

Concepts and impacts of new urban shared mobility alternatives: An agent-based simulation model for the city of Lisbon, Portugal

> Luis Martinez and José Viegas International Transport Forum



The big challenges: Emissions, Air Quality and Congestion

- Emissions (Carbon, pollutants) from urban transport still a significant part of the whole
 - > In spite of progress towards cleaner vehicles
 - Considerable lifespan of vehicles limits emission reductions from new technologies
- Across the whole world, heavy congestion in urban areas

Building more infrastructure leading to self-saturation everywhere

Sharing

The least used resources in urban mobility (vehicles and in-vehicle space)



Very poor capital utilization

Why

Ride-sharing (Shared Taxis)

Quality Requirements for Public Acceptance

Whv

- As the idea is to get most current car trips into shared rides, quality level must be quite high
 - Door-to-door service
 - Great convenience
 - Short waiting time
 - Travel time similar to that of driving your car
 - No concern with parking
 - Very easy transaction (smartphone based)
 - Good comfort on board
 - Price not higher than today

Urban Mobility: System Upgrade

What we did

Agent-based simulation for **a real city (Lisbon)** real trips on a detailed network model (currently only urban core)



Two configurations with Ride-sharing

(the new paradigm for demand-responsive public transport):

2 modes	3 modes
All trips in motorized road	All trips in motorized road modes
modes shift to Shared	served by Shared Taxis and
Taxis, or partly stay in	Taxibuses (on-demand buses), or
private cars	partly stay in private cars

In all configurations, existing Metro service present Private car use tested from 0% to 60% of current users

Quality of Service for Shared Taxis

- Max. acceptable delays variable with direct distance of trip
- a) Waiting time from 5 minutes (<= 3 km), up to 10 minutes (>= 12 km)
- b) Total "lost" time from 7 minutes (<= 3 km), up to 15 minutes (>=12 km) (wait + detour)

• Comfort

minivan currently seating 8 rearranged to seat only 6
 easier and faster entry and exit

Demand responsive Taxibuses

- Fully demand-responsive (Buses to fit your individual requirements, not you to fit their routes and schedules)
- Good service, but not as high quality as shared taxis
 - Booking at least 30 min in advance (regular booking as norm)
 - Boarding and alighting up to 400 m away from door, at points designated in real time
 - Tolerance of 10 min from preferred boarding time
- All trips without transfer
- Minibuses with capacity 8 and 16
- Adjustment of service quality parameters allows different distributions of demand between Shared Taxis and Taxibus



Some key indicators for % private car trips

(except for avg. pax on board, all cases in % relative to current = year 2010):

Aggregate Indicators	2 modes	3 modes	
Avg. Pax on board (Sh.taxis)	2.3 (peak 3.0)	2.0 (peak 2.3)	
Avg. Pax on board (Taxibus)		4.1 (c8) / 9.4 (c16) Peak: 5.1 (c8) / 12.1 (c16)	
Fleet size (Sh. taxis + buses)	4.8%	2.8% (cars) Bus*: 573% veh. / 81 % (pl.)	
VKM (weighted) all-day	86%	77%	
VKM (weighted) peak- hour	82%	63%	
CO2 emissions	84%	66%	

* - but these will be micro-buses with capacities 8 and 16, not standard urban buses, with capacity 80

In both configurations 95%+ reduction of parking space needs

Major improvements on key objectives :

- In the 3-mode configuration (Metro, Shared Taxis & Taxibuses), no congestion, even at peak
 - > VKM at peak 37% lower than current
- Much lower emissions
 - > Short-term due to reduced VKM (34% lower than current)
 - Mid- and long-term even better given faster fleet turnaround (each vehicle travels much more)
- Results for 2-mode configuration also very good on reduction of emissions and congestion

Some Key results for 3-mode Configuration:

- With the parameters in this simulation, modal split is 67% for Shared Taxis and 33% for Taxibus
 - Sometimes (~20% of cases) a client asking for a Taxibus will be upgraded to a Shared Taxi, because it is more efficient on the supply side
- Overall, a much better situation than currently for Public Transport
 > Higher quality:
 - No transfers
 - Much shorter waiting times and access walks
 - Seat always available

Break-even Tariffs vs. current Taxi and Public Transport tariffs

- In the 3-mode configuration, with
 - > professional drivers in 8- and 4-hour shifts,
 - > uniform tariff/pax.km in each mode,
 - > a margin of 25% above operational costs for other costs and profits,
 - Tariffs required for cost coverage would be :
 - > Shared taxi: 31% of current taxis
 - Taxibus: 45% of current <u>price</u> using public transport monthly card, o 29% of current <u>cost</u> of public transport, considering subsidies 60% of the Shared Taxi price in this system

Break-even tariffs vs. own car costs

- The cost of using shared taxis was compared with the costs (ownership and operation) associated with using your own car
 - Commuting was supposed to represent 80% of the usage value of your own car
- 4 types of private car were considered:
- New, purchase cost 15 k€
- New, purchase cost 30 k€
- New, purchase cost 50 k€
- Second-hand, purchase cost 5 k€
- The graphic shows the daily costs associated with each option for a range of kms/day
 - For even the low cost (15 k€) new cars, shared taxis cost less for daily distances up to 45 km



Total commuting cost/day for own car

Impacts of retaining some private car trips

- Retaining some private car trips reduces the overall efficiency but facilitates public acceptance and transition into a system mostly based on shared rides
 - Configurations tested for private cars accepted in city 1, 2 or 3 days per week (roughly 20%, 40%, 60% of trips)
 - Key indicators for configuration with 4 modes (Metro, Shared Taxi, Taxibus, Private car) for different percentages of current car trips kept in private cars

Aggregate Indicators	0% private cars	20% private cars	40% private cars	60% private cars
Active fleet size (Sh. Taxis + priv. cars)	2.8%	2.6% + (20%)	2.4% + (40%)	2.2% +(60%)
Prices rel. to current (Sh Taxi / Taxibus)	31% / 45%	32% / 45%	33% /48%	35% / 49%
VKM (weighted) peak-hour	63%	75%	87%	98%
CO2 emissions	66%	75%	86%	97%
% parking space released	97%	77%	58%	38%

Transition Issues:

- Radical change of the paradigms of urban mobility and of public transport
 - Governance, Public transport and taxis must adapt
- Possibly interesting path:
 - Initially give 2-day / week access for private cars (~13% reduction of traffic and emissions), with later reduction to 1-day / week access (12% further reductions)
 - Quality of service and cost advantage of shared rides should help move modal split in the right direction

Policy insights - KPIs:

- Solutions for the key challenges are within reach, with today's technology
 - Strong reduction of emissions
 - No congestion
 - \succ High quality of service \rightarrow good acceptance expectable in all segments
 - Lower or Zero subsidy for Public Transport
- Further reduction of VKM expectable from great improvement of walking and cycling conditions made possible from massive release of parking space
 - Part of that space usable also for new developments (e.g. missing public services in some neighbourhoods)
- Accessibility could improve from denser and diversified land-use, higher use of active modes, reduced congestion on road transport

What we found

- Large part of urban deliveries can be performed off-peak by the same Shared Taxi vehicles (if seats are easily collapsible)
 - Part of this fleet also easily adapted for transport of mobility impaired people
- Massive release of underutilised private capital (cars)
- This is a rather complex optimization process, results will vary according to parameters used for the allocation of people to modes and vehicles

Policy insights: Expansion, Transfer

- Results from one city are never fully and directly transferable to another city, but
 - Lisbon has relatively low density, efficiency of sharing increases with city density
 - For each city, calibration of quality parameters allows some space for precise targeting of results
- Next steps:
 - Expansion to cover whole of Lisbon metropolitan area
 - Taxibus services as feeders into railway stations (in suburbs and in city center)
 - Bring together a relatively small group of cities for simulation with their own data



Thank you!

luis.martinez@oecd.org jose.viegas@oecd.org

