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Term Paper

Car parking in Waiblingen: Evidence-based recommendations for action

In the study course

Sustainable Mobilities
- Problem Based Research Project-

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ALi	Alternative Liste Waiblingen
BW	Baden-Württemberg
GIS	Geographic Information System
GSMA	Groupe Spécial Mobile Assosiation
P&R	Park & ride
PT	Public transport
P&W	Park & Walk
UK	United Kingdom
USA	United States of America
VVS	Verkehrs und Tarifverbund Stuttgart
ZTM	Zarząd Transportu Miejskiego

Abstract

The aim of the research is to find out the problems associated with car parking that contribute to the traffic problem in the city centre of Waiblingen and to recommend parking management solutions based on research evidences with a particular focus on Fronackerstraße. The paper employed both primary and secondary data for analyses. Primary data of parking situation was collected through covert observation and secondary data such as parking map, parking data and current parking management status was collected from the city authority of Waiblingen. Focus group discussion of the selected stakeholders gave the idea about the citizen's perception about the parking situation. Observation, spatial analyses and quantitative analyses have illustrated the status quo of the parking situation and its impact on city's regular life and formed the base of recommendations for parking solutions for the city centre of Waiblingen. The opinions of the stakeholders also played an important role in the formulation of solutions. The recommendations are two folds: the core solution of reassembling parking in the problem area and the supportive measures that can complement this solution. The core solution includes general rearrangement of parking in Fronackerstraße with the provision of Park&Ride or Park&Walk options and an improvement of on-street parking with measures such as seasonal parklets, car-stacks, parking time limits or designated delivery parking. Supportive measures which involve reactivating the bus stop of Fronackerstraße, incentive for public transport users, parking guide system and shared parking, are expected to contribute to the better functioning of the core solutions. Solutions are recommended based on the best practice examples from other cities and the literature review with the intention of achieving the goal of reducing the number of cars on the street gradually and change people's perception of a parking free street.

1 Introduction

The car is the number one means of transport in Germany and especially in Baden-Württemberg. Over 60% of all passenger kilometres in BW are covered by car and about 82% of all households own more than one car (infas, 2018). Compared to the rest of Germany, the car ownership of households in BW is 4% higher (ibid). Since 2008, the number of cars in BW has grown constantly by more than 100,000 vehicles each year to around 6.6 million cars at the beginning of 2019 – an all-time high (Statista, 2019). And by the end of 2019, this record could again be broken, as in the period from January to October, in Germany, 3.5% more cars were registered than in the previous year (Kraftfahrt-Bundesamt, 2019).

The problems associated with this strong car dependency become obvious when focusing on the question where to park the cars. Especially in urban areas and city centres, where the daily traffic concentrates and public parking space is rare, the so-called parking pressure is high and often results in increased traffic through park cruise traffic (FIS, 2018). Resulting effects like unlawful parking, increased traffic, and congestion can lead to a reduction of the traffic safety, especially for pedestrians and cyclists (ibid). For example, blocked pavements can cause major obstruction for vulnerable road users such as elderly people or parents with children. In addition, air and noise pollution, stress and time-loss are only some of the indirect effects of heavy parking traffic in cities.

Also, in the specific case of Waiblingen congested roads and crowded parking areas are typical symptoms of an extensive car dependency and high parking pressure. According to Alternative Liste Waiblingen (ALi), the inner city, especially Fronackerstraße and Bahnhofstraße, suffer from strong parking traffic. This situation of the congested inner city also was confirmed by earlier studies that have examined the local mobility offer, the work commuting and the space use in the city of Waiblingen (Clauß, 2019). In order to relate directly to one of the highest traffic polluters, the aim of this study is to analyse the parking situation and status quo of parking management in the city of Waiblingen and to suggest a set of parking solutions addressing the parking related problems while considering the different interests of stakeholders in the city.

2 Study Area and Research Question

Waiblingen is a small city within the metropolitan area of Stuttgart in Baden-Württemberg in the southwest of Germany. The city has about 57,000 inhabitants and an area of about 43km² (Stadt Waiblingen, 2020). Its historical centre and the manifold shopping opportunities are also attracting foreigner to come to the city. Furthermore, the city is home to some big industrial companies like Stihl and Bosch. For this reason and due to the proximity to Stuttgart, many people live and work in Waiblingen.

Like many other cities of this size in a metropolitan area, Waiblingen has to face a high volume of traffic. It is the result of the mobility of all these people who are on the move every day and the already mentioned dependence on cars in Baden-Württemberg. In the specific case of Waiblingen, the traffic especially in the Fronackerstraße causes regular congestions and obstruction for pedestrians.

These findings were revealed by previous research studies undertaken by master students of the study course Sustainable Mobilities from the University for Economics and Environment Nürtingen-Geislingen during the months of March to September 2019 on behalf of the independent voters' association ALi. One of the studies was dealing with the developing of a shared space in Fronackerstraße (Gunter, Ochieng and Omarien, 2019). The report emphasises on the traffic congestion in the city centre of Waiblingen, especially on the main streets Bahnhofstraße and Fronackerstraße, and the resulting reduction in the attractiveness of public and active transport (hiking and cycling). In order to provide equal space for all the different user groups, the research proposes the implementation of a so called “shared space”, a single shared road surface without specific traffic regulations where all road users have equal rights (ibid). This idea seemed very interesting from a social and urban point of view, but it entails many risks which need to be properly assessed. Firstly, the safety issue. The road users are supposed to interact spontaneously and thereby the overall number of traffic conflicts increases. The key cause of concern are the vulnerable users i.e. pedestrians and cyclists who are expected to deal with the speed and physical appearance of motorized vehicles. Therefore, it is important to re-

duce the severity of traffic conflicts in order to allow a safe interaction between them first.

Thereby, after reviewing the literature available on shared space and physically observing the city, the group felt that before working on the concept of shared space on Fronackerstraße, there is the need to drastically reduce the parking related traffic first. Because, the chaotic car parking situation on the street leading to congestion, lack of space for other road users and reduced traffic safety. In order to identify the reasons for this situation and find solutions for them, the following research question was formulated:

What are parking problems that affect traffic in the city centre of Waiblingen and how can new parking initiatives help to reduce the number of cars in the city centre, with a particular focus on Fronackerstraße?

This question is faced within the context that the car is still the main means of transport in BW. For many people, especially in rural areas, it is an important part of their daily life and mobility. During the first introduction meeting with ALI, it was revealed that some stakeholders particularly the retail owners did not appreciate the idea to makes changes or to reduce the parking facilities. The retail owners assume that comprising parking space can result into a reduction in the number of their customer. They believe that if the parking situation was restricted, potential customers would switch to shopping centres outside the city centre or to online shopping. In order to take this concern seriously, the goal of this research is not to prohibit downtown parking but to mitigate parking related negative impacts on the liveability of the city centre and to create more space for other road users by reducing the number of parking cars.

The research approach for answering the question is divided into two main parts: First, the analysis of status quo and the problems in the inner city and second, the conceptual planning approach with a set of different parking solutions. Guiding questions in the course of the study are:

- What are the characteristics of the cities (parking) infrastructure and how does the city manage the parking system?

- Where exactly are trouble hot spots in terms of parking?
- What are the specific interests of the stakeholders concerning the parking traffic situation?
- How to reduce the parking pressure and traffic in Fronackerstraße without disregarding the interest of commercial vendors?
- What are the most important target groups for parking?
- What are possible solutions for intelligent public parking?

In order to cope with these questions, an access to city data and the local community was necessary. In this regard, the research team was supported by the local voter association ALi. The association has been committed to sustainable and environmentally friendly transport and urban development for several years and is represented with 4 seats in the city's council in Waiblingen (Alternative Liste Waiblingen, 2019). Through the connection of ALi to the city administration and the local community, the research team was able to connect with city officials and gather important parking data.

3 Methodology

In order to answer the research question and to elaborate on possible parking solutions, a set of methods will be applied in this study. Through a mixed method approach, both qualitative and quantitative data are collected and analysed. Above all, the spatial investigation of the problem area and the acquisition of parking data play an important role. In addition, the interests of the local community are important for designing feasible and acceptable parking improvements. Moreover, a parking management literature review should serve as a basis for creating new conceptual ideas for parking solutions.

3.1 Definition of Key Terms

This study uses has a set of different terms and key words in the context of parking management. In order to clarify the meaning of these terms in the course of this research, they are explained in the following:

1. **On-street parking**: On-street or kerb-side car parking applies to public road parking. The publicly owned asset is controlled by local authorities and has direct control over its use in their regions (Ison, 2014).

2. **Private non-residential parking:** This refers to off-street parking on private property directly linked to a specific building e.g. workplace. On this property, parking is only permitted with an appropriate authorization. This type of parking space supply typically results from the requirements of local authorities, which require developers to provide enough parking spaces to meet the city's new development needs (Ison, 2014).

3. **Residential parking:** Private residential parking is primarily associated with private accommodation: houses or flats. Typically, only residents use these spaces, although in recent years there has been a growing trend to rent them out for use by non-residents at certain places (Ison, 2014).

4. **Illegal parking:** In general, the literature has not yet provided a specific definition of "illegal/irregular parking" or "parking violation." Through certain aspects defined in traffic engineering, the term can simply be understood as the act of drivers stopping and parking their vehicles in a position that is prohibited by law or unauthorized (My Thanh and Friedrich, 2017).

5. **Parking pressure:** The lack of sufficient private and public parking in mixed areas near the city centre, which is already due to urban planning, creates parking pressure (FIS, 2018). There are not enough parking facilities to fulfil the needs of the drivers to park their car at their destination.

6. **Cruise traffic**: Traffic caused by the car driver cruising his/her car on the streets looking up for appropriate parking space for the car. It is the result of parking pressure (FIS, 2018).

7. **Short term and long-term parking:** In the context of our report any car being parked at the designated parking spot for less than 2 hours is considered as short-term parking and any car being parked at designated parking spot for more than 2 hours is considered as long-term parking. A special definition for short-term parking is used for describing the stopping of a car directly on the street or pavement for only a couple of minutes e.g. running bank errands.

8. **Problem area:** The problem area for this research is defined as the city centre of Waiblingen with the streets Fronackerstraße, Am Stadtgraben, Alter Postplatz and Bahnhofstaße. Particular attention is paid to Fronackerstraße and its side streets like Albert-Roller-Straße, Untere Lindenstraße and Blumenstraße.

3.2 Research Methods

In the following, both the quantitative and qualitative research methods are listed and explained. The methods are sorted in the way as they were used in the course of the study. In addition to general theoretical basics, particular emphasis is placed on the methodology applied in the context of this research.

Spatial Analysis

Spatial analysis is a method wherein one can geographically model specific problem situations, deriving results from computer processing, and then analyse and evaluate those findings. This method has been shown to be highly effective in assessing the geographical suitability of certain sites for specific purposes, estimating and predicting effects, and interpreting and understanding change detecting important patterns hidden in the information (Esri Press Team, 2018)

In the context of the research, this method is proved to be useful in the geographical understanding of the spread and land use of the city in general and the location of parking spaces.

There are various online software available for the above-mentioned analysis theory. For this report it was decided to use QGIS, open source software which is available to download for free. It is suitable to process common geo-information data such as so-called shape files. With the help of this data files, it is possible to locate the various parking spaces, commercial buildings and garages, which in turn virtually helped to understand the infrastructure of the city even before physically going to Waiblingen. The visualization and interactive editing of map data was particularly helpful, since the research team has never visited Waiblingen before. Furthermore, the GIS data can be analysed quantitatively. The files are always based on a so-called attribute table, in which various data is stored. For instance, information about the number of parking spots in a garage, the opening hours or number of disabled parking are included in the file. In the course of this research, this data is used to monitor the status quo of the parking situation in the quantitative analysis.

Lastly, aerial surveillance of the urban area with QGIS is used to provide important insights into available areas and space that might be used for the implementation for possible parking solutions. These geographical investigations for planning reasons are used to support the findings in Chapter 6.

Quantitative Analysis

Data is either quantitatively or qualitatively measurable. Quantitative data refers to any numerical data such as number of parking, statistics or percentages in traffic. The analysis of such kind of usually requires statistics to be used. So, quantitative data analysis can be characterized as a systematic investigation approach during the compilation, measurement, and counting of numerical data attributes (Fakir, A N M Asaduzzaman, 2016). It often answers the questions "what" and "how many" about any situation or event (ibid). Quantitative data enriches the data source for a mixed methods approach.

Therefore, in context of our report the statistical data on the number of public garages along with their capacities, incoming cars in the garage and parking prices of respective garages were collected from the city's parking authority to analyse the status quo. In a small statistical analysis, the average occupancy ratio of the garages was calculated by dividing the number of entries by the capacity of the garages. In addition, the parking prices were put into consideration to establish relation between residence time and pricing policy in terms of factors affecting the parking decision of a car owner. Therefore, the findings were also compared with the spatial analysis and general literature findings.

Observation

Bryant, (n.d.) stated that qualitative analysis is a data collection process in which a researcher observes a trend in a particular field of research. Wimmer, RD and Dominick, Joseph R, (2011) demonstrated in a similar vein that observational research involves the study, documentation and evaluation of observed behaviour as it happens in a natural setting. Observations can be overt (everybody knows they're being observed) or covert (nobody knows they're being ob-

served, and the observer is being hidden). The benefit of covert observation is that when the observed participants don't know they are being watched, people are more likely to act naturally (CDC, 2018). Sauro, (2015) listed four stances that the researcher may take when conducting observations in a social setting:

1. The Complete Participant: Here the researcher acts almost like a spy. He engages and participates fully in the various activities with the participants selected for the project.

2. The Participant as an Observer: Here the participants of a study or research are fully engaged by the researcher. He is more of a friend or colleague than a third-party neutral. The point of difference between the above kinds is that the participants know that the person observing them is a researcher.

3. The Observer as a Participant: Here the researcher is known and recognized by the participants and in many cases, the participants know the research goals of the observer. There is some interaction with the participants, but the interaction is limited. The researcher’s aim is to play a neutral role.

4. The Complete Observer: Here the observer acts as a detached observer where participants do not see or hear the investigator. The goal is to make participants act spontaneously, because they do not realize that they are being watched.

Because the goal of the observation was to document the traffic situation and to get a feel of the city in neutral way it was decided on doing covert observations with the researches as complete observers. The persons being observed should remain unaffected by the observation as far as possible and follow their normal routine. The purpose of taking up this method as a 'complete observer' wherein we consciously wouldn’t want people in the surroundings to know that we be observing them is because we want to observe the unaltered behaviour of the car drivers and their behaviour related to parking their cars. The other aspects we want to cover through observations are: parking related signage, illegal parking, the location of various big garages and their usage, the usage of public space in the historical city and the occupation of parking facilities near the main rail station. As suggested by ALi members the observation covers the

surrounding of Bahnhofstraße and Fronackerstraße. We also decided on covering the area bordering the historic city centre of Waiblingen.

The data that is collected using this method is recorded/ documented in written format as well as photographically. Since the research problem is related to parking space and various problems related to it, these photographs will play an important visual role to highlight as well as analyse different situations. The data collected using this method is also important to validate the status quo of the city's parking situation and the various problems related to this issue.

Focus Group

A focus group is a technique to get insights into a specific topic from interest groups involving the use of in-depth group interviews (Rabiee, 2004). In general, the participants are selected because they "serve a specific purpose […] based on a given topic" and, "though not generally representative, are sample of a specific population" (ibid). Therefore, participants in this type of research are selected on the basis that they have a legitimate interest regarding the subject and by their socio-economic characteristics represent a sample of the population involved in the parking situation in the city centre.

For this research, the method has been chosen as one of the methods to collect data, since conceptualizing set of parking solutions requires inter-action with various stakeholders to get their inputs, perspective, concerns, and limitations regarding the issues related to parking and the purposed solutions to it. In addition to that, it would also help to determine the interest and power of different stakeholders in the said matter. As the research has a limited time frame, this method is also feasible in the aspect that we would be identifying the various stakeholders and gets their expert views than individually interviewing each member being affected from the problems and purposed solutions.

As mentioned above the groups can be formed on basis of various factors and therefore for this research project the groups are categorised on the basis of legitimate interest and their involvement in the subject area i.e. parking analysis.

For the research project the following stakeholders have been identified:

1. Residents living on or near the Fornackerstrasse/Bahnhofstrasse

2. Locals coming regularly for shopping and errands

3. Commercial vendors in the Fornackerstrasse.

According to 'Communications for Research' a market research organisation based in the United States has identified various types of focus group discussion methods like single focus group, mini focus group, two-way focus group or dual moderator focus group. One of the distinct features of the single focus-group interview type is its group dynamics; hence the type and range of data generated through the social interaction of the group are often deeper and richer than those obtained from one-to-one interviews (Rabiee, 2004). Therefore, the selected participants should be comfortable talking with each other and the researcher.

Krueger, (1994) believes that rich data can only be generated if individuals in the community are prepared to participate fully in the discussion and are therefore in favour of using a homogeneous group. Although most researchers do not disagree with the principle of homogeneity but recommend that participants do not know each other and thus promote more frank and spontaneous expression of views (Thomas *et al.*, 1995). However, there are many researchers and research papers that suggest that the use of pre-existing groups may be helpful when discussing very sensitive and personal issues, as there is already a degree of trust among the group members that will promote the exchange of views more freely (Rabiee, 2004).

In order to ensure an open and vivid discussion, keeping in mind the time paucity for the research, the best suited type of focus group discussion is the single focus group discussion wherein there is a single moderator asking predefined mostly open-ended questions to the respondents of each stakeholder group. As the topic of this research is not to be considered to be a sensitive or personal one, it was decided to select a homogenous group of participants who did not know each other personally.

With the help of the Ali Waiblingen, till now two members under each stakeholder group have been identified and to keep gender neutrality, one male, and one female is the composition of each group. So, in total there will be six participants taking part in the focus group. Ensuring the homogeneity of the group, all participants were local citizens with a direct connection to the Fronackerstraße.

Krueger, (2002) in his paper 'Designing and Conducting Focus Group Interviews' has defined a general structure for the focus group discussion which is as follows:

1. **Introduction:** This step involves introduction of the researchers and providing the participants of the discussion with the overview of the research project.

2. **Defining the ground rules:** This involves setting the general rules regarding the conduct of the moderator and the participants during the discussion.

3. **Questions and structure for the discussions:** This step involves predefining the questions for each stakeholder group discussion in a chronological order. The order being: 1. Introductory question: which is generally an open-ended question that acts an opening question for the discussion and needs to set the tone of the discussion and should have a positive connotation.

4. **Guiding questions:** These are the questions following the opening question and trying to get the relevant answers for the desired objective of the research, the moderator can also prepare short probing question so as to steer the discussion to the main objective of the discussion. 3. Concluding question: This question is asked at the end of the question and is generally asked to summarise the discussion or in general to ask further suggestions from the participants regarding the process and content of the discussion.

5. **Conclusion:** This involves the moderator giving a thank you note to the participants and taking their opinion about the whole process of the discussion.

According to this approach the focus group of this paper is structured in a similar way. In order to steer the discussion in the desired direction, a semi-structured questionnaire was developed. The questions were arranged according to special topics concerning the different stakeholders, whereby the order of the questions was not rigid. So, the moderator could use the questionnaire to react flexibly to upcoming discussion topics. After a set of open and introducing questions, the questions are narrowed down to topics for the specific stakeholders. After a series of open and introductory questions and the stakeholder-specific questions, the participants at the end of the focus group were asked to make suggestions for solving the parking solutions. The whole questionnaire is attached to the appendix at the end of the report.

4 Literature Review

Car-dependency of people in the cities has many negative effects on the environment as well as urban life. Availability of parking space is one of the reasons that can influence the choice of car ride and to some extent car ownership. Studies show that car parking facilities can influence travel behaviour like mode choice, trip timing, and car occupancy (Feeney, 1989). To reduce the number of cars in a city, restricting cars from certain area solely cannot solve the problem. For example, restricting cars from city centre might divert the traffic to the outer part of the city. Moreover, a number of stakeholders are involved when it comes to the decision regarding car parking. In this respect, an effective parking management can be useful to create an optimal situation for all the stakeholders of the city.

4.1 Importance of Parking Management

"Parking management refers to various policies and programs that result in more efficient use of parking resources" (Litman, 2019, p. 2). And parking management, if applied cost effectively, can reduce parking requirements by 20-40% compared to conventional planning approaches and thus bring about a variety of economic, social & environmental benefit (Litman, 2019).

Parking problems have become the most common and burning problem now-a-days, especially for the cities. This problem can be either be identified in terms of supply i.e. the existing parking is not sufficient, more parking space should be built, or in terms of management i.e. available facilities are not utilized efficiently and should be manage properly (Litman, 2019). The latter one is considered to be better than the former one. Some significant benefits of parking management are:

- “Facility cost savings. Reduces costs to governments, businesses, developers and consumers.
- Revenue generation. Some management strategies generate revenues that can fund parking facilities, transportation improvements, or other important projects.

- Reduces land consumption. Parking management can reduce land requirements and so helps preserve green space and other valuable ecological, historic, and cultural resources.
- Supports mobility management. Parking management is an important component of efforts to encourage more efficient transportation patterns, which helps reduce problems such as traffic congestion, roadway costs, pollution emissions, energy consumption, and traffic accidents.
- Supports transit. Parking management supports transit-oriented development and transit use.
- More livable communities. Parking management can help create more attractive and efficient communities by reducing paved areas, increasing walkability and allowing more flexible design" (Litman, 2019, p. 3).

4.2 Parking Management Solutions

In this section, five possible parking management solutions which can be beneficiary in the case of Waiblingen are discussed.

Parking Regulation

Parking regulations control who, when and to what extent vehicles may park at a specific location, with the aim of prioritizing parking facilities (Litman, 2019). Limitation of parking time, parking price (off-street & on-street Parking), restriction of parking in certain area, and number of parking allocated for various users, all these tools are included in parking regulation. This solution is considered as a fast and easy solution for the parking management problem, as it needs nominal capital & less time to implement (ibid). Regular checks on the part of the public authority office should be carried out for the implementation of these regulations (FGSV, 2005). In the event of non-compliance, parking bans are to be warned in accordance with the catalogue of fines (ibid).

Park & Ride

Park & ride (P&R) facilities are provided in transit nodes, where people will park their private vehicles to enable the use of public transport (train, bus, tram) for the core part of their journey (Parkhurst and Meek, 2014). The aim of this strategy is to reduce the number of cars & thus congestion in the downtown of a city and to encourage the citizen to employ public transport (PT). The basic requirements of a P&R are that the location has to be able to accommodate the demand i.e. having enough parking space for car users, bicycle users etc and it should be placed near the origin of trip generation e.g. residential area (Cornejo *et al.*, 2014). Study shows that most of the P&R users prefer the facility to be located in the same direction to their journey from the origin to destination; fewer would drive in reverse direction more 2.5 miles to use the facility (Cornejo *et al.*, 2014). Other factors include convenient access to the P&R facilities, reliable & fast service of the PT, and personal safety & vehicle security (Ison, 2014).

The impact of P&R largely depends on a number of factors and policy implementations. For example, if the fuel cost and parking price is higher than the travel cost by PT, people usually tends to avail the latter option. Many cities are now implementing this option to battle car-dependency and traffic congestion. One of the good examples is the P&R facilities in Warsaw, Poland. The construction was started in 2006 & now the city has thirteen P& R facilities, which are claimed by ZTM Warsaw to be filled to the brim every day on weekdays (Kuiper, 2015). And when the P&R is filled, fewer cars are found parked on the street & also it has reduced the traffic congestion in the city centre (ibid). The authority also provides incentives such as free parking for the weekly/monthly PT ticket holders (ibid).

Nevertheless, the P&R can result into some unexpected negative effects. For example, the service might attract a new group of commuters to use their cars as last mile mode, who previously undertook their entire journey by PT (Ison, 2014).

Park and Walk

Park and walk (P&W) refers to the fact where people will park their cars in a nearby parking spot, rather than at their final destination and walk the rest of

their trip (Hamilton City Council, 2013). The parking lot can also be act as a meeting area where people can park their cars, meet their friends, and walk together the remainder journey to the destination (SRTS Guide, 2015). P&W can help to reduce traffic congestion and parking issue and thus increase road safety at key destination during the peak hour. This is also an environment friendly and healthy way of moving in the cities (Hamilton City Council, 2013; SRTS Guide, 2015). The ideal key destinations for P&W are Schools and pre-schools, shopping destinations, City Centre, and Hospital (Hamilton City Council, 2013).

One of the good examples of P&W is walking bus of Newland and Barkham C.E. Junior School. In order to ease congestion around Arborfield, UK, the school took an initiative and introduce a bus which leaves from a designated parking area far from the school. The volunteer parents would walk the children together from the parking space to the school. As an incentive for children, a special guests e.g. Santa Claus in December were requested to join their walks to the school. The official report shows success of the P&W such as reduction in the congestion and pollution. Moreover, the children take pleasure in the walk, make new friends and have the opportunity to see things around them that they might miss if they were driven to school (SRTS Guide, 2015).

Car Stacker

Car stackers is a kind of parking facilities for cars, where two or more cars can be parked in the area of a single car space by raising or lowering one vehicles to park another one (Registrar General's Guidelines, n.d). The system is mechanized and needs an attendant to operate the service. The purpose of the car stacker is to provide more storage facilities for cars in a single space, than a conventional parking method can offer (Registrar General's Guidelines, n.d). The TREVIPARK system of Cesena, Italy solves a number of problems related to parking i.e. congestion, pollution, and land use, by introducing compact, circular, under-ground stack parking that optimise space, are easily installed, and completely automatic. The parking facility can accommodate 108 cars within a circular space with a diameter of 18.80 m (Verdict Media Limited, n.d.). Howev-

er, the capital cost of building this type of parking is extremely high and also might have little impact when it comes to reduce the car-use.

Figure 1: TREVIPARK system of Cesena, Italy

Shared Parking

"Shared Parking means that a parking facility serves multiple users or destinations" (Litman, 2019, p. 29). The basic idea of shared parking is that parking space can be and should be shared among a range of land use types with different peak hours. For example, an office building can share its parking space with restaurants on weekdays and after office hour. This system will help to shrink the parking area and save the cost of new construction of parking space as well (Litman, 2019). App-based online platform such as Pavemint, mobypark, for shared parking are already in the market. These apps offer business for the owner to share their parking with others and thus reducing the cruise time for the car users who search for parking space. This type of parking management system can also be implemented through a local organization, or transportation management association in the cities (Litman, 2019).

Smart Parking Approach

Smart parking approach is software-based parking management system, where drivers of the cars are provided with real-time information to locate free parking

spot and to guide the direction to the spot. The smart parking system includes parking guidance and information system, transit-based information system, smart payment, e-parking and automated parking (Idris *et al.*, 2009). With smart parking approach, cities can manage their available parking asset more efficiently and thus generate maximum revenue out of it (GSMA, 2018). The system assists to reduce travel time for the cars searching for parking space and thus contribute to ease traffic congestion as well as to reduce air pollution. As per the case study by GSMA, 2018 Two Pilot projects on smart parking have been introduced in China, one in Yunnan and another in Southeast Guizhou, by China Mobile in collaboration with DT Mobile. This pilot projects include installation of parking sensor system in 4000 parking and an intelligent parking management system connecting more than 300 parking bays (Ibid). The outcome of the pilot project was beneficial for the two cities in terms of reducing congestion and air pollution. In addition, the smart payment system has helped to free up space faster and thus higher utilisation of the parking bays (Ibid).

5 Parking Situation

The analysis of the parking situation in a quantitative and qualitative way is the corner stone for developing on further concepts and solutions for decreasing the number of cars in the city centre of Waiblingen. Only if the problems of parking and concerns of the stakeholders are identified correctly, the right measures can be derived for improving the attractiveness of the problem area for all road users. Therefore, the results of the applied research methods are presented in this chapter. The quantitative analysis builds on the results of the spatial analysis and the observation provides important photo-documented evidence for the parking problems. Finally, the analysis of the parking situation is then abated with the analysis of the stakeholder's opinions with the help of the results of the focus group.

5.1 Spatial Analysis

This chapter provides an overview about the infrastructure and land use patterns in Waiblingen with regard to the parking situation. Therefore, a set of geo-data was examined and processed with the GIS software QGIS. The geo-data was provided by Department of Surveying and Urban Planning of the City of Waiblingen. The research team was given access to a download page, were different data sets were available including a comprehensive parking lot register with the locations of public parking lots and garages of the city's parking company.

First of all, the general land-use and the distribution of different building types like commercial, housing, or work buildings, were examined with the cadastral map of the city area of Waiblingen. The identified commercial areas are an important indicator for where in Waiblingen there is a special demand for parking, since shopping and running errands are one of the most important pull-factors for undertaking a trip by car. According to a general survey on the mobility behaviour of German households, 30% of all trips in Germany are started with the aim to go shopping or run errands (infas, 2018). Furthermore, the analysis was

helpful to define the problem area of this research and the actual city centre of Waiblingen.

As illustrated in Figure 2, there are six spatially delimited areas within the city boundaries of Waiblingen, in which mainly commercial development prevails. The rest of the city is mainly occupied by residential buildings. The three industrial/commercial areas are located at the outskirts of the city near the big radial roads. They are characterized by large parking areas and hall-like buildings. The shops are designed for bulk purchases and therefore offer plenty of space especially for the car.

Further commercial buildings are located north of the Rems at the city's civic centre (Bürgerzentrum). Similar to the industrial areas, the commercial areas is next to a large traffic junction, the buildings are relatively far apart from each other and there are many open parking spaces in between. In addition to supermarkets, there are also some public institutions, the public indoor pool and a healthcare centre in the near surrounding.

In contrast to that, the other two commercial centres of Waiblingen are to be found directly in the city centre surrounded and mixed up with residential buildings. The “New City Centre” and the “Old Town” merge together smoothly and thereby create a large leisure and shopping zone. Although the two commercial centres are not spatially separated from one another, they differ in the density of the buildings and street infrastructure. On the one hand, the new city centre is crossed by the two broad streets Fronackerstraße and Bahnhofstraße from west to east and Am Stadtgraben from north to south which open up the area for the car. On the other hand, the old town is car a car free zone and has a typical medieval village layout with small alleys and historical buildings. The infrastructure is not built for the car and there is hardly any space left between the buildings.

Considering these differences, the focus of this research is put on the parking situation in the city centre around the Fronackerstraße. In this more dense building development with mixed land-use and a higher share of pedestrians,

public transport and bicycle traffic, the negative impacts of parking and cruise traffic is considered to be bigger than in the outskirt commercial areas.

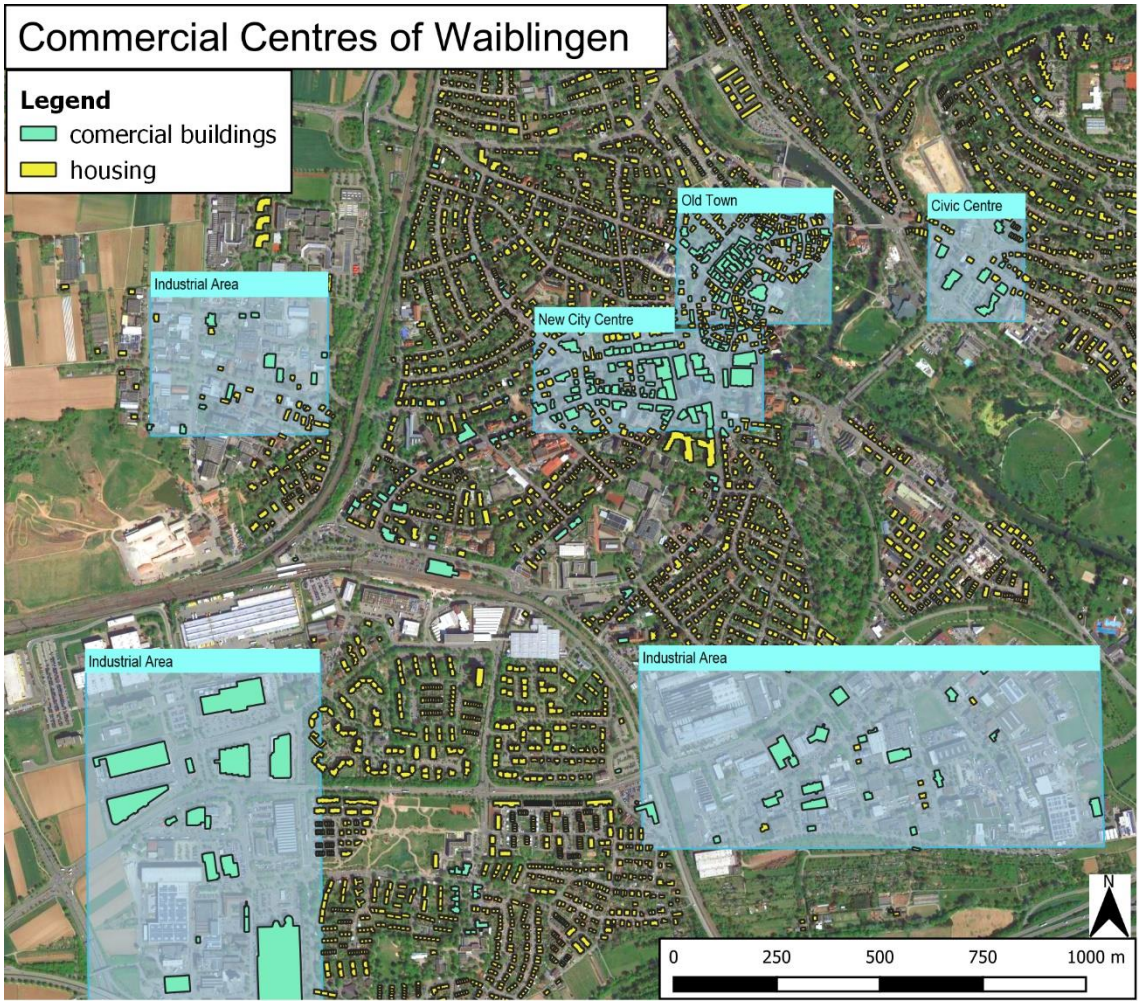

Figure 2: Aerial view: commercial centres of Waiblingen (own illustration; data: City of Waiblingen (2019), Google Maps (2019))

The concentration of public parking spaces also highlights the traffic importance of the commercial and mixed-used city centre. Figure 3 shows that most public parking lots are arranged in a star shape around the city centre, along Bahnhofstraße and around the train station. Further parking facilities are located near the civic centre and the indoor pool of Waiblingen. However, the highest density of parking is found around the old town and the new city centre. Although, there is only few spaces available, a lot of it is covered with parking. Since the building development is very dense in this area, there are also some large under-

ground car parks in the city centre. In general, it can be said that a lot of space is used for parking around the car-free old town in order to compensate the lack of parking in the car-free historical centre.

In addition to public parking lots, there are numerous private and residential parking garages throughout the city. Predominantly, the garages in the surroundings of the city centre relate to the residential areas, but there are also some underground parking garages in the city centre. In addition to the residential garages, the following figure also shows large private parking lots of local companies. It was also found that big parts of the Volksbank garage are reserved for the employees of the bank and for hotel guests.

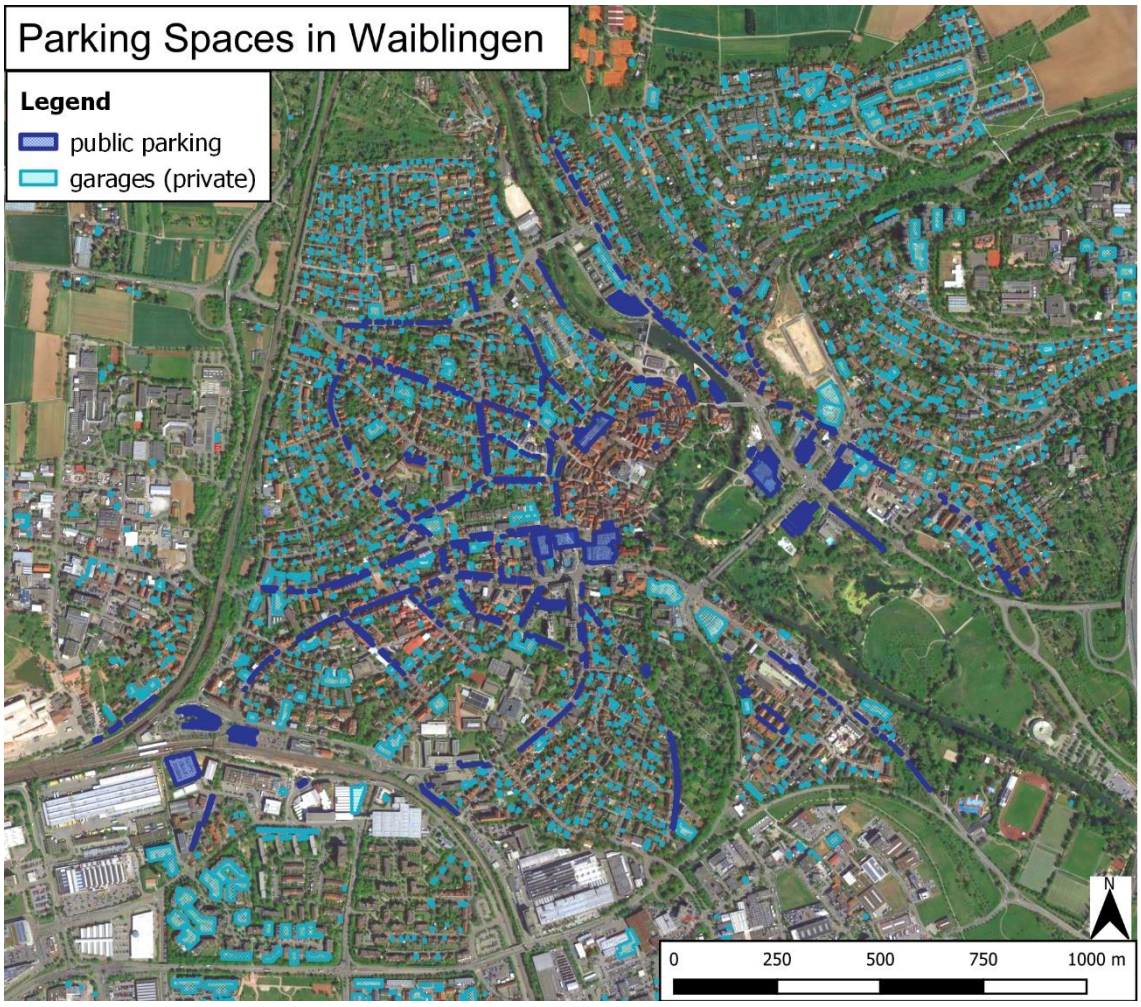

Figure 3: Aerial view: public and private parking (own illustration; data: City of Waiblingen (2019), Google Maps (2019))

Another aspect for the spatial analysis is the road infrastructure and its traffic provision character for the city. Waiblingen is connected to the Stuttgart region and to Schwäbisch Hall via the federal road B14 and to Schwäbisch Gmünd via the B29. As seen in Figure 4, three branches lead to Waiblingen from the B14, one in the south, one in west and one in the north. In addition, the city is connected to the surrounding villages via five other regional roads. The central road Bahnhofstraße, connects the train station with the city centre.

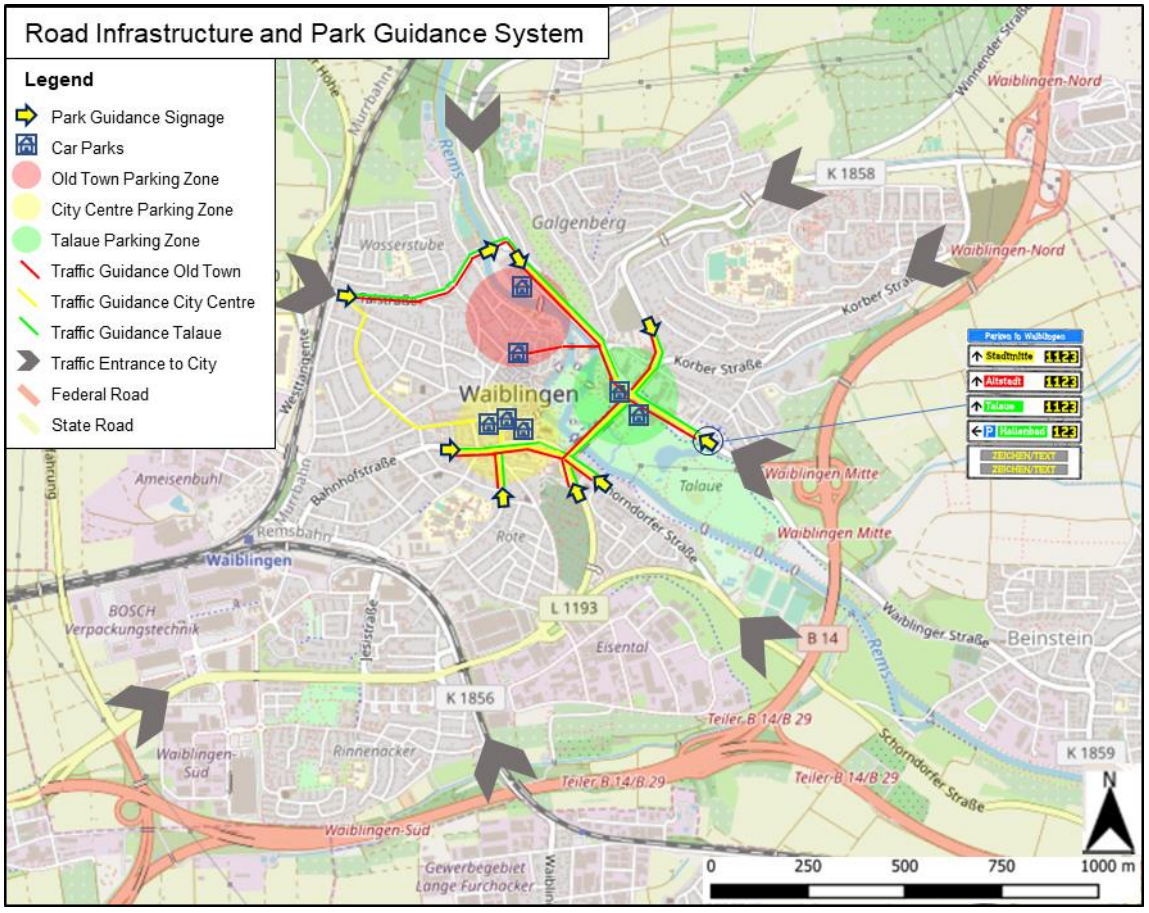

Figure 4: Rodas infrastructure and park guidance system (own illustration; data: City of Waiblingen (2019), OpenStreetMap (2019))

Connected to the road infrastructure, Waiblingen has a central parking guidance system. Large semi-digital street signs display the available parking spots related to three different parking areas: the city centre (yellow), the old town (red) and the parking area Talaue near the civic centre (green) (Figure 4). The signage are located at various points in the city and point the way to the corre-

sponding parking garages and zones. As illustrated in Figure 4, the parking signs are usually attached in the course of the above-mentioned access roads to the city. In the south of Waiblingen, however, the parking signs are very close to the city centre and there is no sign at the entrance to the town.

In addition to the road infrastructure, public transport plays an important role for the local mobility of the city. It can be an alternative for undertaking trips to city by car. As seen in Figure 5, the city centre of Waiblingen is already well covered with public bus stops. There are several lines connecting the inner city with the train station and surrounding neighbourhoods. One of the main streets for bus transport is the Bahnhofstraße with several different bus lines passing through between the civic centre and the train station.

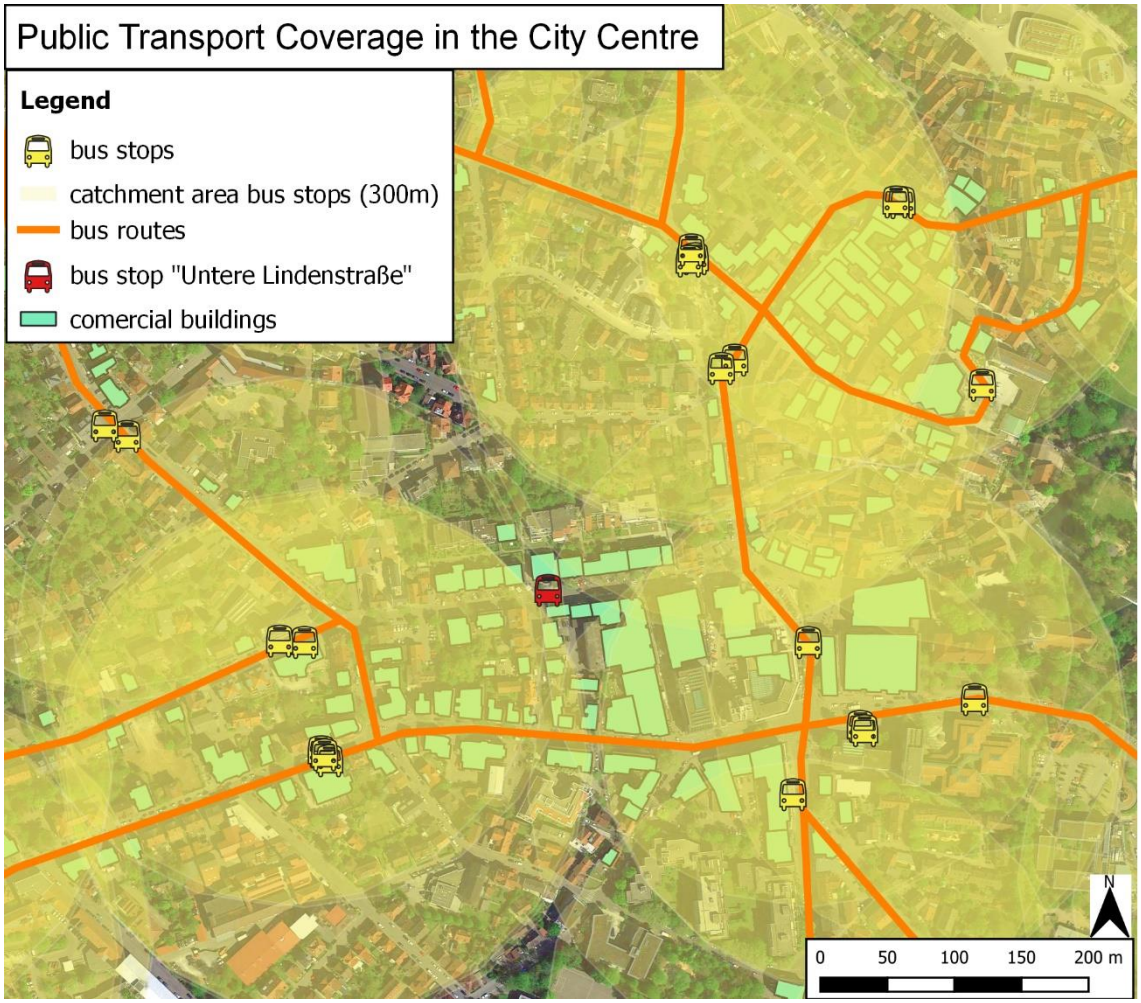

Figure 5: Public Transport coverage in the city centre (own illustration; data: City of Waiblingen (2019), Google Maps (2019), (OpenStreetMap, 2019))

There was also a bus stop in Fronackerstraße, but during the observation it turned out that it had been abandoned. In summer 2019, the operation of the city bus line 207 from Korber Höhe to Waiblingen train station was stopped (Kölbl, 2019a). The main reason given for the closure of the bus stop was the loss of time for the buses, due to the high volume of traffic in Fronackerstraße (ibid). In addition, illegal parked cars have hindered the big city buses in turning in and passing through the Fronackerstraße (ibid). The resulting loss of punctuality was especially a problem for passengers changing to trains at the train station. Therefore, it was decided to reroute the bus line via Bahnhofstraße.

As can be seen in Figure 5, the coverage of the city centre shows a clear gap due to the omission of the bus stop. Although the abandoned bus stop “Untere Lindenstraße” is still inside the required catchment area of 300m of other bus stops, it is located directly in the centre between two catchment areas and the walking distance is longer than towards the next big parking garage (Kölbl, 2019a). Especially for older passengers with destination Fronackerstraße, this distance could be a hindrance to take the bus. The attractiveness of reaching Fronackerstraße by bus has been significantly reduced by taking closing the bus stop.

5.2 Quantitative Analysis

In addition to the geographical data provided by the city, the data also includes a set of different numbers and factual information about parking. The data of the planning department was supplemented by the official parking company of Waiblingen that is integrated into the city administration and manages all public parking facilities. In the following this data is analysed with special focus on the city centre and problem area.

In Waiblingen, there are several parking facilities including on street parking, parking lots, and public garages. According to the data provided by the city administration, a total of around 3,300 public parking spots are available in Waiblingen. More than 1,000 of them are located directly in and around the city centre, as defined by the area around the new city centre and the old town with the

streets Bahnhofstraße, Fronackerstraße, Alter Postplatz and Am Stadtgraben/Weingärtner Vorstadt (Figure 6).

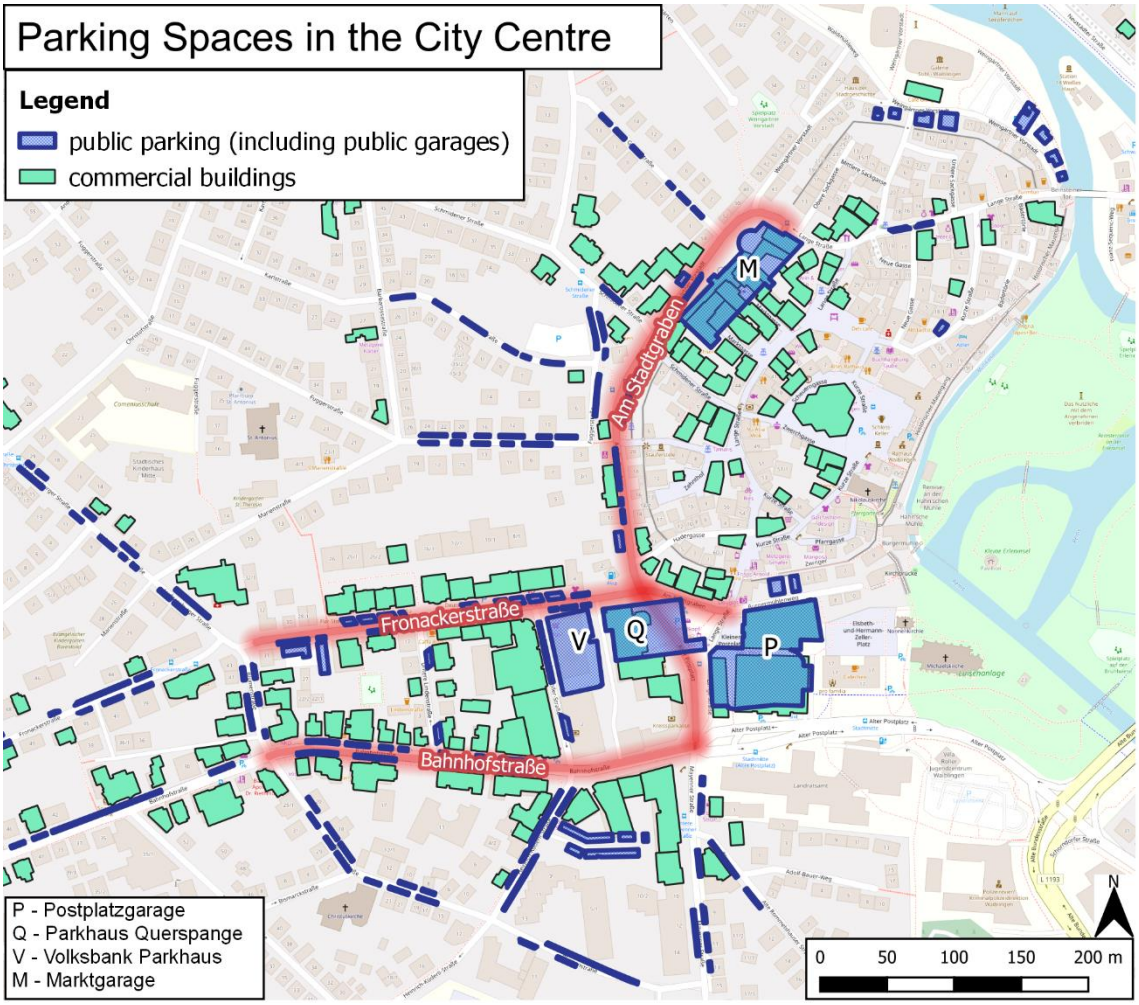

Figure 6: Parking spaces in the city centre (own illustration; data: City of Waiblingen (2019), OpenStreetMap (2019))

At the intersection of Fronackerstrasse and Alter Postplatz, there are three large public parking garages with a total of over 400 parking spaces (Postplatzgarage, Parkhaus Querspange and Volksbank Parkhaus). Furthermore, a high number of on-street parking is found in Fronackerstraße and its backroads. An additional public garage with nearly 300 parking spots is found north-west of the old town (Marktgarage). It serves as parking space for the whole historical centre. The street Am Stadtgraben is the feeder road for this garage, since the road ends right after the entrance of the garage. At Bahnhofstraße, there is also on-street parking on both sides of the road.

The parking garages in the city centre have different levels of traffic frequency. According to data provided by the parking company of the City of Waiblingen, the highest traffic is documented at Marktgarage with around 425,000 cars entered in 2018, followed by Postplatz with around 370,000 cars. Another strongly frequented parking lot is the Wiedmayer Parking, which is next to the civic centre and has a capacity of around 45 parking spaces. Despite the limited capacity, there were 160,000 entries registered in 2018. However, the highest amount of parking traffic in relation to the capacity is found in the garages directly in the city centre. As shown in Table 1, the daily frequency of the Querspange garage is the highest with approx. 6.5 car entries per parking lot per day. The other inner-city garages are similarly frequented. The only exception is the newly opened Volksbank car park, where a parking space is only occupied around once a day.

Location		Marktgarage	Postplatz	Querspange	Volksbank[1]	Bürgerzentrum
Entries	per year	424.584	370.606	104.564	32.121	35.884
	per day	1163	1015	286	131	98
Capacity		292	315	44	130	116
Frequency (per parking space and day)		4.0	3.2	6.5	1.0	0.8

Table 1: Parking capacity and frequency of public garages in the city centre (data: City of Waiblingen (2019))

Considering the fact that the ratio of entered vehicles to available parking spaces in the inner-city car parks is significantly higher than in the parking spaces further outside the city centre, it can be said that in general the cars in city centre have a shorter standing time. This relatively short residence time is also reflected in the findings of the specialist literature. According to Falk and Falk (2006), the average time a car is parked in the city centre of cities with fewer than 100,000 inhabitants is one to two hours. So, in general, it can be interpret-

[1] The Volksbank Garage was opened in May 2018. Therefore, data is only available for May-December 2018. The daily entries have been calculated with 245 days for this period; the rest of the yearly entries were divided by 365 to get the daily entries.

ed that people tend to spend only a few hours for running their errands in the city centre of Waiblingen.

Additionally, the residence time is related to the pricing of parking (Falk and Falk, 2006). Since 2010, there are two tariff zones for public parking in Waiblingen:

- **Zone I**
  Whole city centre from the old town to the train station
  first ½ hour free, 1€ for every additional hour
- **Zone II**
  All areas surrounding the city-centre e.g. civic centre
  first hour free, 1€ for every additional hour

The regulation that the first half hour of parking is free was introduced to enable quick errands by car, e.g. a bakery visit. The only public garage that has different pricing regulations is the Volksbank Garage. Each hour started costs € 1.50, which is 50% more than the price of other parking spaces, such as the on-street parking in Fronackerstraße. Instead of half an hour of free parking, customers of the local supermarket have one free hour of parking. A corresponding voucher will be issued at the supermarket checkout. Other users of the parking garage have to pay the full price for one hour. Since the city's parking company has only leased the garage, it has no direct influence on the pricing. In the past, this fact has already irritated politicians and users (Pöschko-Kopp, 2018).The hesitant use of the parking garage, is also reflected in the occupancy rate, which is significantly lower than in the other parking garages in the city centre, even though the Volksbank parking garage is in a prime location on Fronackerstraße.

In summary it can be said, that the high capacity of the garages and the high occupancy frequency lead to an increased car traffic in the city centre. In particular, the high number of entrances to the Marktgarage and Querspange increase the traffic volume at the trouble spot Fronackerstrasse / Am Stadtgraben / Alterpostplatz. In addition, the differences in the occupancy ratio of the car parks in the city centre and the ones further outside the area show that people prefer to park directly at the shopping destination. Furthermore, the low number

of cars entering the Volksbank garage also shows that pricing can influence parking decisions.

5.3 Observation

The first observation of the inner city of Waiblingen was conducted on Thursday, 05.12.19 from 12:00 to 14:00. The temperature on this day was about 0° C and the weather was sunny without clouds. As usual during this time of the year, there was a Christmas market in the historical centre of the city. These framework conditions are important, since they help to interpret the observations and to put them into relations.

Observation Fronackerstraße

During 12:00 and 13:00, which is usually the lunch hour, there were lots of cars on the street. There was a lot of traffic found at the street corner Fronackerstraße/Albert-Roller-Straße. The congestion was mainly due to delivery vans short-term parked on the road and pavement. The resulting backlog blocked the street and big parts of the sidewalk (Figure 7). It was difficult and dangerous to get on as a pedestrian. The situation was tense, cars honked and crowded past each other.

Figure 7: Congestion Fronacker-/Albert-Roller-Straße

Although there are several stores, e.g. pharmacy, supermarket and bakery, there is no dedicated parking space for delivery vehicles to unload their goods. The on-street parking lots were occupied by regular cars. It has been observed that most of these parked cars occupied the parking lots longer than one hour. Due to that the delivery vans had to park on the road with the emergency light on.

In the eastern part of Fronackerstraße, the traffic and parking situation was slightly more relaxed. A lot of on-street parking on both sides of the roads can be found in this area. Especially on the southern side of the road, some of the cars parked alongside the road blocking the sidewalk. There were big cars on legal parking spots using too much space and illegal parked cars hindering the pedestrians on the pavement (Figure 8).

Figure 8: On-street parking alongside the road in Fronackerstraße

Like in the eastern part of Fronackerstraße, also in this area the crosswise parking lots on the northern side of the road were fully occupied mostly for more than one hour. In addition to the on-street parking lots, the public parking space

on the south side of the road just before the intersection with Blumenstraße was also fully occupied with cars. Due to the lack of available parking spaces, the flat sidewalk on the other side of the street was used by both delivery vehicles and normal cars for illegal short-term parking.

Short-term parked vehicles were also observed in the middle section of Fronackerstraße in front of the “Deutsche Bank”. There, cars were parked outside the marked parking areas on the sidewalk or even on the street with emergency light. It was observed, that this parking behaviour was related to short-term visits to the nearby bank and pharmacy.

Addtional observations regarding the Fronackerstraße are:

- presence of 2 private garages open for customers and residents; one in the middle section of Fronackerstraße and a second in Albert-Roller-Straße
- presence of 2 parking lots for disabled persons in Fronackerstraße
- presence of a bus stop currently out of service
- park guide display indicating the garages: “Rollereck”, “Volksbank” and “Querspange”

In summary, it can be said that the Fronackerstraße, especially in the eastern section, has the characteristics of a highly frequented shopping and commercial street. During rush hours, car traffic dominates the street scene. The on-street parking lots are mostly fully occupied and illegal parking behaviour occurs. In addition, illegal short-term and delivery parking hinder the traffic flow and arise congestion. Both pedestrians and cyclists suffer from these conditions, because they do not have enough space on the road and pavements. After the observation, there was the impression that the quality of stay suffers from parking and parking traffic and that too many cars are looking for the way straight to the city centre parking directly in front of the shops.

Observation Am Stadtgraben/Alter Postplatz

In contrast to Fronackerstraße, there are hardly any shops or businesses along the streets Am Stadtgraben and Alter Postplatz. Rather, the two streets act as a traffic link between Bahnhofstrasse, Fronackerstraße and the old town. There-

by, the streets Am Stadtgraben and in the further course Weingärtner Vorstadt in direction north end in a dead-end, where the big public garage “Marktgarage” is located. This garage is directly connected with the old town and “Marktpassage”, an arcade with shops and cafes.

It was observed that a lot of the cars that entered Am Stadtgraben/Weingärtner Vorstadt via Alter Postplatz and Fronackerstraße headed towards the “Marktgarage” and vice versa. There was a small backlog in front of the Marktgarage but in general the traffic situation was not as chaotic as in Fronackerstraße. Walking on the sidewalk was easily possible without any hinderance through on-street parked cars and it gave the impression that the park cruise traffic is completely intercepted by the “Marktgarage”. It needs to be mentioned that the parking traffic was probably higher than average due to the presence of the Christmas market in the old town and the weather conditions.

During the observation there were not many pedestrians found on the sidewalk, except on the intersection Fronackerstraße/Am Stadtgraben/Alter Postplatz. In this area, however, zebra-crossing was used quite often due to the high traffic volume (Figure 9). The entering and exiting cars also created an enormous backlog of traffic from the intersection with Bahnhofstrasse (Figure 9).

Figure 9: Traffic situation Alter Postplatz

Observation Bahnhofstraße

The Bahnhofstraße has a completely different character than the previously observed streets. It is a main traffic road that leads from the train station through the city down to Alter Postplatz. In the section of the lower Bahnhofstraße between just before Blumenstraße and Alter Postplatz there are some restaurants, a bakery, supermarket, and other shops (Figure 10).

On-street parking is allowed mostly on both sides alongside the road at dedicated parking spots. During the observation, most of the parking spots were occupied. The relatively wide side space of the road seemed cramped by the parked cars.

Other observations from the Bahnhofstraße are:

- presence of a display of the park guidance system at untere Lindenstraße
- widening to a four-lane road at the Albert-Roller-Straße
- high traffic volume and many heavy-duty vehicle on the road

Figure 10: Street scene lower Bahnhofstraße

5.4 Stakeholder Opinions

This chapter provides an overview of the results of the focus group. In order to present the knowledge gained transparently, the procedure, the selection of the participants and the origin of the conversation are first explained. Afterwards the most important statements of the participants of the stakeholder groups are summarized. Lastly, the reflections and limitations of the focus group are presented.

Process and Preparation

The focus group discussion took place in the ALi citizen office on 21st January 2020 from 7.30 pm to 8.45 pm. The questions to be discussed during the focus group were decided and discussed amongst the group members beforehand. Thereby, as the result of the discussion it was decided to divide the questions for each stakeholder group. The stakeholder groups were selected regarding their interest and involvement in the parking situation in Fronackerstraße. Therefore, the three stakeholder groups that were finalized by the group members are:

1. The shop owners

2. The Shoppers

3. The Residents

As a first step, a detailed description of the stakeholder groups was sent to the contact person of ALi via mail. ALi was involved during the selection process of the stakeholders mainly because of the reason that as an organisation based in Waiblingen they had a better understanding of the people that would add value to our discussion and knew them personally so as to convince them to participate in the discussion. In turn, ALi as a green party organisation working for the cause of making waiblingen a "car free city" they also had vested interest in our research topic and to actively help the group during the whole process. As a result, ALi very eagerly helped in selecting a couple of different participants for each stakeholder group along with their contact details. Afterwards, e-mail invi-

tations were sent to each participant containing the date and the time for the discussion. There were a total of 10 participants in the discussion. 4 under the resident's group, four under shopper's group and 2 under the shop owners' group.

At ALi office the moderators for the discussion had reached 30 minutes prior to setting up the discussion table. The placards along with the initials of the participants were placed so that the moderator of the discussion could address the participant easily during the discussion. Next, the audio and video device were set up to record the discussion for the group's understanding while analysing the discussion. Lastly, few refreshments were organized for the participants to make them comfortable during the discussion.

The purpose of the focus group discussion was explained to the participants in detail and it was clarified that their names would not appear in the report as well as that the information given by them would strictly be used for the report purposes. The ground rule for the discussion was also discussed wherein everybody was allowed to share their views on a given topic by raising their hands. In the end the permission to audio and video record the discussion was also asked by the moderators. Since the participants were not comfortable with the video recording therefore only the audio was recorded of the entire discussion.

Figure 11: Focus group discussion table

Summary

The following statements reflect the opinions of the stakeholders and should not be generalized. However, this reflect the opinions of relevant stakeholder that have a legitimate interest in the parking situation in Fronackerstraße. A lot of the points mentioned, have been verified by the observation of the problem area. Furthermore, the statements contain a lot of useful first-hand information of people who are permanently affected by the parking situation in Fronackerstraße.

Shoppers/leisure guests and Residents

As an opening question to the discussion a very broad yet very pertinent question "***How do feel about the current parking and traffic situation at Fronackerstraße***?" was asked. In general participants across all the stakeholders group had a similar view on the situation. All of them felt that the lack of good parking control led to chaotic traffic situation in the Fronackerstraße. The main reason attributing to this situation was considered to be the park cruise traffic. The participants also felt that the cars occupying the street caused hindrance to the pedestrians and cyclists. They also pointed out that in general, the driven speed in Fronackerstraße is very fast and that in their opinion this could lead to some dangerous accidents. The majority of the members of the different stakeholder groups mentioned that the designated parking spaces on the streets and the private garages are mostly occupied by the café and bars customers than by general customers, which might be a possible reason for long park cruise traffic and unavailability of the parking spaces. Furthermore, it was mentioned that the general shortage of parking spots would result in illegal parking along the street both for short- and long-term parking. Also Illegal parking on the disabled parking space is considered a problem too.

When asked the shoppers/leisure stakeholder group about their experience on the street and what opinion do they have on the current situation of the parking in Fronackerstraße, in terms of parking space, traffic situation, and the accessibility to the available parking spots on the street, they had following opinions to share:

One of the participants said that the street would be the liveliest and vibrant street in Waiblingen but at the same time the most chaotic one. Chaotic because there is park cruise traffic that always spills over to the nearby streets and hinders pedestrians and cyclists. In addition to delivery vans, bar & café clientele, residents and customers, hotel guests would also increase traffic on the street when looking for parking spaces.

One of the participant who is also an active cyclist said: "I own a car but I also want a radical reduction of traffic or traffic reduction zone on Fronackerstraße", reason being that if people do not have many choices to park then this would discourage the car owners to get their cars to Fronackerstraße.

When asked about the current parking pricing on the street wherein the first half an hour is free, they all were happy with the current pricing system. However, few participants from the group did mention that they would have no problem with paying for the first half an hour.

Another point that came up during discussion was about the re introducing the subsidized public transport ticket (like a cheaper day ticket) to the inner city. The re-introduction of cheap day tickets would motivate the shoppers and residents to use public transport more often than current scenario as the residents complained about the bus tickets being expensive for one side journey within the city.

Shop owners

The shop owner's perspective also played an important role in the discussion and therefore their insights into the current parking system plays an important role in the analysis too. Regarding how easy it is to find a parking spot directly in front of the store, they said that the current situation is not very favourable, because most of the on-street parking is blocked either by residents or long-term parked cars. It was also revealed that a significant amount of on-street parking is occupied by parking ticket tricksters. These tricksters are likely to be the guests of the restaurants and cafes that use on-street parking for long term stays. The parking ticket trick is that the bar/cafe guests get the half an hour free ticket before they go to the café and then they come back after half an hour

and get a new one and repeat this to not buy an actual ticket. In this way they block the parking for a long time without paying. Another interesting insight provided by the shop owners, was that some of the residents of Fronackerstraße were parking their cars on the public on-street parking spots even for longer durations. The shopkeepers criticized that this parking arrangement would take up valuable parking space and make it difficult for customers to park their cars during their shopping trips.

Another very important insight provided by one of the participants was regarding the private parking garages in Fronackerstraße. The participant revealed that the parking spots in the garage which were meant to provide parking space for the customers of the shops on a renting basis are now often blocked by private residents leading to lack of designated parking spots for the shops.

When asked about what according to them are factors that lead to the spill over traffic on the nearby streets, they all pointed out that along with the illegal parking on the street the short-time parking delivery vans that come for the delivery of the goods. It was pointed out by the shop owners that there is a lack of proper space for the delivery vans to park and as a consequence of this, they very conveniently park their vans right in front of the respective shops causing large traffic jams on the street.

The shop owners were also asked if they would be comfortable reducing the number of current available designated public parking spaces and they all were against this idea as it would adversely affect their businesses. It was also mentioned that a car-free Saturday is not a viable initiative, since on weekends the traffic in Fronackerstraße is anyway much lower, due to the absence of delivery vehicles, the influx of customers into the large shopping centres and the fact that nobody works in the banks and offices. They think that any change towards a car-free zone would unsettle and drive customers away. Furthermore, they highlight the car as an important part of everyday life for many of their customers and especially for the shopping of larger things it cannot be replaced by public transport.

In summary, the shop owners on the one hand rely on the car traffic but on the other hand suffer from too much park cruise traffic and the lack of adequate parking. They understand that there is a need for change but do not favour any option that is connected with reclining the capacity of parking spots.

Suggestions

The final question of the discussion was related to all stakeholders and their proposals to improve parking problems previously mentioned by all stakeholders in the sections above. Since Park & Ride was one of the initial concepts brainstormed by the group while working on the possible solutions for the problem thereby, one of the concluding questions asked to the shoppers and shop owners stakeholder group was " ***What do you think of a P+R approach with permanent shuttle service***?", to which the participants of both the stakeholder group weren't positive about it. The major concern about the concept of the P+R concept was that it solves only the problem of incoming shopping guests from outside Waiblingen rather than solving the traffic problem caused by the car owning residents of the city. They also pointed out that this approach is not suitable for heavy shopping especially for old and pregnant shoppers. Thus, they felt that this solution was just a partial solution to the parking problem in the city.

The other question asked was "***What are important points to consider in the further planning of parking in the city***?" The shop owners suggested that user-friendly underground car parks with uniform tariffs (negative example Volksbank), create parking bays for additional parking. The shoppers suggested introducing a reward program for customers that use public transport e.g. a reward point arrangement between the city public transport and a private grocery store wherein the shoppers get reward points, for showing a valid bus ticket of the day. Such a program can motivate customers to come for shopping without their cars. Another suggestion by one of the participants was to reopen the bus stop “Untere Lindenstraeß” for line 208/218. So that customers and residents can easily use the public transport to move around the city, which in turn would also reduce the number of short-term trips by car.

One of the shop owners also suggested on regulating the parking hours for the residents and change it to 18.00 hours to 09.00 hours as prevalent in many other German towns and cities as this rule will free up parking space in front of the shops on Fronackerstraße and make it available for the customers.

The residents who are active cyclists also suggested promoting concepts of bike sharing for the inner city, however few shop owners had objection to it as most of their clientele were old people and therefore taking up parking space for bike sharing initiative would lead to their business profit going down. However, all the groups believed in following an integrated approach to solve the problem and that all the three groups should be given equal importance while formulating plans to improve the existing parking problem in Waiblingen.

Limitations and Reflections

There were few limitations faced while selecting the participants and conducting the discussion and there are few reflections which were discussed after conducting the discussion. They are as follows:

Limitations

1. The selection of participants through a mediator from ALi may have led to little biased group of participants. Furthermore, the group consisted of participants varying between the age of 40 and above and therefore the perspective from the younger age group (18-30 years) could not be taken into account. Since, their perception would have given a different dimension to the discussion
2. Many of the participants did not own a car. Therefore, the perspective of the car owners can be a bit understated in the overall analysis of the discussion.
3. It was difficult to keep control and lead the group to more concrete questions as they got emotional during the discussion.

Reflections

1. The general opening question triggered a broad discussion and participants took the chance to talk about their general perception about parking in Waiblingen in an unstructured way. In order to lead the conversation to the next concrete questions, the moderator needed to interrupt the speech of the participants.
2. Another reflection was during the solution finding process, stakeholders seemed a bit flustered while providing possible solutions due to the existing conditions and status quo of the parking situation in Fronackerstraße
3. Taking into account the reactions to an incoming Park & Ride solution and the general suggestions, the research group was able to adapt to the concept and convert it into a concept that is more geared towards the needs of the stakeholders. Therefore, although the first reactions were mostly hesitating, it is further elaborated on the concept in the recommendation part.

6 Recommendations for Action

The results of the methodical analysis of this research show that there is a clear need for action in relation to the parking situation in the city centre. The tense traffic situation, especially in Fronackerstraße, is strongly influenced by cruise traffic and illegal parking. In this context, a holistic approach to parking management with a number of different measures is required to relieve the traffic situation and to distribute the scarce traffic space fairly among all user groups.

In the following, a set of measures for rearranging the parking area around the Fronackerstraße is presented. The focus is on innovative solutions that are based on best practice examples from other cities and the literature review. In addition, there are supportive measures that can complement to these solutions. Altogether, these measures are facing the problems and insights gained through the focus group, observation, spatial and quantitative analysis. Their implementation should be considered holistically.

6.1 Rearrangement of Parking in Fronackerstraße

This chapter describes the recommended rearrangement of parking in Fronackerstraße. It is meant to be the core adaption and refers to the findings derived from the mixed method approach.

P&R/ P&W Approach

On-street parking, both legal and illegal, clearly have a major impact on the current traffic situation in Fronackerstraße and its surroundings. Hence, reassembling of the on-street parking can significantly improve the current traffic situation of the problem area. In this regard, P&W/P&R can be considered as one solution to steer out a considerable number of cars from the on-street parking of Fronackerstraße. Thereby, it should be possible to even increase the capacity of available parking while reducing and distributing the on-street parking in a fair way.

As illustrated in Chapter 4, there are clusters of big garages in and around the problem area. Adapting the existing parking lots and garages at the three entry

points into P&R can be a convenient option. The garages located at the intersection of Am Stadtgraben, Alter Postpl. And Fronackerstraße i.e. Querspange and Volksbank, have a total capacity of parking 174 car parking. The cars coming from the direction Schorndorfer Straße and Alte Bundesstraße can conveniently use these two garages to park their car and transfer to public bus or walk. Marktgarages can be accommodate cars coming from northern part of the city, while the surface parking lot, located in the intersection of Fronackerstraße and Blumanstraße-Ludwigsburger straße, can cater parking to the cars from the central station. Postplatz, which has the highest capacity right now, on the other hand, located a bit far from the problem area (entry and exit from Alter Postpl.). This factor may negate the possibility of using this particular garage as P&R.

The reasons behind choosing these particular spots for P&R adaptation are proximity to the existing bus stops i.e. Marktgasse, Querspange and Fronackerstraße, has good accessibility, and optimum capacity. There is already a city bus route running along the street of Lange Straße, Am Stadtgraben and Fronackerstraße which can easily be connected with proposed P&R (Fig. 12).

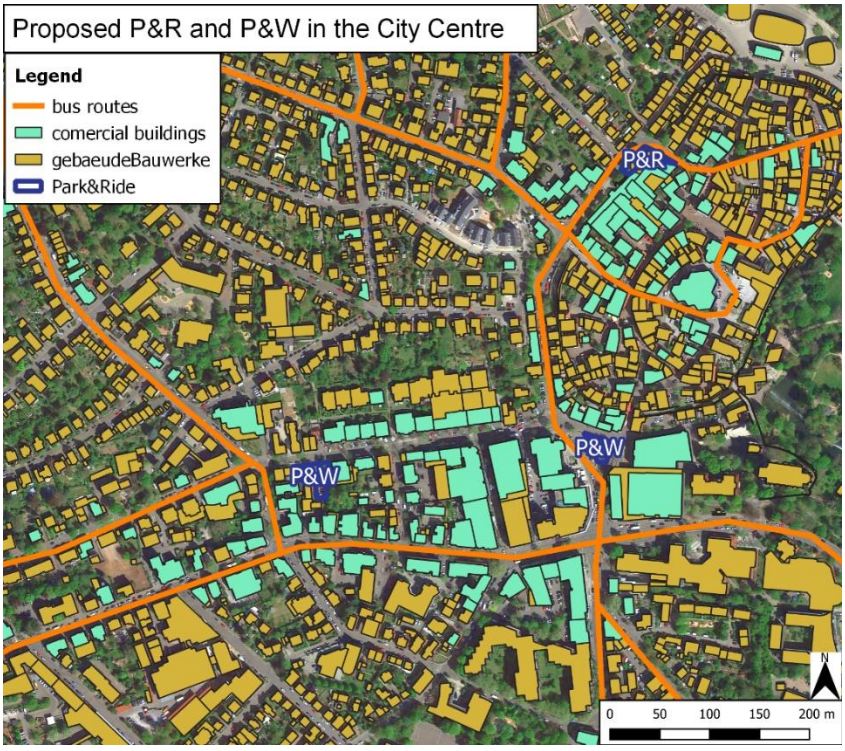

Figure 12: Proposed P&R and P&W (own illustration; data: City of Waiblingen (2019), Google Maps (2019), OpenStreetMap (2019))

These P&Rs can also be tagged as P&W, as some people may also prefer to leave their cars and walk together, especially the customer of cafe and bars. Some public space around the P&R can be created for gathering where people can meet and walk together to their destination. Especially the proposed parking spot in the Fronackerstraße, has a potential to attract customers due to its proximity to the commercial area of Fronackerstraße.

In addition, car stackers can be installed at the surface parking in the Fronackerstraße. There are a number of companies which offers such installations where car stacks of two to three can be easily installed in outdoor parking. For example, German company WÖHR Autoparksysteme GmbH offers a product named Parklift 421, which is a single unit for three cars above each other (Figure 13). This stack can be installed outside, either side by side or in rows behind one another (WÖHR Autoparksysteme GmbH, n.d.). If this type of parking stack can be installed in this particular parking lot, the capacity will increase up to 90 while currently available parking space is only 30 (OpenStreetMap, 2019)

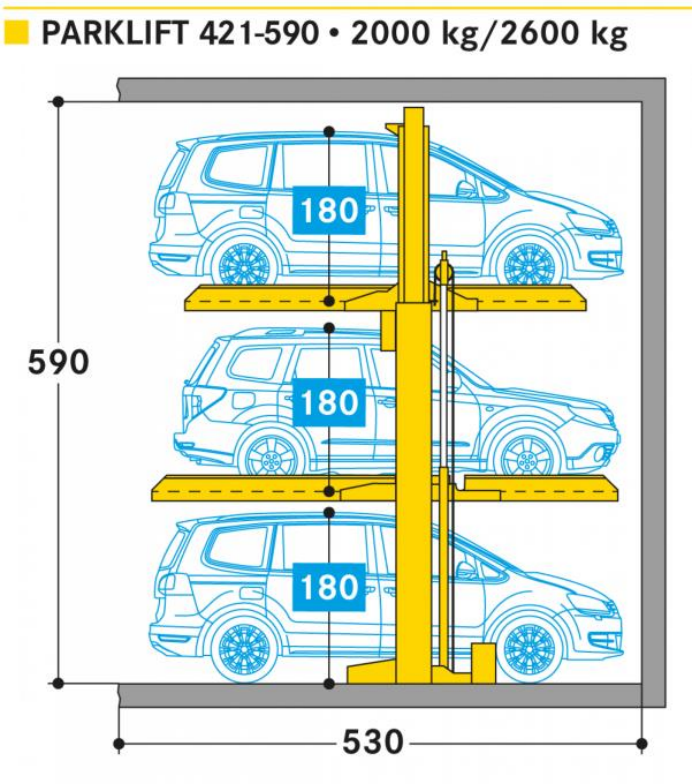

Figure 13: Car stack example (WÖHR Autoparksysteme GmbH, n.d.)

Parking can also be regulated through time limit (for example 30 minutes, 90 minutes, two hours) to increase parking frequency, so that the same number of parking spaces can be used by more cars (Kit Un, 2010a). Present data shows that the frequency of car parking within the problem area is the highest in Querspange (6.5), while the frequency is the lowest in Volksbank (1). The low frequency could be a sign of high pricing and long-term parking. On the other hand, the higher frequency of parking at Querspange and Marktgarages reveals the character of short-term parking. Therefore, the time-limit option can be introduced only for Volksbank and the parking lot with car stackers in order to ensure optimal use.

While asking for the opinion of P&R approach in the focus group discussion, the difficulty of carrying the weekly/ monthly grocery shopping was mentioned several times. One solution to this particular problem might be solved by installing shopping carts' stands in these P&Rs so that customers can carry their grocery to their cars. In that case, the pathway from the shops to P&Rs needs to be safe and pedestrian friendly.

On-street parking

Dealing with the on-street parking in Waiblingen is a difficult taks, as most of the stakeholders favour the idea of parking their cars right in front of the shops. P&R approach singularly cannot reduce the number of on-street parking and banning with regulation might be complicated. Rather, the individual measures have to be combined in order to defuse parking on the street and to create an adequate alternative offer.

Imposing time-limit on parking can be one of the measures to reduce the longer stay of cars on the street. In the case of Wablingen, time limits can be prioritized according to the user groups and also the time of the day. Time limits of parking will be different for shoppers and the residents, while the overall duration can vary at peak and off-peak hour. For example, residents of Fronackerstraße can only be allowed to park their car on the curbs for longer period during the night. Furthermore, on-street parking can be banned for one day in week and during

the peak hour of the day. However, this method requires stronger enforcement to work efficiently (Kit Un, 2010a).

Another measure can be installing features like planter box, street furniture, drinking fountain etc temporarily to reclaim the space gradually. Parklet is a good example of such re-creation of streets. When one or two on-street parking spaces are converted into a small platform providing more space to people on the street, it is called parklet. Parklets offer the residents and visitors to take a break, sit, and enjoy the surroundings. They can increase the vibrancy of the street and thus improving the environment of a street (philadelphiastreets.com, 2016). Some of the on-street parking of the problem area of Waiblingen can be converted into seasonal parklets, for example during the Christmas market and also in the summer. In that way, people may realize the benefit of removing on-street parking.

Figure 14: Parklets

During the observation, the absence of loading/ unloading spots along the Fronackerstrasse was identified as another key contributor to the traffic hindrance. To solve the problem regarding the delivery van (mentioned in the observation chapter), some of the on-street parking spaces are recommended to

use as loading/ unloading dock. Of course, the standard distance between these docks needs to be determined cautiously.

Direct access and short distances to the destinations in the inner city are crucial also for the visitors. This fact was confirmed both by the participants in the focus group, as well as by the spatial analysis and the occupancy figures of the inner-city garages. In addition to the heavily frequented parking garages, especially in Fronackerstraße it was observed that the parking spaces in front of the shops are usual occupied. People tend to park their cars right next to their destination and avoid long walking distances. In terms of short-term visits such as banking, this targeted parking even resulted in illegal parking on the sidewalk.

According to the survey Mobilität in Deutschland (2018), the average walking distances in urban areas are well below one kilometre and depend very much on the age structure of road users. In the specific case of Fronackerstraße, the shop owners mentioned that for their clientele even the parking garage Volksbank is considered to be too far away for walking.

To meet these user requirements, a number of parking spots should be maintained and reserved for specific user groups. One such group are people with special needs i.e. elder people and people with disabilities. According to the study of planning portal of UK, the disable parking should be provided within the distance of 50 metres of a pint of entry of the development and also the pathway in-between has to be smooth, safe and secured (Planning Portal, n.d.). There should be at least 4% of disable parking if the total number of parking exceeds 50 in a development or neighbourhood (Planning Portal, n.d.). Therefore, the number of the disabled parking can be increased and distributed according to the thumb rules. Another group includes short-term parkers. Therefore, the redesign should provide parking spaces for short-term parking scenarios for example to enable banking transactions or short errands. A prerequisite for this is an appropriate parking control management by the regulatory office in order to curb illegal parking. If the parking spaces are arranged and checked accordingly, the occupancy rate can be increased and thus the probability of getting a free parking space directly in front of a shop can even be increased.

6.2 Supportive Measures

As mentioned before, the measures presented in this chapter should complement to the general rearrangement of the parking areas in the commercial centre of Waiblingen.

Re-activation of the closed bus stop at Fronackerstraße

Transferring the demand for short distances between the parking lot and the shopping destination to the network coverage of public transport, bus stops should cover the inner-city of Waiblingen area as closely as possible. Due to the central location of the abandoned bus station “Untere Lindenstraße” in Fronackerstraße, its catchment area would perfectly serve the whole Fronackerstraße. The walking distance to shops, pharmacies, banks and surgeries would be way less than from the surrounding bus stops e.g. Bahnhofstraße. The reopening of the bus stop "Untere Lindenstraße" could therefore have a positive impact on the use of public transport for errands and shopping.

In order to make this measure as effective as possible, it should only be implemented in conjunction with the other proposed recommendations for action and parking solution like the reorganization of the parking space in Fronackerstraße. Only if the negative effects of parking search traffic, e.g. second row parking can be contained by a corresponding redistribution of the parking space; the buses can drive without time loss. In addition, the measures should be accompanied by an increased presence of parking control authorities.

Another supportive opportunity for reopening of the bus stop, is the electric city bus concept introduced in the beginning of 2020. The adaption includes, a fully electric midi-bus operated on the city bus lines 208 and 218, an increased frequency and an extension of the operating hours (Kölbl, 2019b). The smaller dimensions of the electric buses make it suitable for the use in Fronackerstraße. Especially during off-peak times e.g. in the late morning and at the weekend, the smaller buses could complement the line offer and make an additional stop in Fronackerstraße. This could ensure a comfortable connection and development of public transport in Fronackerstraße as required, especially for older people.

Incentives for the use of public transport

The analysis of the focus group showed that the participants hardly consider using the bus as it is not sufficiently supported by the city. It was mentioned that the price model in particular does not make it easier to use buses. Apparently, there was still the possibility for Waiblingen citizens to buy flexible tickets at favourable conditions in the citizens' office. However, this option now is not available anymore. In terms of this, the perception of the research group is that using public transport for running errands in the city in not getting enough incentives in comparison to car parking.

In fact, there is a discrepancy between the pricing of parking and public transport. According to a national comparison of public transport prices with the parking prices in more than 50 cities of civity on behalf of Zeit (2017), public transport prices rose by approx. 13-18% over a period of 10 years, while parking prices have fallen by 1.5% due to inflation. The same corresponds to the situation in Waiblingen, where the parking prices have not been adapted since 2010 whereas the VVS ticket prices have been increased several times (Stuttgarter Nachrichten, 2014, 2019).

In terms of promoting public transport, it is recommended that the city provides incentives for their citizens to use public transport and in general reduce the prices in coordination with the transport association. The funding could include, for example, the introduction of a discounted ticket, which is issued by the bus driver when the passenger shows a current receipt from the city centre. Another option for the city would be to issue flexible strip tickets (for 5, 10, 20 rides) for discounted prices. In course of this, an introduction of a reduced fair for special user groups, such as people without a car, seniors or pupils can help to promote a modal shift.

Park guide system

As shown by the spatial analysis, Waiblingen has a dynamic parking guidance system showing the spare capacity of public garages to direct incoming cruise traffic. However, some of the signals of the system are installed right next to the city centre. Especially for cruise traffic coming from the south, the first signs can

only be seen late after entering the town centre. Due to that, possible bottlenecks in the parking garages cannot be bypassed in time. The cars will then cause congestion while searching for a spot directly in the city centre.

In order to avoid cruise traffic to even enter the city centre when there are no more free parking spots available, the implementation of new signals near the city's southern entrances is recommended. According to the official recommendations for parking systems of the Forschungsgesellschaft für Straßen- und Verkehrswesen (2005) large information boards should be used at the city entrances to draw attention to the entire public parking offer. For example, a simplified representation of the parking areas in the city area for the respective direction of travel could be used to make the system understandable straight away, especially for foreigners. In addition, a dynamic display of the occupancy status for the specific parking areas could be installed to draw attention to crowded parking areas. In connection with the existing guidance system, cruise traffic could be kept efficiently out of the city centre when it comes to an overcrowding. As a result, fewer vehicles would search for parking spaces in the side areas e.g. Fronackerstraße or Albert-Roller-Straße.

Shared Parking

Shared parking can be very effective to optimize the already available parking spaces, particularly in a mixed-use area such as Waiblingen city centre. Participants in the focus group discussion also supported the idea of sharing their parking spaces rather than leaving it empty.

It is evident from the spatial analyses, that there is mixture of urban function within the problem area. Though commercial use is prominent along Fronackerstraße, residential use is also present around Am Stadtgraben and within close proximity of Fronackerstraße. A good number of these residences own private garages. Moreover, the commercial uses also have functional varieties such as hotels, super shops, banks, bars, and cafés. The concept of shared parking can be effective in mixed-use area particularly in the city centre (Kit Un, 2010b). Table 2 shows the typical peak parking hour by land use. Usually, the peak

parking times of different land use are more or less similar in a typical urban area.

Weekday	Evening	Weekend
Banks and public services	Auditoriums	Religious institutions
Offices and other employment centres	Bars and dance halls	Parks
Park & Ride facilities	Meeting halls	Shops and malls
Schools, daycares centres and colleges	Restaurants & Bars	
Factories and distribution centres	Theatres	
Medical clinics	Hotels	
Professional services		

Table 2: Land Uses by time of peak parking and demand (Kit Un, 2010b)

The observation and focus group discussion ensure that Table 2 as well can be applicable for Waiblingen city centre. For example, Participant pointed out that cars parked in the evening are mostly occupied by the customers of bars.

The private parking can be shared among the commercial users by staggering time and also residents of the problem area can rent their garages to the individual shoppers. The parking share is usually managed by an app provider. The app either can be developed locally only for Waiblingen, or the owners who are willing to rent their garages can join the available platform such as Pavemint, mobypark. The shared parking app offers pre-booking of the parking space as well as guided route to the spot. As a result, this very approach will also reduce the cruise traffic related to parking search.

7 Conclusions

The fact that parking has a major impact on the traffic and space use situation in Waiblingen, is reflected in the distribution of the city's public and private parking areas. Especially in the inner city around the Fronackerstraße, Bahnhofstraße and Am Stadtgraben, the commercial centre of the city, the concentration of public parking is the highest. Private parking is usually found in the residential areas, but there are also some garages in the city centre. However, on a first glance it seems that there is a lot of parking space provided, the cruise traffic especially in Fronackerstraße is leading to a chaotic situation. On the one hand the availability of on-street parking drives people to search for a parking spot directly in front of the shops and on the other hand the big garages with up to 400 parking lots, found at Alter Postplatz, contribute to increased traffic in the inner city. Negative impacts like congestion and blocked pavements are the result of an insufficient parking management.

Based on the evidence collected through observation, spatial analyses and the quantitative analyses, a set of recommendations are proposed that are particularly appropriate for the selected problem area. The key intention of formulating the above-mentioned recommendations was not impose any idea all of a sudden upon the citizen of Waiblingen, which they are not ready to accept. Rather, the objective was to achieve the goal of reducing the number of cars phase by phase. This attempt will give the citizens an opportunity to get familiar with the idea and be prepared for a parking reduced Fronackerstraße.

Both the core solution of reassembling the parking in the problem area and the supportive measures are based on adaptation of the existing infrastructure, supported by regulations and measures which have already proved to be effective for parking management in an urban area. Possible impacts of the proposed measures can be:

- Reduction in traffic congestion

  Both the observation and focus group discussion illustrate that the on-street parking of Fronackerstraße contribute to the traffic congestion of the nearby area. If the proposed solutions, particularly the P&R/P&W, park guide sys-

tem and shared parking, can be implemented, traffic volume in Fronackerstraße and nearby street is expected to reduce significantly. The locations of P&R/P&W were selected in a way that the cars coming to the Fronackerstraße, can be stopped at the entry points of the problem area, consequently reducing the car traffic in the mentioned streets. Measures such as park guiding system and shared parking assist car driver to locate the free parking spots and to some extent reserve in advance, might result into a significant decrease in cruise traffic, not only in Fronackerstraße, but in the entire city of Waiblingen.

- Optimum use of parking spaces

The current data of Fronackerstraße, shows that the frequency of car parking use is not uniform for all the garages and also for the on-street parking. As pointed out in the analyses part, one of the reasons can be the discrepancy in parking price. For example, the on-street parking is free for half an hour, where the price for Volkbank garage starts from 1.5 euro per hour. So, people coming for short trip prefer to park their car on the street. As a result, the parking place remains empty at Volksbank, while the on-street parking remains occupied the whole day. The regulation of time-limit along with the uniform pricing policy is expected to ensure the optimum use of the existing parking capacity and reduce the problem. In addition, installation of car stacker on surface parking lot will increase the capacity making way for reducing the number of on-street parking and distribute them fairly among all special user groups. This can be particularly beneficial for those who rely on parking the car as close as possible to their destination e.g. older people or real short-term parkers. The purpose of another supporting measure i.e. Shared parking is to take in the private garages for commercial use to provide parking to the people coming to Fronackerstraße. Parking guide system will give the information on available free parking space within the city as well. Thus, the proposed measures are expected to maintain the maximum use of the available car parking garages in and around Fronackerstraße.

- Encouraging modal shift

It is clear from the observation and focus group discussion that the primary mode of the travel of Waiblingen is the car. Motivating people to shift from using their car to alternative transport is one of the major objectives of proposed parking management solutions. During the focus group discussion, some participants pointed out their doubt about P&R mentioning that walking with the grocery shopping to the car would be difficult. However, in the suggested scenario of Fronackerstraße, most of the super shops of the problem area are located within walking distance of the proposed P&R/P&W and the existing bus stops are situated right in front of these garages as well. In addition, installation of shopping trolley stands has been suggested to address the problem of carrying heavy shopping bags. Furthermore, the incentive measures as mentioned in the solution chapter can also play a major role in modal shift. This is a common way to make the PT more attractive to the citizens. Many cities have employed transit incentives as a means to make the trade-off for cars' less appealing and proved to be successful (Urban Times, 2017). In Arlington, USA, the PT trips increased by 45,000 per day after the introduction of the incentives (Urban Times, 2017). So, it can be assumed that the measure will also encourage more and more people to use the bus service while travelling in and around the Fronackerstraße. However, the bus service as well has to be reliable and frequent so that people find it more convenient rather taking their cars to the city centre.

- Changing people perceptions

As mentioned before, strong car dependency is one of the major problems of Waiblingen like in any other city in Germany. Participants of Focus group discussion express their concern about the problem associated with car dependency, yet they do not want to compromise the benefit coupled with it. This leads to the impression that if anything regarding the parking situation needs to be changed, it should be done gradually. Hence, the idea of phasing out on-street parking has taken into consideration. For example, the idea

of seasonal parklets might help people to realize what was missing and also they can compare the two situations to understand which one is better. In San Francisco, Rebar, an art and design studio developed the concept of parklet from Park (ing) day, to convert the on-street parking into temporary public space. The idea was so welcomed by the people that now it has become a main feature of streetscape with over 40 parklets occupying the former on-street parking space (Baard, n.d.). Many cities in USA have developed parklet manuals and also this has become an integral part of city policy (Baard, n.d.; philadelphiastreets.com, 2016). Similar reaction can also be expected from the citizen of Waiblingen as well as city authority. Additionally, the time-limits, pricing policy and parking free day might make them ready for the ultimate goal of parking free roads. This will also improve the urban environment of the city centre. In this way, the gradual changes are expected to help them understand the negative impact of car-dependency.

- Economic benefit

The economic benefit to the car users from the innovative parking management solution is reduced expenditure on fuel and maintenance cost of the cars. Since the main objective of the above mentioned parking management is not only to reduce the number of cars on the street but also to motivate the car owners to shift to other alternative modes of transport to commute in the city and therefore the reduced usage of cars will automatically reduce the expenditure the car users on fuel and related costs of the car and thereby, be an economic benefit for the car users. In addition, the shared parking will be a new source of income generation of the private garage owners. Also, the city authority would be able to earn revenue from the pricing of P&R and invest it to develop an efficient bus service for the Fronackerstraße.

8 Limitations and Outlook

One of the main limitations of this study is the actual technical planning and the estimation of the traffic results. In order to plan the recommended solutions properly it needs a solid traffic survey, traffic planning measures and architectural expertise. In order to collect as much parking data as possible, it would make sense to equip the parking machines at the public parking lots with software that records the duration of the parking ticket that has been released. Furthermore, the costs for the proposed restructuring of the parking in Fronackerstraße have to be calculated.

On top of this more professional approach, the concerns of all people involved in the rearrangement process have to be considered. For example, in the study it was not possible to interview other stakeholders from the mixed-use area in Fronackerstraße e.g. bar or restaurant owners and also policy makers. Only if all stakeholders take part in a common planning process, the various usage requirements for the parking spaces can be considered. Therefore, a lot of public relation work will be necessary.

Appendix

Questions for Focus Group Interview

Open Questions	Addressors	Notes
How do feel about the current parking and traffic situation at Fronackerstraße? *What makes you feel like that?* *Describe the situation.*	all	
How do you rate the quality of stay in the Fronackerstraße? *Is it a place where you would spend time or like to walk through?*	all	
Guiding Questions		
Do you own a car?	all	
Do you think there are enough parking facilities in Fronackerstraße? *What is your favourite parking facility on-street parking, parking space or public garages?* *What is your opinion about the accessibility to the parking space in terms of cruise time?* *How easy is it to find a parking space*	shop owners & leisure guests	

directly in front of the shops? *Where do you park your car on a regular basis?*	residents	
How often do you go for shopping and when? On the weekend or during weekdays? *What would you consider as a peak time?*	leisure guests all	
Would you consider public transport for shopping? *Do you think customers would consider public transport for shopping?* *If, not, why? What are hindrances?*	leisure guests shop owners both	
Do you think taking away parking space from Fronackerstraße would have negative impact on the businesses?	all	
What do you think of a P+R approach with permanent shuttle service on Saturday? **In connection with a car traffic free Saturday at Fronackerstraße.**	leisure guests shop owners	

(showing a map and a timetable)		
Are you satisfied with the on street and public garage parking prices? If yes, why and If no then why? *What is your opinion on increasing the parking prices as one of measures to discourage the car drivers from driving cars to the city center?*	leisure guests shop owners	
How do you rate the parking quality for delivery vehicles?	shop owners	
Concluding Questions		
From your point of view: What are important points to consider in the further planning of parking in the city?		
Who do you think should be given most priority while improving/changing the environment of Fronackerstraße? *I.e. car riders, pedestrians, cyclists.* *what are the most important parking users in your opinion?* *older people, short term parking etc.*		

Reference list

Alternative Liste Waiblingen (2019) *Wer wir sind,* 6 March. Available at: https://www.ali-waiblingen.de/ (Accessed: 6 March 2020).

Baard, S. (n.d.) *Seven examples of placemaking in San Francisco and the Bay Area - a visitor's perspective*. Available at: http://www.social-life.co/blog/post/placemaking_san_francisco/ (Accessed: 5 March 2020).

Bryant, M. (n.d.) *Conducting Observational Research*. Available at: https://www.deakin.edu.au/__data/assets/pdf_file/0004/681025/Participant-observation.pdf (Accessed: 6 December 2019).

CDC (2018) *Evaluation Briefs: Data Collection Methods for Program Evaluation: Observation*. Available at: https://www.cdc.gov/healthyyouth/evaluation/pdf/brief16.pdf (Accessed: 6 December 2019).

Clauß, A. (2019) *Verkehrsuntersuchung für Waiblingen: Straßenraum soll gerechter verteilt werden,* 4 December. Available at: https://www.stuttgarter-zeitung.de/inhalt.verkehrsuntersuchung-fuer-waiblingen-strassenraum-soll-gerechter-verteilt-werden.74b7e097-71e1-4e70-9425-755064955d0e.html (Accessed: 4 December 2019).

Cornejo, L. *et al.* (2014) 'An Approach to Comprehensively Evaluate Potential Park and Ride Facilities', *International Journal of Transportation Science and Technology*, 3(1), pp. 1–18 (Accessed: 5 March 2020).

Esri Press Team (2018) *How to Perform Spatial Analysis*. Available at: https://www.esri.com/arcgis-blog/products/product/analytics/how-to-perform-spatial-analysis/ (Accessed: 6 December 2019).

Fakir, A N M Asaduzzaman (2016) *Quantative Data Analysis*. Available at: https://www.researchgate.net/publication/308647394_Quantative_Data_Analysis_in_Social_Science_Research (Accessed: 28 February 2020).

Falk, B. and Falk, M.T. (eds.) (2006) *Handbuch Gewerbe- und Spezialimmobilien*. Köln: Müller. Available at: http://deposit.dnb.de/cgi-bin/dokserv?id=2677949&prov=M&dok_var=1&dok_ext=htm.

Feeney, B.P. (1989) 'A review of the impact of parking policy measures on travel demand', *Transportation Planning and Technology*, 13(4), pp. 229–244. doi: 10.1080/03081068908717403

Forschungsgesellschaft für Straßen- und Verkehrswesen e.V. (FGSV) (2005) *Empfehlungen für Anlagen des ruhenden Verkehrs EAR 05*.

Forschungs-Informations-System (FIS) (2018) *Folgen des hohen Parkdrucks*. Available at: https://www.forschungsinformationssystem.de/servlet/is/43192/ (Accessed: 3 December 2019).

GSMA (2018) *China Mobile Smart Parking: Internet of Things Case Study* (Internet of Things Case Study Series – Smart Cities). Available at: https://www.gsma.com/iot/wp-content/uploads/2018/03/iot_china_mobile_parking_04_18.pdf (Accessed: 9 December 2019).

Gunter, A., Ochieng, B. and Omarien, M. (2019) *DEFINING A FRAMEWORK FOR THE IMPLEMENTATION OF A "SHARED SPACE" PILOT PROJECT ON FRONACKERSTRAßE*.

Hamilton City Council (2013) *Park and Walk*. Available at: https://www.hamilton.govt.nz/our-services/transport/movingaround/Pages/Park-and-Walk.aspx (Accessed: 4 March 2020).

Idris, M.Y.I. *et al.* (2009) 'Car Park System: A Review of Smart Parking System and its Technology', *Information Technology journal*, 8(2). Available at: http://docsdrive.com/pdfs/ansinet/itj/2009/101-113.pdf (Accessed: 9 December 2019).

infas (2018) *Mobilität in Deutschland 2017 - Ergebnisbericht*. Available at: https://www.agfs-nrw.de/fileadmin/user_upload/parkraum_brosch_2015_WEB.pdf (Accessed: 28 February 2020).

Ison, S. (2014) *Parking Management Policy: its potential in improving urban traffic flows*. Available at: https://www.acea.be/uploads/publications/21th_SAG.pdf (Accessed: 13 December 2019).

Kit Un (2010a) *Regulating the Duration of On-Street and Public Parking*. Available at: https://www.mapc.org/resource-library/regulating-the-duration-of-on-street-and-public-parking/ (Accessed: 4 March 2020).

Kit Un (2010b) *Shared Parking*. Available at: https://www.mapc.org/resource-library/shared-parking/ (Accessed: 4 March 2020).

Kölbl, A. (2019a) *Verkehrschaos in Waiblingen: Bus 207 hält nicht mehr in der Fronackerstraße - Waiblingen - Zeitungsverlag Waiblingen,* 4 March. Available at: https://www.zvw.de/inhalt.verkehrschaos-in-waiblingen-bus-haelt-nicht-mehr-in-der-fronackerstrasse.14cd3f2c-03f2-421e-b39d-7c8c624eb1e6.html (Accessed: 4 March 2020).

Kölbl, A. (2019b) *Waiblingen: Elektrischer Citybus kommt, Fahrpläne ändern sich - Waiblingen - Zeitungsverlag Waiblingen,* 4 March. Available at: https://

www.zvw.de/inhalt.waiblingen-elektrischer-citybus-co-das-aendert-sich-beim-busverkehr.d880f131-aaf7-43ff-b6e5-e50ae61ffc85.html (Accessed: 4 March 2020).

Kraftfahrt-Bundesamt (2019) *Fahrzeugzulassungen im Oktober 2019*. Available at: https://www.kba.de/DE/Presse/Pressemitteilungen/2019/Fahrzeugzulassungen/pm24_2019_n_10_19_pm_komplett.html?nn=2141748 (Accessed: 2 December 2019).

Krueger, R.A. (1994) *Focus groups : a practical guide for applied research*. 2nd edn.: Thousand Oaks, CA: Sage Publications.

Krueger, R.A. (2002) *Designing and Conducting Focus Group Interviews*. Available at: https://www.eiu.edu/ihec/Krueger-FocusGroupInterviews.pdf (Accessed: 6 December 2020).

Kuiper, D. (2015) 'Reducing congestion with Warsaw's Park-and-ride system (Poland)', *The Eltis,* 8 June. Available at: https://www.eltis.org/discover/case-studies/reducing-congestion-warsaws-park-and-ride-system-poland (Accessed: 13 November 2019).

Litman, T.A. (2019) 'Parking Management', *Victoria Transport Policy Institute*. Available at: https://vtpi.org/park_man_comp.pdf (Accessed: 25 November 2019).

My Thanh, T.T. and Friedrich, H. (2017) *Legalizing the illegal parking, a solution for parking scarcity in developing countries. World Conference on Transport Research*. Shanghai, July 10-15, 2016: Elsevier B.V. Available at: https://reader.elsevier.com/reader/sd/pii/S2352146517306816?token=A4C881AB32A7B4F3B348F2254F7D36B9658DCB2ABD17654CB05340161B8675D24575EF3407B6C1CD7A0A8CC7D80A2D40 (Accessed: 4 March 2020).

Office of Transportation & Infrastructure Systems (2016) *City Of Philadelphia City Of Philadelphia: Parklets Guidelines & Application*. Available at: https://philadelphiastreets.com/images/uploads/resource_library/City-of-Philadelphia-Parklet-Application.pdf (Accessed: 5 March 2020).

OpenStreetMap (2019) 'Open Street Map'. Available at: https://www.openstreetmap.org/way/150221119 (Accessed: 4 March 2020).

Parkhurst, G. and Meek, S. (2014) *The Effectiveness of Park-and-Ride as a Policy Measure for more Sustainable Mobility* (Ison, S. & Mulley, C. (Eds) Parking Issues and Policies). Available at: http://eprints.uwe.ac.uk/26149/7/Park-and-RidePolicytext.pdf (Accessed: 13 November 2019).

Planning Portal (n.d.) *DCAN 11: Access for People with Disabilities: Car Parking Provision*. Available at: https://www.planningni.gov.uk/index/policy/planning_statements_and_supplementary_planning_guidance/dcans/dcan11/dcan11_car_parking.htm (Accessed: 5 March 2020).

Pöschko-Kopp, J. (2018) *Volksbank-Tiefgarage in Waiblingen: Ärger wegen teurer Parkgebühren - Waiblingen - Zeitungsverlag Waiblingen,* 28 February. Available at: https://www.zvw.de/inhalt.volksbank-tiefgarage-in-waiblingen-aerger-wegen-teurer-parkgebuehren.279b65f6-4ff0-4a7a-ae05-54f4759486d1.html (Accessed: 28 February 2020).

Rabiee, F. (2004) 'Focus-group interview and data analysis', *Proceedings of the Nutrition Society*, 63(4), pp. 655–660. doi: 10.1079/PNS2004399

Registrar General's Guidelines (n.d) *Car stackers*. Available at: https://rg-guidelines.nswlrs.com.au/strata_schemes/miscellaneous/car_stackers (Accessed: 9 December 2019).

Sauro, J. (2015) *4 Types of Observational Research,* 6 December. Available at: https://measuringu.com/observation-role/.

SRTS Guide (2015) *Park and Walk*. Available at: http://guide.saferoutesinfo.org/encouragement/park_and_walk.cfm (Accessed: 4 March 2020).

Stadt Waiblingen (2020) *Zahlen, Daten, Fakten,* 5 March. Available at: https://www.waiblingen.de/de/Die-Stadt/Unsere-Stadt/Stadtportrait/Zahlen,-Daten,-Fakten (Accessed: 5 March 2020).

Statista (2019) *Pkw - Bestand in Baden-Württemberg bis 2019*. Available at: https://de.statista.com/statistik/daten/studie/255176/umfrage/bestand-an-pkw-in-baden-wuerttemberg/ (Accessed: 2 December 2019).

Stuttgarter Nachrichten (2014) *Verkehrsverbund Stuttgart: Harsche Kritik: „Betrug" an Automaten - Stuttgart - Stuttgarter Nachrichten,* 4 March. Available at: https://www.stuttgarter-nachrichten.de/inhalt.verkehrsverbund-stuttgart-harsche-kritik-betrug-an-automaten.98cbc97a-17a0-4228-8bd1-a76ff33d9b66.html (Accessed: 4 March 2020).

Stuttgarter Nachrichten (2019) *Fahrpreiserhöhung im VVS: Die Nullrunde ist so gut wie abgelehnt - Stuttgart - Stuttgarter Nachrichten,* 4 March. Available at: https://www.stuttgarter-nachrichten.de/inhalt.fahrpreiserhoehung-im-vvs-nullrunde-ist-so-gut-wie-abgelehnt.d8157ab1-a308-4dd9-a3d8-86ffb0351304.html (Accessed: 4 March 2020).

Thomas, L. *et al.* (1995) ‘Comparison of focus group and individual interview methodology in examining patient satisfaction with nursing care’, *Social Sciences in Health*, 1(4), pp. 206–220.

Urban Times (2017) *Incentives to Make Public Transportation More Appealing*. Available at: https://www.smartcitiesdive.com/ex/sustainablecitiescollective/incentives-make-public-transportation-more-appealing/134251/ (Accessed: 5 March 2020).

Verdict Media Limited (n.d.) *Cesena Automatic Underground Parking System* (Accessed: 25 November 2019).

Wimmer, RD and Dominick, Joseph R (2011) *Mass media research: An introduction, International Edition*.

WÖHR Autoparksysteme GmbH (n.d.) *PARKLIFT 421*. Available at: https://www.woehr.de/en/product/parklift-421.html (Accessed: 4 March 2020).