Assessing Round-trip and One-way Carsharing: an agent-based simulation approach

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Abstract

Carsharing companies can customize their service by adopting different pricing schemes and offers with the aim of increasing fleet use and profits. Different business models have been developed such as round-trip and one-way. Is it clear that, even though the service at the base is the same, the different way in which they are supplied leads to diverse responses from the users. In this work, we analyze how a fixed pricing scheme affects the behavior carsharing users, explicitly considering different income distributions to analyze equity aspects. The policy is simulated in MATSim, an agent-based simulator. Scenarios with a synthetic population of carsharing members for the city of Berlin are analyzed. Simulation results show that the two services are not in competition between each other while the response from the different income classes tends to be similar for both services.

1. Introduction

Although the last decade has seen a decline in the use of private vehicles in Western Europe, the United States and Japan, many major cities still suffer from critical congestion levels (Steven Melia, 2012) (Tom Tom International BV, 2013). Daily use of a car is only around 5%, while vehicles are stationary most of the time. Parking is another important problem, since an average space of 12 m\textsuperscript{2} is needed to accommodate a car and the average duration of the parking is 3.5 hours (Marsden, 2014). In order to address these problems, both companies and public institutions are showing a growing interest in new mobility solutions. While carsharing grew in popularity, it is not clear yet if these new modes favor those who have already a limited transport options or low incomes (Shaheen, Susan et al., 2017). In order to have more insights into people attitude towards two different kind of carsharing services, we develop an experimental analysis using an agent-based simulator adopting economic sensitive attributes for the population.

2. Methodology

Regarding the two-way (TW) and the one-way (OW) carsharing, it becomes clear how a classical four-step model is not employable to assess important KPIs such as the availability at a precise point in space and time (Ciari et al., 2014). Disaggregated methods are necessary to describe the behavior of a single user and the activities executed at different locations and at different times. That is why, in order to assess single user’s behavior, an agent-based modeling approach is used. In this work we adopt an agent-based simulation to analyze a round-trip and a one-way carsharing system on the Berlin network, following a well-established stream of research in the field, which adopts a similar methodological approach (Lopes et al., 2014)(Laarabi et al., 2017).

2.1. Value of Time

Using the Berlin micro census data (Amt für Statistik, 2017) we distributed the income on the synthetic population following the income distribution per neighborhood. Using only the income as sensitive variable would not be
sufficient. What could make one choose for a mode of transport instead of another is the value of time saved by doing that choice. For this reason, the value of time (VOT) is chosen as parameter and it is introduced in the population following the procedure illustrated in Giorgione et al., (2019) based on the values retrieved from Axhausen et al. (2015). We obtain the synthetic population in Fig.1. Carsharing stations were located randomly within the Berlin central area as shown, in yellow, in the same figure.

The VOT is then implemented in MATSim in the scoring function, working as a purchase power utility attribute in order to characterize every user with their budget.

3. Preliminary Results

In order to assess the impact generated from the two different systems on the population, we use different KPIs such as the booking time and the distance covered by each vehicle as well as the number of bookings for the two services and IFs. Research already conducted on the TW shows how customers with different VOT are pushed away from the service leading to inequalities (Giorgione et al., 2019). The exploration is now focusing on the comparison among the two different services with the introduction of the OW.

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References

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