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Technology Acceptance of Autonomous Mobility Services: A Mixed – Methods Study

Masterarbeit

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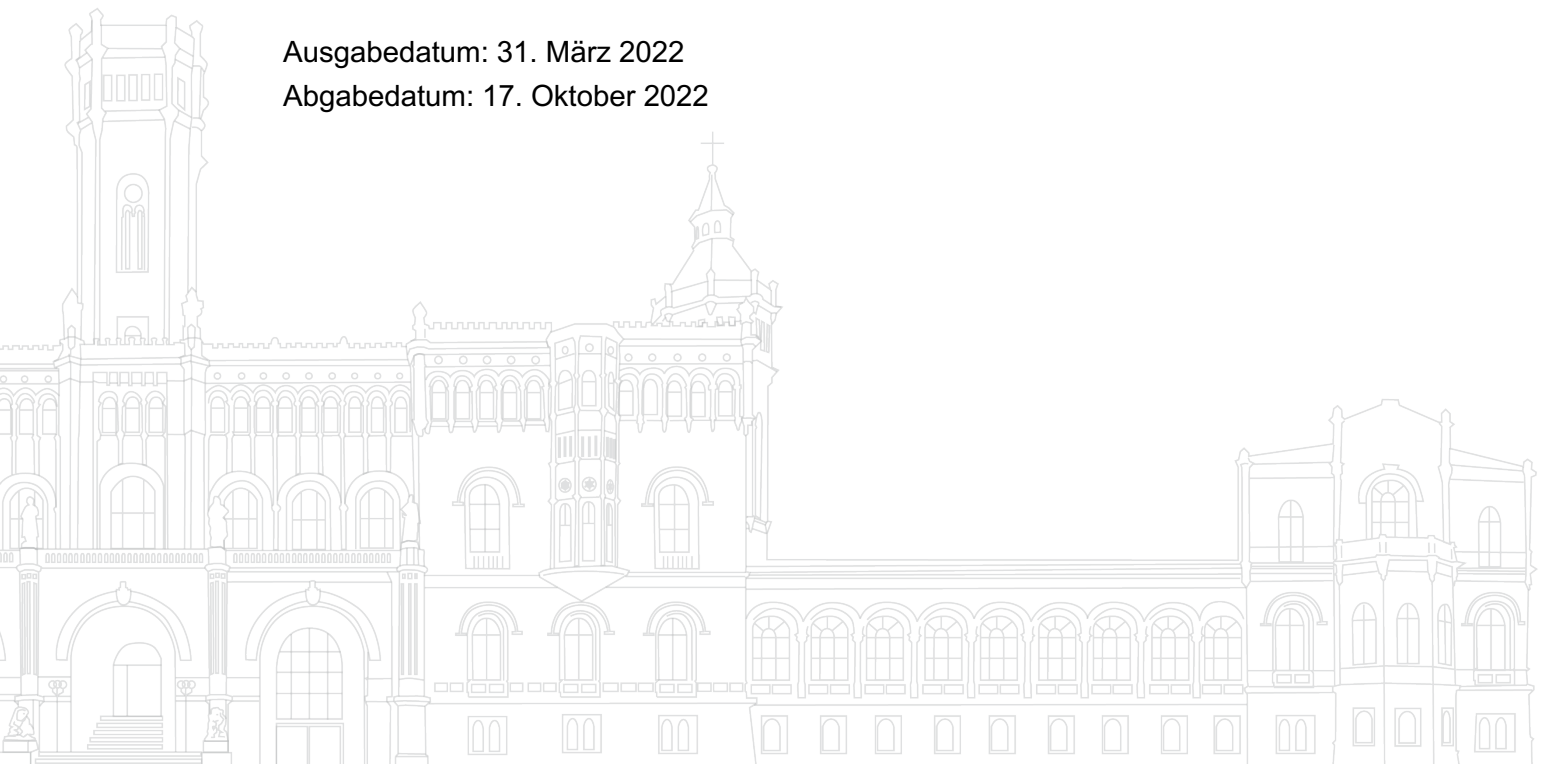


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1. Introduction

1.1 Status Quo and Problem Definition

Over the past few years, urban mobility options have been continuously enhanced by new concepts and the dynamic of the mobility sector (Dodt & Teichert, S. 19). Nowadays, people are no longer limited to choosing between trains, bicycles, or automobiles. With the rapid rise of digitization, e-scooters, car-sharing, and ride-ooling services are no longer a novelty in German cities. For example, the use of car-sharing as an alternative mobility model has consistently increased since 2012 in Germany (see Figure 1). In this case, the sharing economy has aided this development by reducing the need for an own vehicle and making it more efficient to utilize existing resources, in this case transportation means.

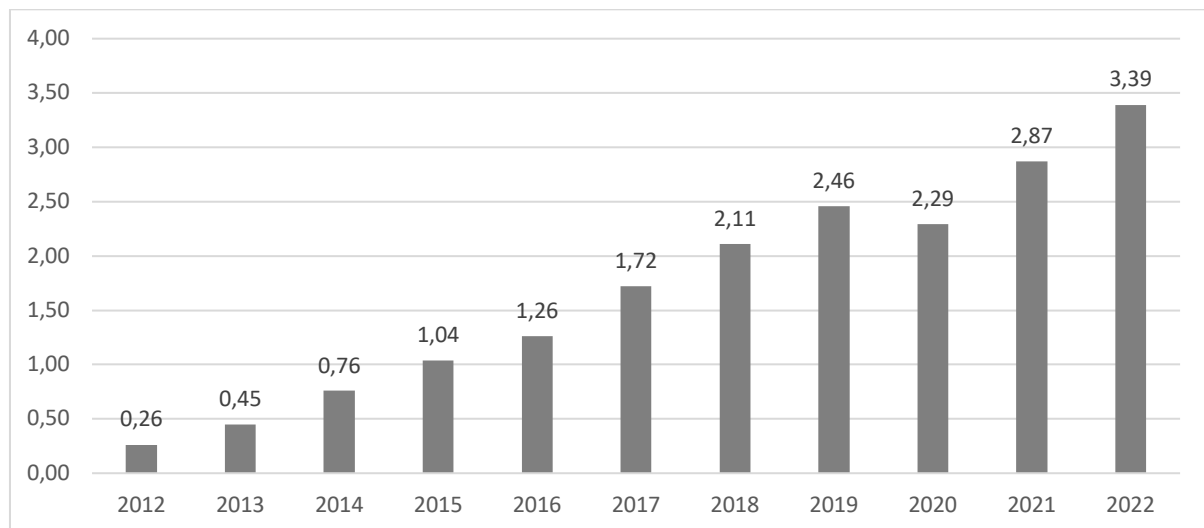


Figure 1: CarSharing User in Germany (in million)

Source: (Statista, 2022)

Despite existing alternatives, the presence of cars in urban areas remains significant, and the importance of private vehicles in Germany remains high compared to other countries. Also evident in this trend is the increase in traffic in Germany over the past few years. There is a strong emphasis on allowing users to plan their routes independently and individually when using their private vehicles. As a result of individual motorized passenger transportation, there are often congestions, overcrowded cities, and a corresponding increase in CO₂ emissions. In addition, automobile travel in Germany is becoming more expensive due to price increases and high inflation in general.

Because of the mentioned problems and also the rising significance of climate protection in Germany, it is vital to rethink the automobile industry and the mobility behavior, especially in urban areas. This includes the transportation modes and provision of services in the cities of the country. In accordance with the Paris Climate Agreement, Berlin has committed to becoming climate neutral by 2030 and reducing emissions in the city on a step-by-step basis (Hirschl and Bernd, 2015).

It is possible to reduce the impact of these problems on urban mobility by introducing sharing options in the area of mobility and replacing the static motorized traffic in the cities. According to a study conducted at the University of California, 13 vehicles in private ownership can be replaced by one car sharing vehicle. Furthermore, it would also be a way to reduce the overall amount of carbon dioxide generated in a city.

Despite being still a relatively new concept in the field of mobility, services like Car-Sharing and Ride-Pooling are already in the process of undergoing their next revolution. In the last decade, self-driving or even autonomous vehicles have become a distant future mobility concept due to increasing digitization and high research and development expenditures within the automobile industry. The IAA 2021 has already seen the introduction of Robo-taxis, which makes autonomous mobility system not just a fable trend anymore. As a result of changes in German laws that facilitate the establishment of autonomous vehicles, they may already be a part of our daily lives soon. Automated vehicles can satisfy social mobility needs while contributing to environmental goals at the same time as on-demand mobility systems. By optimizing driving habits and solving problems like traffic congestion in cities, CO₂ emissions can be further reduced. As autonomous vacuum cleaners and rakes have already become commonplace in German households, this could soon be a reality with autonomous vehicles on German roads as well. Thus, autonomous driving is no longer an illusion, and it is technically ready to be introduced to the market. Furthermore, autonomous driving has the potential to meet mobility service requirements and address environmental problems.

1.2 Objective of this Thesis and Course of Investigation

Aside from technical advancement, the condition for a successful market entry of autonomous mobility services, such as autonomous car-sharing and ride-pooling, is also the level of user acceptance. The aim of this research study is to evaluate whether such mobility services have a high level of acceptance and actual usage potential in the German population. In addition, the goal is to identify the factors that contribute to such acceptance. It is therefore necessary to raise both expectations and concerns that could contribute to the successful marketing of such concepts.

Firstly, relevant terms will be considered as well as mobility behavior and current trends in Germany in order to ensure a basic understanding of the study context.

As a next step, the background of autonomous driving as well as the development stages will be discussed. In addition, current autonomous transportation service providers in Germany will be examined so that a current performance overview of the concept can be obtained. Furthermore, legal and ethical aspects of autonomous driving and the problems resulting from them will be discussed.

The empirical analysis begins in chapter 4 with a definition of the term acceptance and an examination of a number of scientific models that may be used to investigate the acceptance of an innovation.

Throughout the following empirical study, both qualitative and quantitative analyses are carried out according to a mixed methods approach based on Wunderlich et al. (2019) As part of the qualitative component of the study, interviews were conducted with people who have experience with the use of mobility concepts such as car sharing and are therefore also potential users of autonomous mobility systems. The objective is to identify factors affecting acceptance through the interviews, which will be followed by a quantitative investigation through a survey to check these factors. Because autonomous mobility services are concepts that are still pending final market introduction, the qualitative approach can provide an insight into what factors could influence the acceptance of autonomous mobility services independently of the actual usage experience.

The results of the interviews are then translated into hypotheses and incorporated into a context-specific acceptance model. After that, the quantitative component of the Mixed Method Approach helps to confirm or reject the hypotheses that have been formulated. The empirical analysis of the data from the survey is conducted using a software program called SmartPLS4 and is explained in detail in the appropriate chapter. At the end of the research, the results of the in-depth analysis will be discussed as well as a summary and a conclusion will be presented. In conclusion, implications for future research are discussed as well as limitations of the work.

Developing hypotheses and validating or rejecting them through a statistical analysis is based on the first research question:

RQ1: Which factors have a significant influence on the potential intention to use autonomous mobility services?

In addition to the first research question, a descriptive review of the survey results from the quantitative portion of the study will explore the following research question:

8. Concluding remarks

8.1 Summary

The work makes clear that a future change in transport is indispensable. Increasing individual traffic and ambitious climate targets conflict with each other in German cities and need new solutions. Technological progress in the automotive industry can be used to offer precisely such solutions. Autonomous driving is no longer a thought of the future, and the work shows that research and development, but the political leadership of the country are trying to jointly manage this project. At the same time, autonomous driving promises a high potential benefit and should not simply be yet another mobility concept.

The scientific community has already focused on autonomous driving. However, little research has been done on user acceptance and the resulting intention to use the vehicle. Some work did deal with this, but mostly the focus was on autonomous individual transport or autonomous driving itself. Autonomous mobility systems as a shared mobility concept have been less considered. The present work was able to provide new insights through a mixed methods approach. By surveying users of current mobility services, a context-specific acceptance model could be created. It shows that the topic is significantly more complex than other studies imply. The work can show that trust in the system and experience with car-sharing services does not imply use of these services. Thus, the results show that an interest and a potential evaluation are currently not yet sufficient to derive an adoption of these mobility systems.

Nevertheless, the study was able to show that the evaluation of these mobility services is basically positive and that interest has been aroused.

It therefore remains to be seen how the technology, the legal situation and the supply side will develop in the coming years. Implications for operators are to convince potential users of this mobility concept through targeted advertising and to convert the interest into the use of these concepts.

8.2 Limitations and Future Research

Since the work deals with a phenomenon that is still before market implementation in this form, no objective data on the actual use could be collected. Thus, the work is rather based on perceptions and expectations of the concept under investigation. Therefore the respondents were expected to comment on a model, which may still be very abstract for many.

An additional limitation is the acceptance model used here, which was created on the basis of the findings from a qualitative survey with 12 people. The constructs and indicators of the constructs used are not ones that have stood the test of time in research like the acceptance models of Davis or Venkatesh. However, because a completely new concept was considered, a context-specific acceptance model was essential. In addition, the sample of respondents is relatively young. This is due to the fact that mainly people with experience in the use of current mobility services were interviewed and that they are generally younger on average.

The discussion provides clear implications for future research. It is necessary to examine the extent to which interest in autonomous driving can lead to its use. Operators in particular must address this question to ensure successful market implementation. Operator approaches must be created that make autonomous driving a serious alternative and not a nice-to-have.

To bring objective data into the research, future work can increasingly look at existing pilot projects such as HEAT and SMO to get an impression of which people participate in the pilot project and which factors influence this acceptance and especially the actual usage.