IMPACTS OF SHUTTLE BASED RIDE SHARING SERVICE IN MUNICH

Extended abstract

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The advent of information and communication technology (ICT) in people's daily life has impacted several sectors worldwide. Transportation and mobility are no exceptions as evident by the introduction of on-demand shared mobility services, which can simply be defined as the "sharing of a vehicle instead of ownership, and the use of technology to connect users and providers" *(1)*. Munich has been ranked amongst the most liveable cities in the world in recent years and one of the key reasons behind is the efficient public transport system that the city has to offer. However, Munich was ranked as the third most congested German city in 2016 *(2)* as a result of high car ownership - 475 car owners for every 1000 inhabitants *(3)* - and an average car occupancy of 1.3 which also drop as low as 1.15 persons per vehicle for commuting trips *(4)*. The city is gradually adopting on-demand mobility services as a regular mode of transport, and dynamic ride-sharing services could be an appealing alternative to increase the average vehicle occupancy and eventually reduce the number of cars in the streets.

This study aims to evaluate the different impacts of door-to-door shuttle based ride-sharing service in the city of Munich in the future scenario in year 2030, that has the potential to partially substitute private car usage. The scope of the study covers the city of Munich and nearby areas within the *Innenraum*. This area was selected because the impacts of ride-sharing service are likely to be most efficient in densely populated areas *(5)*. Indicators for the evaluation are selected on the basis of an extensive literature review on traffic, social, and environmental impacts. Traffic-related indicators comprise congestion and average occupancy, while the reliability of the service is interpreted with the ride rejection rate and distance detour. The environmental impacts are measured in terms of local CO_2 emissions, vehicles' energy consumption, and parking land use.

The social acceptance of the proposed mobility service in the city of Munich is examined through a primary survey that covered around 150 respondents. The survey also sought the existing modal share of the respondents. During survey, it was found that 60% of the respondents are willing to use the proposed shuttle service, thus indicating attractiveness of such a service. Mode share for year 2030 was projected after conducting adoption analysis based on Mobilität in Deutschland (MiD) data (2002 - 2018), market research and primary survey. The analysis estimated the share of the shuttle based ride-sharing service to be between 7 and 9 % of the total available transportation modes. This accounts for the replacement of approximately 40 to 60 % car trips (drivers only) by shuttle rides within the study area. The three population growth scenarios considered are low, moderate and high growth of trips at the yearly rate of 0.33%, 1%, and 1.6%, respectively, assuming that population growth has a linear correlation with trip generation.

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The scenarios were used to conduct a sensitivity analysis by evaluating the mentioned indicators in each case.

The modeling tool adopted for the study is MATSim which is a widely used agent-based microsimulation tool especially in the transportation domain *(6)*. The adoption of MATSim is further motivated by the availability of an extension that allows modeling the ride share with dynamic vehicle routing capabilities; model that has already been applied in other studies for German cities like Berlin *(8, 9)*. The synthetic population data *(10)* was used to develop plans for the agents and only 10% sample of the total population was simulated, due to limitation of computation resources. Based on projected mode share, certain percentage of car driving agents are randomly forced to use the door-to-door shuttle-based ride-sharing service. Since the objective of the study is limited to analyzing the impacts of the shuttle service, only private cars and shuttles are simulated, whereas other modes such as public transport and green modes like walking and biking are not simulated. Simulations were performed for shuttles with a capacity of 8 persons and different fleet sizes viz. 1000, 2000 and 3000 shuttles.

Preliminary results show a replacement factor of 20 to 25 cars per shuttle in service, depending on the scenario simulated. The impact on land use required for parking shows a reduction from 19% to 30% for the two different mode shares analyzed. Although the introduction of such shared on-demand service to the area of study indeed replaces car usage and has an impact on land use required for parking, there is no significant change in the total vehicle traveled mileage when compared to the base scenario. Therefore, a major reduction in local emissions and energy consumption accrue mainly due to electrification of the fleet. The analysis shows an average occupancy of vehicles in the network of 1.5, representing an increase of 25% compared to the base scenario, while the average speed remains almost the same. Regarding the distance detours for the shared rides, there is an increase in average trip distance of 50%, which implies a further recommendation to research and analyze the impacts the stop-based service in order to compare it to the already modeled door-to-door service.

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