Evaluating the Potential of New Mobility Services as a Measure to Reduce Urban Traffic Volumes – A Case Study

Masterarbeit

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1. Introduction

1.1 Relevance of the Topic

With climate change becoming an increasingly pressing issue and subject of discussion, the transport sector and its contribution to global warming also become more and more apparent. As a result, there are several policies aiming at reducing pollution and emissions emitted by the transport sector. The latter, in turn, is looking for measures to reach these goals and reduce emissions caused in traffic (Agora Verkehrswende, 2018, p. 11).

On top of that, the increasing degree of motorized individual transport (MIT) as well as the continuing urbanization pose great challenges for cities and their infrastructure, which are expressed both in social and financial burdens. Traffic congestion not only causes time loss, but is also responsible for heavier pollution and higher accident rates (Reed, 2020, pp. 2, 6). Accordingly, Figure 1 shows that in Germany alone, urban congestion has caused costs amounting to several billion Euros of which the largest shares come from large cities.

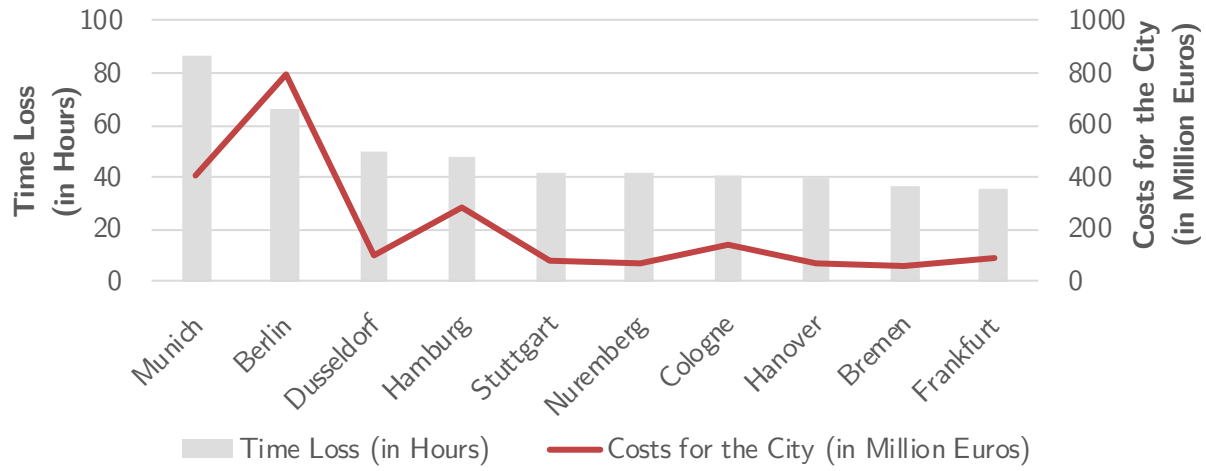

Figure 1: Costs and Time Loss due to Urban Traffic Congestion in Germany in 2019

Source: Own illustration based on Reed, 2020, p. 16

As these numbers are rising, public authorities are interested in finding sustainable solutions for addressing and improving the mentioned challenges. In this context, traffic turnaround is defined a superordinate goal and it is aimed at making public transport (PT) more attractive (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit, 2019, p. 66). In order to make traffic more environmentally friendly, not only sustainable transport solutions are needed but private car traffic also needs to be reduced. In recent years, mobility services, namely carsharing (CS), bikesharing (BS), ridesharing (RS), ridehailing (RH) as well as ridepooling (RP) and micromobility (MM) services, have entered the market and expanded the mobility portfolio of

many cities worldwide. These services can be considered a tool to addressing traffic-induced difficulties (Ortgiese *et al.*, 2018, pp. 308-309). While in Germany a few of these services currently do not have the legal grounds to operate in the long-term, some public authorities already consider cooperating with certain mobility service providers. As it is currently widely discussed in what way and to what extent these new mobility services (NMS) impact traffic volumes (Jacoby and Wappelhorst, 2016, p. 3), it is important to gather more information on whether these services can be beneficial to fighting traffic problems in bigger cities in order to make well-founded statements.

1.2 Objective of the Thesis

As briefly described in the previous chapter, the transport sector plays a significant role in attaining set climate goals and therefore strives to reduce its impact on the environment. Diverse mobility services have emerged over the last couple of years and provide new transport options in primarily urban surroundings. This thesis aims at giving an insight in current empirically ascertained impacts of NMS on traffic volumes as well as identifying future potentials of these services. Therefore, this thesis can contribute to deciding whether NMS can be a tool to relieving cities from their traffic induced challenges or themselves add to traffic congestion.

The superordinate research question that focuses on the preceding research gap and allows conclusions for future opportunities stemming from NMS is summarized as the following:

Which potential do NMS have to reduce urban traffic volumes?

In order to be able to answer this research question, a subordinate question was defined based on the findings of which a more sophisticated conclusion to the first research question is possible. Since it was decided that only a successful and accepted mobility service can impact future traffic developments, the following research question provides the basis for the overall potential analysis:

What are critical success factors for NMS?

Furthermore, due to only little research centering around new mobility in Germany, the scope of this thesis was set to especially evaluating the potential of the services in German cities. To emphasize the circumstances of German cities, a case study for the city of Hanover is conducted, which is supposed to give insight in the application of one of the services in a medium-sized German city. In this context, it needs to be noted that the researched potential evaluation of the services solely concerns traffic-related impacts.

1.3 Structure of the Thesis

In order to answer the research question in a well-founded and comprehensive manner, a thought-out approach has been chosen that not only bases on existing findings but also reveals new findings derived from different research methodologies.

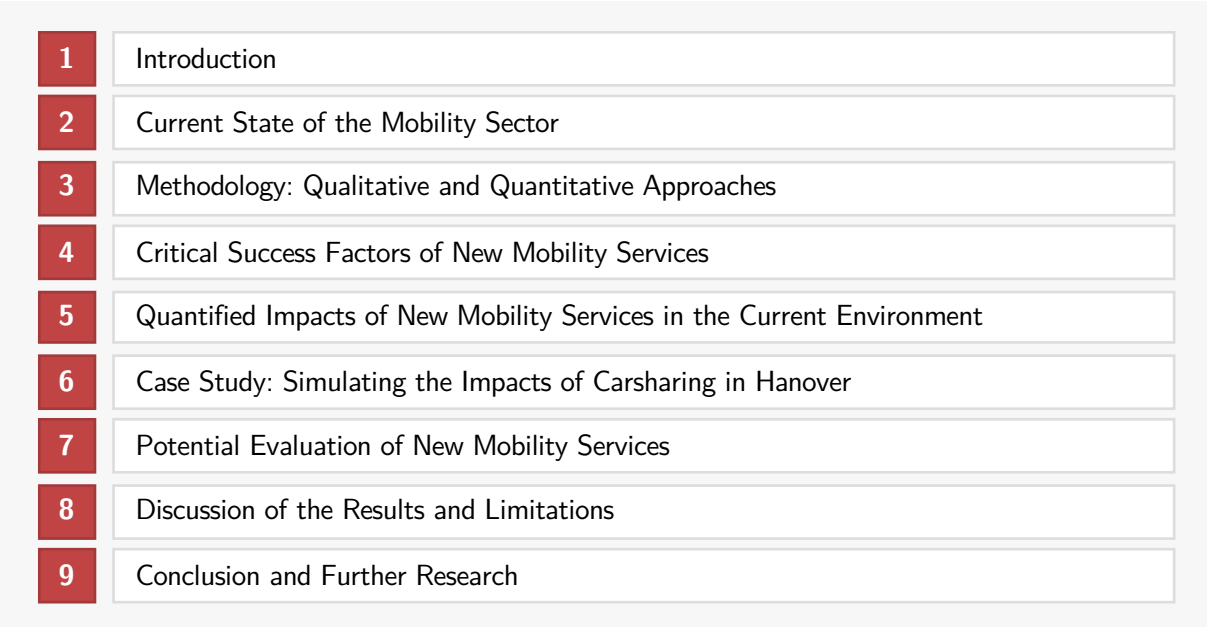

Figure 2: Chapter Structure of the Thesis

Source: Own illustration

Figure 2 displays the thematic structure of the thesis. Following the introduction, chapter 2 provides an overview of the current state of the mobility sector in which regulations impacting the sector and the regarded mobility services are described. Further, current initiatives involving mobility services are presented. In the next chapter, the methodology is explained in depth. The qualitative approaches include an extensive literature review based on Webster and Watson (2002) as well as the conduction of eleven semi-structured expert interviews. The latter are evaluated based on a qualitative content analysis approach by Mayring (2015) which allows for thorough analysis of the information given. Moreover, a quantitative method was applied, which included the use of the simulation tool MATSim in order to display the impacts of CS on the city of Hanover. Chapter 4 presents the results of the expert interviews in form of a structured overview of internal and external success factors of NMS. These factors were additionally complemented and confirmed by findings from current literature. Subsequently, chapter 5 is concerned with currently quantified impacts of NMS in different settings, providing a basis for further evaluation. In the following chapter, the case study in MATSim centering around Hanover and the application of CS is conducted. This comprised the comparison of different application models or more precisely of different influencing parameters. In chapter 7, the comprehensive potential evaluation for each

mobility service is performed in which the potential is measured based on defined criteria including the previously investigated influencing parameters. Afterwards, the results of the evaluation are discussed and limitations to it are pointed out. Eventually, the final conclusions are drawn and further research possibilities are highlighted.

9. Conclusion and Further Research

Climate protection goals as well as traffic-induced challenges in bigger cities put the transport sector under pressure which hence aims at supporting sustainable transportation modes and reducing MIT. In case of NMS, it is largely unclear whether they will have the potential to contribute to this traffic turnaround and become an integral part of sustainable mobility. In order to provide more clarity and express a tendency, this thesis is concerned with the question if NMS have the potential to act as a meaningful measure to reduce urban traffic volumes and which requirements need to be met for them to be successful.

With this objective in mind, three internal and four external success factors of NMS were derived from expert interviews and current literature. One of these success factors, *affordability*, and another crucial aspect, *dimension of the service*, were further implemented and tested in a simulation environment of the city of Hanover, which confirmed the influence of these previously defined factors. The subsequent potential analysis based on evaluation categories composed of the derived success factors and the results of the investigation of empirically quantified impacts of NMS. Every category was rated from zero to five for each mobility service so that eventually, a potential-score for all mobility services could be calculated.

The highest scores were achieved by CS and RP indicating the highest potential to reduce urban traffic volumes and contribute to a traffic turnaround. This is widely in line with current studies and especially the ideas of the experts who placed great emphasis on RP. This result, however, is subject to a few important requirements. Especially with regard to RP, the potential can only be fulfilled if current legal grounds are adapted and the foundation for a long-term operation of the services is established. Otherwise, and if the services are continuously as restricted as they are today, they will not be able to make significant positive contributions to traffic in cities. Furthermore, the network in which the services are offered is crucial to their large-scale and long-term success. This means that the services will only represent a transport alternative attractive enough to impel people to abandon their cars and thus reduce traffic volumes if they are offered in an integrated mobility system. In this regard, MaaS services or other strong partnerships play significant roles. For instance, PPPs with mobility providers and public authorities can accelerate and support the development of the services in places and dimensions attractive from a societal point of view. Another noteworthy requirement for significant impacts of CS and RP is the previously mentioned dimension with which they operate. Current fleet sizes are not sufficient to bring about the substitution of millions of cars. Consequently, the dimension of both CS and RP needs to be increased in order to raise their chances of making a substantial impact.

For RS and MM, moderate potential-scores were calculated. In case of RS, this is mainly due to the difficulty of measuring the actual occurrence and impact as the service generally happens as

part of private arrangements and the commercial RS organized on platforms primarily aims at matching people for longer-distance travels. Therefore, as the potential-score is set for the urban environment, RS is considered only little suitable even though it might also have positive traffic-impacts outside of cities. MM, on the other hand, particularly lacks affordability, so that it does not represent a viable option for everyone. Nonetheless, if it is aimed at a comprehensive mobility offer and at creating an attractive alternative to the personal car, transportation modes for shorter distances are also needed. Especially in this regard, in other words with regard to a MaaS system, MM can fill the gap while at the same time increasing the popularity of electric mobility in case of e-scooter sharing.

Lastly, RH achieved a rather low potential-score (based on the second calculation method presented in Table 5) compared to the other services. Although it seems to be an attractive mobility mode that does not require much change in travel behavior, the low score for *quantified positive impacts* depresses the score drastically. As a result, it cannot be recommended as a measure to reduce urban traffic volumes.

With regard to further research complementing and expanding the research matter of this thesis, the MATSim simulation could be used to verify both the presented categories for the other remaining services as well as the meaningfulness of other evaluation categories, as briefly mentioned in chapter 8. Moreover, MATSim can be used to conduct even more profound research and investigate the differences for the network load in the simulation depending on the respective change of the parameters.

In addition to that, the potential evaluation method itself could be structured and specified in more detail. For one thing, the other success factors and evaluation categories could be verified further by, for instance, conducting surveys regarding the users' appraisal of certain attributes of a service. For another thing, it could be interesting to evaluate the suitability of certain services for different city sizes. Currently, most studies researching the impact of mobility services on traffic congestion are conducted primarily in metropolises in which traffic congestion is a serious problem. However, smaller or medium-sized cities such as Hanover also aim at reducing their MIT levels so that it is of great interest to identify what factors are decisive for the suitability of a certain mobility service. This way, cities could identify more easily a customized mobility portfolio fitting their individual spatial situation.

All in all, even without the suggested further research aspects, the results of the underlying thesis present a well-founded tendency as to which services can contribute to reducing urban traffic volumes and drive traffic turnaround in the future.