-A-SERVICE (MAAS): GOVERNING INNOVATION AND MULTIMODALITY IN URBAN TRANSPORT

This self-reading module is part of the Leaders in Urban Transport Planning (LUTP) program.

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Last updated: June 2022

This module was developed with the generous financial support of the following donors:

WORLD BANK GROUP

Korea Green Growth Trust Fund

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Multimodality: Promises and challenges for users

People living in cities have **more mobility options** than ever before, including:

- Walking, biking, public transport (formal and informal), taxis, and private vehicles
- Innovative, private sector-led, information and communication technology (ICT)-enabled services like

While expanding travel choices, this complexity and fragmentation often come at a cost to travelers.

Multimodality: Promises and challenges for cities

The number of deaths on the world's roads remains unacceptably high

- About 1.35 million people die every year from road traffic crashes; that's around 3,700 people every day!
- About 20-50 million more are injured non-fatally every year, with many incurring life-long disability.
- Since 59% of road deaths occur in adults aged between 15 and 44 (most productive years of life), this can mean significant loss of income for households, particularly the poor.
- Road traffic injuries are currently the leading cause of death for children and young adults, ages 5 to 29.
- More people die as a result of road traffic injuries than from HIV/AIDS, tuberculosis or diarrheal diseases.

If no action is taken, road traffic injuries are expected to become the fifth leading cause of death globally by 2030.

Mobility-as-a-Service (MaaS)

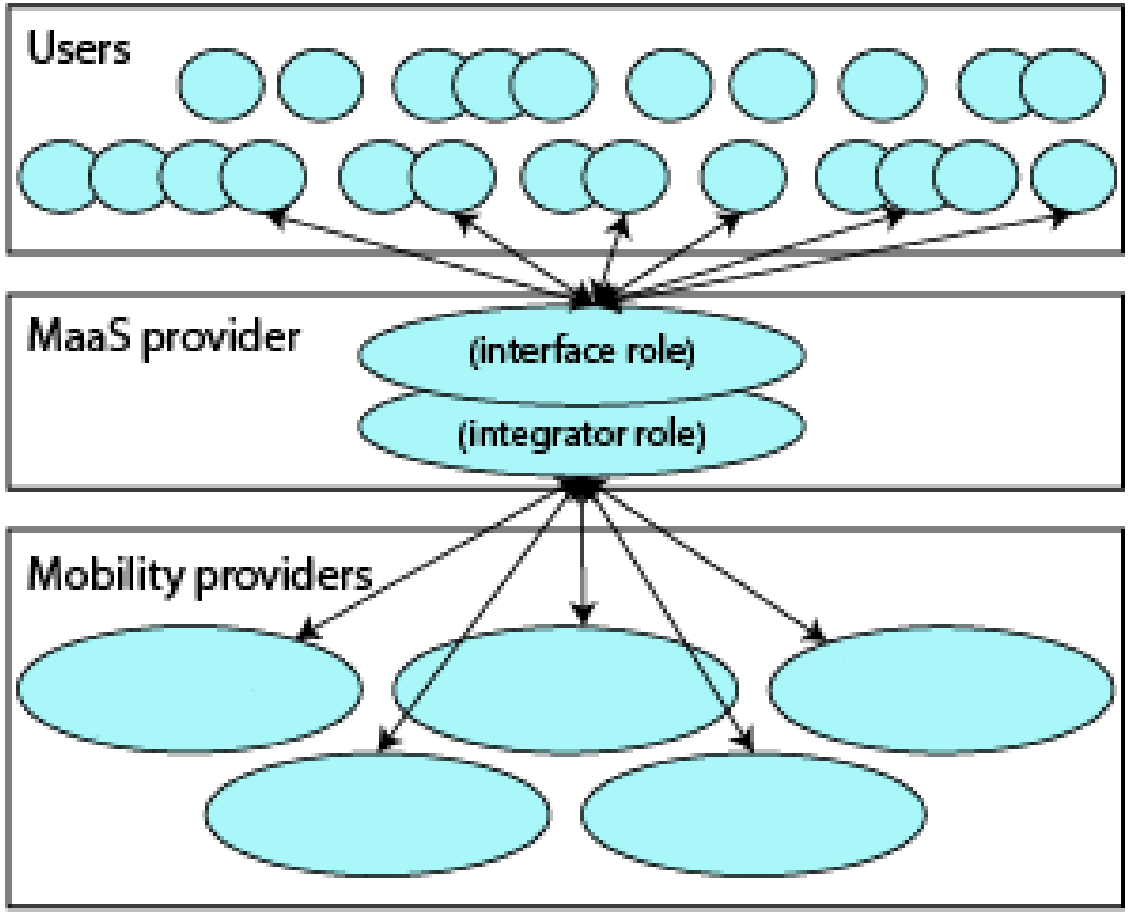
MaaS leverages technology to enable integration of multiple travel modes in a single interface

For users: it provides a simplifying link to multiple mobility service providers that integrate:

- Information on service availability, schedules, and routes for trip planning
- Booking, ticketing, and payment

For cities: it provides a platform for regulating and coordinating operations across modes to better align with societal and environmental goals

Integration of information, ticketing, or operations across modes can bring a significant improvement on its own; but, if implemented together, they can build on and reinforce one another



The **MaaS provider** is a new actor in the mobility ecosystem charged with developing the products and technologies that bring together various mobility services in a single platform. The goal is to provide multimodal mobility services that satisfy the diverse needs of people and minimize externalities.

Basic tenets of MaaS

Low- and middle-income countries have higher levels of traffic deaths among pedestrians, bicyclists, and motorcyclists, which are also the main road users in cities.

Types of integration

Text

Examples of MaaS: UbiGo, Sweden and Gojek, Indonesia

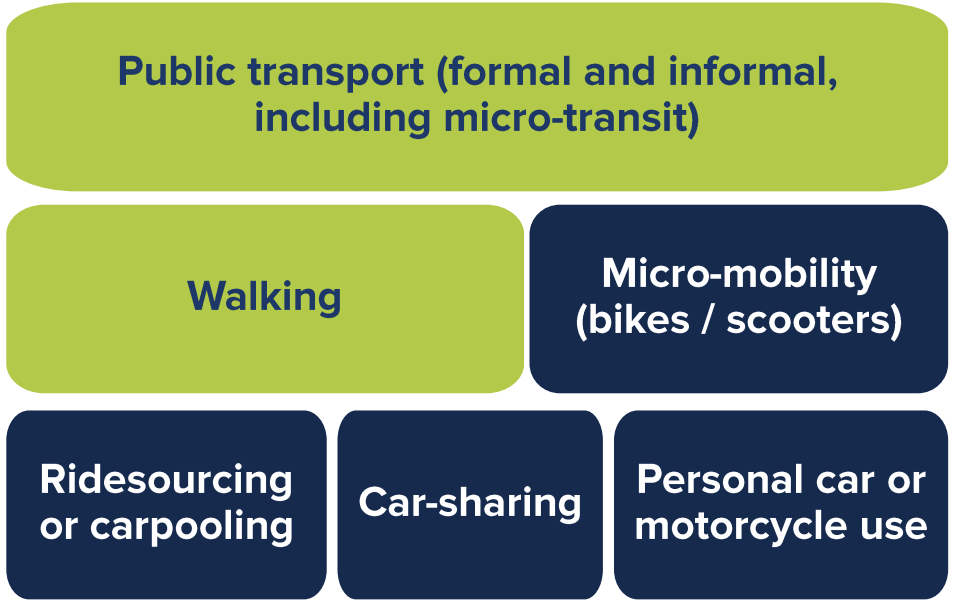
MaaS supply

The integration of as many transportation modes as possible through MaaS allows the platform to offer a range of mobility services that can fit the needs of different individuals and their trips.

The most effective MaaS platform is multimodal, organized with the following guiding principles:

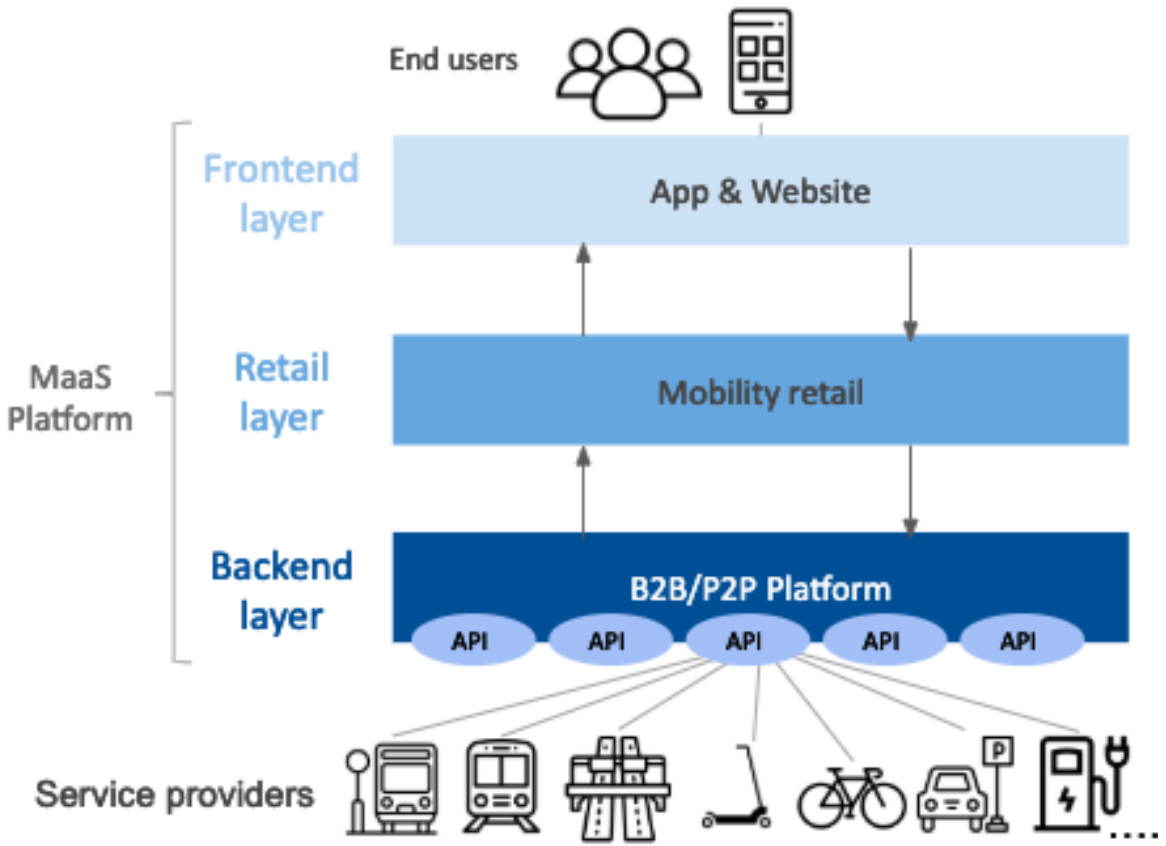
- Formal and informal public transport operate as the backbone
- Active modes, provide an efficient, healthy, affordable, and environmentally friendly mobility option for shorter door-to-door trips and as the most common way to access public transport. Despite existing outside the digital ecosystem, decision-makers and planners must remember walking and personal biking should not be forgotten in MaaS discussions
- ICT-enabled mobility services must complement, not compete with, public transport

MaaS provides a way to leverage each mobility mode/service where it is most efficient, creating a mobility system that advances desired outcomes



Bringing informal transit providers onboard MaaS schemes is one of the greatest opportunities for implementation of the concept in developing cities. However, informality, the fragmentation of operations, and complex stakeholder ecosystems are key challenges for advancing transport system data, service, and policy integration with MaaS

MaaS technology



On May 11, 2011, the United Nations General Assembly launched the (first) Decade of Action for Road Safety 2011–2020 with a goal to reduce the level of road traffic fatalities. At the time, it was estimated that 5 million lives could be saved on the world's roads during the decade if appropriate action was taken.

Technology and inclusion

While technology has been a driver for the development of MaaS platforms, it can also be an important barrier to MaaS adoption:

- **Digital divide** – the gulf between those who have smartphones, mobile internet connectivity and access to financial services that are digitally connected, and those who do not
- **Technological divide** – accelerated use of digital products poses a challenge for certain individuals, particularly the elderly, who are not as familiar with technology
- **Financial divide** – the larger share of unbanked people makes the implementation of MaaS more challenging in emerging economies
    - Smartcards, micropayments, and other innovations can help bridge these gaps

Opportunity/challenge for developing cities = inequities in digital access and informality/fragmentation of operators
MaaS's reliance on technology could either exacerbate mobility equity issues or catalyze efforts to bridge the digital divide and other inequities in access in emerging economies. While emerging economies have lagged in the implementation of ICT that underpins the MaaS schemes piloted in developed countries, innovations in the developing world to bridge the digital and financial divides can unlock new opportunities for MaaS implementation. Issues surrounding universal access to smartphones and banking systems in emerging economies should not be seen as an obstacle to the implementation of MaaS (which is built on these systems), but instead as a motivator of broader efforts to ensure technological inclusivity and access to banking among the bottom 40 percent.

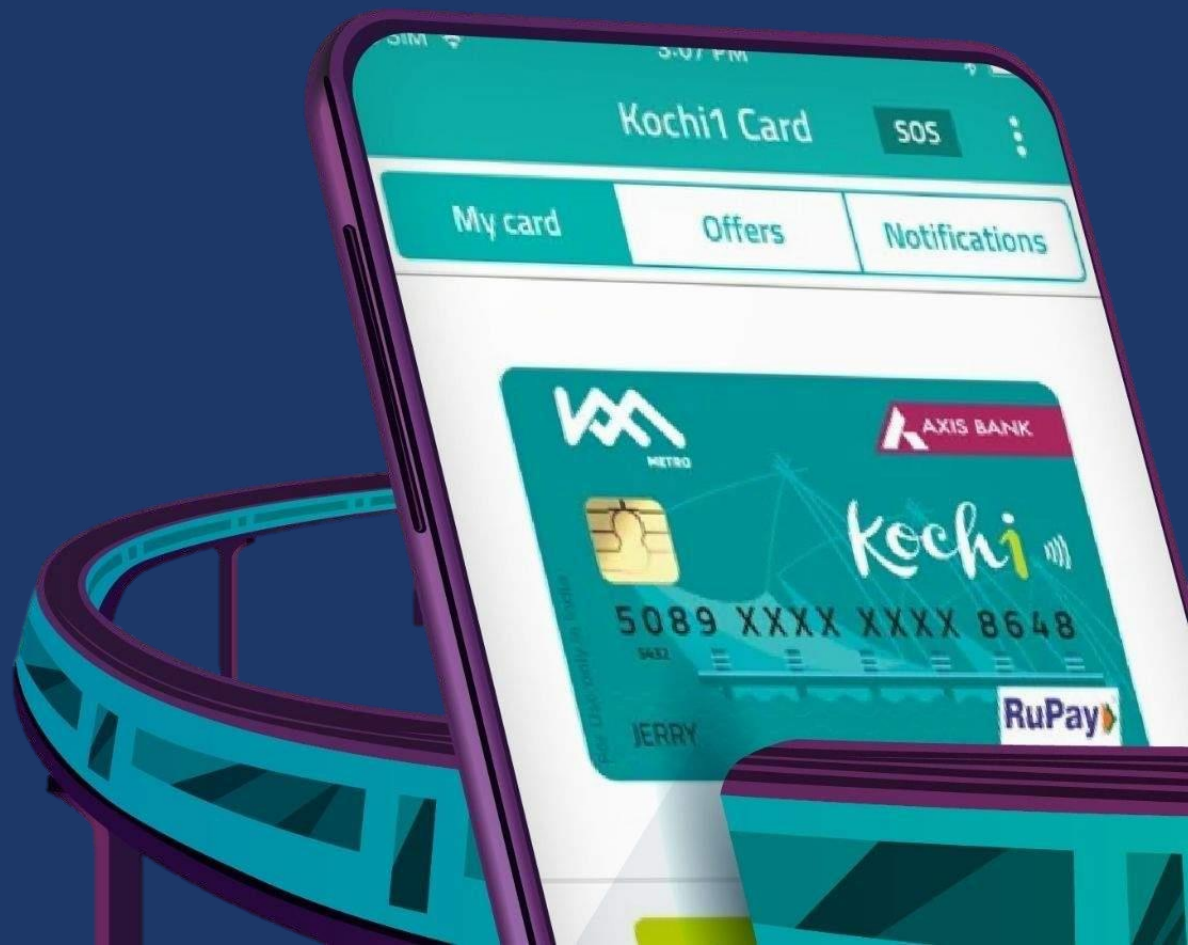
Example: Kochi One, India

Kochi One is a MaaS scheme implemented in 2017 in the city of Kochi, India

The goal of the scheme was to improve multimodal integration and expand public transport in a cost-efficient manner; all to provide an attractive alternative to private motorization

Key features:

- Smartphone app as primary user interface, but also provides smartcard for individuals without smartphone-based Internet connectivity
- Covers formal public transit (bus) and public bike-share services
- Integrates informal transit services through establishment of co-operative society for auto rickshaw drivers and the registration of private bus operators as Limited Liability Partnerships



Example: M-Pesa mobile payment, Kenya

Transactions are recorded electronically, providing enhanced security and a check against corruption compared to transactions in traditional banking systems
Two-way communication between the user and the system
M-Pesa fosters financial inclusion
Is a retail payment platform that many transport service providers use for collecting payments
Inexpensive to load with a QR code or at a kiosk as opposed to cards that require investments in loading infrastructures

Arroyo-Arroyo, et al. (2021); Mas and Radcliffe (2010)

Technology as a means of nudging behavior

MaaS can help nudge behavior away from private car ownership/use towards more sustainable and healthy options
Reduces information asymmetry
Changes operational and attitudinal attributes of a trip
Offers alternatives to private vehicle ownership (potentially avoiding motorization)
Government has a central role in shaping MaaS to align with societal goals and to use it to encourage sustainable lifestyles

MaaS schemes will provide positive results in reducing emissions and improving air quality if assessing the systemic impacts of transport, focusing on the potential complementarity (serving the first-/last-mile) and substitution of private vehicle ownership and use (replacing more polluting modes). MaaS may also support building back better in the wake of the Covid-19 pandemic by offering better matching between user demand and service supply, supporting teleactivities that curtail the need for travel, and nudging users into green choices of transport, such as public transit and active modes with appropriate safety precautions. Governments should support initiatives that target these objectives.

The ability that MaaS has to nudge behavior away from private car ownership and use is dependent on recognizing and meeting unique user needs and supporting service-based approaches through complementary investment in infrastructure and implementation of reinforcing policy measures (such as transport demand management).

MaaS business opportunities

MaaS business models must offer a compelling value proposition to each participating stakeholder, including customers, mobility service providers, MaaS platform(s), and government agencies

MaaS business models require establishing multiple revenue streams:

Ancillary customer services

Advertising and data revenues

Government subsidies

MaaS business models are often first implemented as pilots; more experiences in developing countries are needed to assess the long-term viability of different models

MaaS business models are often first implemented as pilots. This approach allows all participating actors to identify unforeseen barriers to implementation, to assess the long-term viability of the business model, to make any necessary adjustments. However, pilots should not be the end-goal and MaaS schemes should be implemented with the goal of scaling up and making permanent successful interventions

Opportunity/challenge for developing cities = city governments providing strategic policy goals to signal the market how it wants the industry to evolve

MaaS governance

MaaS governance

MaaS infrastructure

Supply of infrastructure needs to mirror the policy vision and prioritization of modes/services within MaaS:

•Preferencing public transit and active modes in allocating street space

•Physical and operational integration to make transfers among modes easier

MaaS goals


L.I.T.O

Overview of ICT-enabled mobility services

‘To ride’ mobility services include a vehicle and driver, such as ridesourcing or microtransit. These services are commonly offer[illegible]rcing compani[illegible]er, Didi, or Grab—tha[illegible]w[illegible]ers.

Ridesourcing or ride-hailing (by 2-, 3-, or 4-wheeler)

Microtransit

Carpooling

‘To rent’ mobility services do not include a driver, so operating the vehicle is the user’s responsibility

Car-sharing

Bike-sharing

Scooter-sharing (kick or moped)

Ridesourcing

Business and service models

- Online platform that matches, in real time, users requesting a trip to drivers offering rides in their personal vehicles
- Compared to traditional taxi services, ridesourcing often provides greater service coverage, better information and tracking of vehicle availability and trip times, dynamic pricing and cashless payment, and review and rating systems
- Vehicles can be 2-wheelers (motorcycles), 3-wheelers (auto rickshaws), or 4-wheelers (cars)
- Two main service models:
  - Exclusive: One vehicle/driver serves a single trip request
  - Pooled (or shared): One vehicle/driver serves multiple trip requests based on similarity of time and route
- Provides convenient, comfortable, and prompt door-to-door service without the need for a personal vehicle

Main challenges

- Have led to increases in vehicle miles traveled (VMT) in almost every city introduced – 'empty' vehicle miles while drivers search for ride requests, induced trips due to ease of access and other service quality improvements, and modal shifts from public transit and active modes account for these increases
- Can also cause lane blockages during pick-up and drop-off, contributing to congestion and road safety incidents
- Only affordable for higher-income travelers

Ridesourcing

Technology-enabled transport services that offers the agility of on-demand systems with:

- The space- and energy-efficiency provided by medium-sized vehicles (such as vans),
- Aggregation of trips along dynamic or semi-fixed routes (similar to more ‘tradition’ public transit services),
- Matching of supply and demand in real-time, and
- Dynamic pricing to improve efficiency (potentially)

Typically provide service during times of day or in areas that are difficult or too expensive to serve by mass public transit (e.g., when/where there is lower density of demand)

Car-sharing

Business and service models

- User pays for access to a car for a given unit of time or distance; can be daily rental similar to a typical car rental company or for shorter lengths such as hours
- Two main business models:
  - Business-to-consumer (B2C): car-sharing platform or company maintains a vehicle fleet around the city (often in dedicated parking spaces), matches supply and demand, and oversees logistics of regional fleet rebalancing
  - Peer-to-peer (P2P): private vehicle owners list their vehicles for rental on a platform
- Two main service models:
  - Roundtrip: pick up and return car to the same location
  - One-way: pick up and return car to different locations

Main benefits

- Provides a way to access car-based travel without the need for personal car ownership
- Improves utilization of vehicles by sharing the asset across multiple users/trips

	Roundtrip	One-way
Private vehicles replaced per carsharing vehicle	9 to 13	7 to 11
Percent reduction in vehicle-miles traveled (VMT)	27% (average)	6% to 16%
Percent reduction in greenhouse gas emissions	34% to 41%	4% to 18%

In the U.S., studies have found that users of roundtrip car-sharing services reduce their VMT by 27% (average). They also increase their use of public transport, carpooling, walking, and biking. However, in some cases, carsharing members decreased their use of public transport.

Lazarus, et al. (2017); Shaheen, Totte, and Stocker (2018)

“Micro-mobility”: Bike- and scooter-sharing

Business and service models

- Micro-mobility operator owns, maintains, and rebalances a fleet of small vehicles throughout the city; operator may be public, private, or a public-private partnership
- Users rent the bicycle or scooter closest to them on a trip-by-trip basis per minute or kilometer (or potentially by subscription for a bundle of trips)
- Vehicles can be bicycles or scooters; can be fully human-powered or electric
- Two main service models:
  - Docked (or station-based): Bikes are stored at stations with rental kiosks
  - Dockless (or free-floating): Bikes are parked where previous user ended trip and unlocked using a QR code and smartphone app

Uneven flows of travelers among locations in the city require operators to relocate vehicles from areas where they accumulate to areas where there are few vehicles available throughout the day. This process is called **‘rebalancing’.**

“Micro-mobility”: Bike- and scooter-sharing

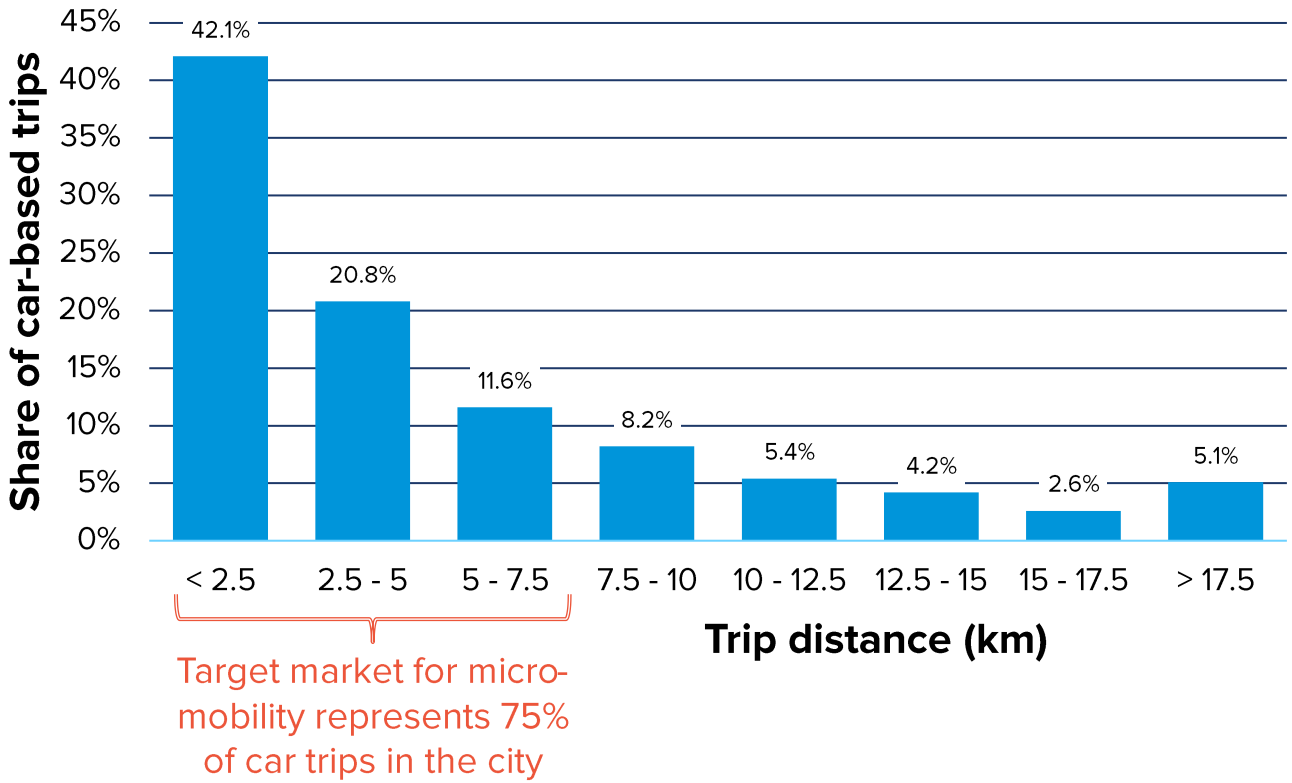
Target use cases

The widespread availability of bicycles and scooters can potentially reduce reliance on personally-owned vehicles either by replacing short car-based door-to-door trips or by addressing the first- and last- mile access to public transit services:

- **Short door-to-door trips (<7.5km):** In cities around the world, a large share of car-based trips are short enough that they could be replaced by smaller, more fuel- and space-efficient vehicles, like bikes or scooters.

- **First-/last-mile access to public transit:** Bikes and scooters can also help to expand the catchment area of public transit stations, allowing more individuals to reach existing transit services

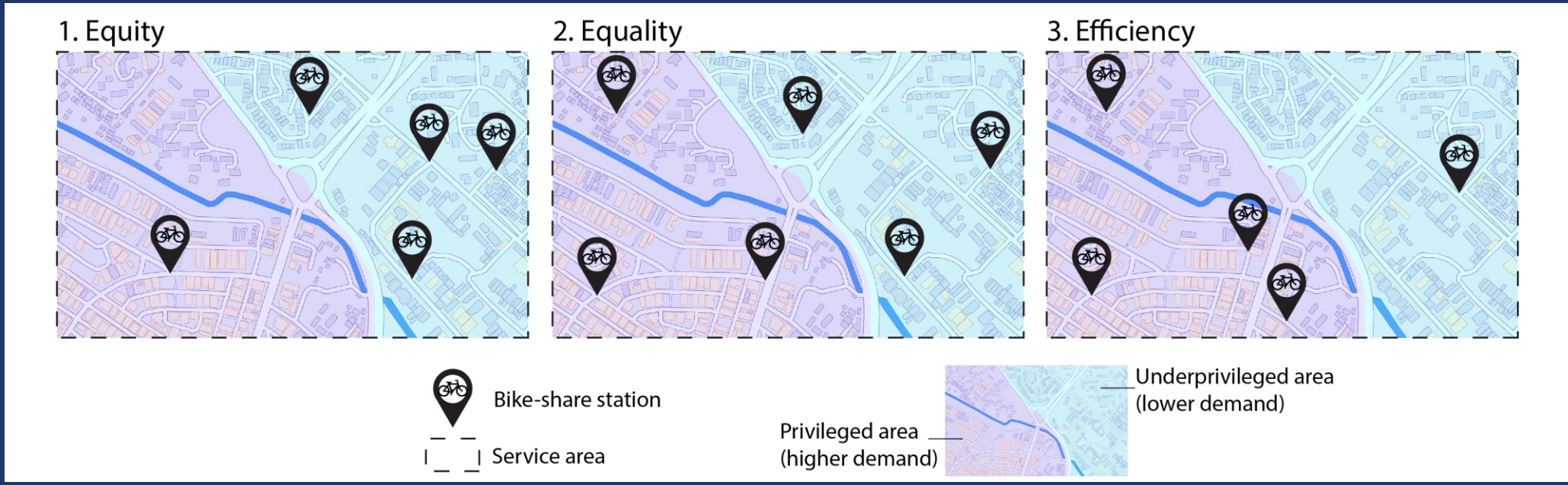
Distribution of car-based trips in Sao Paulo, Brazil by distance (2012)



99 Policy and Research analysis based on 2012 Sao Paulo Origin-Destination Survey; Sá, et al. (2016); Sá, Parra, and Monteiro (2015). Zarif, et al. (2019) found similar results in U.S. cities

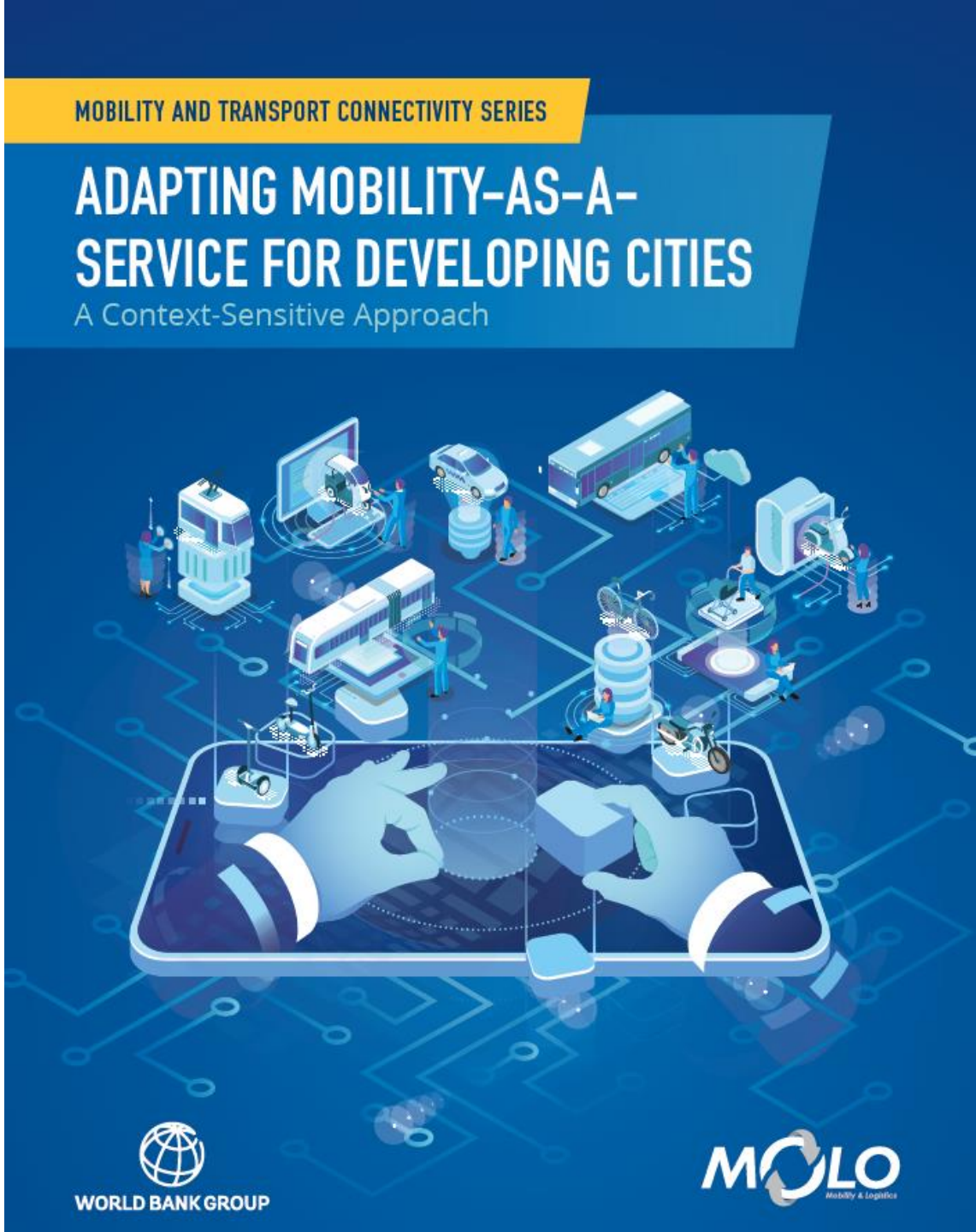
Example: Fair allocation of bike-share infrastructure

- Distribution of ‘to rent’ infrastructure can influence how and by whom car-, bike-, and scooter-share services are used
- Different strategies for the spatial distribution of vehicles (for dockless systems) and/or stations (for docked systems), will impact quality of service, equity of access, and social inclusion:
  - Strategy 1 allocates more stations in underprivileged areas, improving accessibility especially among the more vulnerable;
  - Strategy 2 distributes stations evenly across the whole area, fostering more equal access to bike-sharing infrastructure; and
  - Strategy 3 introduces more stations in areas where profit is expected to be highest and vandalism lowest, improving accessibility primarily among the most privileged.
- These strategies can be merged in different ways to better deliver equity, equality and efficiency at the same time.
- Customers will also relocate bikes through use, which impacts the availability of bicycles at any given station (often requiring ‘rebalancing’ by the operator)
- Distribution strategies should be incorporated into permits and regulations for bike share operators



Further reading

Bianchi Alves, Bianca, Winnie Wang, Joanna Moody, Ana Waksberg Guerrini, Tatiana Peralta Quiros, Jean Paul Velez, Maria Catalina Ochoa Sepulveda, and Maria Jesus Alonso Gonzalez. 2021. Adapting Mobility-as-a-Service for Developing Cities: A Context-Sensitive Approach. *Mobility and Transport Connectivity Series*. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/36787



References

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Arroyo-Arroyo, Fatima, Philip van Ryneveld, Brendan Finn, Chantal Greenwood, and Justin Coetzee. 2021. Innovations in Fare Collection Systems for Public Transport in African Cities. Africa Transport Policy Program (SSATP). https://www.ssatp.org/sites/ssatp/files/publication/SSATP_fare_collection_single_5_0.pdf

Bianchi Alves, Bianca, Winnie Wang, Joanna Moody, Ana Waksberg Guerrini, Tatiana Peralta Quiros, Jean Paul Velez, Maria Catalina Ochoa Sepulveda, and Maria Jesus Alonso Gonzalez. 2021. Adapting Mobility-as-a-Service for Developing Cities: A Context-Sensitive Approach. *Mobility and Transport Connectivity Series*. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/36787

Lazarus, Jessica, Susan Shaheen, Stanley E. Young, Daniel Fagnant, Tom Voege, Will Baumgardner, James Fishelson, and J. Sam Lott. (2017). Shared Automated Mobility and Public Transport. Road Vehicle Automation, 4: 141-161. https://link.springer.com/chapter/10.1007%2F978-3-319-60934-8_13 [Retrieved from https://escholarship.org/uc/item/6589k2h1]

Mas, Ignacio & Radcliffe, Daniel. (2010). Mobile payments go viral: M-PESA in Kenya. Journal of Financial Transformation. 32. 169-182.

Sá, Thiago Hérick, Ana Clara Duran, Marko Tainio, Carlos Augusto Monteiro, and James Woodcock. (2016). Cycling in São Paulo, Brazil (1997–2012): Correlates, time trends and health consequences. *Preventative Medicine Reports,* 4: 540-545. https://doi.org/10.1016/j.pmedr.2016.10.001

Sá, Thiago Hérick, Diana C. Parra, and Carlos Augusto Monteiro. (2015). Impact of travel mode shift and trip distance on active and non-active transportation in the São Paulo Metropolitan Area in Brazil. *Preventative Medicine Reports,* 2: 183-188. https://doi.org/10.1016/j.pmedr.2015.02.011

Shaheen, Susan, Hannah Totte, and Adam Stocker. (2018). Future of Mobility White Paper. UC Berkeley: Institute of Transportation Studies at UC Berkeley. http://dx.doi.org/10.7922/G2WH2N5D [Retrieved from https://escholarship.org/uc/item/68g2h1qv]

Zarif, Rasheq, Derek Pankratz, and Ben Kelman. (2019). Small is beautiful: Making micro-mobility work for citizens, cities, and service providers. Deloitte Insights, Series on Future of Mobility. https://www2.deloitte.com/content/dam/insights/us/articles/5000_small-is-beautiful/DI_Small-is-beautiful.pdf

Image sources (by slide number)

11. https://timesofindia.indiatimes.com/city/kochi/now-book-metro-ticket-via-kochi1-app/articleshow/81676307.cms
20. https://commons.wikimedia.org/wiki/File:Zipcar_Car_Sharing_(27886975043).jpg
https://techcrunch.com/2021/05/09/telkomsel-invests-an-additional-300-million-in-gojek/
https://transportation.ucsd.edu/commute/carpools.html
"e-scooter rider in Mexico City." Sonia Medina, 2019, via Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Grin_e-scooter_rider_in_Mexico_City.jpg
22. MOIA (Hamburg, Germany): https://www.briansolis.com/2019/12/cnet-features-insights-by-brian-solis-on-vws-moia-and-eco-friendly-transportation-startups-entering-rideshare-market/
23. "Alfa Romeo car share." Pava, 2012, via Wikimedia Commons. https://en.wikipedia.org/wiki/File:-_01_Car_Sharing_Alfa_Romeo_MiTo.JPG
24. "Docked bike-share in Paris, France." Coyau, 2012, via Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Place_de_la_R%C3%A9publique_(Paris),_r%C3%A9am%C3%A9nagement,_2012-04-05_39.jpg
"Dockless bike-share in Los Angeles, United States." waltarrrr, 2017, via Flickr (CC BY-NC-ND 2.0). https://www.flickr.com/photos/waltarrrrr/38226283741
"Dockless, shared electric kick-scooters in Tomaszów Mazowiecki, Poland." WrS.tm.pl, 2021, via Wikimedia Commons. https://commons.wikimedia.org/wiki/File:Shared_electric_kick-scooters_on_the_main_square_of_Tomasz%C3%B3w_Mazowiecki_with_a_population_of_60,000.jpg
26. "Figure B3.1. Different strategies to plan the introduction of bike-sharing stations." (Bianchi Alves, et al., 2021)

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