Effects of Street Space Redesign on Travel Demand in Berlin, Germany

Simon Nieland(✉), Daniel Krajzewicz, Jan Weschke, and Julia Schuppan

Institute of Transport Research, German Aerospace Center, Rudower Chaussee 7, 12489 Berlin, Germany
simon.nieland@dlr.de

Abstract. Many cities today are struggling with increasing urban car traffic and the associated negative effects such as emissions, air pollution, accidents and noise. To overcome these challenges, cities are investing in public transport services or reducing fares, building cycle paths or implementing measures to reduce car traffic. These include measures such as one-way streets, reduced speed limits or reduced parking spaces and increased parking fees. However, it is important for city administrations to know the effects of their measures in advance, both to anticipate their impact and to discuss them with the public and legitimize their actions. Therefore, this study describes the application of an agent-based travel demand model in combination with a microscopic traffic simulation model to simulate the effects of a baseline scenario and a redesign scenario of urban transport infrastructure on a small spatial scale of an inner-city neighborhood. From the results, we can infer the impact of different measures on mode choice and traffic volumes. The presented methodology show a high potential for planning, evaluation and decision making in the field of sustainable urban mobility.

Keywords: Traffic Management Measures · Simulation · Agent-based

1 Introduction

Cities around the world are facing enormous challenges in terms of traffic-related emissions and increasing motorized traffic. Many of them are trying to create a more accessible and sustainable environment by promoting mixed-use neighborhoods and shifting urban mobility to more sustainable modes of transport. Recent successful examples (e.g. Barcelona and Paris) have implemented traffic-reducing measures such as redesigning streetscapes to encourage active modes of transportation such as walking and cycling. In addition, the redesign of streetscapes is a key element in achieving more sustainable cities with less negative impact from traffic [1, 2]. The design and allocation of street space in cities has a significant impact on the traffic connections and mobility patterns of residents, which affects their quality of life and road safety (e.g. [3]). Therefore, city governments are keen to take effective policy measures to achieve a shift towards sustainable mobility and more liveable neighborhoods. In order to support city and local governments in their decision-making and to legitimize their street redesign measures,

C. McNally et al. (Eds.): TRAconference 2024, LNMOB, pp. 46–51, 2025.
https://doi.org/10.1007/978-3-031-85578-8_6

it is crucial to quantify ex-ante the expected impacts on transport demand, traffic volumes, accessibility, land use, air quality and noise (e.g. [4]). Modeling and simulating the impact of policy measures provides administrations with data and visualizations to discuss the design and implementation plans with citizens and thus create acceptance. On this basis, we present a modeling approach that quantifies the impact of several traffic reduction measures and apply the model to a real-life example in the Kreuzberg district of Berlin, Germany. The presented results show the potential of the method for planning, evaluation and decision making in the field of sustainable urban mobility.

2 Method

This section describes the methodological framework of this work and illustrates the redesign measures implemented.

2.1 Modelling of Transport Demand and Traffic Volume

To model the transport demand and the traffic volume for each edge of the road network, a model of the traffic in the city of Berlin is generated using the agent-based traffic demand model TAPAS[1] [5] and the traffic simulation package SUMO[2] [6]. TAPAS is used to calculate the mobility behavior of a synthetic population of Berlin, including the choice of means of transport and the destination locations. The daily mobility pattern of a single simulated person is retrieved from about 50,000 mobility diaries from mobility surveys, randomly selecting one that matches the person's socio-demographic characteristics. For the selected mobility diary, the places where the activities listed in the diary can be performed and the means of transportation by which they can be reached are calculated, again using functions derived from mobility surveys. The result of a TAPAS run are daily trip chains for all modeled persons.

These trip chains, i.e. the trips included that are made by private car, are passed on to SUMO. SUMO simulates the movement of the corresponding vehicles through the road network with time steps of one second and taking into account the road network and its traffic rules. The result of the simulation of private car journeys in SUMO are both traffic measurements, including average speeds or traffic flow, as well as derived measurements, such as the amount of pollutants emitted.

2.2 Study Area and Redesign Measures

The study area and its location within the city of Berlin are shown in Fig. 1. Since urban redevelopment is usually carried out in small urban areas, the application of microscopic demand modeling at a low aggregation level is of great interest. In total, two scenarios were created. The first is the baseline scenario, which reflects the current state of transportation demand and traffic volumes in the study area. In a second scenario, specific measures are implemented in a neighborhood around Lausitzer Platz in the

[1] https://github.com/DLR-VF/TAPAS.
[2] https://github.com/eclipse/sumo.

Friedrichshain-Kreuzberg district of Berlin. This redesign scenario includes a number of infrastructural and regulatory changes, in particular speed reduction, reduction of parking space, increase of parking fees, introduction of protected bicycle lanes as well as modal filters and one-way streets (see Fig. 2).

Fig. 1. Left: City boundary of Berlin, Germany. Right: Study area "Lausitzer Platz".

Modal filters describe road closures that allow access by bicycle and on foot, but not by car. Cycle lanes have been introduced on some of the main roads around the district, while the speed limit on some sections of road has been reduced from 30 or 50 km per hour to walking speed.

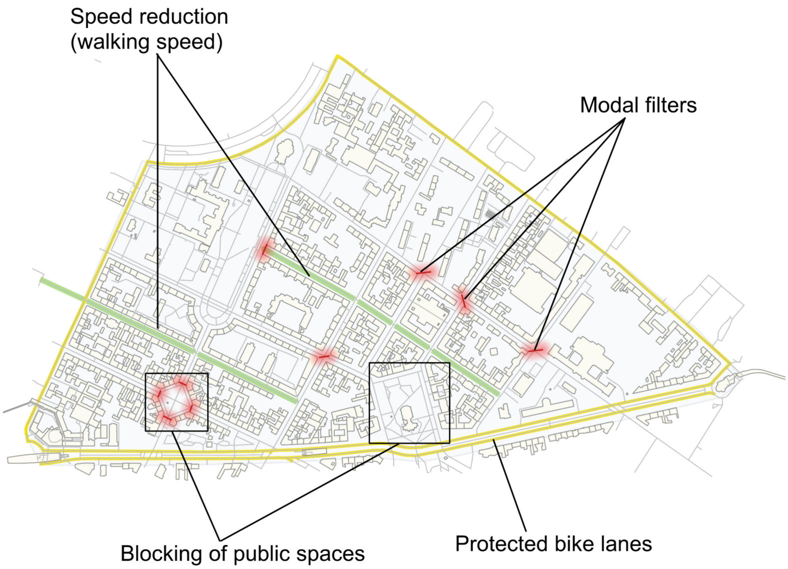

Fig. 2. Implemented measures.

The measures are intended to achieve three effects: firstly, to calm traffic in certain streets by introducing a speed reduction; secondly, to impede through traffic by means of traffic filters and one-way streets; and thirdly, to reduce the number of journeys by private motorized transport that end in the area by introducing parking space management and reducing the number of parking spaces. The selection of the measures to be implemented is the result of public participation procedures performed by the local administration. Although the study area only covers a very small part of Berlin, the simulation covers the entire city in order to also examine the effects on the surrounding areas.

3 Results

This section illustrates the results of the modeling approach with a focus on the differences betweet the baseline and the redesign scenario.

3.1 Effects on Transport Demand

The results of the redesign scenario show a significant reduction in motorized traffic (from 13.2% to 10.1%) for trips that start in the study area. In addition, a clear shift towards sustainable modes of walking and cycling can be observed, increasing from 28.9% to 30.4% and from 19.8% to 21.7% respectively (see Fig. 3). The total number of trips starting or ending within the area decreases by 4% overall, with an increase in the number of trips made by bicycle (+5.5%) and on foot (1.1%), while the number of trips made by car (-26.5%), as a passenger (-15.9%) and by public transport (-1.8%) decreases.

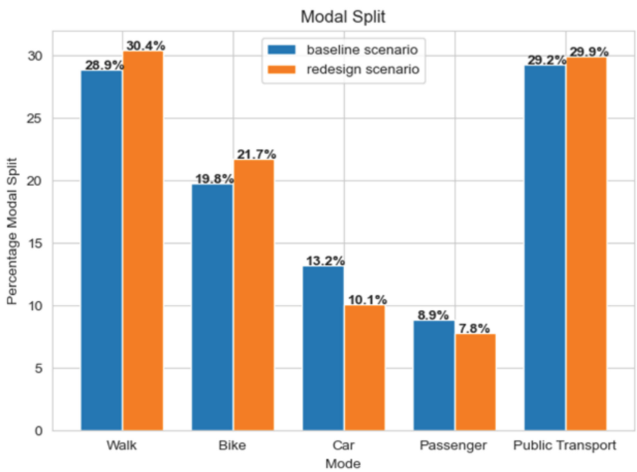

Fig. 3. Modal Split of baseline and redesign scenario.

3.2 Effects on Traffic Volume

The modal filters, speed reduction and parking space management lead to a reduction in car traffic within the study area of around 30% (see Fig. 4); the volume of car traffic in the streets on the edge of the study area increases sharply in some cases, but overall there is also a reduction of 10% here. The decrease in traffic within the area is not evenly distributed throughout the day. The strongest decline can be observed especially after the rush hour peak times (09:00–11:30 and 18:00–10:00).

Fig. 4. Difference in traffic volume (cars per day) between the baseline and the redesign scenario.

4 Discussion and Conclusion

In summary, the results of the redesign scenario compared to the baseline scenario inevitably show that infrastructural and regulatory measures related to urban transport have an impact on travel demand and traffic volumes in inner-city neighborhoods and can be part of the solution to enable more sustainable urban environments and address urban challenges. In particular, the reduction of parking spaces and the introduction of parking management play an important role here, as these measures effectively prevent trips that end in the study area or shift them to more sustainable modes of transportation. The speed reduction does not appear to have a major impact on traffic demand, as car travel times change only slightly. Nevertheless, an increase in road safety due to this measure can be assumed [8].

The presented approach shows that by using travel demand and traffic simulation models, combinations of measures can be analyzed in terms of their impacts, informing stakeholders ex-ante about the expected outcomes of urban measures. This helps local authorities to make decisions and develop applicable solutions for practitioners and to discuss action plans with the public. However, the calibration and the complex and static input data for demand modeling limit the predictive power at the district level, but encourage the derivation of trends and tendencies. In the future, further scenarios will be added, derived in additional iterations with local authorities, including assessment of the impact of individual measures on transport demand and traffic volumes to generate ideal bundles of measures that optimize the desired effects.

References

1. City of Barcelona: Pla de Mobilitat Urbana 2024 (2023). https://www.barcelona.cat/mobilitat/ca/qui-som/pla-de-mobilitat-urbana-2024, Accessed: 24 March 2023
2. City of Paris: Paris ville du quart d'heure, ou le pari de la proximité (2022). https://www.paris.fr/dossiers/paris-ville-du-quart-d-heure-ou-le-pari-de-la-proximite-37, Accessed 24 March 2023
3. Holz-Rau, C., Scheiner, J.: Land-use and transport planning–A field of complex cause-impact relationships. Thoughts on transport growth, greenhouse gas emissions and the built environment. Transp. Policy **74**, 127–137 (2019)
4. Li, M., Zhao, J.: Gaining acceptance by informing the people? public knowledge, attitudes, and acceptance of transportation policies. J. Plan. Educ. Res. **39**(2), 166–183 (2019)
5. Heinrichs, M., Krajzewicz, D., Cyganski, R., von Schmidt, A.: Introduction of car sharing into existing car fleets in microscopic travel demand modelling. Pers. Ubiquit. Comput. **21**, 1055–1065 (2017)
6. Alvarez Lopez, P., et al.: Microscopic Traffic Simulation using SUMO. In: 2019 IEEE Intelligent Transportation Systems Conference (ITSC), The 21st IEEE International Conference on Intelligent Transportation Systems, pp. 2575–2582. IEEE. (2018). https://doi.org/10.1109/ITSC.2018.8569938
7. Krajzewicz, D., Heinrichs, D., Cyganski, R.: Intermodal contour accessibility measures computation using the'UrMo accessibility computer'. Inter. J. Adv. Syst. Measurem. **10**(3&4), 111–123 (2017)
8. Wang, C., Quddus, M.A., Ison, S.G.: The effect of traffic and road characteristics on road safety: a review and future research direction. Saf. Sci.. Sci. **57**, 264–275 (2013)