SuSMo (Sustainable Urban Shared Mobility) Project Webinar

How can cities evaluate the impacts of shared mobility?

Results from ongoing work on the state-of-the-art and state-of-the practice from cities around the world

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Delft University of Technology

SuSMo eit Climate-KIC

30 June 2020

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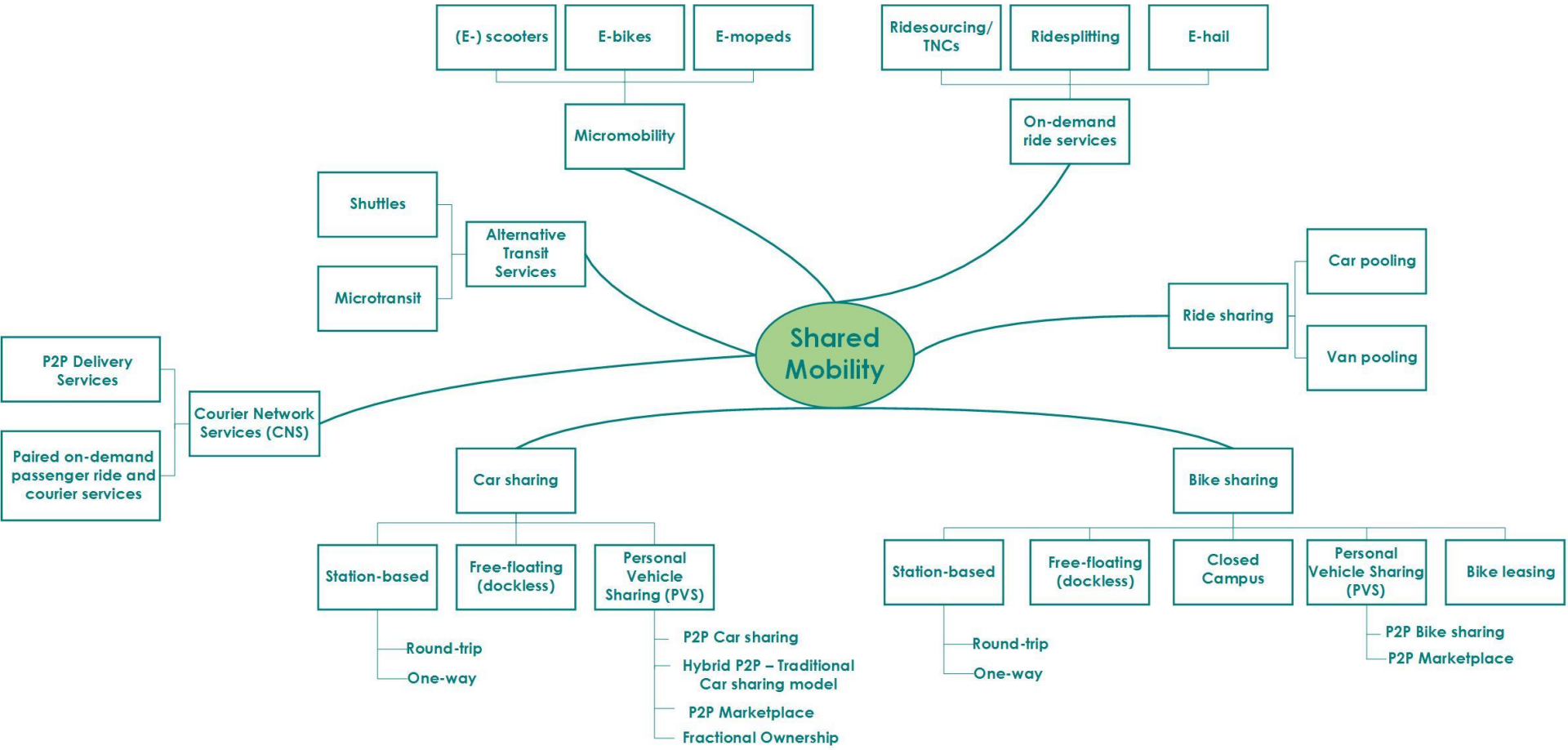
Outline

- Shared mobility modes and services
- Evolution and trends of shared mobility
- Shared mobility and Covid - 19
- Categories of impact of shared mobility
- Evaluation of impacts
  - ✓Methods (State-of-the art)
  - ✓Case studies (State-of-the-practice)
- Conclusions, open questions & perspectives

Shared mobility modes and services



Based on: Machado et al., 2018 and Shaheen et al., 2020
Synthesis and elaboration: Authors

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A large part of the recent literature focuses on Shared Electric Vehicles and Shared Autonomous Vehicles

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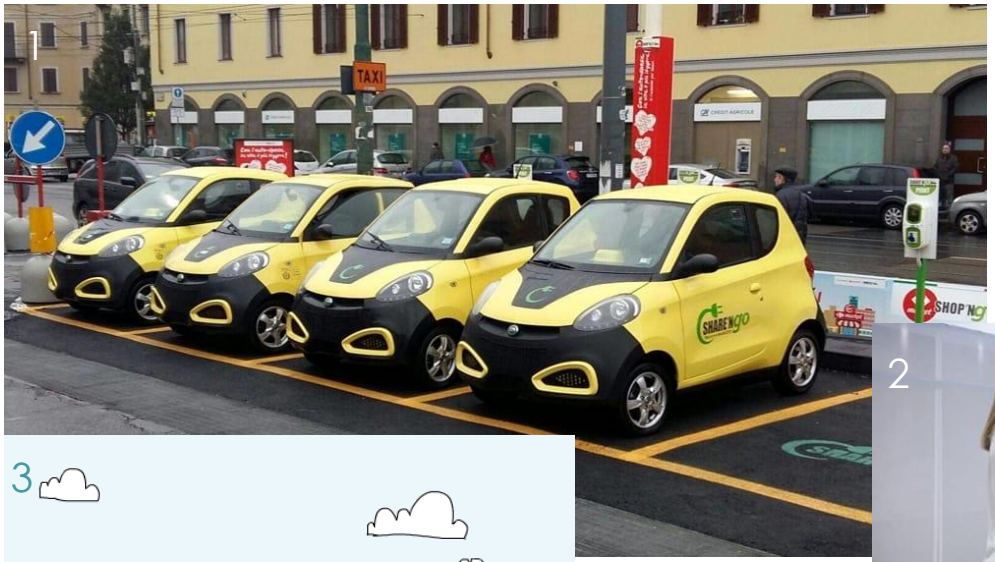

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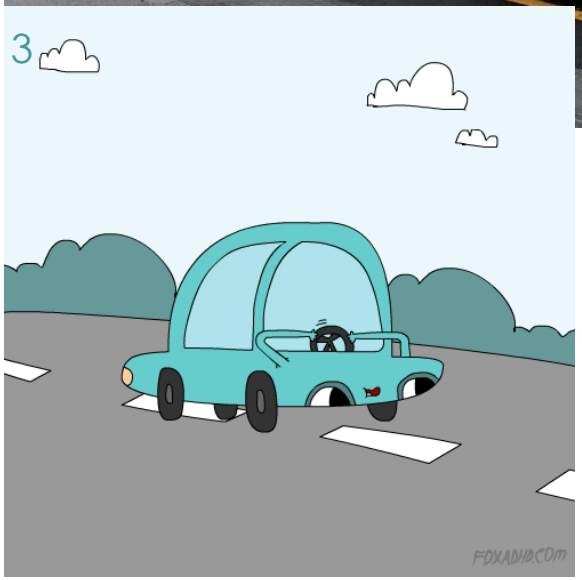

Sources: 1: http://www.milanotoday.it/attualita/sharengo-chiude.html
2: https://www.designboom.com/technology/jaguar-land-rover-driverless-cars-virtual-eyes-trust-08-28-2018/
3: http://clipart-library.com/driving-a-car-animated-gif.html

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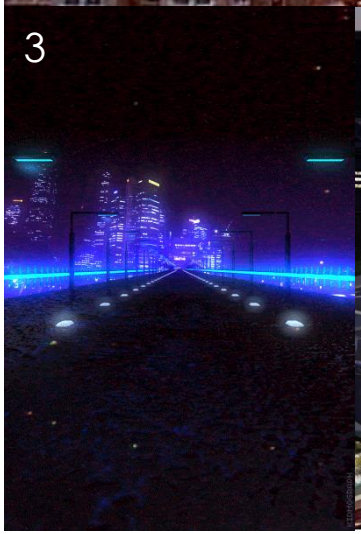
Shared mobility of the future?



Mega Skyport

Sources: 1, 2 & 3: https://giphy.com/
4: https://techcrunch.com/2018/05/09/ubers-aerial-taxi-play/

Evolution of car sharing worldwide

Source: Shaheen, S., Cohen, A. and Jafee, M. (2018), "Innovative mobility: carsharing outlook. Carsharing market overview, analysis and trends", Transportation Sustainability Research Center, University of California, Berkley.

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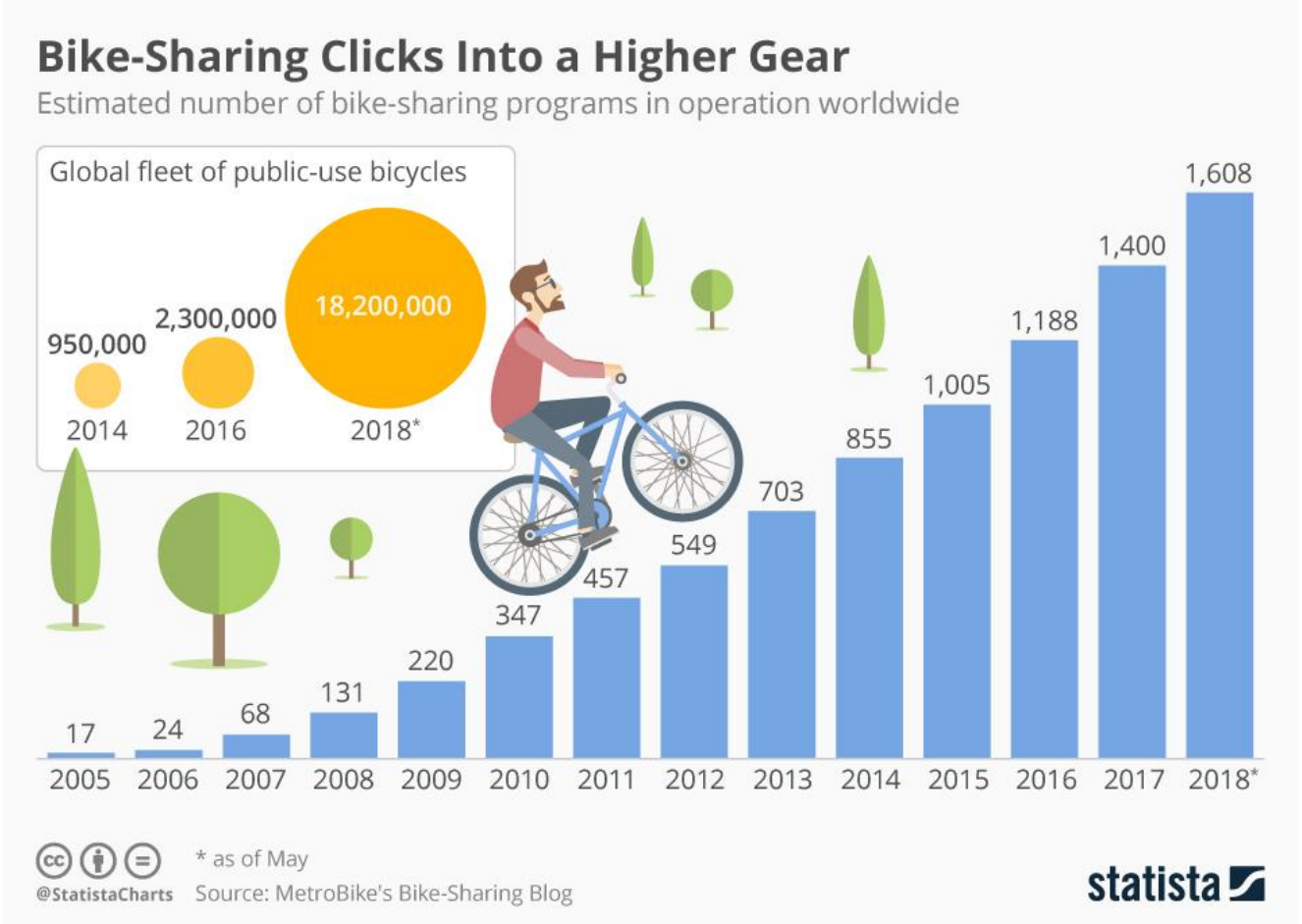
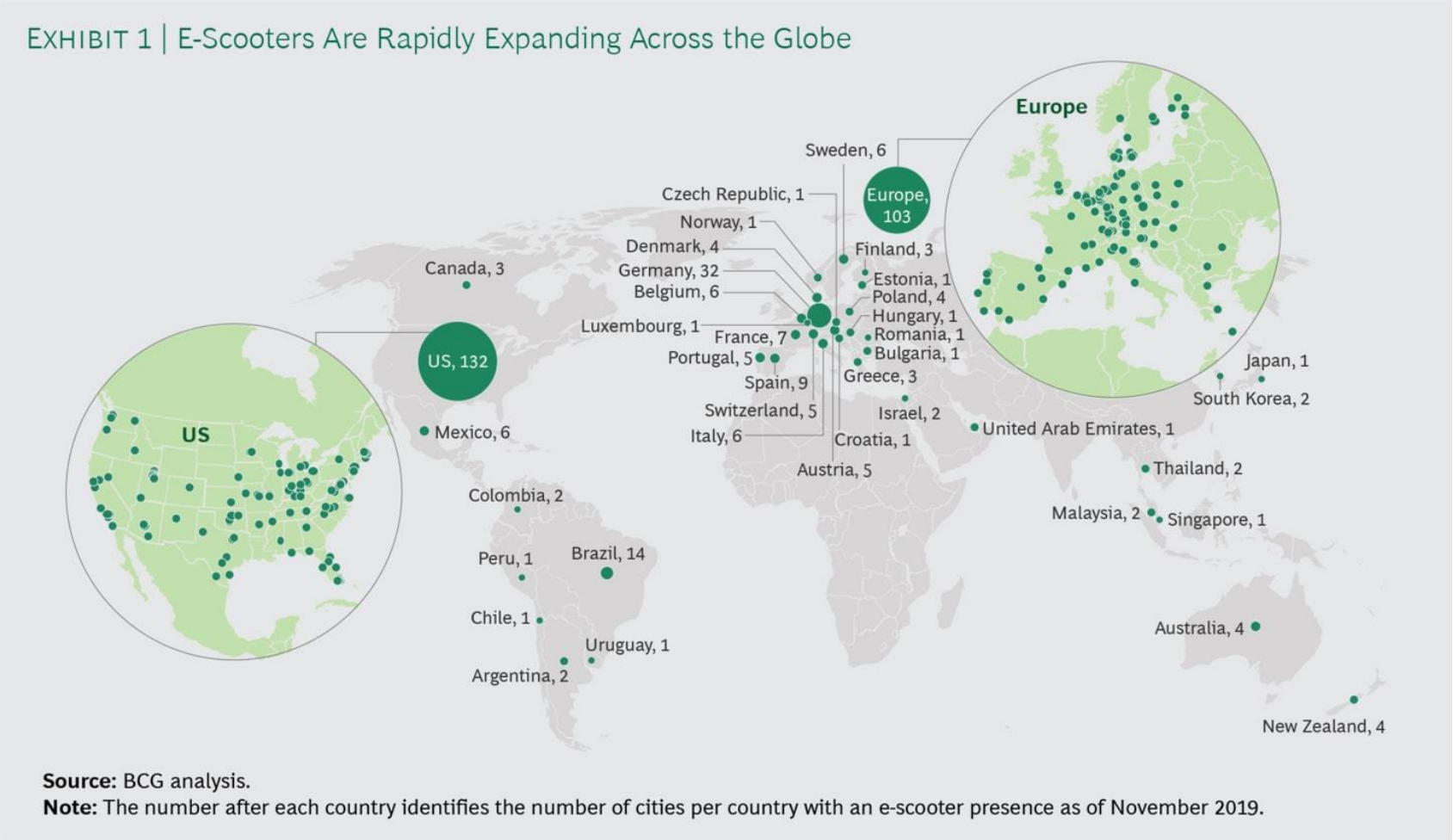
Evolution of bike sharing worldwide



Source: https://www.statista.com/chart/14542/bike-sharing-programs-worldwide/

Evolution of shared micromobility worldwide



Source: https://www.bcg.com/publications/2020/e-scooters-can-win-place-in-urban-transport.aspx

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Shared mobility and Covid – 19..

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Global Agenda | COVID-19 | Future of Mobility

How shared cars, scooters and other mobility solutions are fighting coronavirus

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COVID-19: IMPACT ON SHARED MOBILITY

02/04/2020

COVID-19: Impact on shared mobility

In these unprecedented and very confusing times, it is safe to say that the COVID-19 virus has had an impact on every aspect of our daily lives, including the transportation services that we regularly use.

Most operators have experienced free-fall declines in bookings and journeys because of people staying and working from home. This is also the first time that a virus of this kind has managed to unearth the epidemiological aspect of shared mobility, on a global scale. With social and physical distancing measures in place in many countries, ridehailing, public transit and carpooling services have had to re-evaluate how to safely transport passengers in services where people not only use a shared vehicle consecutively but simultaneously with strangers.

Never before, have personal transportation offers, whether they're airlines, shared mobility operators or transit authorities, had to adapt their core services in such a fast time frame. The resulting pressure to reduce service or even shut down operations altogether has thrown the service and entire transportation networks into an unknown territory.

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Shared mobility firms experiment with new models as Covid-19 cripples their business

Companies that have captive fleets will eye increased occupancy with business-to-business partnerships, corporate tie-ups and product delivery in the near term.

Aditi Shrivastava | ETtech | Updated: May 05, 2020, 00:32 IST

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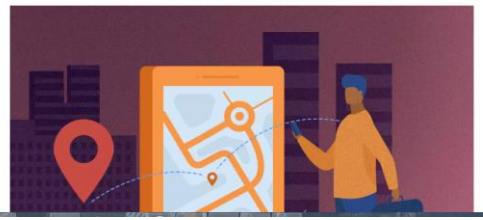
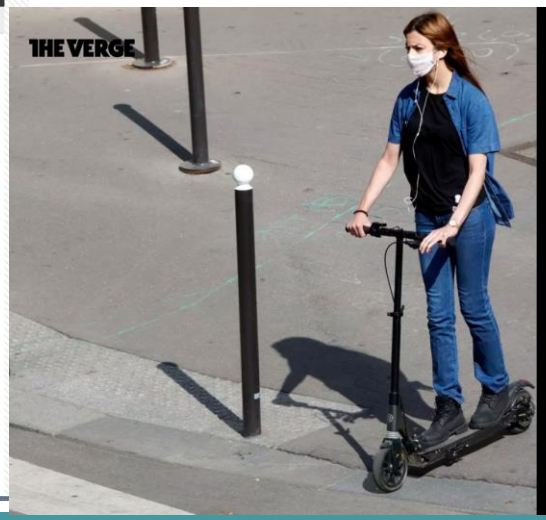


Trending In Internet

Amazon signals entry into alcohol delivery in India with nod in key state

Flipkart to launch hyperlocal delivery services starting with Bengaluru

ETtech Top 5: India-China standoff to hit startups, Saudi's Jio



REPORT

HOW THE NOVEL CORONAVIRUS IS SPEEDING THE SCOOTER APOCALYPSE

The scooter sharing industry is getting killed by COVID-19, but something better may emerge

By Andrew J. Hawkins | @andyjayhawk | May 13, 2020, 12:51pm EDT

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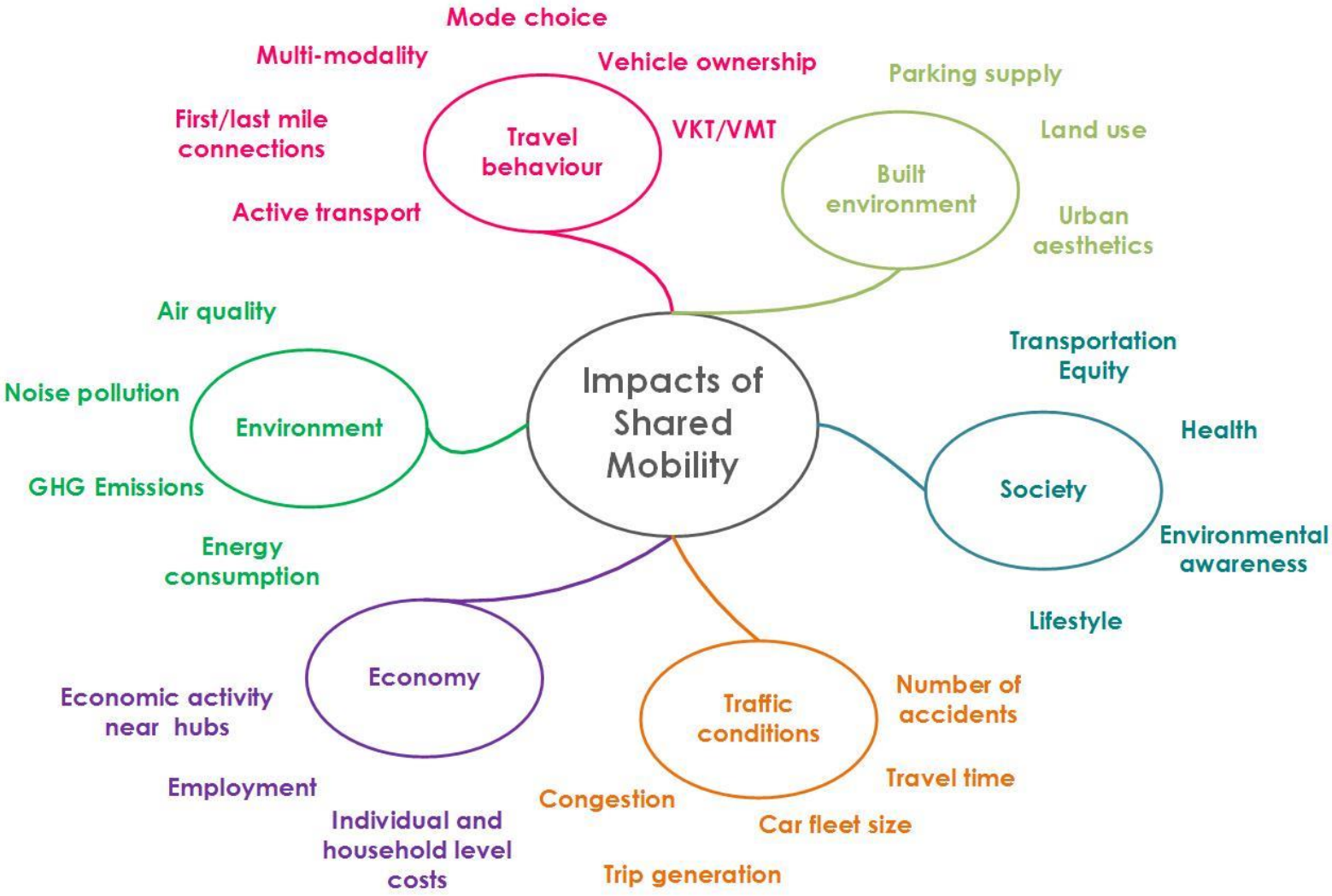
Categories of impacts of shared mobility



Synthesis and elaboration: Authors

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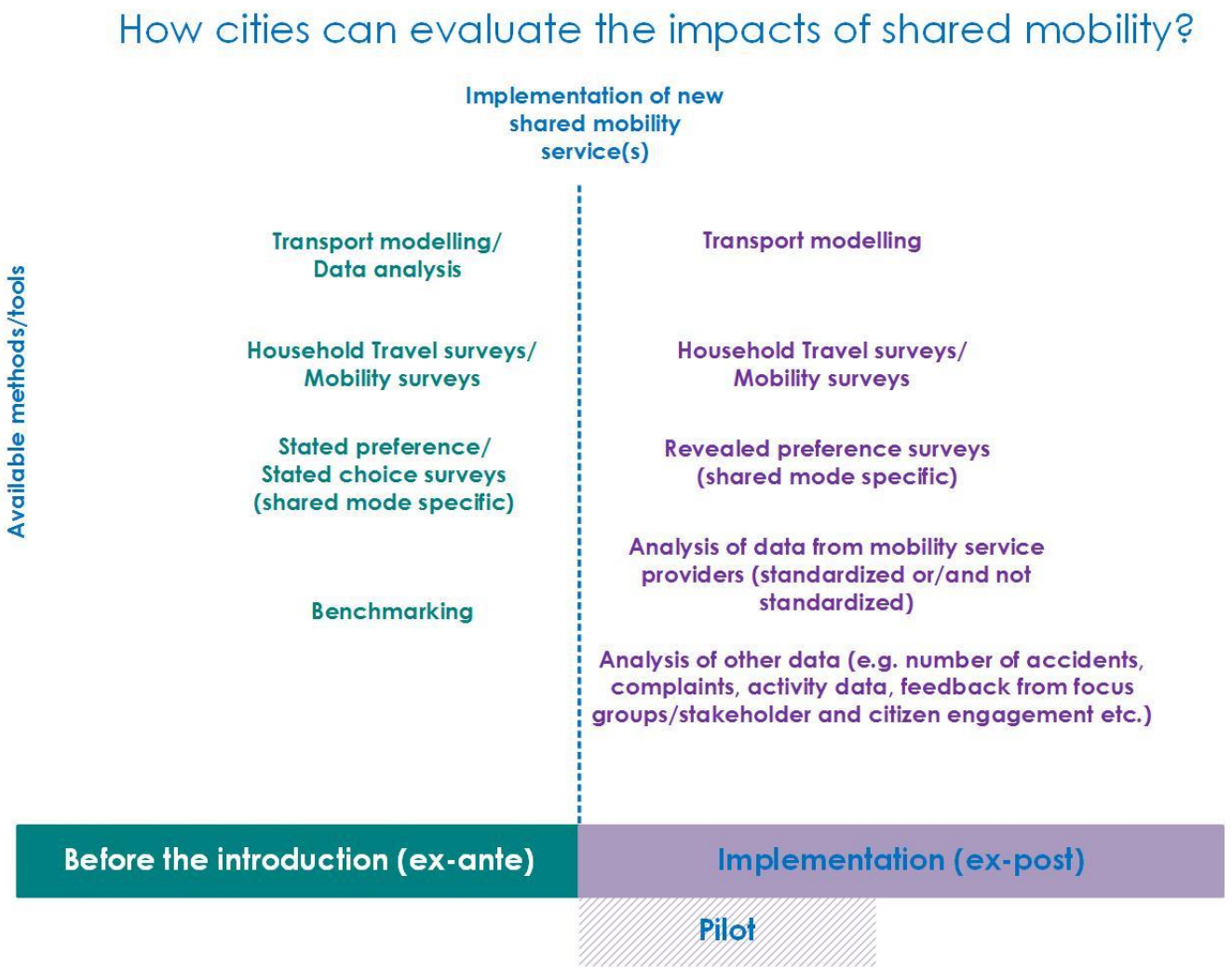
Available evaluation methods



Synthesis and elaboration: Authors

Ex-ante evaluation

Ex-ante: Stated preference/stated choice surveys

- Stated preference (SP) or stated choice (SC) surveys have been extensively used in the last decades in transport and other fields to identify behavioural responses to choice situations which are not yet revealed in the market (Hensher, 1994)

- Theses surveys provide answers to hypothetical situations with "what would you do/what would be your choice" type of questions.

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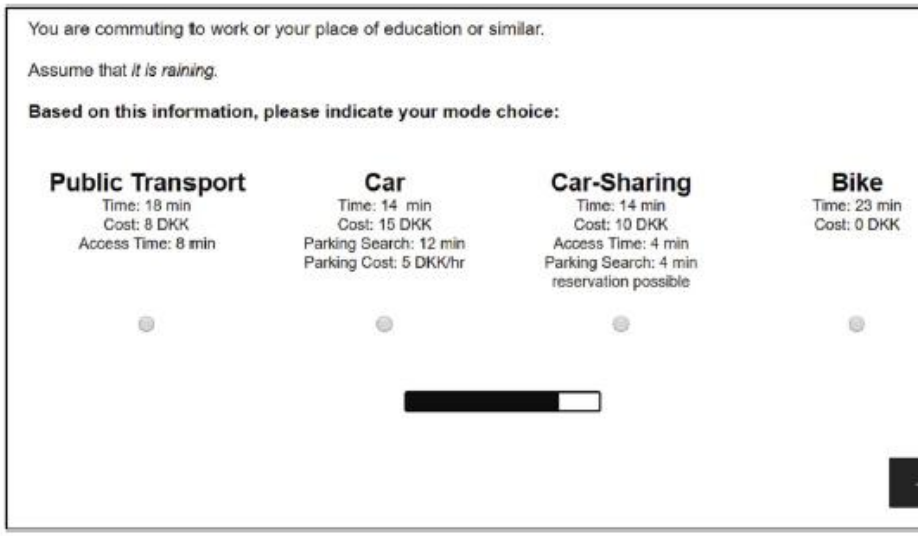
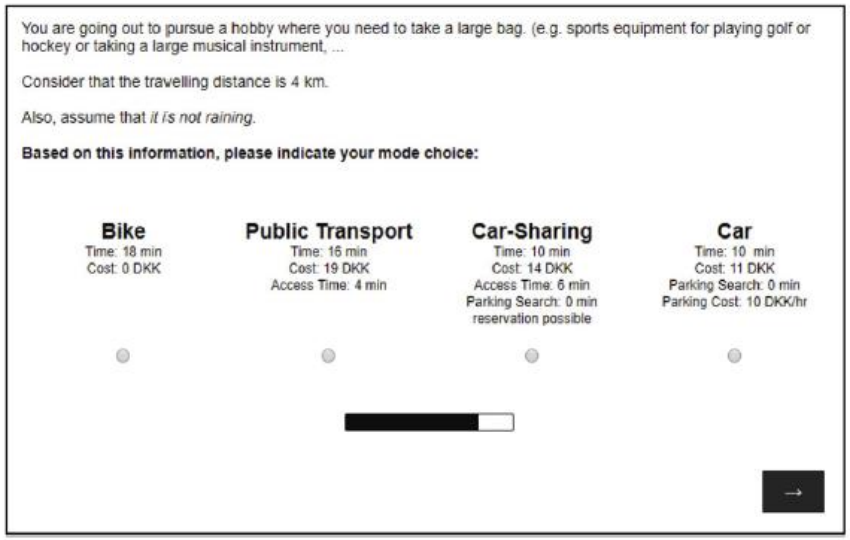
Sources: Hensher, D.A. (1994), "Stated preference analysis of travel choices: the state of practice", *Transportation*, 21, 107-133.
1: https://www.dragnsurvey.com/blog/en/the-difference-between-survey-and-questionnaire/
2: https://www.mememaker.net/meme/survey-meme-128532
3: https://www.memecenter.com/fun/1156002/true-story

A stated preference mode choice experiment for car-sharing in Copenhagen

- Objective: to examine how individuals value various characteristics of free-floating car sharing services and explore substitution patterns between them and traditional transport modes (private cars, public transport, bike).

- The willingness-to-pay for vehicle reservation, parking availability and convenient access to car sharing vehicles was estimated.





Sources: Carrone, A.P., Hoening, V.M., Jensen, A..F., Mabit, S.E. and Rich, J.(2020), "Understanding car sharing preferences and mode substitution patterns: A stated preference experiment", Transport Policy, in press

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A stated preference mode choice experiment for car sharing in Copenhagen

- Results show that free-floating car sharing is a strong competitor of public transport and bike trips and to a lesser degree of private car trips.
- Value of time spent searching for parking > by 20% and value of access time > 30% than value of the actual travel time inside the vehicle.
- Guaranteed availability of car sharing vehicles, convenient access and parking availability are very valuable characteristics for the users and could play an important role in car sharing adoption.


Sources: Carrone, A.P., Hoening, V.M., Jensen, A..F., Mabit, S.E. and Rich, J.(2020), "Understanding car sharing preferences and mode substitution patterns: A stated preference experiment", Transport Policy, in press
1: https://www.iexpats.com/wonderful-copenhagen-wins-best-city-vote-for-expats/
2 & 3: https://urbandevelopmentcph.kk.dk/artikel/mobility-copenhagen

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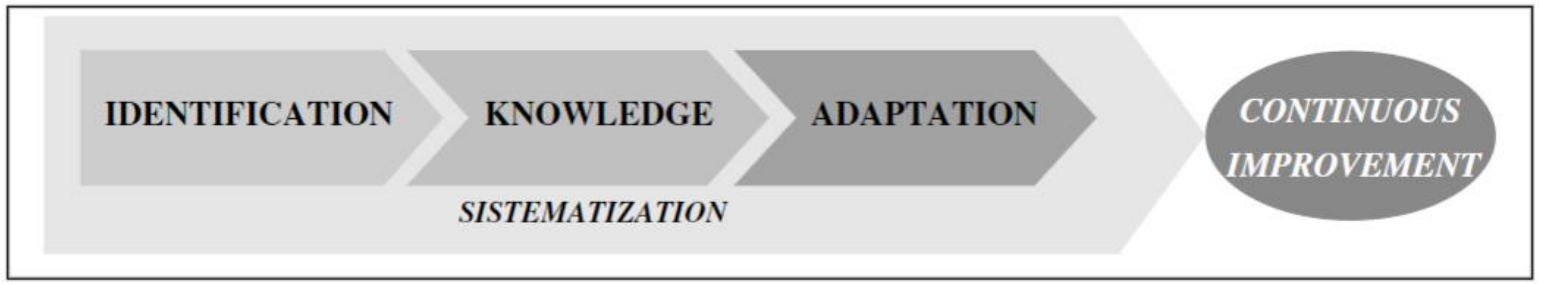
Ex-ante: Benchmarking

- Camp (1989) defined benchmarking as ‘‘the search for industry best practices that lead to superior performance”.

- In the context of city planning, benchmarking is a systematic and continuous process that includes identifying, learning from and eventually implementing the most effective practices from other cities (Zope et al., 2019).

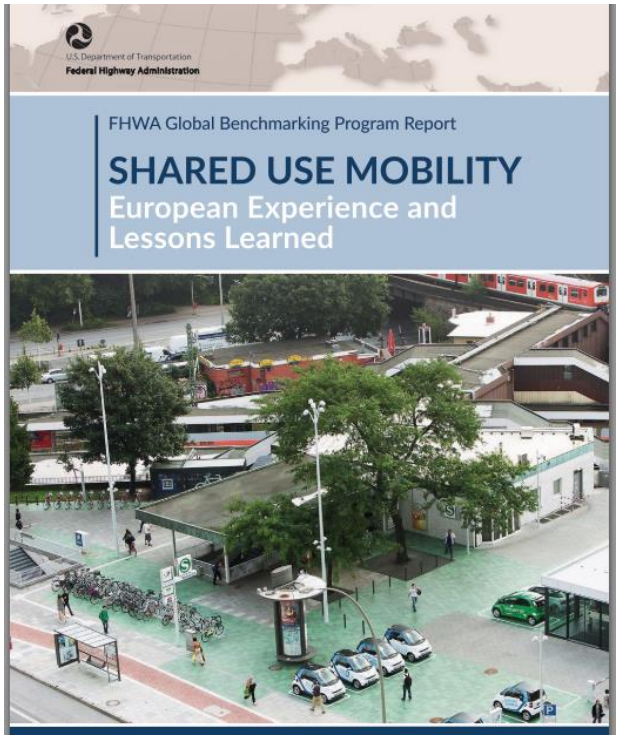


Basic conceptual process of city benchmarking (Luque-Martínez and Muñoz-Leiva, 2005)

Sources: Camp, R.C. (1989), *Benchmarking: The Search for Industry Best Practices that Lead to Superior Performance*, Taylor & Francis.
Zope, R. et al. (2019), “Benchmarking: A tool for evaluation and monitoring sustainability of urban transport system in metropolitan cities of India”, *Sustainable Cities and Society*, 45, 48-58.
Luque-Martínez, T. and Muñoz-Leiva, F. (2005), “City benchmarking: A methodological proposal referring specifically to Granada”, *Cities*, 22(6), 411-423.

FHWA Global Benchmarking Program Report on Shared Use Mobility in Europe

Objective: to study the European experience and lessons learned in shared mobility, to help avoid duplicative research, reduce overall costs, and accelerate improvements to the U.S. transportation system.



Methodology:

- Literature review
- Interviews and meetings with experts
- Synthesis of the information

Three cities were selected (Munich, Paris and Brussels) based on factors such as the size and scale of their shared mobility systems and the existence of policies relevant to U.S. practices.

Source: Feigon, S., Frisbie, T., Halls, C. and Murphy, C. (2018), "Shared Use Mobility: European Experience and Lessons Learned", FHWA Global Benchmarking Program Report No. FHWA-PL-18-026, Available from: https://international.fhwa.dot.gov/sum/fhwapl18026.pdf

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FHWA Global Benchmarking Program Report on Shared Use Mobility in Europe

The study focused on three main topics:

✓Incubating new shared mobility innovations to fill important service and system gaps.

✓Sustaining and growing the scale and scope of shared mobility programs to meet expanding mobility needs and population demands.

✓ Successful integration of shared mobility services with existing public transport services, in areas such as on-demand services, first mile/last mile services, fare payment, and information/data sharing.


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Source: Feigon, S., Frisbie, T., Halls, C. and Murphy, C. (2018), "Shared Use Mobility: European Experience and Lessons Learned", FHWA Global Benchmarking Program Report No. FHWA-PL-18-026
1: https://sharedusemobilitycenter.org/fhwa-global-benchmarking/
2: https://transportpolicymatters.org/2020/01/13/paris-managing-the-shared-mobility-revolution/
3: https://www.brusselslife.be/en/article/mobility-shared-in-brussels-services-that-move

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Ex-post evaluation

Ex-post: Revealed preference surveys

- Can be addressed to users or/and non-users of a shared mobility service. Objective is to obtain a better understanding of travel behavior and of the motivational factors influencing it.

- Typical questions to users:
  - ✓How did you travel before?
  - ✓How would you travel if X was not an available option?

- To non-users:
  - ✓What are the reasons for not using the service?

1

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Sources: 1: https://uxdesign.cc/7-tips-for-a-great-questionnaire-survey-results-d7c2e2c33a27
2: https://brainstuck.com/tag/questions/

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Bike-sharing systems' impact on modal shift: A case study in Delft, the Netherlands

- This study examines the modal shift dynamics and influential factors with respect to three different bike-sharing systems that operate in Delft:
- OV-fiets (round-trip docked bike-sharing)
- Mobike (free-floating bike-sharing)
- Swapfiets (bike lease)

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Sources: Ma, X., Yuan, Y., Van Oort, N. and Hoogendoorn, S. (2020), "Bike-sharing systems' impact on modal shift: A case study in Delft, the Netherlands", Journal of Cleaner Production, 259, 1-13
1: https://www.iamexpat.nl/expat-info/dutch-expat-news/ns-trialling-bikes-you-can-unlock-your-ov-chipkaart
2: https://androidworld.nl/apps/mobike-rotterdam-delft/, 3: https://www.dutchnews.nl/features/2019/06/pay-to-pedal-subscription-biking-model-wants-to-shake-up-the-way-we-cycle/

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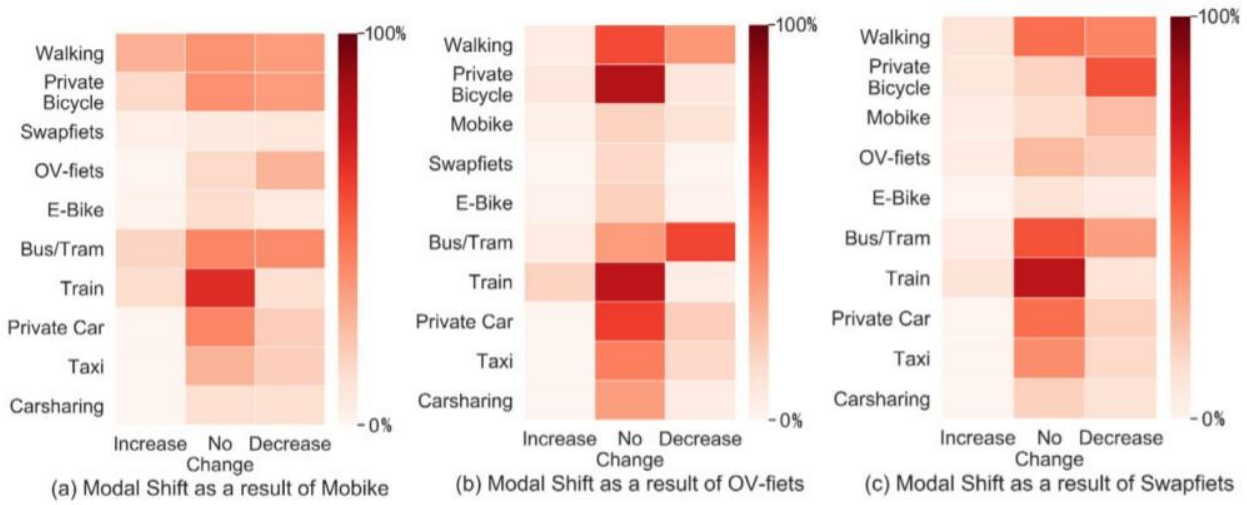
Bike-sharing systems' impact on modal shift: A case study in Delft, the Netherlands



(a) Modal Shift as a result of Mobike (b) Modal Shift as a result of OV-fiets (c) Modal Shift as a result of Swapfiets

Key findings:

- Except for train use, bike-sharing users reduced walking, the use of private bicycle, bus/tram and car
- Swapfiets showed a most significant influence on modal shift
- "Public transport subsidy by employer" encourages commuters to shift to docked bike-sharing
- Male and multimodal commuters more likely to use dockless bike-sharing

Source: Ma, X., Yuan, Y., Van Oort, N. and Hoogendoorn, S. (2020), "Bike-sharing systems' impact on modal shift: A case study in Delft, the Netherlands", Journal of Cleaner Production, 259, 1-13

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The impact of shared mobility on trip generation behavior: Findings from the 2017 National Household Travel Survey, US

- The NHTS is an annual survey designed to understand the daily travel habits and patterns of Americans. It has a long history of being used for transportation research, especially to understand people's travel behaviour and patterns.

- The survey asks households to keep a travel diary of all the trips they made in a single travel day. It is not a static survey; every year it is updated to reflect changing mobility patterns.

- Starting in 2017, the NHTS asked about shared mobility services: bike sharing, ride-hailing, and car sharing, due to their increasing popularity and usage in US cities.

- The NHTS data sets include person, trip, household and vehicle level data.

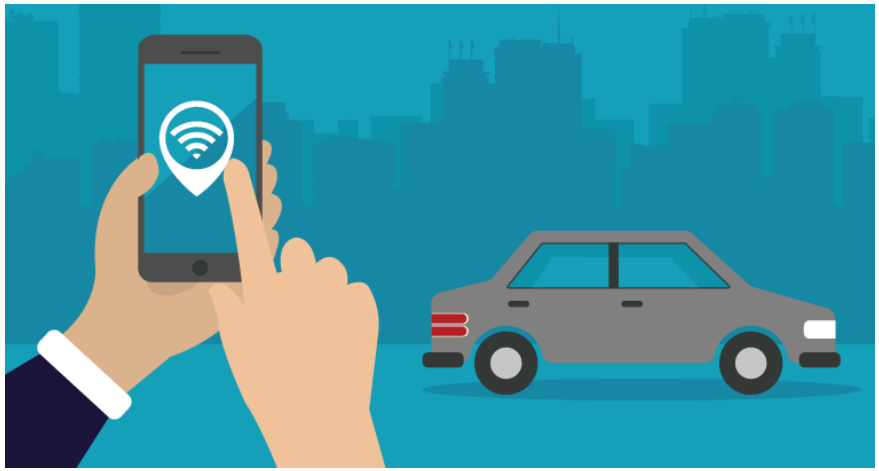
Source: Jiao, J., Bischaak, C. & Hyden, S. (2020), "The impact of shared mobility on trip generation behavior in the US: Findings from the 2017 National Household Travel Survey", Travel Behaviour and Society, 19, 1-7.

The impact of shared mobility on trip generation behavior: Findings from the 2017 National Household Travel Survey, US

Key findings after analyzing the data using models:

- Ride-hailing services appear to be causing people to make more trips than they otherwise would if they did not have access to them, in contrast with bikesharing and carsharing which do not seem to induce travel demand.

- Ride-hailing shows potential to enhance individual level urban mobility; however, it may also cause more strain on road networks.



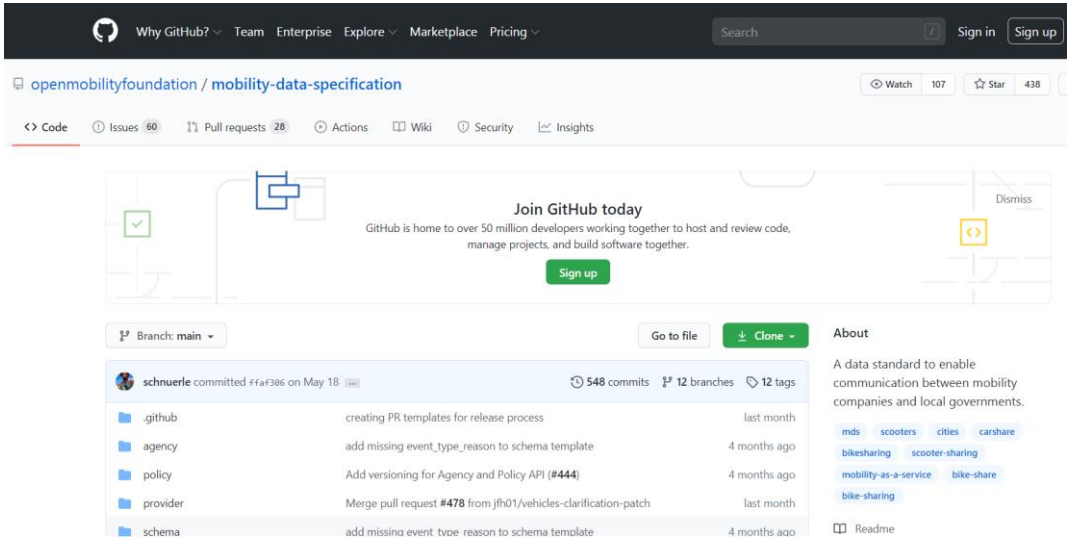
Sources: Jiao, J., Bischaak, C. & Hyden, S. (2020), "The impact of shared mobility on trip generation behavior in the US: Findings from the 2017 National Household Travel Survey", Travel Behaviour and Society, 19, 1-7.
https://medium.com/@emretok/ride-hailing-after-covid-19-842a2733c62c

Data standardization: Mobility Data Specification (MDS)

- The Mobility Data Specification (MDS) is an open-source project, created by the Los Angeles Department of Transportation in 2018 and owned and managed by the Open Mobility Foundation since late 2019.

- Aim: to provide a standardized way for municipalities/regulatory agencies to receive, compare and analyze data from mobility service providers, and also to give them the ability to express regulation in machine-readable formats.

  - MDS comprises three Application Programming Interfaces (APIs) for
  - e-scooters,
  - bicycles,
  - mopeds
  - carsharing



https://github.com/openmobilityfoundation/mobility-data-specification

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Examples of how cities can use MDS in practice

- Verify how many shared e-vehicles are operating and whether they are being deployed equitably across neighborhoods and being parked in appropriate spaces, within their service area.
- Make more informed decisions on infrastructure planning efforts/investments such as the addition of bike lanes or street redesigns.
- Understand the relationship between shared mobility and public transit.
- Develop ways to communicate dynamic information on unplanned events to mobility providers, such as emergency road closures.

Sources: https://github.com/openmobilityfoundation/mobility-data-specification
https://www.vox.com/2018/8/27/17676670/electric-scooter-rental-bird-lime-skip-spin-cities

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Challenges related to the MDS implementation

- Data include trip distance travelled, origin – destinations, trip duration and vehicle status changes.

- A growing body of research demonstrates that anonymous mobility data can potentially still be used to re-identify specific individuals and activities – compliance with the General Data Protection Regulation (GDPR)?

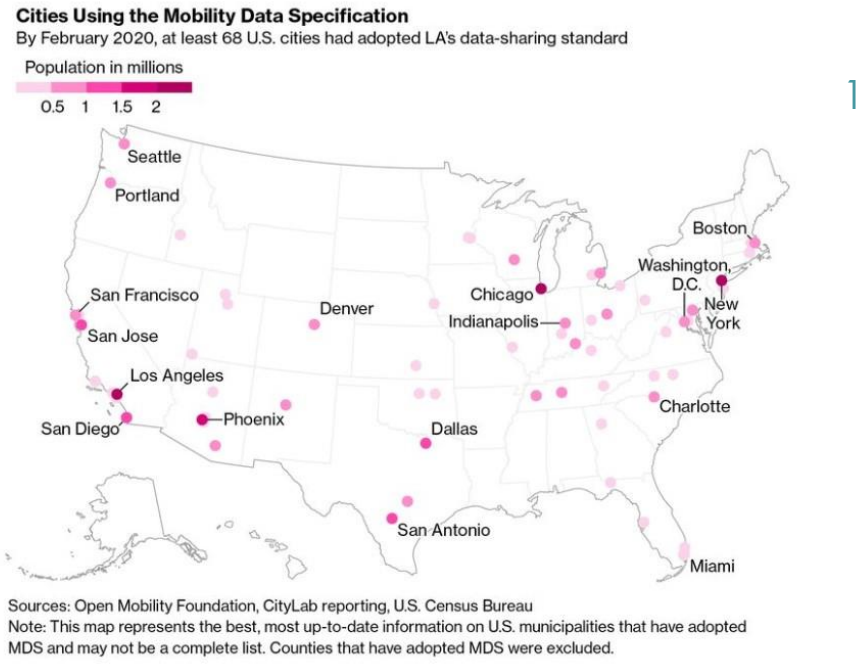
- Additional challenges: Do cities have the ability and knowledge to store and analyze the data, once they have them (computer, personnel..)? Sometimes an "intermediary" body is needed.

Sources: https://github.com/openmobilityfoundation/mobility-data-specification
https://www.vox.com/2018/8/27/17676670/electric-scooter-rental-bird-lime-skip-spin-cities

Cities where the MDS is being used

More than 80 cities and public agencies around the world are currently using the MDS.

Cities in Europe include Zurich, Helsinki, Brussels, Lisbon, Lyon, and Hamburg.



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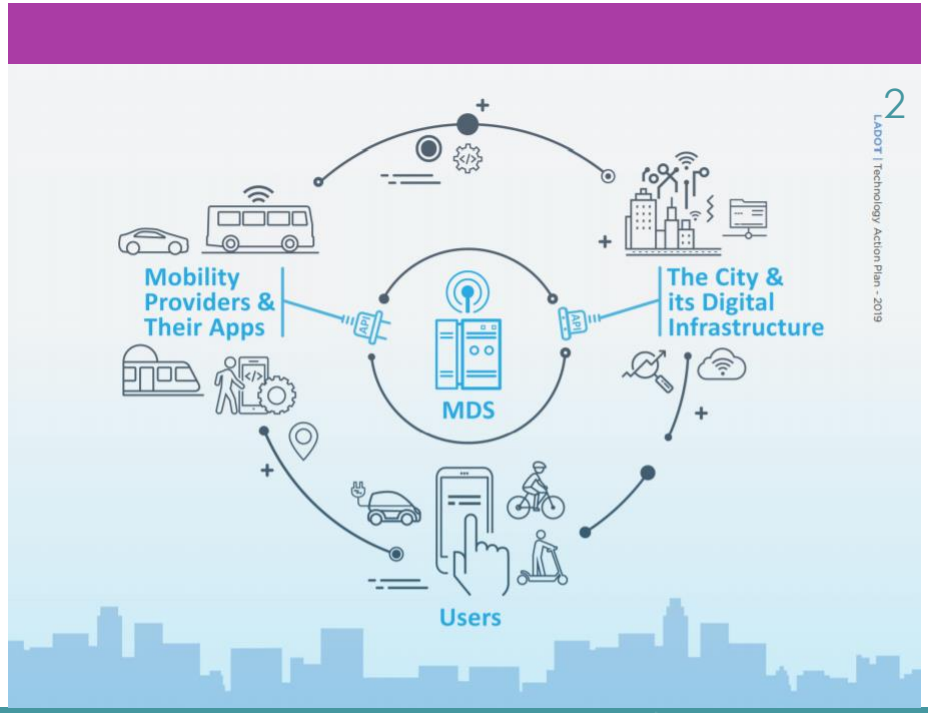

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Sources: https://github.com/openmobilityfoundation/mobility-data-specification
1: https://www.bloomberg.com/news/newsletters/2020-02-24/citylab-daily-a-city-sick-of-tech-disrupters-becomes-one
2: https://ladot.io/wp-content/uploads/2019/03/LADOT-TAP-v7-1.pdf

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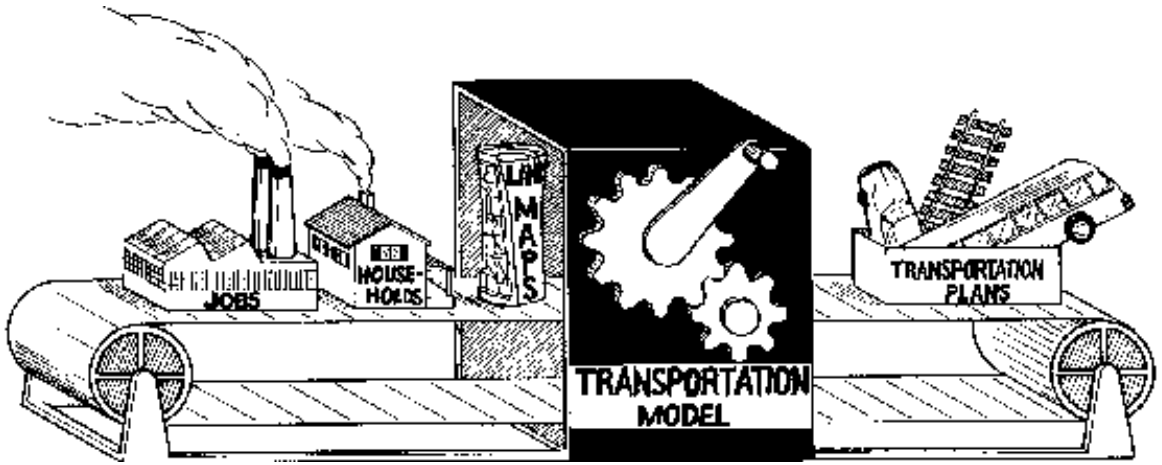
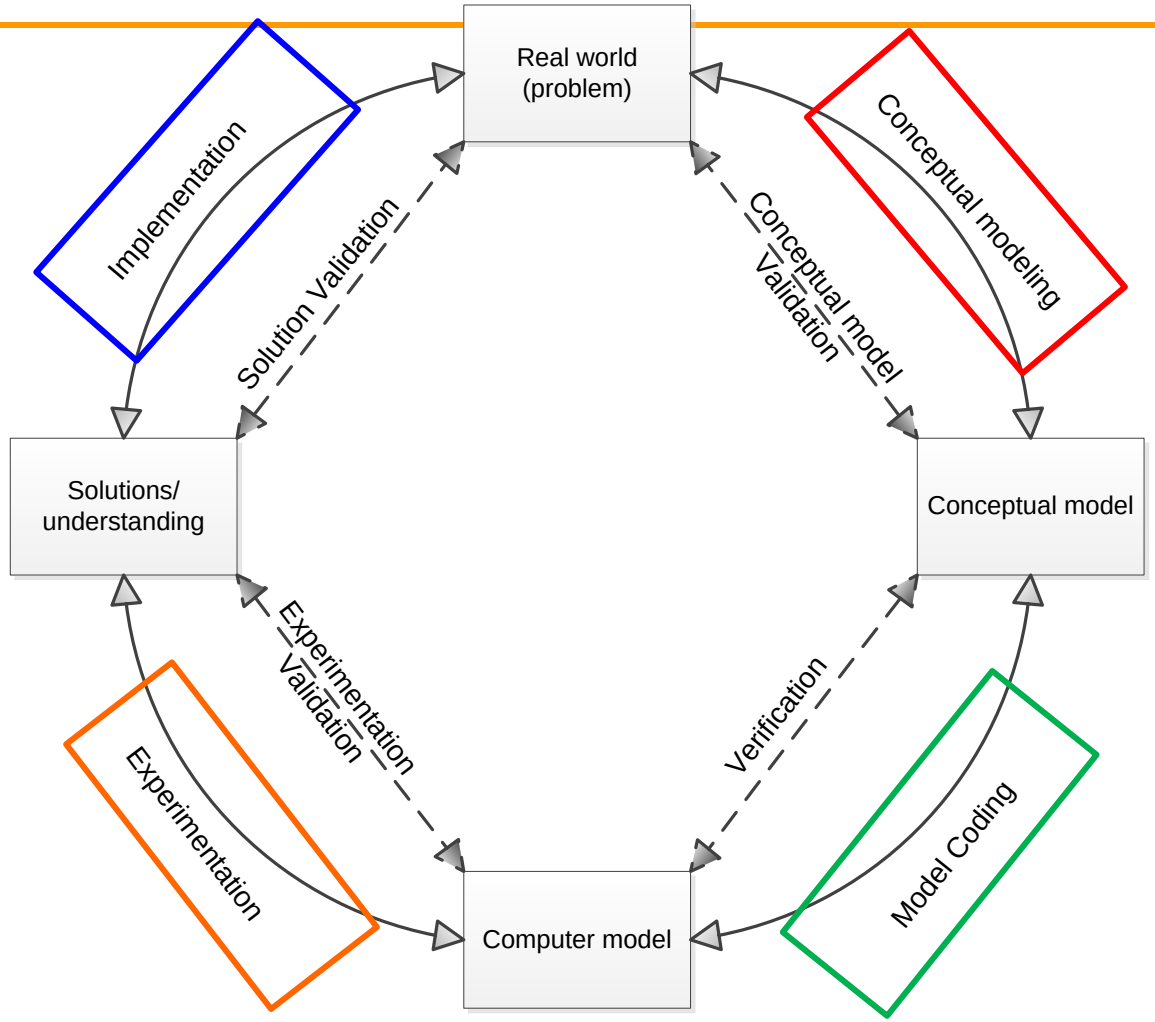
Ex-ante and ex-post: Transportation Modelling

- Predict the effect of a certain policy, change of the transport system, society trend before it happens.
- Many academic studies, fewer possibilities in commercial software



General approach

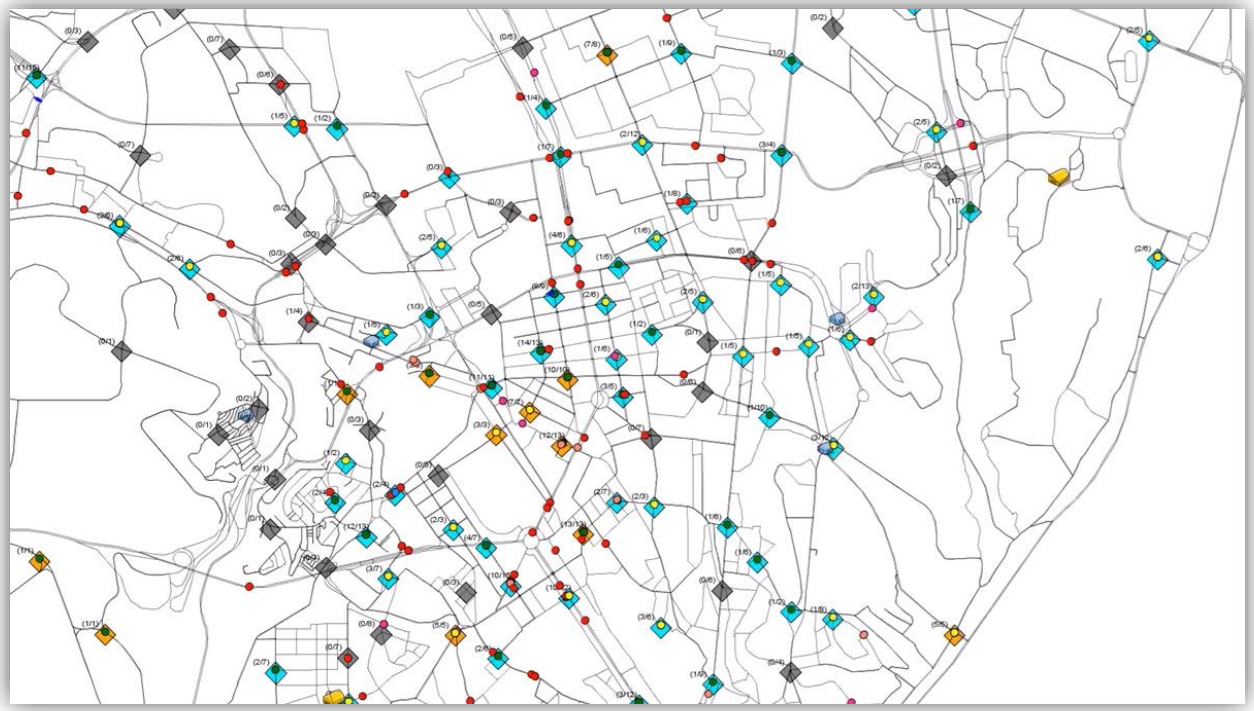
- Identify the problem, build a conceptual model of the simulation, code the model, experiment with the model and implement the solution.
- For share mobility our main problem is understanding what changes with its implementation and how to manage these systems in the most sustainable way.



Adapted from (Robinson, S., 2003)

Carsharing simulation

- Simulation of station based carsharing system in Lisbon (Portugal)



- Demand-supply integration.

Source: https://www.tandfonline.com/doi/full/10.1080/15568318.2016.1226997

Carsharing simulation

- Mode share changes

Table 2. Modal share before and after the introduction of carsharing (realistic system).

Scenario	Private car (PC)	Taxi	Bus	Metro	Walk	Moto	Heavy + light	Carsharing (CS)
Census 2011 work and study trips (%)	43.7	0.7	21.4	13.8	19.4	1.0		—
Model before CS (%)	38.9	1.4	23.0	7.8	26.3	1.1	1.5	—
Model after CS (%)	38.3	1.3	22.5	7.5	25.5	1.1	1.4	2.4

- 40% of carsharing trips come from walking trips, 26% used private cars, 22% took the bus, 10% took metro, 2% used taxi and the remaining used the Heavy/Light public transport combination or motorbike.

Source: https://www.tandfonline.com/doi/full/10.1080/15568318.2016.1226997

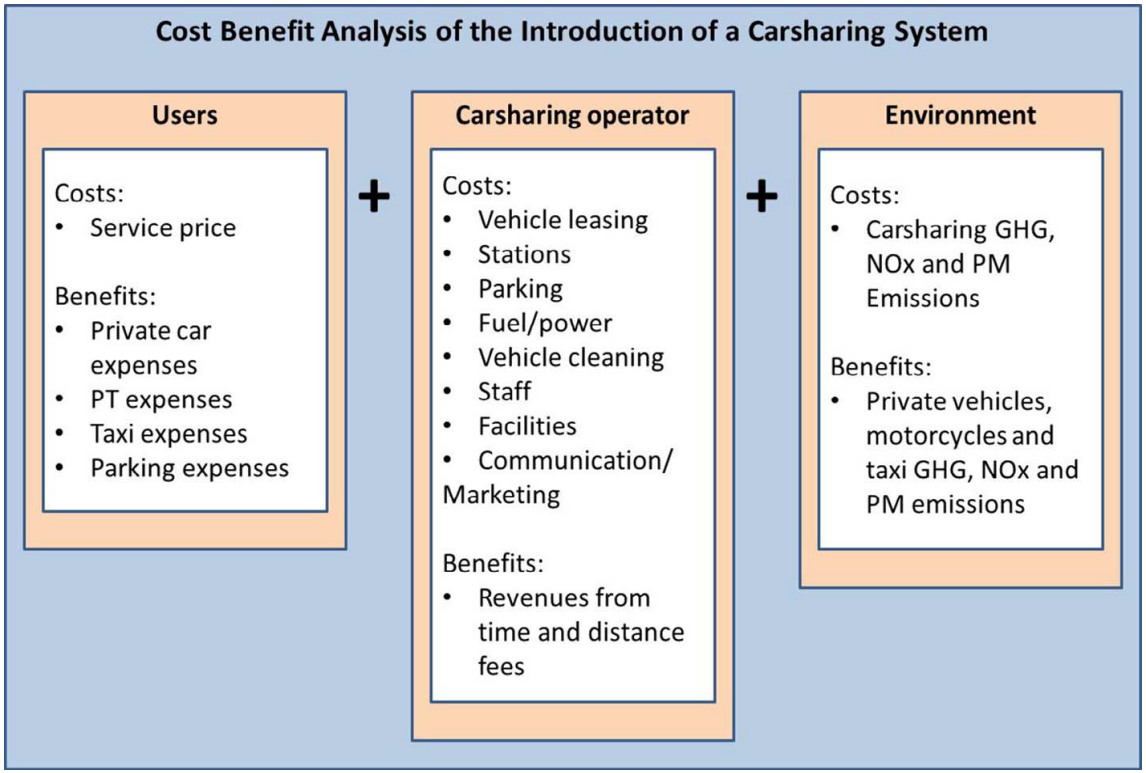
Carsharing simulation for effect of relocations

Models	69 Stations in Lisbon	
	Profit (€/day)	Improvements (€/day)
No relocations	-1160.7	--
Optimization of relocation operations	3865.7	5026.4

Source: https://ieeexplore.ieee.org/abstract/document/6754142

Cost-benefit (CBA) analysis

- Running the simulation model it's possible to calculate costs and benefits of carsharing.



CBA yearly results for a carsharing system with vehicle relocation using electric vehicles (EV) (values in thousand euros) under different scenarios.

	Base-scenario	Parking for EV = 0	VAT = 0 for EV	EV cost = Diesel cost
Revenues	5748.3	5748.3	7465.4	5748.3
Costs	−6640.1	−6460.1	−6640.1	−4501.7
ANP	**−891.7**	**711.8**	**825.3**	**1246.6**

Source: https://www.sciencedirect.com/science/article/pii/S1361920916300992

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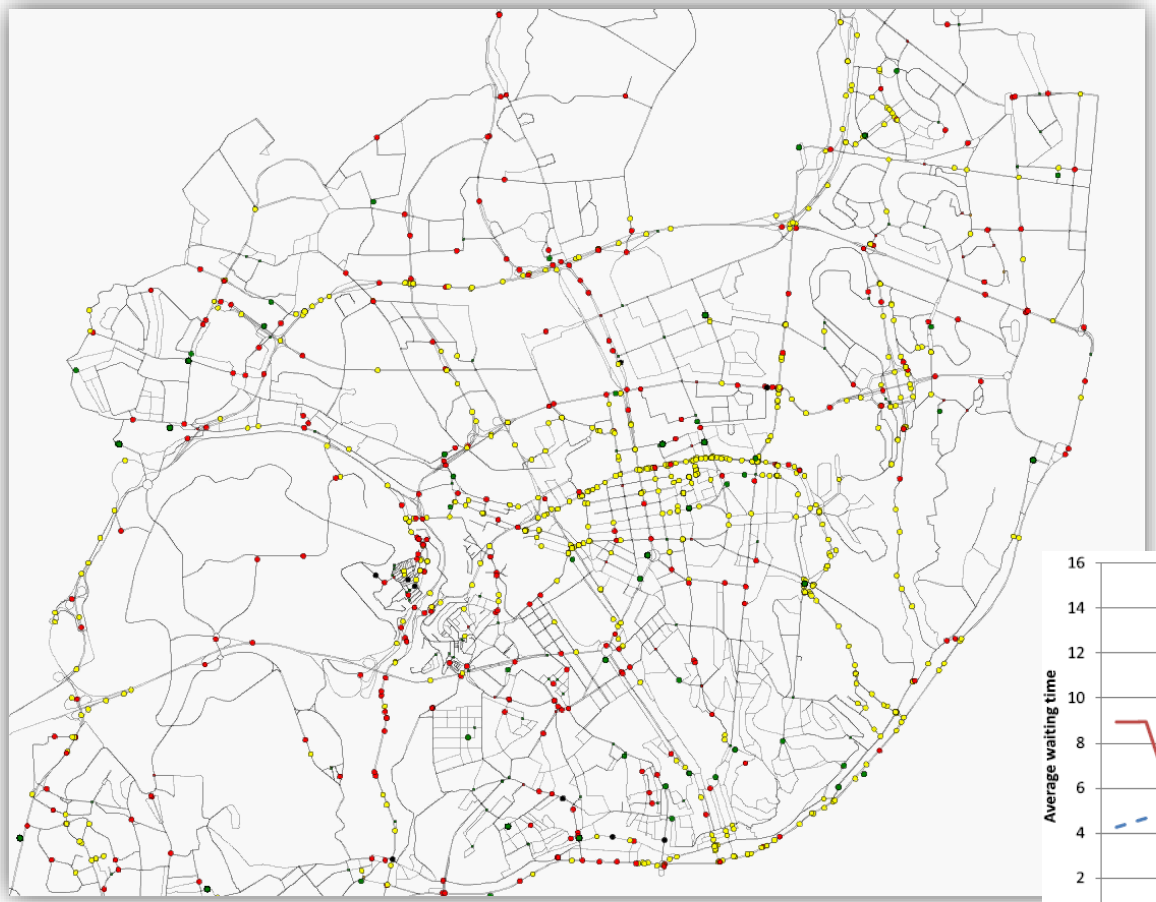
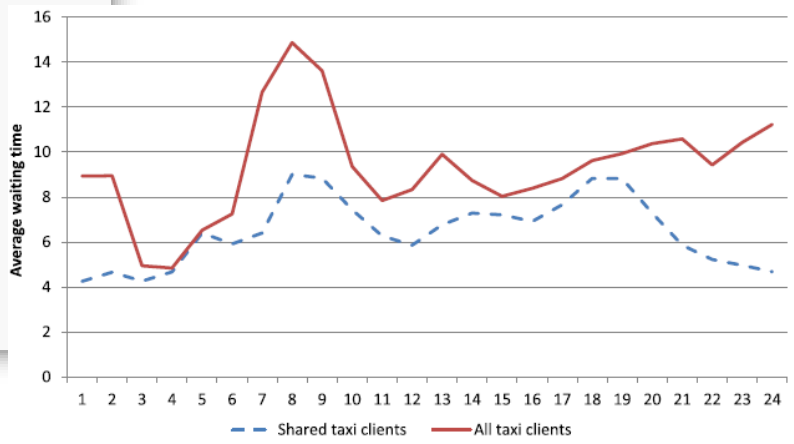
Shared taxis simulation



- Assess more advanced modes in this case shared taxis (like Uber ride-pooling)



Source: https://onlinelibrary.wiley.com/doi/epdf/10.1002/atr.1283

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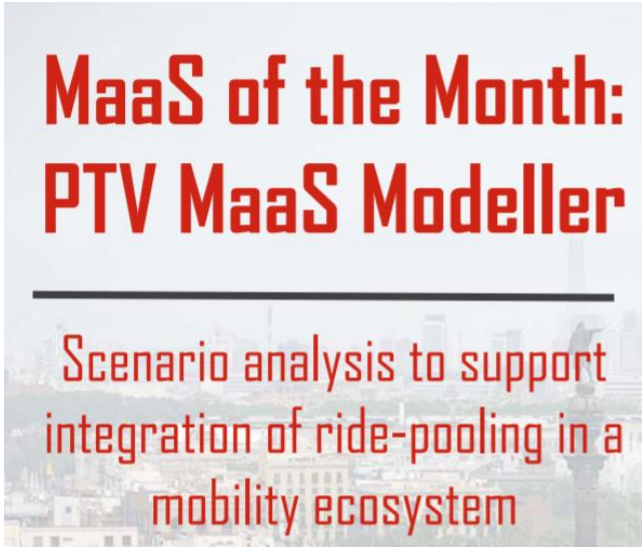
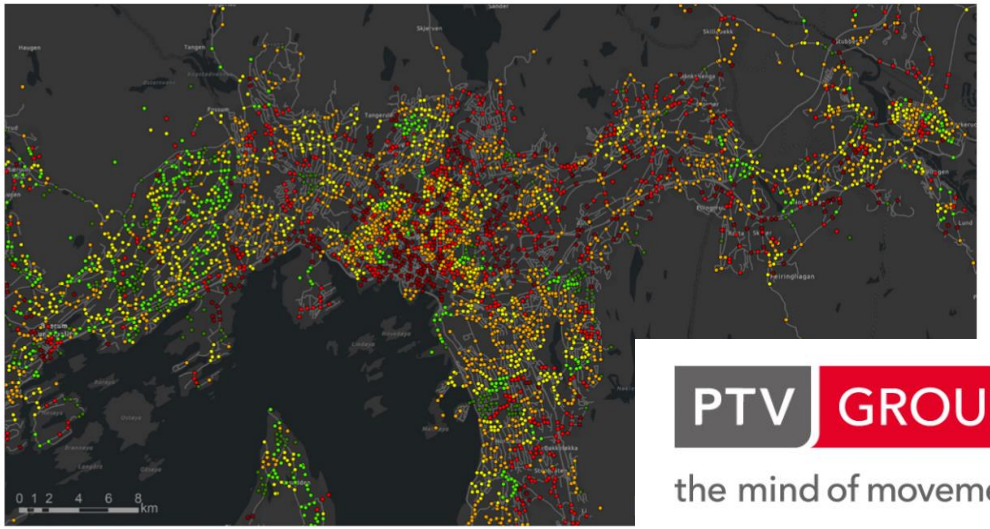
Commercially available software





PTV GROUP
the mind of movement

Pick up and drop off activities in one of the scenarios analyzed in 'The Oslo Study'

Establish holistic mobility concepts

Plan and test sharing concepts within a digital replica of your city.
Customer centric, integrated, on demand and/or for fixed routes.

Forecast mode choices

Calculate the switch in mode choice from public transit, single occupancy car, walking and biking to ride-sharing

Analyze public policy impacts

Evaluate how to best regulate sharing services in cities:
What is the impact on travel times, access to transportation and cost of operations?

Sources: https://ptvtraffic.us/MOD/
https://www.ptvgroup.com/en/mobilitynext/
https://maas-alliance.eu/wp-content/uploads/sites/7/2019/11/MaaS-of-the-Month-PTV.pdf
https://www.ptvgroup.com/en/mobilitynext/public/media/PTV_MaaS_Modeller_SUC_Oslo_Study.pdf

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Case studies

State-of-the practice: Case studies

- E-scooter pilot, Portland, Oregon, USA
- BlueLA pilot (EV car-sharing), Los Angeles, California, USA
- "Direct Connect" pilot (transit authority - TNC partnership to provide fist/last mile connections), Pinellas, Florida, USA

Source: https://www.word-works.co.nz/wp/6-steps-for-writing-a-case-study-tips-from-a-freelance-writer//

Case studies: Portland, Oregon, USA

- In Portland, the Bureau of Transportation (PBOT) initiated an e-scooter sharing pilot that ran for 4 months in 2018.

- Key goals of Portland's pilot included:

  - ✓Reducing vehicular use and congestion;
  - ✓Preventing fatalities and serious injuries;
  - ✓Expanding access for underserved communities
  - ✓Reducing pollution and GHG emissions.

- Methods and data used for the impacts 'evaluation during the pilot:

  - ✓Revealed preference user-survey
  - ✓Standardized data through MDS
  - ✓Collection of other data: accident tracking, observational studies, feedback from focus groups and online engagement tools such as webforms, emails, polls.

Sources: Portland Bureau of Transportation (PBOT) (2018), "E-Scooter Findings Report", Available from: https://www.portlandoregon.gov/transportation/article/709719
https://www.vox.com/2018/8/27/17676670/electric-scooter-rental-bird-lime-skip-spin-cities

Case studies: Portland, Oregon, USA

Impact on travel behavior (main findings of the revealed preference user survey):

- E-scooters replaced 19% of personal car and 15% of ride-hailing trips. But e-scooters also replaced lower-emission trips, as 42% said they would have either walked or biked.
- 6% of users reported selling their car because of e-scooters and another 16% considered it. Illegal sidewalk riding caused feelings of unsafety/discomfort to pedestrians.

Impact on transportation equity (focus groups and the engagement tools):

An overall concern was expressed, as the often prohibitive cost of renting and a lack of knowledge of e-scooter laws presented barriers to use for low-income residents.

Portland Bureau of Transportation (PBOT) (2018), "E-Scooter Findings Report", Available from: https://www.portlandoregon.gov/transportation/article/709719

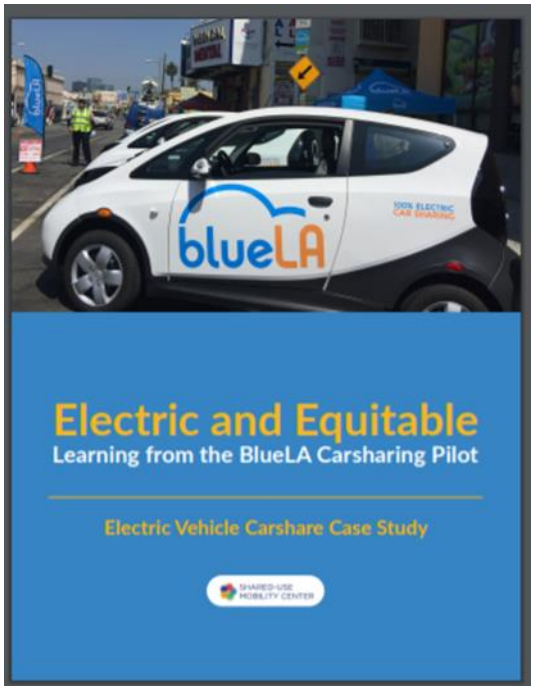
Case studies: Los Angeles, California, USA

- BlueLA EV carsharing, launched in 2018, is a pilot program aiming at improving transportation equity by increasing the transportation options for disadvantaged communities, while reducing congestion and providing environmentally sound, all-electric transportation at an affordable price.

- Methods and data used for the impacts 'evaluation:

  - ✓Monthly reports to the City with data regarding membership type, travel demand, and popular origin-destination pairs.

  - ✓Members' surveys during onboarding (but they are not re-surveyed on a regular basis to identify changing behaviors, preferences, or provide feedback).



Source: Ferguson, M. and Holland, B. (2019), "Electric and Equitable: Learning from the BlueLA Carsharing Pilot", Shared-Use Mobility Center, Available from: https://sharedusemobilitycenter.org/wp-content/uploads/2019/04/NewFile_SUMC_04.15.19.pdf

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Case studies: Los Angeles, California, USA

Impact of BlueLA on transportation equity

The service has been effective in reaching low-income residents, who are able to utilize discounted pricing as "Community" members, upon income verification. Community members have taken around 60% of all trips.

Source: Ferguson, M. and Holland, B. (2019), "Electric and Equitable: Learning from the BlueLA Carsharing Pilot", Shared-Use Mobility Center, Available from: https://sharedusemobilitycenter.org/wp-content/uploads/2019/04/NewFile_SUMC_04.15.19.pdf

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Case studies: Pinellas, Florida, USA

- The Pinellas Suncoast Transit Authority (PSTA) signed a service provision contract with a private TNC (Uber) to provide subsidized first/last-mile connections to transit stops, in 2015, starting the "Direct Connect" pilot.
- PSTA wanted to have access to data on a trip-level but Uber did not agree in data sharing.
- The pilot thus started without explicit goals needed to measure changes in service quality or ridership and evolved without a way of understanding its impacts.
- This limited the program's scalability; while the pilot succeeded in reducing operational costs, it could only remain financially sustainable by serving a relatively niche travel market.

Murphy, C., Karner, K., Accuardi, Z. (2019), "When Uber Replaces the bus: Learning from the Pinellas Suncoast Transit Authority's "Direct Connect" Pilot", Shared-Use Mobility Center, Available from: https://learn.sharedusemobilitycenter.org/wp-content/uploads/SUMC_CaseStudy_Final3_06.21.19-1.pdf

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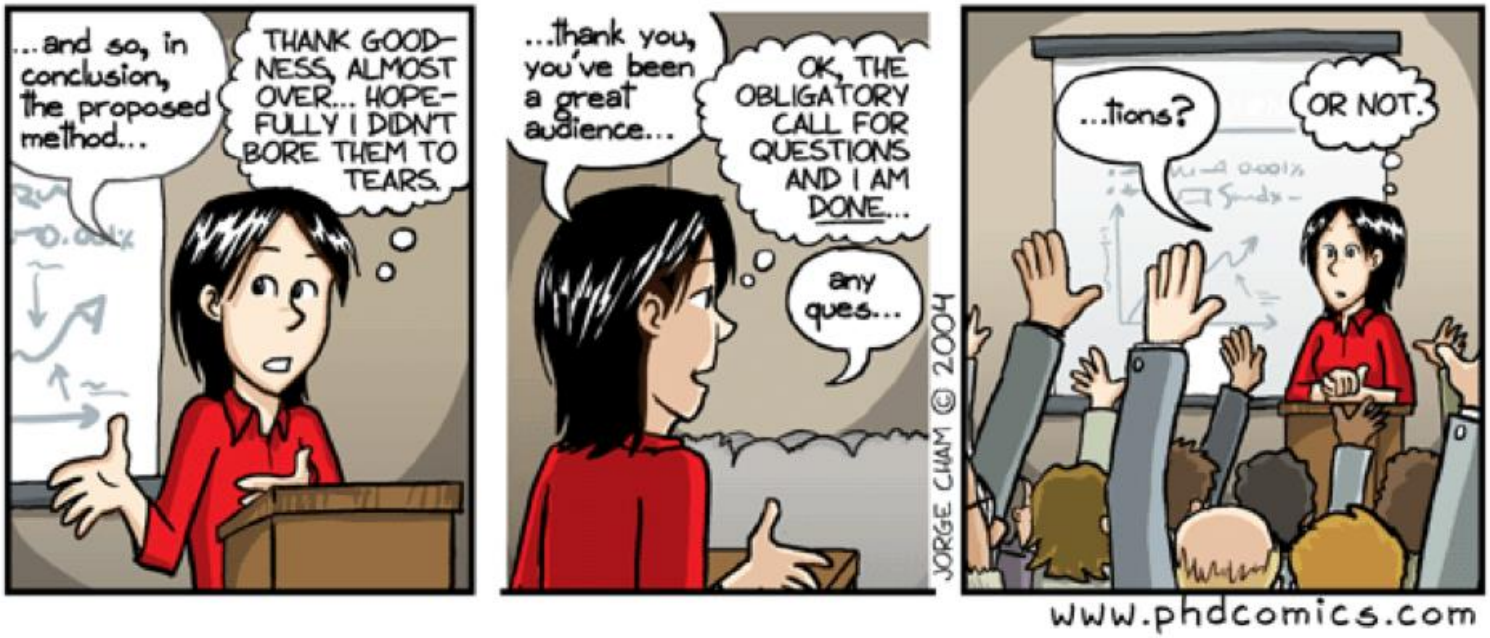
Conclusions, open questions & perspectives

- There is no comprehensive evaluation framework, or a step by step guide for cities to follow in order to evaluate the impacts of shared mobility (ex-ante or/and ex-post).
- Pilots exists, mainly in the USA, but the evaluation attempts are rather scarce and case-specific.
- How can we address the issue of evaluating the impacts of shared mobility in a more systematic and robust way?
- How can cities learn from the success (or failure) of other cities in an organized, constructive and dynamic way?

Thank you for your attention!



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