Assessing the welfare impacts of MaaS: A case study in Switzerland

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Assessing the welfare impacts of MaaS: A case study in Switzerland

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Extended Abstract

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1 Motivation

In current transport systems, short-term travel behaviour is to a large extent governed by long-term choices of mobility tool ownership. Such mobility tools usually require a substantial investment up-front and subsequently allow to travel with the specific modes at low (or zero) marginal cost. Eventually, distinct mobility portfolios arise dividing a population into car drivers and transit riders (Becker et al., 2017).

The concept of Mobility as a Service (MaaS) aims to break the determining role of mobility tool ownership in favour of a pay-per-use approach. Translating fixed (sunk) costs into marginal costs allows for a more time- and cost-aware travel behaviour – an observation already made for early car-sharing customers (Cervero and Tsai, 2004). More recently launched shared mobility services already point into this direction: Uber, Bridj, car2go as well as many others do not charge any membership fees, but follow a pay-per-use approach.

In the past years, there were first attempts to transfer this concept to private cars and public transport, and thus turn travellers into mobility consumers. For example, Sochor et al. (2016) conducted a six-month field test in the city of Gothenburg, Sweden, in which participants could purchase a monthly credit for the use of private cars, car-sharing and public transport. Using one-week travel diaries, they show that participants generally over-estimated their actual travel demand and that as MaaS users, they would substantially reduce their use of private cars and increase their use of public transport instead.

However, it is still unclear how to re-design a whole transport system to reap these benefits of MaaS shown in the small-scale field tests. In particular, this will require changes in the supply side of the system, i.e. restructuring public transport services (Hensher, 2017) and integrating it with novel systems of shared mobility (Cervero, 2017). On the demand side, the first insights from field tests have to be generalized to learn more about the preferences of travellers in such integrated mobility systems (Matyas and Kamargianni, 2017). Indeed, differences observed between Uber riders and taxi customers indicate that even small changes in the service types may attract different customer segments (Rayle et al., 2016).

Following the approach suggested by Ciari and Becker (2017), in this research, a framework to assess the impact of supply side characteristics of a potential MaaS scheme on the transport network is developed. Variables include type and fleet sizes of shared modes, their integration with public transport and additional taxes on car travel. Target indicators are generalized cost (welfare) measures, total network travel times and total energy consumption. The framework is applied to the city of Zurich, Switzerland.

2 Methodology

In this research, the agent-based microsimulation tool MATSim (Horni et al., 2016) is used to simulate the MaaS services along with the existing transport services in the city of Zurich. In MATSim, a synthetic population of agents aims to pursue their desired daily activities whilst trying to minimize their generalized cost of travel. A key advantage of MATSim is that it offers a dynamic demand response towards changes in service attributes such as travel times or costs. Agents have pre-defined levels of mobility tool ownership (cars, season tickets and car-sharing membership), which reflect the current distribution in the local population. In the standard model, cars, public transport (timetable-based and routed), bike and walk are available modes. For this research, bike-sharing and car-sharing services are added using earlier work of Balac et al. (2015, 2017), and a plugin for autonomous taxis (Hörl, 2017) is adapted to simulate ride-hailing services.[1] Hence, this is the first time that these different modes of shared mobility are jointly simulated in MATSim.

From a supply perspective, MaaS does not actually change the type of modes available in a transport system, but it is a means to change the cost structures, so that existing modes and infrastructure are used more efficiently. In this research, the following aspects are considered:

- Turn fixed costs of private cars to variable costs: The fixed costs of car ownership are now included in the variable costs of using the vehicle, hence increasing the (perceived) cost of car use. In reality, this could be implemented using an additional road tax.
- Optimizing fleet sizes: Find a mix of fleet sizes of the different mobility services to reduce total generalized cost.
- Revise pricing strategies: If providing a minimal level of service, shared modes can be considered a public service just like bus networks. Hence, the impact of subsidizing the fares of such modes is considered, e.g. by a general subsidy or more specific approaches such as allowing for a free bike-share ride to or from metro stations.
- Moving beyond buses: To what extent and with what impacts can smaller bus lines (having low demand and/or low frequencies today) be substituted by ride-hailing services, for which eligible customer groups may receive subsidies.

Different scenarios will be created based on the aspects outlined above. Each of the scenarios will then be evaluated with respect to total generalized cost, total network travel times and total energy consumption.

[1] The corresponding mode choice models are taken from the existing literature (Hörl et al., 2018).

3 Expected results

Comparing the scenarios described above with the baseline model describing the current transport system will provide first insights into how MaaS concepts would impact the transport system with respect to measures of welfare or system performance. In particular, they will indicate, how subsidies for (public) transport services can be restructured or even reduced whilst maintaining an attractive level of service for travelers. Also they may shed light on the questions of the extent to which car travel has to be penalized further to trigger a substantial mode shift. Although the study is conducted for the example of a Swiss city, the results can inform policies towards integrated mobility systems worldwide.

4 References

Balac, M., F. Ciari and K. W. Axhausen (2015) Carsharing demand estimation: Zurich, switzerland, area case study, *Transportation Research Record*, **2536**, 10–18.

Balac, M., F. Ciari and K. W. Axhausen (2017) Modeling the impact of parking price policy on free-floating carsharing: case study for Zurich, Switzerland, *Transportation Research Part C*, **77**, 207–225.

Becker, H., A. Loder, B. Schmid and K. W. Axhausen (2017) Modeling car-sharing membership as a mobility tool: A multivariate Probit approach with latent variables, *Travel Behaviour and Society*, **8**, 26–36.

Cervero, R. (2017) Mobility Niches: Jitneys to Robo-Taxis, *Journal of the American Planning Association*, **83**, 404–412.

Cervero, R. and Y. Tsai (2004) City CarShare in San Francisco, California: Second-Year Travel Demand and Car Ownership Impacts, *Transportation Research Record*, **1887**, 117–127.

Ciari, F. and H. Becker (2017) How disruptive can shared mobility be? A scenario-based evaluation of shared mobility systems implemented at large scale, *Disrupting Mobility*, 51–63.

Hensher, D. A. (2017) Future bus transport contracts under a mobility as a service (MaaS) regime in the digital age: Are they likely to change?, *Transportation Research Part A*, **98**, 86–96.

Hörl, S. (2017) Agent-based simulation of autonomous taxi services with dynamic demand responses, *Procedia Computer Science*, **109**, 899–904.

Hörl, S., M. Balac and K. W. Axhausen (2018) A first look at bridging discrete choice modeling and agent-based microsimulation in MATSim, paper presented at the *7th International Workshop on Agent-based Mobility, Traffc and Transportation Models, Methodologies and Applications (ABMTrans 2018)*, Porto.

Horni, A., K. Nagel and K. W. Axhausen (2016) *The Multi-Agent Transport Simulation MATSim*, Ubiquity Press, London.

Matyas, M. and K. Kamargianni (2017) Stated Preference Design for Exploring Demand for “Mobility as a Service” Plans, paper presented at the *5th International Choice Modelling Conference*, Cape Town.

Rayle, L., D. Dai, N. Chan, R. Cervero and S. Shaheen (2016) Just a better taxi? A survey-based comparison of taxis, transit, and ridesourcing services in San Francisco, *Transport Policy*, **45**, 168–178.

Sochor, J., I. C. M. A. Karlsson and H. Strömberg (2016) Trying out mobility as a service: Experiences from a field trial and implications for understanding demand, *Transportation Research Record*, **2542**, 57–64.