REQUIREMENTS TOWARDS SUSTAINABLE FUTURE URBAN MOBILITY IN GERMANY

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Abstract
Given both socio-economic changes as well as innovative approaches to react to these trends, the current urban mobility in Germany is subject to adapt to these changes in the near future.
It is expected that the demand for mobility will further rise in the future, while flexibility, comfort, price and complexity reduction becomes more important in the field of mobility. As both existing public transport as well as motorized private mobility can only satisfy the above requirements to a certain extent and with limited flexibility, new modes of transportation are becoming more and more important. Self-driving cars that are currently in the testing phase offer a never before existing combination of all advantages of different transport modes if used in a carsharing model.
This paper examines different mobility studies and statistics on the preference of transport modes in order to identify requirements towards a sustainable future urban mobility. The aim of this paper is to compare the results with the possibility of self-driving cars in a carsharing model.
As a result it can be stated that self-driving cars in a carsharing model are not only an alternative to private motorized mobility and public transport, but could possibly replace existing transport modes in the future.

Keywords: mobility trends, transport mode, innovation, sustainability, self-driving cars, carsharing.

JEL Classification: R4, Y3, J6.

Introduction

The demand for mobility is characterized and influenced by demography, politics, economy, technology and social trends (cf. Institut für Mobilitätsforschung 2015). In order to meet future requirements in regard to the design of sustainable urban mobility, future scenarios and their impact are of high importance. Having analyzed various future scenarios for Germany, the following specific trends can be identified:

- Urbanization

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- Aging population
- Reduction of people numbers per household
- Reduction in consumption of resources (including crude oil)
- Limited financial resources for infrastructure
- Increase in demand for multimodality
- Higher demand for flexibility in regard to mobility

These expected changes highly impact the current characteristics of mobility. Based on these trends, requirements can be identified for sustainable future urban mobility to respond to these changes in the most effective manner.

In order to determine these requirements, the modal split in Germany shall set the basis for further discussion in this paper. Looking at the different shares, it becomes obvious, that individual traffic is the preferable option to satisfy the need for mobility.

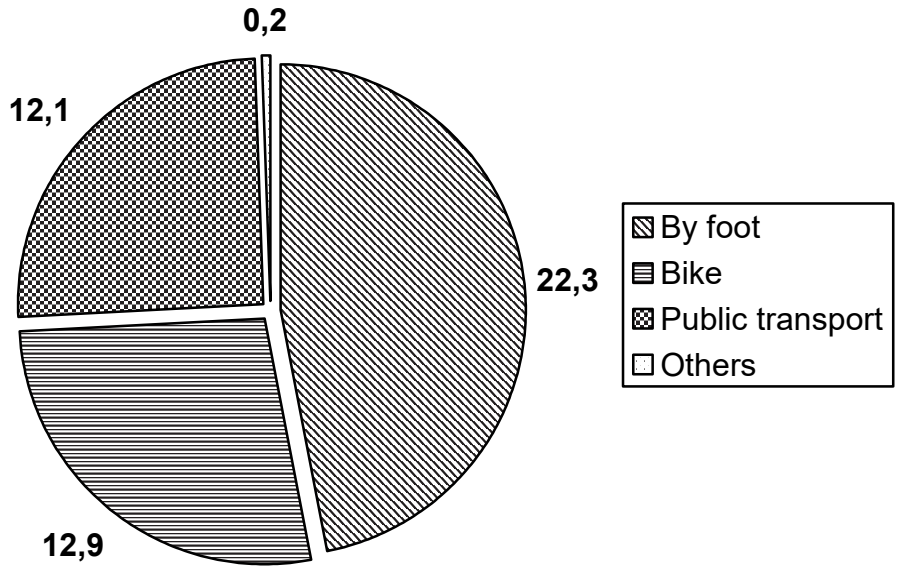

Figure no. 1: Modal Split in Germany
Source: based on: KIT 2015, p.108,

Based on this split, reasons for the choice of each transport mode (private individual transport: car/motorbike; bike; public transport: rail/tram/bus, carsharing, footpath) shall be interpreted, based on quantitative secondary sources. The paper will further outline the motivation and set the requirements towards the future design of an innovative and sustainable mobility system in Germany.

1. Classifying Characteristics of Different Transport Modes

It must be clarified that mobility itself does not describe a motive, but is used to physically reach another goal: movement.

Nevertheless, the choice of transport modes is based on different criteria and due to individual circumstances. These criteria can derived from the marketing mix, as each transport mode can be analyzed to that effect. Later, the gaps of each transport mode become obvious and lead to the conclusion of innovating different transport modes to fit the public needs in regard to:

- *Product*
- *Price*
- *Place*
- *Promotion*

The marketing mix connects the strategic general conditions with the operative implementation of a possible product. The marketing mix is usually characterized by the four "4 Ps", but can be reduced to three (product & price are combined under one "P") or extended to up to seven "P"s in the area of services (cf. Pepels 2012). The following interpretations of the marketing mix with the identification of motives for different transport modes shall not be viewed as exclusive motives, but display the main arguments. The marketing mix is there for applied in its original format with 4 Ps.

Product: The product describes the characteristics of each transport mode. The characteristics include the comfort, time saving, ecological awareness, availability, accessibility and reliability.

Price: The price of the transport mode depends on the owner. Speaking about public transport mode, prices are either paid by single trips or by season tickets. This same pricing scheme applies to carsharing. Individual transport modes, such as the car, motorbike and bicycle require asset and maintenance costs.

Place: The place shall be defined as the place of the provision of the mode of transport. As for individual mobility (car/motorbike, bicycle, by foot), the transport mode is directly provided at the location of the individual. As for public transport, the individual is required to cover a certain distance to the place of pick-up and after drop-off to the final destination.

Promotion: This dimension of the marketing mix can be considered as the least important one in regard to comparing transport modes. As both public and private mobility is advertised, the reasons for choosing one or the other are rather dependent on the above mentioned factors. This dimension shall therefor not further be considered.

2. Evaluating Different Transport Modes

According to the preference of the population, the car is the primary choice of preference in everyday life, followed by public transport, the bicycle and by foot.

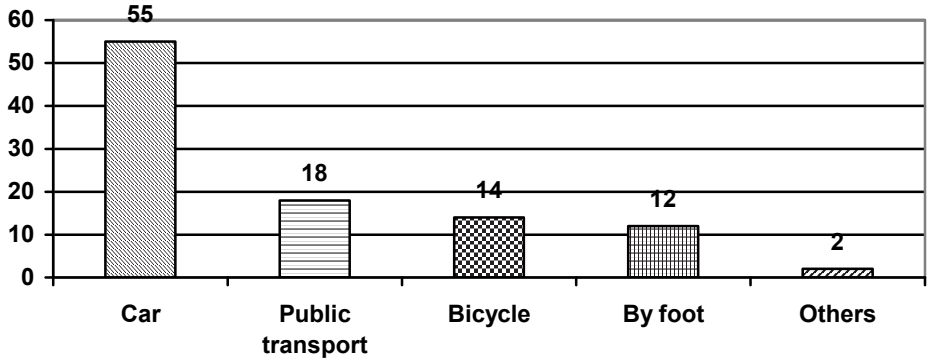

Figure no. 2: Primary Choice of Transport Mode
Source: Statista, 2016

Comparing this figure with the modal split, these statistics reveal a difference in desired transport mode and actual transport mode. The preference of using a car is higher than it is actually in use. The bigger difference can be seen in the preference for public transport and the actual use: 18% of the interviewed prefer this transport mode, while only 12% actually use it.

Having clarified the question what transport mode people desire, it shall be further outlined why this transport mode is preferred (motives). Mobility by bike and foot are excluded in the further outline, as they are used for shorter distances of up to 3,4 km and therefor out of scope when compared to travelling by private motorized vehicles or public transport (cf. Statistisches Bundesamt 2013).

According to a study made by Ernst & Young, the quality, safety and price of a car is of extensive importance to the people, followed by fuel usage and ecological friendliness (cf. Ernst & Young 2012). However, an average car is used for only 1 hour per day, making this transport mode a relatively expensive one, compared to public transport or carsharing (cf. Verkehrsclub Deutschland). Although private cars are considered as very flexible and comfortable in terms of availability and reliability, they require regular inspections, insurance, fueling and space for parking.

Carsharing, as part of individual motorized travel currently deals with the problem with a certain distance from door to carsharing station or car location. If this distance could be minimized, more people would use this transport mode (cf. Puls 2013). Berylls Strategy Advisors identified further reasons against carsharing in one of their studies and found out that the biggest reasons are uncertainty about availability (28%), the discomfort of driving someone else's car (26%), the effort and complexity of renting (25%) and the lack of carsharing offers close-by (cf. Berylls Strategy Advisors 2014). Comparing the carsharing offer with a private car, it requires less effort in terms of maintenance as this is usually done through the carsharing provider.

Another study of the "Verkehrsclub Duetschland" (VDV) revealed the motives of users of public transport. The first motive for using public transport is flexibility (75%), followed by gain of time (52%) and punctuality (51%). The motives are followed by comfort, availability, low costs (42%) etc. (cf. VCD 2009). In addition, public transport is accessible

to anyone living in an area with availability, while the private car requires a driver's license. While the amount of driver licenses slightly increases each year, it shall be notified that with the aging population in Germany and for safety reasons, a big proportion of the people won't be able to use their private cars in the future (cf. KBA 2016).
Decisions on the mode of transport are taken on an individual level in the end, while preferences can have different values. Derived from these requirements, it is possible to allocate the possibility of self-driving cars in a carsharing model through the instrument of positioning. This marketing method that connects to the above mentioned marketing mix is used to position this idea in the mind of the potential customers (cf. Ries, Trout 2001).
Positioning is characterized by the product (self-driving cars in a carsharing model), the distinct features of this product in comparison to existing transport modes and the characteristics of the customer. The following figure summarizes these attributes:

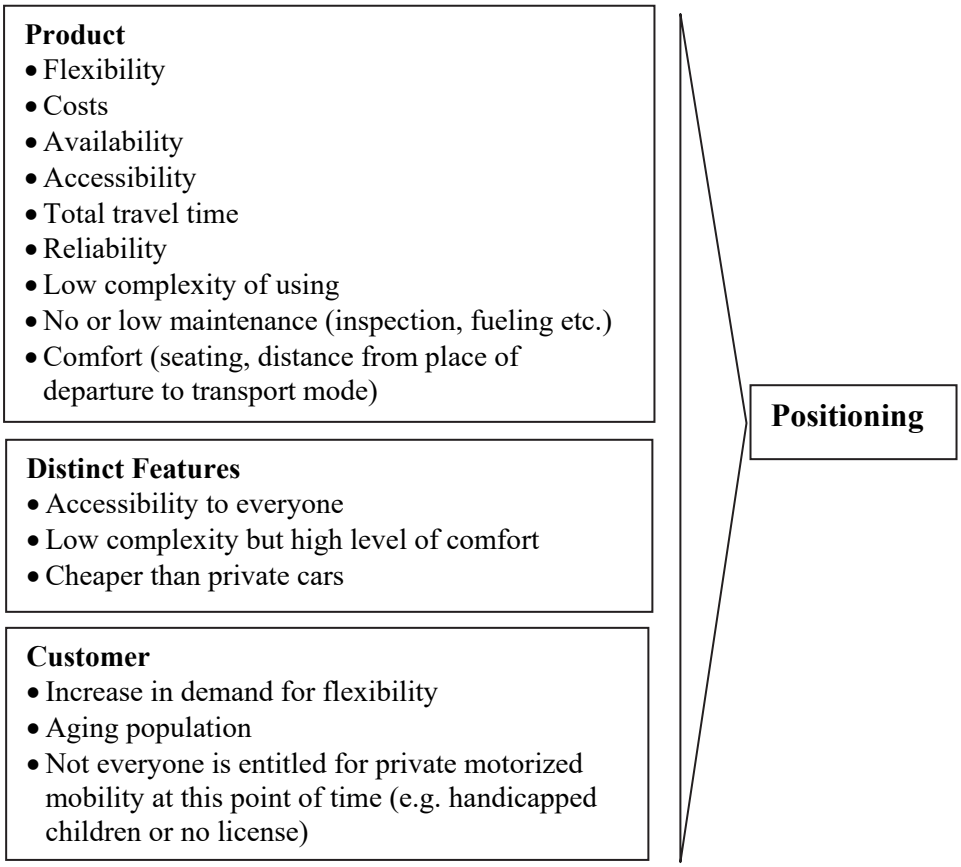

Figure no. 3: Positioning of self-driving cars in a carsharing model
Source: authors

3. Future Urban Mobility in Germany

Having analyzed the criteria towards future sustainable mobility, it becomes obvious that none of the current transport modes can combine the identified requirements.
The above outlined requirements are therefore further matched with the possibility of self-driving cars in a carsharing model.
Such a self-driving carsharing model could be provided by the state (public transport) or by private mobility providers, e.g. automotive manufacturers or software provides such as Google. If a country-wide roll-out of this model can be realized, it becomes obvious, that this model reacts not only to the socio-demographic change, but also to many of the current issues in the mobility sector.
Coming back to the marketing mix, the product of self-driving cars in a carsharing model could be set up in the following way:

Table no. 1: Possible marketing mix of self-driving cars in a carsharing model

Product	**Place**
Cars are provided by a third part → no need for registration, maintenance etc. Reduction in accidents in comparison to normal cars Ecological friendliness Full availability when called via e.g. app Full accessibility (broader group can be reached than for private car or public transport: e.g. elderly people who don't want to drive anymore or children, blind people etc.) Full reliability: car arrives when called at any time of day (no long waiting time as for e.g. public transport) Time saving: no waiting for e.g. public transport, no search for parking space Comfort: high level of comfort as seating is guaranteed and no need of interference allows time for other activities e.g. reading	Self-driving cars can be provided from place of departure to final destination (door-to-door mobility) An app can support the booking of a car to provide the car at the desired place
Price	**Promotion**
Making full usage of a car (no parking) Highly efficient in fuel consumption Sharing the ride, shares the fuel expenses Different price schemes (flat rate, minute packages, price/minute) can address different customer groups: a) High-use customers (e.g. commuter) b) Medium use customers (e.g. housewife) c) Low-use customers (e.g. students)	The provision of self-driving carsharing model would require a certain amount of promotion to attract new customers, especially in the starting phase. Self-driving cars in the city automatically raise and attract new customers

Source: authors

Conclusions

Socio-demographic changes and an increase in the demand for mobility require a paradigm shift in the provision of mobility services. Having analyzed the most common modes of transport, it becomes obvious that many of the current transport modes cannot fulfil the desires of the German society. It is therefore recommended to use innovative technology in order to react to these changes, opening new business opportunities to existing companies in the field of mobility as well as to new start-ups. Implementing a self-driving carsharing model in Germany would shift the existing mobility to being sustainable and future-oriented.

This paper can be considered as the prerequisite for further research on this topic that include the analysis of acceptance of self-driving cars in a carsharing model from a customer perspective, as well as the analysis of possible stakeholders (mobility providers).

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