The Future of Shared Mobility: Investigating the Acceptance of Autonomous Driving Technologies in Car-Sharing Services

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Table of Contents

1 Introduction

In a world with high urbanization rates, climate change and the desire for individual independence, mobility is a key factor in many areas of people´s lives. A strong movement from the countryside to the cities causes infrastructural capacity problems in many parts of the world and lets the pollution increase in cities to health endangering levels. Since individuals want to be independent in their movement, the private car is still a necessity for a high share of the society. The number of registered vehicles in Germany increased in every of the last ten years, being 48.501.859 in 2022. (Statista (B), 2022) A variety of reasons potentially cause this development. Alternatives could be disadvantageous in comparison, when assessing the performance and costs. Public transportation could be too inflexible or unreliable for users and the availability outside of a large city could be worse than in the city center. Another reason could be that a person perceives an amount of positiveness when driving the own car, which cannot be achieved by driving a rental car or using other transportation modes. Also, the costs play a role when it comes to the decision whether to purchase a vehicle or using alternative solutions. For mobility to be sustainable, the further increase of privately owned vehicles and especially those with a combustion engine needs to stop and the question for economic participants is, with what kind of solution the private vehicle can be substituted.

An upcoming phenomenon of recent years is the increasing number of shared mobility providers in Germany as well as worldwide. Especially car-sharing is on a rise with a total fleet, accumulated from all providers, of 30.200 vehicles in 2022. In 2012, only 5.600 cars were in fleet, showing the magnitude of the development. (Statista (A), 2022) The offer of other shared mobility modes like e-scooter sharing, ride-sharing or ridepooling is expanding as well, but car-sharing has the closest relation and most similarities to a private car. Therefore, it is essential for car-sharing providers to design their offer in a way that it can provide an alternative to the private vehicle. Information system (IS) research authored some auxiliary technology acceptance models in the past to analyze the effects of a technology´s design characteristics on the user´s acceptance.

Mobility as sector, which is highly driven by innovations, frequently provides new technologies that should facilitate the usage of a vehicle. A major innovation of recent years is the development of autonomous driving technologies. When fully developed, a vehicle is able to drive fully autonomous with the driver only paying attention to the traffic and reacting in case of an unexpected situation. Since there are still legal issues to be

clarified and more tests to be conducted, the technology is not available in daily lives. The technology of autonomous driving is interesting for car-sharing providers since it could be a way to increase the acceptance of the service as not everyone will be able to purchase a vehicle with the ability of autonomous driving in the beginning. The German start-up Vay has made the first step into the direction of autonomous car-sharing services. They will provide a service, where the customer gets the vehicle delivered to a desired pick-up location, then drives on her or his own and finally does not have to park the car when reaching the final destination. The technology is different from autonomous driving in the way that the pick-up and the parking is handled through a so-called tele-driver, who can control the vehicle remotely from an office. Nevertheless, Vay has the vision to provide a fully autonomous car-sharing concept in the future. There is no data and research on experiences of users for this technology, hence it is not certain whether this service is accepted or not by the customers. This largely depends on the specific design characteristics of the service as well as the pricing and other external influences.

The above-mentioned is leading to the research question of this paper: "What are the determinants for the customer acceptance of autonomous driving technologies in car-sharing services?"

In this paper, the current state of shared mobility and the new technology of autonomous driving will be reviewed first. Afterwards different technology acceptance models will be introduced and evaluated for the appropriateness regarding our research. Subsequently, the applied methodology to answer the research question is described. Since the Mixed Methods approach will be guiding the research, a qualitative and a quantitative strand are utilized and will be explained in chapter four. After analyzing the empirical results for each strand separately, meta-inferences are developed to be able to generate profound findings. Finally, these findings are discussed and a direction for future research will be indicated. In chapter seven the content and the implications of the research paper are concluded.

2 The Future of Mobility

2.1 Sharing Economy and Shared Mobility

The so-called sharing economy is described with the following definition: "Collaborative consumption made by the activities of sharing, exchanging, and rental of resources without owning the goods." (Lessig, 2008, p.143)

6.2 Recommendations

In our research, we gained some valuable insights about the acceptance of autonomous car-sharing services as of today. It will be interesting to see how the acceptance will develop in the following years when there is the possibility to try these services and maybe even fully autonomous driving vehicles. There is a need for further research regarding the price value when the final prices of these services are known and can be evaluated by the customers. As of now, there are only indications and estimations, which make it very difficult for the normal respondent to assess the construct of price value. Future research should also address the acceptance in other countries or in the optimal case worldwide. For this, a high number of participants is needed and autonomous car-sharing services have to be available in more countries. Individuals in developing countries are not able to evaluate autonomous car-sharing services when they have not even used an electric vehicle yet. Because of this, future research should be first conducted in leading industrial and technological countries like the USA, Germany, or maybe China.

Another recommendation is changing the pattern of data collection. Self-reported usage is often not optimal as indicated in the literature, consequently collecting the data directly from the users of a new autonomous car-sharing service could be advantageous. Also, the type of instruments for collecting the data could differ from personal interviews and an online survey. For all of this, autonomous car-sharing needs to be introduced into real life and has to operate commercially on a daily basis and in the optimal case in more than only one location.

7 Conclusions

In this paper, we provided a vast overview of the theory behind technology acceptance and of innovative mobility services. We applied the Mixed Methods approach to expand the existing literature regarding technology acceptance models. The theoretical paper of Venkatesh et al. from 2012 functioned as basis for our work and guided our research. A concurrent data collection procedure was conducted, where personal interviews represent the qualitative strand and an online survey the quantitative strand. After analyzing both strands separately, meta-inferences were developed in order to fulfill the defined research purposes, namely completeness, complementarity and compensation.

Most of the findings of the qualitative and quantitative research were congruent, especially the constructs covering perceived usefulness, perceived ease of use and parking. Nevertheless, we also found divergent results the quantitative and qualitative parts. Sustainability and costs were mentioned by the interviewees when being asked about important mobility factors. Opposing to these results, the equivalent constructs in the online survey were not significant determinants for behavioral intention, following the linear regression.

A major finding of quantitative and qualitative research is the influence of the parking situation on the decision of used mobility modes. Parking appears to be a significant problem, especially for large city-dwellers. An advantage of autonomous car-sharing services in comparison to traditional free-floating offers is the fact that the customer does not have to park the vehicle. This is perceived as very useful by the interviewees of our study. Hence, a practical implication is that car-sharing providers must use this advantage proactively. Another advantage is the higher flexibility since an autonomous or tele-driven vehicle can give the customer access in every street of the operating area. Contrary, station-bases and free-floating services are inflexible as the customer has to move towards the location of the vehicle.

These findings should encourage future researchers and service providers to focus on the mentioned constructs when examining further autonomous car-sharing services.