CETRA2020* 20-21 May 2021, Zagreb, Croatia
6th International Conferenceon Road and Rail Infrastructure

CARSHARING AS AN INTEGRATED MEAN OF TRANSPORTATION - A COHESIVE PLANNING APPROACH FROM THE CITY OF WIESBADEN, GERMANY

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Abstract

In Germany and beyond there is a widespread social and political discussion on a "mobility turnaround", which refers to the technological and behavioural change of the entire transport sector towards sustainability goals. Within that approach of a "mobility turnaround" the concept of car-sharing is universally seen as a central component. This attribution is mainly based on the presumed combination of the advantages of rationally using a car on one hand without baring the negative social effects of a private-car ownership.
Until recently, however, it has not been legally possible in Germany to reserve exclusive parking spaces for carsharing vehicles in public spaces. Carsharing stations could therefore only be located in private spaces, which in turn was a strong limiting factor in the expansion of the service. With the introduction of the German "Carsharing Law" in 2017, municipalities were given the possibility to identify and assign exclusive parking spaces in public areas, which now serves as an instrument for targeted planning of carsharing services.
The following contribution presents an overview of the typical organizational and operational forms, use-cases and user groups of casharing services. The positive and negative effects are identified, classified and discussed. Further, the paper proposes how an ideal carsharing service should be designed from a municipal and transport planning perspective.
Based on this general findings, the contribution presents the exemplary approach of the city of Wiesbaden. The municipality allocates public spaces to private-sector providers based on a defined comprehensive network concept. Within that concept public spaces are only tendered to providers in accordance with clearly defined targets and operational standards. With that approach Wiesbaden is proactively fostering a city-wide carsharing network as an integrated mobility service.

Keywords: carsharing, urban mobility, multimodality, sustainable mobility, traffic planning

1 Introduction

For a good 30 years, carsharing has become increasingly widespread as a new transport service in many countries. Carsharing refers to mostly commercial offers in which a car can be used independently by different people. In contrast to classic car rental, carsharing cars can also be booked for short periods (usually hourly) and are available close to the journey's starting point.
In the sense of sustainability oriented transport planning, carsharing is an attractive mode of transport as it can help to tackle the dominance of private cars by reducing its numbers to a reasonable and city-sensitive level.

One of the main arguments in favour of carsharing is its potential to gradually reduce private car ownership, which results in a decreasing need for parking space in favour of qualitatively upgraded public space. Furthermore, carsharing decreases car usage in general as each single trip is preceded by a more rational consideration of alternatives and a conscious decision rather than an automatic choice of transport based on routine and comfort.
Transportation planning is faced with the question of how to design a reasonable and attractive carsharing service. The answer to this question should not be left to commercial carsharing providers alone, but must be part of a cohesive and integrated transport planning approach on a municipal or regional level, so that the best possible integration into existing transport systems can succeed.
In the following, we will first show which forms of carsharing services do exist and which effects those different forms have on the individual mobility behaviour.
Then, using the example of the city of Wiesbaden, possible approaches are discussed as to how a reasonable and attractive carsharing service can be developed within existing planning structures. Finally, potential tools and instruments that a municipality can use to implement an integrated service are elaborated and proposed.

2 Basics of Carsharing

2.1 Types of service

There are two fundamental types of different carsharing services [1]: Free-floating and station-based carsharing. Station-based carsharing represents the classic form of carsharing in which the vehicles are assigned to a fixed station. Pick-up and return of the vehicles must take place at the same station, i.e. only round trips with return to the starting point are possible. The stations are usually marked by signs on a specially designated zone and hold several carsharing vehicles. Each carsharing car must be booked in advance for a fixed period of time. The rates are based on the duration of the booking period and the distance travelled.
Free floating carsharing was first introduced in Germany in 2009. The providers offer a large number of vehicles for flexible use in defined business areas, usually areas in and around central parts of major cities. The vehicles are not assigned to fixed stations, but can be parked in public parking spaces within the specified business area. This allows one-way trips between any points in the business area. Booking and reservation in advance is not possible. The rates refer solely to the actual period of use.
In addition, there are also hybrid forms combining the two main concepts (called “station-flexible” or “combined carsharing”): As with station-based carsharing, the vehicles are only available at defined stations, but can be returned at other stations as well, so that one-way trips are possible.

2.2 Dissemination in Germany

At the beginning of 2021 a total of 26,220 carsharing vehicles are available in Germany [2]. Despite a growth of 400 % within the last ten years in the number of carsharing vehicles, this corresponds to only 0.05 % of all passenger cars in Germany. In contrast, the number of people registered with a car-sharing provider results add up to 2.87 million, which corresponds to 3.54 % of the German population and roughly 5,0 % of all driver’s licence holders in Germany. Of these, however, only one third regularly use carsharing [3].
Around half of the vehicles are offered within station-based systems and the other half with free floating systems. As free floating systems are concentrated in 15 major cities, station-based systems are offered in a total of 855 municipalities across Germany. 83 % of German cities with a population over 50,000 inhabitants hold a carsharing service.

Four large commercial providers operate in Germany. Outside the metropolitan areas, however, carsharing is often offered and operated by voluntary associations on a non-profit basis [2].

3 Carsharing as an integrated mean of sustainable transport

3.1 Effects of carsharing services

In recent years, a large number of national and international studies have analysed the effects of carsharing on overall car use, on the mobility behaviour of users, and on car ownership (e.g. [4], [5], [6], [7], [8]). Even if the results vary depending on the research question, design and methodology, they overall show a significant potential of carsharing towards a more sustainable mobility.

This thesis is exemplified by the results of the EU-funded STARS project [9]. As a key finding the study shows that carsharing customers of station-based systems have reduced the number of privately owned cars by almost two-thirds overall compared to the period before registering as customers. This clearly confirms the potential of carsharing to reduce the number of privately owned cars in general as well as affecting the common mode choice of its users, 91.4 % of whom use a car less than weekly.

The situation is considerably different with customers of free floating systems: here, the decrease in private car ownership is less than 5 %. Free floating carsharing is probably mainly used as a substitute for public transport or cab when the private car is not available or situationally not suitable. 61 % of free floating carsharing customers use a car at least once a week, however, only one third of these trips are made by carsharing.

A good 67 % of station-based carsharing customers state they use a car less frequently after signing up for carsharing, while 38 % of free-floating customers show reduced general car use.

Various studies have used different empirical methods to determine how many private cars a carsharing vehicle practically replaces. The results vary widely, but show predominantly high values from 1 : 7 (one carsharing vehicle replaces 7 private cars) up to 1 : 20, especially for station-based systems.

3.2 Municipal goals and requirements for a carsharing service

For years, the predominant transport policy goal of many municipalities has been to reduce the burden of car traffic and to enhance the quality of public spaces more, while at the same time ensuring mobility. Carsharing can significantly contribute to this by reducing vehicle trips and easing the demand for parking space, as described above. Station-based systems in particular appear effective, while the benefits of free-floating systems are not as apparent.

In order to achieve the primary goals, from the perspective of municipal transport planning a carsharing service must meet various requirements:

- wide and dense spatial service coverage to enable efficient system access for as many people as possible,
- different types of vehicles for different purposes (e.g., small cars, vans),
- environmentally friendly vehicles,
- integration into the overall transport system, e.g. through integrated information, booking and payment platforms for carsharing, public transport, bike sharing and other mobility services.

3.3 Challenges in the expansion of carsharing

The growth of station-based carsharing, which seems particularly promising from a sustainable transport policy perspective, is hampered by limited space available for stations within the cities. In the past, carsharing companies had to rent private parking spaces because the designation of exclusive station areas on public ground was not legally permissible. Additionally, in neighbourhoods with high parking demand, where carsharing could potentially relieve parking pressure significantly, private parking spaces are especially scarce and expensive. Moreover, stations on private ground are often publicly not well visible, so that the service is only known and used to a limited extent.
Since 2017, the federal Carsharing Act [11] has in principle created the legal framework to provide carsharing on public ground. Since carsharing providers are usually private companies, but the intended road space is publicly owned, many questions must be addressed before stations can actually be set up. In particular, municipalities need to consider how the carsharing service should be designed to meet their transportation policy goals. While the projected locations of the stations should also be attractive for the carsharing providers to meet their economic expecations. In this area of sometimes conflicting priorities, completely new types of planning considerations must be initiated.

4 Municipal planning strategies - the example of Wiesbaden

4.1 Project framework

The city of Wiesbaden has politically and strategically set the goal of proactively shaping mobility and urban transport. To this end, attractive services for multimodal transport are to be introduced. Mobility stations are to be rolled out throughout the city as points of connection between different multimodal modes of transport, a central component of which will include the service of carsharing. Within this planning framework, the city of Wiesbaden plans to introduce a cohesive, visible and attractive carsharing service as an integrated mode of public transport for the entire city area.
Central elements of the presented project consist of a city-wide potential analysis with regard to the various capabilities and use-cases of carsharing, the search for locations on a macro level, the consideration of the defined macro locations as mobility stations, and the preparation of a transparent and legally compliant implementation procedure. A strategic benchmark of 100 stations on public ground was politically predetermined, so that a multi-stage process needed to be developed for the distribution and location of these 100 public stations.

4.2 Site selection procedure

The site selection contains a quantitative and qualitative approach. The quantitative location selection defines where in the city area stations are to be located, the qualitative location analysis then defines the specific service quality of each carsharing station. In the quantitative location selection, a distribution system is developed that initially distributes the 100 stations proportionally to the respective city districts based on the factors population and population density. It was strategically determined beforehand that even the smallest districts should obtain at least one station in order to theoretically provide access to a carsharing service to every resident.
In the next step of the site selection, a GIS-based accessibility analysis of the existing public transport system was then carried out to identify both central nodes and gaps in the system. Both aspects can be important in the strategic design of an integrated carsharing service.

Where there is no sufficient public transport service, carsharing as part of public transport can close specific service gaps and thus reduce the dependency on private cars; where, on the other hand, there are central transport nodes in the public transport network, carsharing can function as an important part in an intermodal travel chain integrated in mobility stations.
Then, urban characteristics were identified for each district at the macro level in order to ensure good accessibility and a large catchment area for each station, as well as to enable high visibility through a clear allocation in the area of existing infrastructures (e.g. local bank, supermarket). Based on these spatial criteria, the number of stations determined in the first step were then located for each of the 26 districts of Wiesbaden.

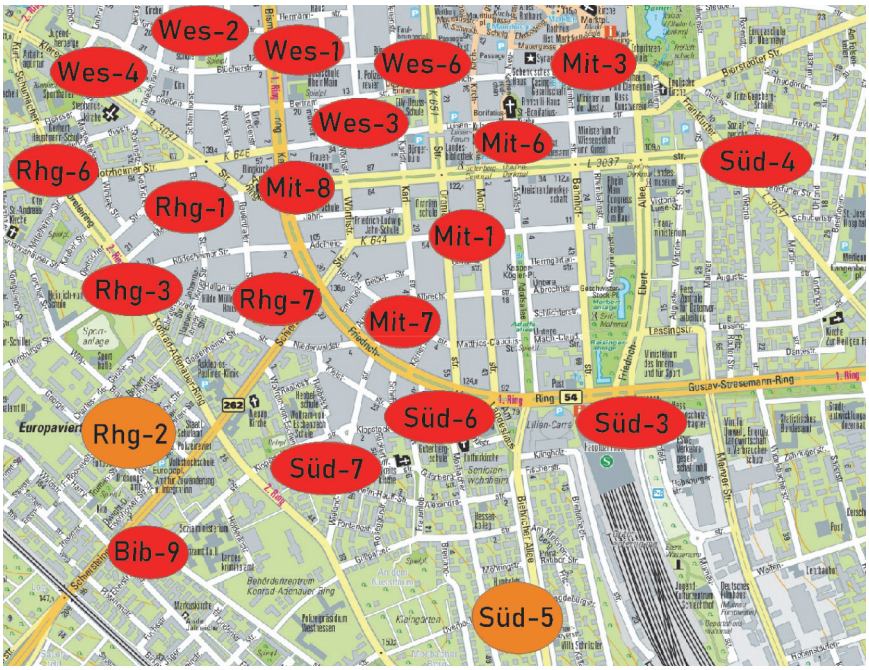

Figure 1 Exemplary section of the defined car sharing stations at macro level in Wiesbaden city centre with clear coding for later specific allocation (red are L-stations, M-stations are orange).

4.3 Different service levels

In order to achieve the best possible transport benefits, it is not only important to define where the stations are located, but also what (minimum) services they should provide. Therefore, three different station categories were initially developed: Small stations ("S-stations") each have 1 to 2 vehicles that universally cover the widest possible range of uses (e.g. small family car). The service is solely station-based.
Medium-sized stations ("M-stations") provide 2 to 5 vehicles per station in a station-based concept. The range of vehicles is mixed, from small cars to vans, in order to meet different usage requirements.
"L-stations" have 4 or more vehicles in a combined system of station-based and semi-flexible services, so that one-way journeys from one "L-station" to another are possible.
In the next step, the defined station types are assigned depending on the population density at the district level. Rural and peripheral districts with a population density of less than 1.000 people per km² are predominantly assigned "S-stations", residential and mixed-use areas

close to the city are predominantly assigned “M-stations” and urban districts with a population density of more than 3.000 people per km² are predominantly assigned “L-stations” with semi-flexible services.
The proposed systematic station distribution at macro level is a data-based transport planning recommendation. The individual locations must all be examined again in detail at the small-scale level in accordance with urban planning criteria and, if necessary, coordinated with local stakeholders.

4.4 Roll-out strategy

After quantitatively and qualitatively locating 100 carsharing stations throughout the city, in the last project step a roll-out strategy was developed. In an immediate action programme, 35 stations will initially be implemented in all larger city districts (› 7.000 inhabitants) with theoretically high carsharing potential. To analyse districts with a high carsharing potential, the factors affinity to environmental transport (derived from modal split), car availability per household, purchasing power and parking pressure in public spaces were considered.
The aim of this immediate action programme is the prompt introduction of a large-scale carsharing service to enable low-threshold entry and to generate visibility of stations and vehicles on the road. This immediate action programme should be accompanied by professional marketing and scientific evaluation. After the successful implementation of the first 35 stations and the succeeding awareness of the carsharing service, the next 65 stations will be implemented gradually expanding to all districts of the city as well as further densifying the service in the high potential areas.
In addition to these 100 stations, the city of Wiesbaden is aiming to integrate local businesses and public administrations into the city-wide carsharing service as a further important element. By using carsharing companies and public administrations can reduce their own vehicle fleet when, in return, they have fixed contingents from the carsharing pool at their disposal throughout their business hours. Outside business hours and at weekends, these carsharing vehicles are then available to all public users. The potential is estimated at around 30 additional stations for commercial cooperation partners citywide, all of which must be proactively acquired through targeted marketing. The cooperation with local companies and administrations has the opportunity to further expand the carsharing service with private engagement and at the same time to gain stable anchor-customers.

4.5 Allocation procedure for stations

For the implementation of the developed network, an effective and transparent procedure for the allocation of stations to specific carsharing providers needs to be established. In theory, the city of Wiesbaden determines requirements on the service quality and carsharing providers then agree to those requirements by applying for tendered stations. In practice, however, this enters uncharted territory in terms of planning and public law. Therefore, a step-by-step approach is necessary in which potential service providers and municipalities discuss and negotiate realistic parameters of the service design in joint exchange.
Questions to be addressed include how to distribute the stations fairly among the providers, what requirements for vehicle availability are reasonable and what data the city needs from the providers to monitor the quality of service and as a basis for transport planning? The proceedings in Wiesbaden had not yet been completed when this article was written.

5 Conclusion and outlook

Carsharing can have an important impact on more sustainable mobility as it has the potential to make private cars redundant, decrease car use, and reduce parking spaces in cities. The carsharing service must be well integrated into the overall transport system to be successful. With carsharing municipalities mainly aim to achieve transport planning goals. The carsharing providers, in turn, primarily pursue economic goals. Municipalities and carsharing providers must therefore jointly design the service in order to create the best possible solution for both parties. The planning procedures and the rules for cooperation have yet to emerge in practice. The carsharing concept for Wiesbaden can be a promising approach for this new type of public and private co-creation in transport services.
The unique charaterictic of services such as carsharing compared to rather more conventional transport infrastructure measures is their potential for dynamic adaptation to new developments, innovations and changes in the framework conditions during their lifetime. They therefore can perform as potential learning systems. To enable this learning potential, constant monitoring of success is vital; digitization provides the necessary technical basis for this. The effective utilisation of digital possibilities by service providers and municipalities alike is a key success factor for carsharing and other new mobility services.

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