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COPENHAGEN

COPENHAGEN – AFTER THE CAR?

An examination of existing car-free projects and a future development of a car-free environment in Middelalderbyen



Master Thesis 4th Semester of Msc. in Sustainable Cities

Prepared by Maiken Kiefert Møller Thomsen
Supervision by Morten Elle
Handed in 2nd of August 2016

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PREFACE

This Master Thesis has been written in the final semester of the Master Programme in Sustainable Cities, in the Department of Development and Planning at Aalborg University of Copenhagen, It accounts 30 ECTS and has been carried out in the period from 1th of February to 2nd of August 2016 under the supervision of Morten Elle.

This thesis aims to gain more knowledge about the essential actions in developing a car-free environment in Middelalderbyen by mapping the implemented measures in existing car-free projects. With this work, I hope to inspire the Municipality of Copenhagen to keep developing Middelalderbyen towards a car-free environment.

The motivation for writing this thesis comes along with the increased interest in reducing car traffic and improving the more sustainable transport modes such as walking, cycling and public transport world wide. If this happens, the reduction of car traffic will bring a positive side effect of lower CO₂ emission. As an urban planner it is always interesting to look into a city structure and think 'how could this have been otherwise'.

Acknowledgements

I would like to give a great thanks to Morten Elle for his supervision of this thesis. Thanks to Annette Kayser and Helene Albinus Søgaaard from the Municipality of Copenhagen for the two meetings, which led to this very interesting case area of Middelalderbyen. Furthermore, great thanks to my friend Katja for helping me collecting interviews, and Tim for reviewing the final text. Very special thanks to my boyfriend Emil and family for great support in the, from time to time, very frustrating process. And lastly, I want to thank the people that were willing to help with answering the small interviews.

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ABSTRACT

Purpose - The aim of this thesis is to gain more knowledge about existing car-free projects and the underlying strategies in order to understand the essential actions in relation to a future development of a car-free environment in Copenhagen's Middelalderbyen.

Design/Methodology/Approach - This research has been an explorative case study design. The case study area is the old historic city centre of Copenhagen, which is termed Middelalderbyen (Medieval Town). The research is based on qualitative research methods including literature review on car-free developments in Europe, interviews of current users and observations of the present situation in Middelalderbyen. In addition to this, the following theories were chosen as tools to analyse and interpret the findings: the *Staging Mobilities* framework and the *8 Principles for Transport in Urban Life*.

Findings – The essential actions for developing a car-free environment in Middelalderbyen requires a combination of push and pull effects. Car-free developments are not just related to one simple action, but a combination of several that in some ways discourages car use and in another ways encourages the attractiveness of walking, cycling, public transit and car-sharing services. In addition, the planning process has to include the surrounding cities as well as Middelalderbyen if the car traffic has to be reduced and not just pushed even further out. Moreover, to determine the specific solutions for Middelalderbyen, there is a need for more comprehensive interviews and observations in order to understand the daily mobility choices of residents, employees and visitors.

Originality/Value – Brief research has been done regarding existing car-free projects and their approaches to reduce the car traffic. The awareness and improvements of people-oriented transport modes are important factors in making cities more sustainable and carbon neutral.

Keywords – Staging Mobilities, 8 Principles for Transport in Urban Life, Urban Planning, Mobility Planning, Transport Planning, Car-free Developments, Car-free Cities, Car-sharing, People-oriented Transport Modes, Historic City Centre, Middelalderbyen, Copenhagen.

TABLE OF CONTENTS

PREFACE.....	V
ABSTRACT	Fejl! Bogmærke er ikke defineret.
1 INTRODUCTION	13
1.1 Problem Field and Research Question	14
1.2 Academic and Societal Relevance	15
1.3 Delimitations	15
1.4 Structure of the Thesis	16
2 LITERATURE REVIEW	17
2.1 The Understanding of a 'Car-free' Concept.....	17
2.2 The Impacts of Implemented Measures in Car-free Developments	18
2.2.1 Bologna, Province of Emilia-Romagna, Italy	20
2.2.2 Vauban, Freiburg, Germany	22
2.2.3 GWL Terrein, Amsterdam, the Netherlands	24
2.3 Summary	26
3 METHODOLOGY	27
3.1 Research Strategy	27
3.2 Research Methods.....	28
3.2.1 Literature Review	28
3.2.2 Interviews.....	29
3.2.3 Observations.....	30
3.3 Validity and Reliability	30
4 THEORETICAL FRAMEWORK.....	31
4.1 Staging Mobilities.....	31
4.1.1 The Physical Settings, Material Spaces and Design.....	32
4.1.2 Social Interactions.....	33
4.1.3 Embodied Performances.....	34
4.3 Eight Principles for Transport in Urban Life.....	34
4.3 Summary	36
5 CASE STUDY.....	37
5.1 Car-free Days in Middelalderbyen.....	37
5.2 Middelalderbyen and its Functions.....	38

6 ANALYSIS	43
6.1 Walk	43
6.1.1 Bologna	43
6.1.2 Vauban	44
6.1.3 GWL Terrein	46
6.1.4 Potential Measures to Improve Walkability in Middelalderbyen.....	47
6.1.5 Middelalderbyen	47
6.1 Cycle	48
6.2.1 Bologna	49
6.2.2 Vauban	49
6.2.3 GWL Terrein	50
6.2.4 Potential Measures to Improve Cycling in Middelalderbyen	51
6.2.5 Middelalderbyen	52
6.3 Connect.....	53
6.3.1 Bologna	53
6.3.2 Vauban	54
6.3.3 GWL Terrein	55
6.3.4 Potential Measures to Improve the Connectivity in Middelalderbyen	56
6.3.5 Middelalderbyen	57
6.4 Transit.....	58
6.4.1 Bologna	58
6.4.2 Vauban	59
6.4.3 GWL Terrein	60
6.4.4 Potential Measures to Improve the Accessibility to Public Transit in Middelalderbyen	61
6.4.5 Middelalderbyen	61
6.5 Mix.....	62
6.5.1 Bologna	63
6.5.2 Vauban	63
6.5.3 GWL Terrein	63
6.5.4 Potential Measures to Ensure the Balance of Mixed-use in Middelalderbyen	64
6.5.5 Middelalderbyen	64
6.6 Densify.....	65
6.7 Compact.....	66
6.7.1 Bologna	66
6.7.2 Vauban	67
6.7.3 GWL Terrein	67
6.7.4 Potential Measures to Improve the Compactness in Middelalderbyen	68

6.7.5 Middelalderbyen	69
6.8 Shift	70
6.8.1 Bologna	71
6.8.2 Vauban	72
6.8.3 GWL Terrein	73
6.8.4 Potential Measures to Make the Private Car Less Convenient in Middelalderbyen	74
6.8.5 Middelalderbyen	74
6.9 Summary	76
7 DISCUSSION	79
8 CONCLUSION	81
REFERENCES	83
APPENDICES	89
APPENDIX A: Interviews of Parkers in Nørre Kvarter	89
APPENDIX B: Observation Note in Nørre Kvarter	91

1 INTRODUCTION

Back in the early 1900s when the first mass production car, the Ford Model T, was put on the market no one had predicted its dominating role in the contemporary world. The car was created in a rural context, and not for the city centre and short trips as we use it today. The twentieth century became the century of the car system, where extraordinary high levels of carbon were generated (Dennis & Urry, 2009).

“The car has redefined movement, pleasure and emotion in the contemporary world, transforming the fitness landscape for other mobility systems that have to find their place within a landscape formed and maintained by this car system”

(Dennis & Urry, 2009, p. 133)

The car became quickly a public property, which led to its dominating role in the urban development. Planners, architects and politicians had to prioritize it, thus planning the requisite space in the urban landscape. In 2010, one billion cars and trucks were registered, and it is expected to increase to 1.7 billion by 2030 (ICCT, 2013). This rapid growth of the transport sector and the car-dominated urban development are challenging the transition towards an improved liveable environment for the inhabitants of the cities. However, in the end this is a political question.

In the last decades, the restructuring movement has been high on many policy agendas. In fact it is crucial for a successful transition process towards future with reduced car use (Dennis & Urry, 2009). Before the advent of the car, the most essential need for cities was walkability and to which Southworth (2005) describes, *“cities of the middle ages were remarkable in their walkability and typically packed all the necessities of urban living into an area no more than ½ mi from the central square”* (p. 247). In addition to this, it is important to notice that the continuing population growth and uncontrolled urbanization also are challenging the idea of re-constructing the walkable city.

Nevertheless, Oslo is going to ban all cars in 2019 inside the area of ‘Ring 1’, which is the main road that circles the city centre. Florence has since 1990s limited the access of cars in parts of the city centre, some more restricted than others. Moreover, Milano has implemented different initiatives since 2012 in order to reduce car use in the city centre. Paris had a ‘car free day’ in September 2015 in connection with COP21, whose positive results on the environment were remarkable (Willsher, 2015).

In relation to these, Copenhagen announced last year a car-free day in September 2016, but unfortunately this day has been cancelled again due to economical issues.

If returning to the quote in the beginning by Dennis & Urry (2009), they also state that the car has redefined pleasure and emotion of the contemporary world. The car has made it easier to travel longer and faster. As Dennis & Urry (2009) states, *“the cars’ flexibility enables car drivers to get into their car and start it without permission or the expertise of others”* (p. 39). The car is available 24 hours a day; you can leave whenever you want to. This sounds like a very desirable system, and a system that is here to stay. However there are several alternative transport systems to this, which just have to be drawn attention to, and over time, will change the idea of owning a car.

1.1 Problem Field and Research Question

The main objective of this research is to challenge the twentieth century urban development, which has been dominated by the car system. A special focus will be on the measures and different approaches that have been implemented through previously car-free case studies in other cities, because these seem to be crucial for a successful transition process. Moreover, private car ownership is reconsidered through an upcoming alternative type of ownership, which supports the car-free development. Previously mentioned studies will contribute to a potential implementation of a car-free environment in Middelalderbyen in Copenhagen. In this way, this research contributes to the awareness and knowledge about car-free developments both in a Danish context and in general.

Therefore, the following research question is developed:

What actions are essential for developing a car-free environment in Middelalderbyen in a sustainable urban development context?

The following sub-questions are created to help answering this:

- What are the experiences from existing car-free developments, and how can these contribute to the case about Middelalderbyen?
- Which development in car ownership supports car-free developments, and what role does this play in existing car-free developments?

1.2 Academic and Societal Relevance

Climate changes are an often discussed topic by the world's leaders, which has turned the attention to the reduction of CO₂ emissions. Last year at COP21 in Paris, 195 countries agreed on the first-ever universal, legally binding global climate deal (European Commission, 2016). This means that the Paris Agreement is a bridge between today's policies and climate-neutrality before the end of the century. By looking at the percentage distribution of the different sectors that contributes to the total emission, the transportation sector covers almost 16 per cent (OICA, n.d.). Therefore, larger cities are focusing on both reducing the number of cars and the usage of cars.

This has increased the interest in car-free developments. The literature on car-free developments refer almost exclusively to European examples, however, the literature is limited. Nevertheless, there is evidence that these developments reduce car use, while improving non-motorized transport modes (walking and cycling). When the car-free developments in Europe have been investigated, the researchers mainly focus on case studies of local communities or housing projects (Foletta & Field, 2011). Even though, car-free developments in city centres have been carried out, these have not been extensively researched (Topp & Pharoah, 1994). In addition, the studies have mainly concentrated on mobility aspects, although containing some evidence of other benefits (Nobis, 2003; Melia 2014)

The academic relevance of this research will be the collection and reflection of the implemented measures and experiences from other car-free developments in order to clarify the potential approaches to a car-free environment in Middelalderbyen and what actions it takes. In addition to how certain measures can be adapted in a Danish context. Societal relevance of this research will contribute to increased knowledge about car-free living and the underlying strategies for these developments.

1.3 Delimitations

In relation to the research question and the aim of this thesis, the literature review is primarily focused on the implemented measures and experiences from car-free projects around Europe. Due to the limited literature on car-free developments in city centres, the car-free developments in local communities will be included. In addition, this research will not have focus on the political decisions within the planning process, but only analysing the outcome of the different implementations.

This thesis is not going to design the future Middelalderbyen, but instead it outlines the potential measures and strategies for the creation of a car-free environment in the area.

1.4 Structure of the Thesis

The first chapter introduces the problem area related to the car system and its dominating power on the urban development. In chapter two, a literature review on car-free developments in Europe and a research on three existing car-free projects are conducted. The used methodology in this research is explained in the third chapter. Chapter four consists of a description of the applied theory and guideline. In the fifth chapter the chosen case, which is Middelalderbyen in the Inner City of Copenhagen is introduced. An analysis of the potentials for implementing a car-free environment in Middelalderbyen is carried out in the sixth chapter. Chapter seven consists of a discussion and reflection upon this research. Finally, eighth chapter concludes this research by answering the research question. After the last chapter, references and appendices are listed.

2 LITERATURE REVIEW

In this chapter, a literature review on car-free developments in Europe is conducted. The aim is to examine the different measures, which have been implemented in the attempts to reduce car use in both city centres and housing projects. In the end, a brief summary will outline the most important points, and describe how these will be used throughout the research.

2.1 The Understanding of a ‘Car-free’ Concept

The car-free concept is not something recently developed of which Morris et al. (2009) states, *“prior to widespread car ownership, all residential areas were car-free ... ”* (p. 19). Nevertheless, the car-free development implies a physical change, either new building or changes to an existing built area (Melia et al., 2010).

In a context of new building, Melia et al. (2010) defines the car-free developments as residential or mixed-use developments, which *“normally provide a traffic free immediate environment, and offer no parking or limited parking separated from the residence, and are designed to enable residents to live without owning a car”* (p. 29). Whereas, Todd & Pharoah (1994) applies the concept on historic city centres, and defines it as the effort by the city governments *“ ... to increase the activeness and economic vitality of their city centres by reducing the presence of parked and moving vehicles, and encouraging access by ‘urban compatible’ means of travel”*. Moreover, they stress that *“it implies greater intervention than in the more familiar isolated pedestrian shopping streets, but it does not (yet) mean the complete removal of cars, nor does it necessarily mean a reduction of total vehicle kilometres driven in the city as a whole”* (p. 231).

This makes the car-free concept a contested term where the details depend on the context. However, the car-free concept is something of a misnomer. In most cases the car-free concept appears as restriction to the traffic, which makes terms such as car-limitation or car-reduced more appropriate.

2.2 The Impacts of Implemented Measures in Car-free Developments

Although the literature on European car-free developments is limited and mostly referred to car-free housing projects, and only little has been written about car-free city centres, the evidence of car-free developments are clear. The literature shows that these developments reduce car use and increase walking and bicycling, moreover, it improves the quality of public spaces by reducing noise and pollution, and increases safety amongst the soft road users (Todd & Pharoah, 1994).

In relation to this, Melia et al. (2010) introduces the benefits of car-free developments (see Figure 1), which have focus on the two main aspects: *exclusion of vehicles* and *reduction in car ownership*. The figure outlines the direct and indirect effects of these aspects followed by the benefits for the environment, quality of life and health on a residential, local and national/global scale.

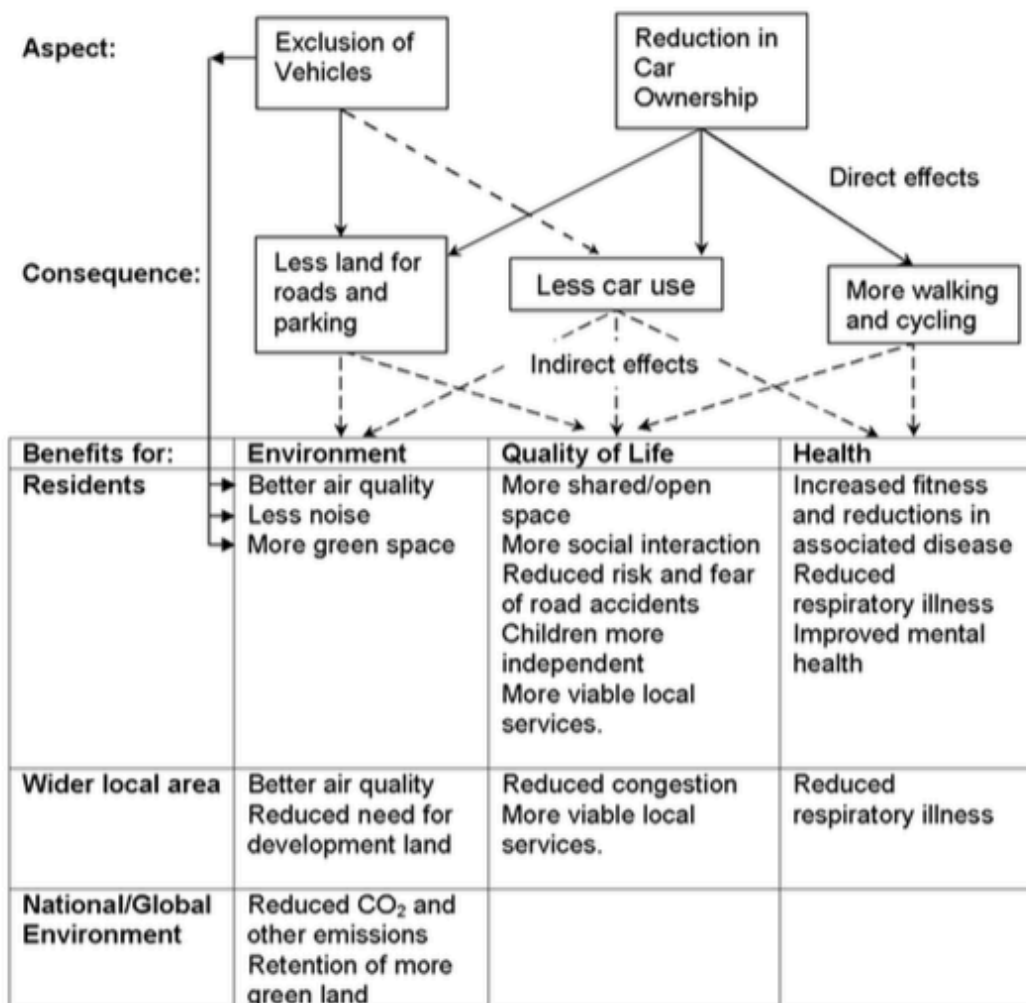


Figure 1: Benefits of car-free developments (Melia et al. 2010)

The direct and indirect effects illustrate the effects of measures that can be implemented in order to either exclude cars or reduce car ownership. For instance measures such as making parking less convenient and increasing the advantages of walking illustrates the indirect effect between 'exclusion of vehicles' and 'less car use' (Melia et al., 2010). In addition, these measures are associated with push- and pull-effects, which both Todd & Pharoah (1994) and Foletta & Field (2011) uses in their research to describe the outcome of car-free developments.

Basically, the push-and-pull strategy ensures the intended effect and avoids the unintended side effects of car-free developments by combining measures with both push- and pull-effects (Todd & Pharoah, 1994). Table A outlines examples of different measures and their effects.

Table A: Push-and-pull measures (Todd & Pharoah, 1994)

Measures with push-effects	Measures with pull-effects	Measures with push- and pull-effects
Area-wide parking management	Priority for buses and trams	Redistribution of carriageway space to provide cycle lanes
Parking spaces restrictions in zoning ordinances	High service frequency	Broader sidewalks
Car limited zones	Passenger friendly stops and surroundings	Planting strips
Congestion management	More comfort	Bus lanes
Road pricing	Park-and-ride, bike-and-ride etc.	Redistribution of time-cycles at traffic lights in favour of public transport and non-motorized modes
Speed reductions	Area-wide cycle-networks	Enforcement and penalizing
Permanent or time-of-day car bans	Attractive pedestrian connections	Public awareness-concepts
		Citizens' participation and marketing

In the following, three cases will be introduced in order to examine the implemented measures and the outcome of them in the attempt to reduce car use. Based on the before mentioned the main focus will be on: which measures have been implemented, to whom has these measures been implemented and why have these measures been implemented.

2.2.1 Bologna, Province of Emilia-Romagna, Italy



Figure 2: Site plan of Bologna (Italian Tourist Office, n.d.)

The old town of Bologna is one of the largest historic city centres in Europe on 430 hectares, which is similar to a square of approximately 2 x 2 kilometres. Its historic core with narrow streets and alleys characterizes it. In addition, about 54,000 people live and 80,000 work in the old town (Todd & Pharoah, 1994).

Which measures have been implemented?

In 1989 the traffic-limitation zone (ZTL), which contains the entire old town of Bologna, was implemented as a permanent regulation to car traffic (see Figure 2). Access by cars was restricted between 07:00 am and 08:00 pm. However, a large number of exemptions permit the access for about 25,000 of residents' car, 15,000 delivery vehicles and 10,000 holders of private parking spaces. In relation to this, cars from outside the Bologna region were likewise allowed to enter the old town (Todd & Pharoah, 1994).

Other measures such as parking management, extension of the pedestrian zone and improvement of the public transport system supplements the ZTL. Inside the old town, only one large public car park for long-term parking exists, and moreover, residents are only allowed to park in their own quarter.

However, about 7,000 park-and-ride spaces were established at the edge of the city, and more than 3,000 free parking spaces outside the ring road. In addition, the public transport system was improved not just within the old town but also on main routes through the city to support the ZTL (Todd & Pharoah, 1994). To this, Todd & Pharoah (1994) states, *“public transport achieved shorter journey times because of less traffic on the bus routes, and in 1989 the trend of decreasing patronage was broken for the first time”* (p. 235).

For whom has these measures been implemented?

The wish for a further traffic reduction by the City administration of Bologna led to a referendum in 1980s. The majority agreed to the new comprehensive plan elaborated by the City administration, and which succeeded in a total reduction of cars entering and leaving the old town by 50 per cent from 177,000 cars per day in 1981 to 87,000 in 1989 (Todd & Pharoah, 1994). In addition to this, later experiences had shown that the concept of car limitation has been reduced. The traffic has nearly increased to the original levels. Todd & Pharoah (1994) substantiate this by the large number of permits and weak enforcement by the city administration of Bologna.

Why have these measures been implemented?

According to the City administration of Bologna, the restriction on traffic within the old town was implemented to greatly reduce the volume of cars. Moreover, the purpose has never been to create a total car-free old town of Bologna (Todd & Pharoah, 1994). In relation to this, Todd & Pharoah (1994) stresses, *“... being ‘car-free’ will remain a catch phrase which cannot be taken literally”* (p. 246) because of the limitation of traffic to that mostly generated by the residents and business.

2.2.2 Vauban, Freiburg, Germany



Figure 3: Site plan of Vauban (Vauban, 2014)

The district of Vauban is a car-reduced housing project on 41 hectares, which is constructed over 12 years, from 1998 to 2010. The area was until 1992 a military base used by the French army. Vauban is characterized as a car-reduced brownfield development with parking-free residential streets (Foletta & Field, 2011). In addition, 5,000 people live in Vauban.

Which measures have been implemented?

The characteristic U-shaped streets shown in purple in Figure 3 were designed to avoid cars parking on the residential streets. These streets have a width of 4 meters and signed 'Stellplatzfrei' (no parking spaces), moreover, as Foletta & Field (2011) stresses, “cars must be driven at walking pace, giving priority to other road users, and may stop only for the purposes of picking up and dropping off” (p. 97). However, the speed limit is 30 km/h on main roads within the area shown in yellow in Figure 3 (Nobis, 2003).

Related to the parking-free residential streets, two communal car parks with a total of 470 spaces were established at the edge of the residential area. Moreover, a property has been bought if more parking spaces are needed in the future, but currently the space is used for barbecues and sporting activities (Nobis, 2003). In addition to this, Nobis (2003) stress, *“up to now approximately 400 households have decided to live in Vauban without a private car. This corresponds to more than 40 per cent of all households in that part of the residential area ...”* (p. 703).

Other measures such as extension of the tram system, high quality non-motorized infrastructure and car-sharing supplements the reduced car use in the area. The extension of Freiburg’s tram system runs through the parking-free residential area shown in red in Figure 3. According to Foletta & Field (2011), no home has more than 400 meters to a tram stop. Moreover, 12 shared cars are available in the district, and which is used by 59 per cent of car-free households and 11 per cent of car-owning households (Nobis, 2003).

To whom has these measures been implemented?

After the French army pulled out their military base in Vauban, local environmental campaigners formed the association Forum Vauban in an attempt to introduce more radical design measures into the new master plan. Their key policy was to create an area where the car use should be less convenient than alternative modes (walking, bicycle, public transport etc.) (Foletta & Field, 2011). Risk-averse developers were unwilling to invest in such untested concept, which led to the establishment of building cooperatives of interested architects, residents, and financiers. However, the City of Freiburg does not publicly support the parking-free street model (Foletta & Field, 2011).

Why have these measures been implemented?

The measures were implemented to achieve the aim of creating a car-reduced mixed-use eco-suburb (Foletta & Field, 2011).

2.2.3 GWL Terrein, Amsterdam, the Netherlands



Figure 4: Site plan of GWL Terrein (GWL Terrein, 2010)

GWL Terrein is a car-free housing project on 6 hectares (170 metres wide and 360 metres long), and constructed from 1995 to 1998. The area was formerly used by the municipal water utility, Gemeente Waterleidingen (GWL). GWL Terrein is characterized as a car-free brownfield redevelopment with limited parking, car sharing provision and good transit access (Foletta & Field, 2011). In addition, 1,400 people live in the area.

Which measures have been implemented?

To prevent cars entering the area, the 6 hectares were raised from street level and developed without any streets passing through (see Figure 4) (Foletta & Field, 2011). In addition to this, cars have to be parked in the 129 on-street parking spaces along the west side of the district. By this, overflow parking in the surrounding area could be an issue, but Melia et al. (2010) stress that “*parking in the surrounding areas was already controlled, so the development did not significantly change the parking situation there*” (p. 33). However, certain entrances have ramped access points for service and emergency vehicles can access the area.

As the car has been banished from the inner area of GWL, one of the main focuses has been the green and recreation spaces between the buildings. These spaces includes public green spaces, children’s play areas, shared gardens and mixed use pathways (Foletta & Field, 2011). This invites residents to interact with each other and leave their stamp on the community in GWL.

Other measures such as extension of the tram system and car-sharing supplements the reduced car usage and sustainable living in the area. Car-sharing plays an important role in reducing private car ownership in GWL. Five shared cars are located in the on-street parking spaces and belonging to two organisations: Greenwheel and Diks (Foletta & Field, 2011).

For whom have these measures been implemented?

The increased interest in the area where the water company previously was located came along with their announcement of relocation. Residents of Westerpark lobbied for the location to become a residential area, while companies wanted it to be zoned for industrial purposes. However, the Amsterdam city council decided to zone the area for housing. In continuation of this, local residents became an active part of the decision process for which they appealed for a car-free eco-district. Both politicians and the local community center supported this idea from the very beginning (Foletta & Field, 2011).

Why have these measures been implemented?

The measures were implemented to achieve the aim of creating a car-free eco-district (Foletta & Field, 2011).

2.3 Summary

In this chapter a literature review on car-free developments in Europe has been conducted. This includes an introduction to the concept, the impacts of car-free developments and a brief research on three car-free projects. The cases were chosen due to the fact that they each represent a top-down approach, a bottom-up approach or a mix of the top-down and bottom-up approaches in order to reduce car use. However, the different approaches are only used as a reflection for further research in this project.

The first case about the old town of Bologna introduces a top-down approach to the traffic limitations requested by the City administration. Contrary to Bologna, the second case about the district of Vauban introduces a strongly bottom-up approach to the planning process of the car-reduced brownfield redevelopment with parking-free residential streets. Whereas the third and last case about GWL Terrain introduces a mix of a top-down and a bottom-up approach to the planning process of the car-free brownfield redevelopment with limited parking, car-sharing provision and good transit access. Despite the chosen approach, each case has succeeded in reducing car usage through different measures with push- and pull-effects.

The brief research on Bologna, Vauban and GWL Terrain outlines potential solutions as well as problem issues that could occur in a future planning process of Middelalderbyen. For instance the remarkable factor such as the special permissions to enter the traffic limited-zone in Bologna that got out of control.

In relation to above-mentioned, the aim of this is to examine the push- and pull-measures that have been implemented in existing car-free projects in order to create a car-free zone in Middelalderbyen. To understand the potential transferability in the three cases, it is worth noting the size, approach and the degree of car-free. Moreover, the foundation of the development is crucial for the potential transferability. This means if it is a change to existing built areas (Bologna) or a new-built area (Vauban and GWL). In the following, these three cases will be used to outline the potentials for a car-free Middelalderbyen and the needed actions.

3 METHODOLOGY

This chapter explains the methodologies behind the research of this thesis. This means that the following will explain in which way the study took place and its structure in order to clarify the procedure and the aim of this research. This helps to identify and interpret the patterns that will follow and thus be able to contribute new knowledge to existing literature.

3.1 Research Strategy

This project is an explorative case study research of the essential actions for developing a car-free environment in the historic city centre of Copenhagen, which in this research is termed Middelalderbyen. Middelalderbyen is characterized by its historic identity as the birthplace for Copenhagen, the preserved homogeneous building structure and narrow, crooked streets from the middle ages, and the role as the central urban area of the capital today. In relation to this, the area has a great diverse use due to the fact that Middelalderbyen is functioning as home, workplace and tourist attraction at the same time.

Middelalderbyen was selected as the case study of this project after suggestions from the Municipality of Copenhagen. They want to develop a more sustainable city, where people-oriented transport modes such as walking, cycling and public transit become the obviously choice for the residents and the many commuters. In relation to this, they are interested in gaining more knowledge about other car-free projects, and the implemented measures and planning processes of those projects.

- The first meeting with the Municipality of Copenhagen was held the 1st of March 2016. The persons present at the meeting were Annette Kayser, Helene Albinus Søgaard and myself. The agenda for this meeting was just a brief discussion about ideas and thoughts in relation to a possible car-free environment in a city context. Both Annette and Helene suggested that it would be interesting to look into the old historic centre of Copenhagen (Middelalderbyen) and the possibilities within the area.
- The second meeting with the Municipality of Copenhagen was held the 7th of March 2016. The persons present at the meeting were Annette Kayser, Helene Albinus Søgaard, Morten Elle and myself. The agenda for this meeting was to narrow down ideas and create some kind of

framework for the project, which would both be relevant for my education and useful for them later on in the urban development of Middelalderbyen and Inner City of Copenhagen. We agreed to look into implemented measures and the outcome of these in other car-free projects in their attempt to reduce car use, which would provide us with more knowledge for the development of a car-free environment in Middelalderbyen.

To answer the research question of this project, a theoretical framework has been constructed. This contains the *Staging Mobilities* framework and the *8 Principles for Transport in Urban Life*. The *Staging Mobilities* framework is used to outline that mobility practices are not only related to the build environment but also to how people interact and perform mobilities in the physical settings. While the *8 Principles for Transport in Urban Life* is used to examine the essential actions for developing a car-free environment in Middelalderbyen. In relation to this, the principles are not used as an evaluating tool, which means that the scoring system will not be taken into account in this project. Moreover, a literature review was conducted to gain more knowledge about the approaches in car-free developments.

Based on this theoretical framework of this project, semi-structured interviews were made to understand why some people choose to take the car into Middelalderbyen. Furthermore, observations were made to get a picture on the present situation and the use of Middelalderbyen. The results of both interviews and observations are used during the analysis to outline potential improvements in Middelalderbyen in order to develop a car-free environment. In the following the research methods will be elaborated on even further.

3.2 Research Methods

As just mentioned, different methods have been used to answer the research question. This has been done to ensure the academic work and validation of the research, and moreover, to understand the essential actions in car-free developments and the choices of mobility to and from Middelalderbyen. The applied methods were as mentioned earlier: a literature review, interviews and observations. In the following the usage of these methods will be described.

3.2.1 Literature Review

A literature review related to car-free developments and the approaches to this was conducted to formulate the background of the project. Furthermore, research of previous projects related to car-

free developments was briefly carried out to identify possible potentials or barriers of a car-free environment in Middelalderbyen. Finding literature about car-free developments on existing city centre was extremely challenging, even though they do exist. Many bigger cities in Italy have made their historical city centre more or less car-free, but most of the literature on those is in Italian. That is why two best practices of car-free housing projects have been included in the literature review.

3.2.2 Interviews

The short semi-structured interviews were used to obtain information regarding the parked cars in Middelalderbyen; to whom they belong and why the car was chosen as the means of transport into the area. This harmonizes with how Kvale (1996) defines the semi-structured interview, as “... *an interview whose purpose is to obtain descriptions of the life world of the interviewee with respect to interpreting the meaning of the described phenomena*” (p. 5).

Given the fact that Middelalderbyen encompasses an area of 80 hectares, a smaller area was chosen to carry out the interviews. Therefore, the interviews were carried out in the area of Middelalderbyen called Nørre Kvarter. Nørre Kvarter is one of the largest residential areas in Middelalderbyen. In addition to this, the area provides the highest density of on-street parking spaces.

The interviews took place on 11th of April 2016 from 12:00 pm to 01:00 pm and again from 05:00 pm to 06:00 pm. Due to special parking regulations being valid Monday to Friday from 10:00 am to 05:00 pm, the two rounds of interviews were ideal to get a realistic picture of the present parking situation in Middelalderbyen. The interviews consisted of three questions in order to understand why the driver was using a car in Middelalderbyen. In addition, the questions were also used to figure out potentials or barriers for developing a car-free environment. Below, the three questions are listed:

- What is your purpose to be here today?
- Why did you chose a car as your means of transport?
- Why did you not choose alternative means of transport (e.g. bicycle, walking, bus, metro, s-train)?

During both rounds of interviews 5 people were interviewed, which gives 10 in total. The interview subjects could be difficult to spot and talk to, even though the area was narrowed down to only Nørre Kvarter. Related to this, none of the interviewed people were residents of the area. However, a brief

observation after 05:00 showed cars with resident parking permits for the area. In addition, the collected interviews give a clear picture of potentials and barriers in order to develop a car-free environment in Middelalderbyen. The answers are presented in Appendix A.

3.2.3 Observations

Observing the area of Middelalderbyen was a significant part of the project. Observations, filming and taking photos were tools that helped understand the present situation within Middelalderbyen. Moreover, these tools helped to identify the weaknesses and the potential for an implementation of a car-free environment in the area. This relates to the concept of ‘thick descriptions’ by Ponterotto (2006). He defines this working form as “... *the researcher’s task of both describing and interpreting observed social action (or behaviour) within its particular context*”. In continuation of this, he outlines that “... *thick description accurately describes observed social actions and assigns purpose and intentionality to these actions, by way of the researcher’s understanding and clear description of the context under which the social actions took place*” (p. 543). Identical to the previous research method, the observation took likewise place in Nørre Kvarter.

The observation took place on 11th of April from 12:00 pm to 06:00 pm. This time span was ideal due to the special parking rules in the area as mentioned previously. An observation note has been written and is presented in Appendix B.

3.3 Validity and Reliability

The study aimed to find the information necessary to answer the research question. Therefore, the structure of this study was based on existing data, interviews and observations, which contribute to a more accurate view on the topic of this project. The research question was answered successfully giving a clear idea of the potentials and barriers to a development of a car-free environment in Middelalderbyen. In addition, this project has a high validity due to the fact that data, interviews and observations were collected in a legitimate and justifiable manner, and because it is based on well-grounded research structure with theories. However, one could say that this project has an inadequate reliability due to the limitations of this research. The reliability of this project would increase with more data such from interviews and traffic counts.

4 THEORETICAL FRAMEWORK

In continuation of the research question the following theoretical framework is constructed to understand the complexity of the transition process towards a car-free environment. Below, the *Staging Mobilities* framework by the Danish sociologist Ole B. Jensen and the *8 Principles for Transport in Urban Life* will be introduced. The *Staging Mobilities* framework is chosen to give a reflection upon how mobility practices are linked to the built environment designed and regulated by planners, architects and politicians, and also the way people interact and perform mobilities in the physical and material settings. While the *8 Principles for Transport in Urban Life* will be used as a guiding tool providing measurable performance objectives that have been developed to create the vibrant, low-carbon city of the future where people-oriented urban transport modes are prioritized. Finally, a brief summary will outline the most important points from the theoretical framework, and describe how these will be used as references throughout the research.

4.1 Staging Mobilities

The main objective of the *Staging Mobilities* is that mobilities are more than just a movement between point A and B. The new way of understanding mobility allocates that mobilities do not ‘just happen’ or simply ‘take place’ to which Jensen (2013) states, “*mobilities are carefully and meticulously designed, planned and ‘staged’ (from above)*”, and moreover “*equally importantly acted out, performed and lived as people are ‘staging themselves’ (from below)*” (p. 4).

In order to develop a car-free environment in Middelalderbyen, the area has to be understood as an assemblage of circulating people, goods, information and signs in relational networks creating the ‘meaning of movement’ (Jensen, 2013). As illustrated in Figure 5, situational mobility practices manifest themselves in three key themes: the physical settings, material spaces and design; the social interactions; and the embodied performances. Each of these dimensions will be elaborated in the following subchapters.

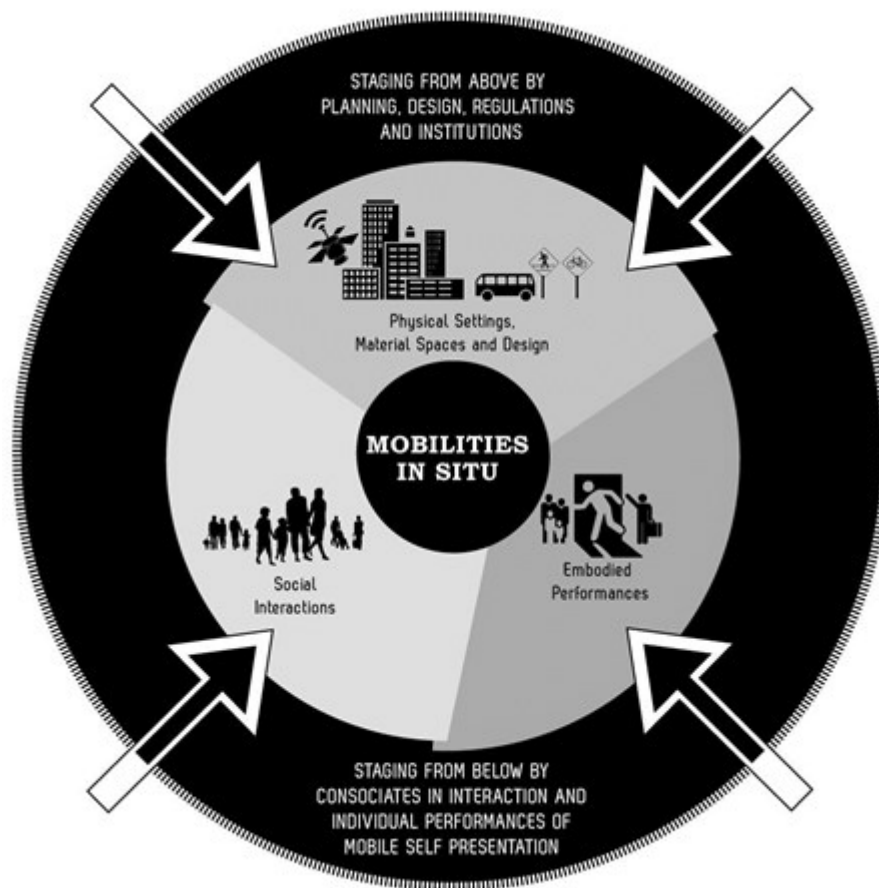


Figure 5: The Staging Mobilities Model (Jensen, 2013)

4.1.1 The Physical Settings, Material Spaces and Design

The first dimension in the *Staging Mobilities* framework concerns the design of physical settings and material spaces of the urban space in which mobilities obviously take place (Jensen, 2013). To illustrate how the built environment and physical settings are encouraging as well as discouraging particular mobile practices, Jensen (2013) introduces three new concepts: *mobile sociopetals*, *mobile sociofugals*, and *mobile semiotics*.

The concept of *mobile sociopetals* describes how some sites and settings invite people to go there and undertake their activities, while the contrary concept, *mobile sociofugals*, describes how others tend to 'push' people away. For instance shared thoroughfares or public spaces that support a vibrant urban environment and that attracts people for shopping or other activities can be thought as *sociopetal* space. Whereas, transit areas can be thought as *sociofugal* spaces that force people apart. However, spaces can perform as both *sociopetal* and *sociofugal* depending on the function at

different times and the actual situation, which emphasizes that the everyday-life mobilities are staged through a combination of these.

In addition, the notion of *mobile semiotics* is used to describe how mobility practices are affected by the semiotic systems, which may promote or obstruct particular motions, directions, speeds, modes etc. in more or less codified systems of infrastructure. Moreover, how we as individuals relate these to signs and symbols due to the fact that the material spaces have to be 'read' as a semiotic system in order to make sense of the mobile situation (Jensen, 2013). Based on this, the notice of mobile semiotics is referring to both terms 'staged from above' (intentions of the designer) and staged from below' (people's gesticulation, body language etc.).

Given the fact that mobile situations are performed in space and time within the designed physical settings and material spaces that either encourage or discourage particular mobilities, the social interactions in this built environment are just as important.

4.1.2 Social Interactions

Next dimension concerns the social interactions of humans in the built environment. It can be argued that social interactions are preconditions to mobility practices and crucial in understanding the mobile situation (Jensen, 2013). When travelling, regardless if it by public transport, car, bicycle or on foot, the process of engaging and interacting with fellow consociates will always be present. To illustrate these interactions, Jensen (2013) uses the following concepts: *mobile with*, *temporary congregation* and *negotiation in motion*.

The notion of mobile with is described as "*a group of two or more either co-presently moving together or in mediated contact 'stretched' across time and space facilitated by networked technologies*" (Jensen, 2013, p. 81). By this the mobile with can both be the group of friends who are out shopping or the suddenly raised queue in front of the elevator, where nobody knows each other. However, the last case rarely leads to deep interaction because the situation quickly arises and can dissolve just as quick for which Jensen (2013) uses the term temporary congregation to describe the situation.

In addition, above-mentioned concepts are linked to the overall process of *negotiation in motion*, which describes the way we negotiate in the city's space amongst other mobile consociates. For instance when we negotiate a passage on the pavement. The concept of 'negotiation in motion' is

important to draw attention to when talking about social interactions in the fact that social interaction is made in a mobile space of norms, values and power (Jensen, 2013). Moreover, the negotiation process can also be seen as physical embodied performances, which will be presented in the next subchapter.

4.1.3 Embodied Performances

The third and last dimension concerns the embodied performances of mobilities. Given the fact that mobilities are performed with our bodies in time and space, a firm understanding of the human body is needed to explore what norms, meanings and everyday-life cultures are being produced and reproduced in the complex relations between the mobile body, the built environment and mobility modes (Jensen, 2014). In order to explore this, Jensen (2013) introduces the following concepts: *mobile affordance* and *mobile body semiotics*.









The notion of *mobile affordance* describes how the specific relationship between the moving body and its material environment opens up or narrows down to particular modes of mobilities, different driving modes, development trajectories etc. (Jensen, 2013). While, the concept of mobile body semiotics (related to mobile semiotics) describes how the human body on its own becomes a 'sign' of which intensions, meanings and norms can be read.

4.3 Eight Principles for Transport in Urban Life

As the *Staging Mobilities* framework gives any specific parameters to develop a car-free environment, the *8 Principles for Transport in Urban Life* are applied to identify essential actions. The principles are characterized as a guiding tool that helps shaping and assessing contemporary sustainable urban development. Moreover, they reflect a fundamental shift from the old paradigm of car-oriented urbanism towards a new paradigm where urban forms and land uses are closely integrated with efficient, low-impact, and people-oriented transport modes such as walking, cycling, and public transit.

In addition, the principles deal with a combination of push and pull factors to ensure a vibrant, low-carbon city where people want to live and work. The first seven principles embody together the pull factors to improve the attractiveness of walking, cycling and public transit, while the last principle informs the push factor concerning the reduction of the space given over to cars. The 8 key principles are introduced below in Table **B**, and will be elaborated on during the analysis of this project.

Table B: The 8 Principles for Transport in Urban Life (ITDP, 2014)

 <p>WALK</p>	<p>Develop neighbourhoods that promote walking</p> <ul style="list-style-type: none"> • The pedestrian realm is safe and complete • The pedestrian realm is active and vibrant • The pedestrian realm is temperate and comfortable
 <p>CYCLE</p>	<p>Prioritize non-motorized transport networks</p> <ul style="list-style-type: none"> • The cycling network is safe and complete • Cycling parking and storage is ample and secure
 <p>CONNECT</p>	<p>Create dense network of streets and paths</p> <ul style="list-style-type: none"> • Walking and cycling routes are short, direct and varied • Walking and cycling routes are shorter than motor vehicle routes
 <p>TRANSIT</p>	<p>Locate development near high-quality public transport</p> <ul style="list-style-type: none"> • High quality transit is accessible by foot
 <p>MIX</p>	<p>Plan for mixed use</p> <ul style="list-style-type: none"> • Trip lengths are reduced by providing diverse and complementary uses • Lower income groups have short commutes
 <p>DENSIFY</p>	<p>Optimize density and transit capacity</p> <ul style="list-style-type: none"> • Residential and job densities support high quality transit and local services
 <p>COMPACT</p>	<p>Create regions with short commutes</p> <ul style="list-style-type: none"> • The development is in an existing urban area • Travelling through the city is convenient
 <p>SHIFT</p>	<p>Increase mobility by regulating parking and road use</p> <ul style="list-style-type: none"> • The land occupied by motor vehicles is minimized

4.3 Summary

In this chapter, the *Staging Mobilities* framework and the *8 Principle for Transport in Urban Life* have been introduced, which create the theoretical framework of this research. The *Staging Mobilities* framework illustrates how mobility practices are affected through the design and regulation of the built environment from above as well as through the social interactions and embodied practices of people performing mobilities from below. While, the *8 Principles for Transport in Urban Life* provide specific measurable performance objectives within the categories: walk, cycle, connect, transit, mix, densify, compact and shift, in order to develop the sustainable city of tomorrow where urban forms and land use are closely integrated with efficient, low-impact and people-oriented transport modes such as walking, cycling and public transit.

The aim of this theoretical framework is to understand the complexity of urban mobility practices in order to identify the essential actions for developing a car-free environment in Middelalderbyen. The various concepts introduced in the *Staging Mobilities* framework will be used to examine and understand the present situation in Middelalderbyen, while the principles are structuring the analysis to allocate possible solutions to reduce car use and improve the attractiveness of the more people-oriented transport modes (walking, cycling and public transit) based on experiences from other car-free projects in Bologna, Vauban and GWL Terrain.

5 CASE STUDY

This chapter will explain the chosen case of this project, which is the historic city centre of Copenhagen. The area is termed Middelalderbyen (the Medieval Town) due to its construction time. The main focus is to give an overall description of the present conditions in Middelalderbyen. This means that there will be a brief description of Middelalderbyen and its different functions, and more specially the car traffic in the area. In addition to this, some special conditions will be extracted even further during the analysis. However, there are several reasons why Middelalderbyen became the case study area. It is the historic birthplace of Copenhagen and the central urban area of the capital we know today, which makes the area something special. Middelalderbyen provide a great diversity with a pedestrian-friendly network in a historical environment with lots of shops, cafés, restaurants, cultural offerings and housing units. Moreover, the Municipality of Copenhagen and politicians have an interest in making Middelalderbyen a preserved area without car traffic. In relation to this, prior car-free events in Middelalderbyen will be described first.

5.1 Car-free Days in Middelalderbyen

In November 2015, the city's deputy mayor for technical and environmental, Morten Kabell, announced a car-free day in September 2016 with great support from the city council of Copenhagen (Politiken, 2015). This event was thought of as a forerunner for a more permanent pacification of Middelalderbyen. Unfortunately, the Konservative party vetoed the idea in March 2016, which makes the upcoming car-free day unlikely (Politiken, 2016). However, similar events have been carried out in the beginning of the twenty-first century as part of the European Mobility Week, which has been an annual weekly event in the month of September since 2002. In 2001, 2003, 2004 and 2005 different car-free days were held in the area of Middelalderbyen.

The main objective of these car-free days was to raise awareness about the means of transport and the environmental benefits of the alternatives to individual car traffic (Københavns Kommune, 2004b; Københavns Kommune 2005), and to draw attention to problems and future solutions (Københavns Kommune, 2004a). Furthermore, to demonstrate and debate the solutions to our transport needs through greater consideration of the environment, the city and the citizens' quality of life (Københavns Kommune, 2002). The events spanned from one day to three days in a row. During the events cars were banished from Middelalderbyen in the time span between 06:00 am to 08:00 pm due to the fact

that peak commuting to and from the area is in this period. However, exceptions were given to residents and businesses in the area, which means that they were not affected by the restrictions during the event. Moreover, deliveries of goods were allowed between 04:00 am to 11:00 am.

According to the evaluations of these prior car-free days it is clear that the people of Copenhagen want a reduction of car traffic in Middelalderbyen. From the evaluation of the three car-free days in 2005, 6 out of 10 wanted the arrangement to become a permanent solution (Københavns Kommune, 2005). However, nothing has happened during the greater than 10 year time period since the last car-free event.

5.2 Middelalderbyen and its Functions

Middelalderbyen is part of the Inner City district of Copenhagen and known as the historic city centre. As the name implies, the area can be dated back to the Middle Ages. In addition, Middelalderbyen encompasses an area of 80 hectares and defined by the old ramparts, which today counts the streets: Vester Voldgade, Stormgade, Vindebrogade, Holmens Kanal, Kongens Nytorv, Gothersgade and Nørre Voldgade, as shown in red in Figure 6.

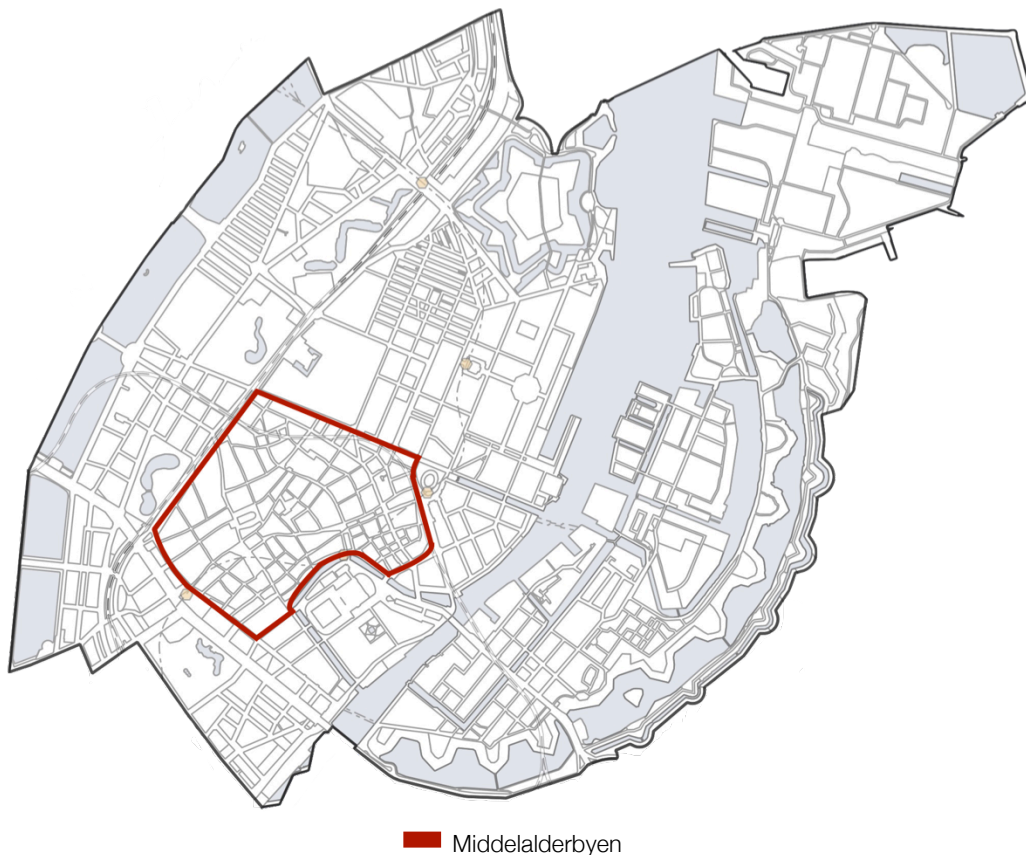


Figure 6: Middelalderbyen in relation to Inner City of Copenhagen (Københavns Kommune, 2016)

As mentioned earlier, Middelalderbyen is characterized by its historic identity as the birthplace of Copenhagen, the preserved homogeneous building structure and narrow, crooked streets from the middle ages, and the role as the central urban area of the capital. At the same time, the area is functioning as home for about 5,000 people, workplace for more than 40,000 and a well-attended area of many thousands of visitors and tourists (Københavns Kommune, 2009).



■ Pedestrians-only streets

Figure 7: Pedestrian network in Middelalderbyen (Københavns Kommune, 2007)

Today, great parts of Middelalderbyen consist of a central pedestrian-friendly network, which connects Rådhuspladsen with Kongens Nytorv and Højbro Plads with Nørreport (see Figure 7). This network makes it possible for pedestrians to walk around in safety and protected from motor vehicles. In relation to this, the first pedestrian street was established in the beginning of the 1960s, where the car was dominating the streetscape. That means that the use of Middelalderbyen has changed over time. These days, Middelalderbyen counts for more than 100,000 square metres of car-free streets

and squares (Københavns Kommune, 2009). In addition to this, a survey from 2005 shows that there are about 28,000 pedestrians per hour on average on a good summer day at the different shopping streets in Middelalderbyen (Københavns Kommune, 2007). Given the fact that cars in general are not allowed on the pedestrian streets, signs are posted at the entrance points (see Figure 8), which states the specific rules for motorized vehicles and cyclists at this central pedestrian network.



Figure 8: Signposting at entrance points to the pedestrian network

In contrast to the above-mentioned, the car is still playing a dominant role on the narrow, crooked streets outside the great pedestrian network (see Figure 9). According to the results from traffic counts from 2005, more than 22,000 cars circulate daily the streets in Middelalderbyen (Københavns Kommune, 2007). However, there are only about 3,000 parking spaces available in Middelalderbyen distributed as on-street parking spaces, disability parking spaces and parking spaces in public car parks. Beyond this, there are more than 1,000 private parking spaces in backyards and basements (Københavns Kommune, 2007). This constitutes to a considerable high rate of visitor parkers in Middelalderbyen compared to other parts of Copenhagen.



Figure 9: Lyrical pictures showing the car dominance from different parts of Middelalderbyen

In addition to this, Middelalderbyen is located in the red parking zone, which is the most expensive one. Residents can buy a resident license for their car for a yearly price of 740 DKK, which allows them to park in the area (Københavns Kommune, n.d.). However, in the red parking zone the license is not valid on certain streets from Monday to Friday in the time span between 10:00 am to 05:00 pm, which means that the residents have to buy parking tickets as everybody else in that period (Københavns Kommune, 2014a). With this in mind, it is not the residents that occupy the parking spaces, but visitors and businesspeople.

In order to understand who travels by car to Middelalderbyen and why, semi-structured interviews of the parkers has been carried out in the greatest housing district of the area. This housing district is called Nørre Kvarter and located in the left upper area of Middelalderbyen. Because of the narrow, crooked street design the streets are only allow one-way traffic. However, Nørre Kvarter has about 145 parking spaces distributed on the following streets: Studiestræde, Sankt Peders Stræde, Teglårdstræde, Larslejsstræde and Larsbjørnsstræde.

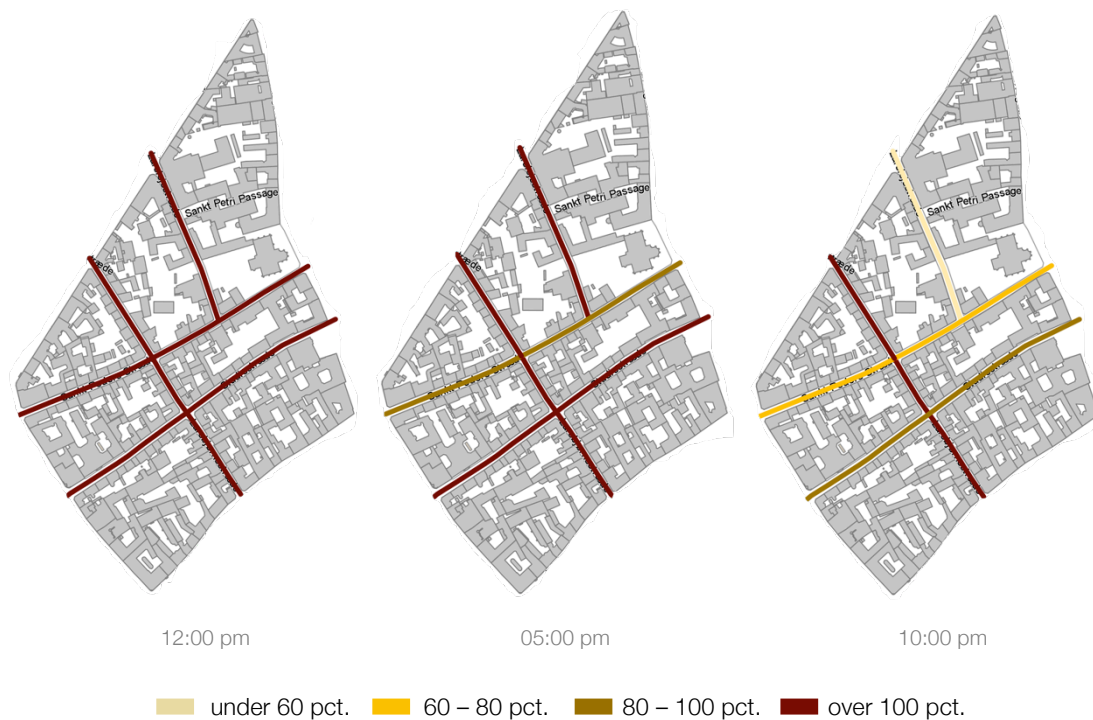


Figure 10: Parking space occupancy rate in Nørre Kvarter throughout the day (Københavns Kommune, 2016)

The parking occupancy rate for Nørre Kvarter is shown in Figure 10. This illustrates also the more general picture of the entire Middelalderbyen. As it can be seen, the parking occupancy rate exceeds more than 100 per cent during work hours. This indicates that people have a tendency to park outside the marked parking spaces, if they cannot find a free space. In relation to this, the short semi structured interviews were carried out around 12:00 pm and 05:00 pm, where the greatest number of cars are parked in the area.

Among the interviewed people there were no area residents, which substantiates the theory that it is not the residents who occupy the parking spaces during day time, but instead visitors and businesspeople. The general excuse for taking the car is ease and independence the car affords. They do not have to think about travel schedules for public transport. However, one of the businesspeople was willing to travel by bicycle between the meetings, but his bike had just got stolen (Appendix A). After the end of the work day, the majority of parkers are not businesspeople, but instead visitors doing leisure activities such as visiting friends, going to the theatre, eating at cafés or restaurants etc. The results of the interviews will be elaborated even further in the next chapter concerning the analysis.

6 ANALYSIS

In this chapter, the essential actions for creating a car-free environment in Middelalderbyen will be outlined through the collected data and the 8 principles of transport in urban life as introduced in the theoretical framework. This includes an analysis of each principle: walk, cycle, connect, transit, mix, densify, compact and shift, in relation to the situation in Middelalderbyen. The requested potential implementations are based on implemented measures in the three reference cases, Bologna, Vauban and GWL Terrein.

Each of the principles presents the measures that have been implemented in order to reduce car usage in Bologna, Vauban and GWL Terrein. This is followed by a summary of the different implemented measures. At the end, these measures will be analysed in relation to the situation in Middelalderbyen, and the possibilities to adapt those in a Danish context. Finally, when principles are analysed, a summary will outline the essential actions for the creation of a car-free zone in Middelalderbyen.

6.1 Walk

Walking is the fundamental building block of sustainable transport due to the fact that it is the most natural, affordable, healthy, and clean way of getting around (ITDP, 2014). Creating a safe walking network or giving priority to other road users other than the car, will contribute to a safe, vibrant and comfortable environment for pedestrians. The following will describe the implemented measures in order to improve walkability.

6.1.1 Bologna

In order to improve walkability, the Municipality of Bologna has enlarged the semi-pedestrian area in the historic centre of Bologna. This means that they have encouraged the access to shopping streets and environmental areas that have been penalized by narrow pavements or by the lack of spaces for pedestrians and cyclists (CIVITAS, 2013a). In addition, this contributes to an active and vibrant pedestrian network due to the fact that populated and inviting sidewalks are lined with useful ground-floor activities makes walking highly productive (ITDP, 2014, p. 19).

To prevent unauthorized access by vehicles on semi-pedestrian areas, the Municipality of Bologna has installed Intelligent Transport Systems (ITS) such as electronic bollards throughout the city. These bollards are controlled from a control room (see Figure 11). By this, deliveries to shops are still possible, but only during certain times of the day. In addition, the bollards can at anytime be lowered for the transit of emergency vehicles. However, this system has significantly reduced vehicular access to the semi-pedestrian area, more than the Municipality had forecasted (CIVITAS, 2013a).



Figure 11: Example of Electronic bollards in Bologna (FAAC, n.d.)

As part of the enlargement of semi-pedestrian areas, the Municipality of Bologna also organised an extraordinary event called ‘T-days’ back in 2011. This event has since May 2012 been a recurring event every weekend and on public holidays. T-days is a weekend with several events for pedestrians and cyclists. During the weekends, the main streets Rizzoli, Indipendenza and Ugo Bassi are closed to traffic and open to pedestrians and cyclists between 08:00 am to 10:00 pm. Throughout these weekends, pedestrians and cyclists can experience and learn more about sustainable modes of transport, and explore the historic centre of Bologna in a new way (CIVITAS, 2012).

6.1.2 Vauban

In Vauban everything is located within walking distance. Along Vaubanallee you will find: a supermarket, neighbourhood grocery store, cafés, pub-restaurants, fast-food take-away, bakery, offices, doctor’s surgery, pharmacy and a primary school. Moreover, an organic supermarket,

cosmetics store and discount supermarket are located on Merzhauser Straße (Foletta & Field, 2011). This provision of several retail stores not only contributes to a minimized need for traveling out of the district, but also a more active and vibrant district at its central points.

In addition, Vauban provides large green spaces and recreational areas (see Figure 12), which contribute to a more temperate and comfortable walking environment. Given the fact that these areas separate the residential blocks, residents do not need to travel out of the district in search of pleasant recreation areas (Foletta & Field, 2011). Related to one of the performance objectives, the provision of simple elements such as trees can enhance the attractiveness of walking in general (ITDP, 2014, p. 19).



Figure 12: Example of green spaces in Vauban (Foletta & Field, 2011)

Furthermore, the prioritization of mobilities in the district contributes to the completeness of a safe walking network. This means that cars are forced to drive at walking pace (5 km/h), which gives the priority to the pedestrians and other users (Foletta & Field, 2011).

6.1.3 GWL Terrein

The entire inner area of GWL Terrein is car-free, which means the land that otherwise would have been used for parking and roads for the car is available for creation of green, recreation spaces and wide pathways that connect all buildings within the 6 hectares. The provision of green and recreation spaces contributes to a temperate and comfortable site bringing many environmental as well as psychological benefits for both residents and visitors. In addition to this, other measures such as raised curbs, bollards and signs prevent unauthorized access by motorized vehicles in the inner area (see Figure 13).



Figure 13: Signposting stating that only non-motorized vehicles are allowed in the area (left) and raised curbs and bollards preventing unauthorized access by vehicles (Foletta & Field, 2011)

By looking closer at the sign, the text says that bicycles are only guests and motorized vehicles are not allowed in the area of GWL, which gives the primary priority to the pedestrians.

6.1.4 Potential Measures to Improve Walkability in Middelalderbyen

The different implemented measures to improve walkability as presented above in the three reference cases are summarized below in bullet points:

- Extension of pedestrian zone
- Movable bollards that protect pedestrians from unauthorized vehicular access
- Events that promote sustainable means of transport
- Prioritization of pedestrians over cars
- Provision of green and recreation spaces

In the next subchapter every measure will be analysed in relation to the situation in Middelalderbyen and the possibilities for adapting these in a Danish context.

6.1.5 Middelalderbyen

As introduced in *Chapter 5 – Case Study*, Middelalderbyen already has a safe and complete walking network that connects Rådhuspladsen (Western part) with Kongens Nytorv (Eastern part), and Højbro Plads (Southern part) with Nørreport (Northern part). This network includes among other streets, the famous shopping street called 'Strøget', Fiolstræde and Købmagergade. Related to existing conditions, a further extension of the pedestrian network is not as important as the improvements of the pedestrian environment in the rest of Middelalderbyen.

The streets outside the pedestrian network are still dominated by parked and driving cars, which does not create a sufficient safe environment for pedestrians. Based on the interviews, this overload of cars is caused by businesses or area visitors who choose to take the car into Middelalderbyen. By prioritizing room for cars rather than pedestrians, the sidewalks have become quite narrow. A restructuring of the priority will therefore force cars to drive at a walking pace such as in the residential streets in Vauban. However, such streets do already exist in Middelalderbyen, which makes it even more possible to extend this idea to the rest of the area. Another solution to the large numbers of cars could be an implementation of electronic bollards, which will drastically reduce the numbers of cars. The placement of the bollards should be at the entrance points to Middelalderbyen. Identical to the system in Bologna, a special permit would be needed to enter the area. With this, residents and businesses have to be considered. However, delivery and emergency vehicles are exempted. All in all, this will generate a considerable debate of who has the right to get a special permit.

If the car traffic is reduced to a level that is generated by residents and businesses, many parking spaces could be reclaimed and allocated to more social use such as meeting point or small urban gardens. As observed in Nørre Kvarter, one of the kiosks has already taken parts of the road space in use as a little café area, where people can unwind a little (Appendix B). In addition, a green space or recreational area does not necessary have to be something huge; a small flowerbed or potted plants can have the same psychological effect. An example of this is TagTomat and their parking garden as shown in Figure 14.



Figure 14: Parking garden by TagTomat (TagTomat, 2014)

This parking garden could also be used as an event location to show residents and others how the streetscape could be used if the car is not prioritized. However, the Municipality of Copenhagen has tried several times with car-free days in the area of Middelalderbyen as mentioned in *Chapter 5 – Case Study*. The main objectives of these prior events have been to increase the awareness of alternative means of transport to the car. Unfortunately, this has not yet had any major impact on everyday mobility.

6.1 Cycle

Cycling is a healthy and more sustainable alternative to cars for short trips. It is furthermore an elegant, emission-free and more affordable transport option (ITDP, 2011). Creating a safe network that connects all buildings and destinations, and providing secure bicycle parking and storage at destinations are what make cycling more appealing. The following will describe the implemented measures in order to improve cycling.

6.2.1 Bologna

Bologna is not a great bicycle city; about 7 per cent use the bicycle as means of transport to work and school (Carlini, 2014). However, the Municipality of Bologna wants to increase this number in the coming years. In order to improve the cycling environment, measures such as bike sharing and segregated cycle lanes (see Figure 15) have been implemented. In relation to this, a bicycle ring road has been established on the former ramparts, in the middle of the four-lane boulevard that surrounds the old town. This bicycle ring road consists of segregated bike lanes, which protects the cyclists from motorized vehicles and contributes to a safe cycling network that makes cycling more appealing.



Figure 15: Bicycle ring road (left) and segregated bike lanes in the city centre (right) (Carlini, 2014)

In addition, the cycling network is also improved by the weekly T-days event, as mentioned in previous principle about walkability.

6.2.2 Vauban

Giving the fact that the district of Vauban is located in the city of Freiburg, which has a clear green strategy for the city, the cycling infrastructure becomes highly prioritized. Throughout the city of Freiburg, 500 kilometres of bike lanes and 5000 bicycle parking spaces have been constructed. This strategy has been extended through a fine-grained network of direct, high quality routes in the district of Vauban (see Figure 16). The network makes cycling even more direct and convenient than the car for many journeys. However, pedestrians have the priority on these wide pathways.

The result of this implemented measure can be seen in the high bicycle mode share in the districts, where 61 per cent of car-owning households and 91 per cent of the car-free households commute by

bicycle. In addition, as an extra service such as free labor is offered at the community bicycle repair store located within the district (Foletta & Field, 2011, p. 103).



Figure 16: Shortcut of the cycling network in Vauban (left) and the hierarchy on these routes (right) (Foletta & Field, 2011)

6.2.3 GWL Terrein

Cycling is the main means of transport for most of the residents in GWL Terrein. This might not be strange due to the fact that it is located in one of the greatest bicycle-friendly cities in the world. However, the efforts of implemented go even further in GWL. In GWL more than 50 per cent travel by bicycle, compared to the 30 per cent in the rest of the city (Foletta & Field, 2011).

To ensure cycling remains the main means of transport, several policies to improve cycling have been implemented. GWL Terrein is bordered by a brick-coloured bike lane (see Figure 17), which is protected from moving traffic either by rows of trees, tram platforms or strips of parked cars. In addition, wide, mixed-used pathways for both pedestrians and cyclists have been developed inside the area. According to the developers, the shared pathways indirectly improves the safety amongst the users given the reason that *“... both cyclists and pedestrians are more aware of their surroundings, looking out for fellow travellers rather than assuming that paths will be segregated”* (Foletta & Field, 2011, p. 21).



Figure 17: Segregated and protected bike lanes bordering GWL Terrein (Foletta & Field, 2011)

6.2.4 Potential Measures to Improve Cycling in Middelalderbyen

The different implemented measures to improve cycling as presented above in the three reference cases are summarized below in bullet points:

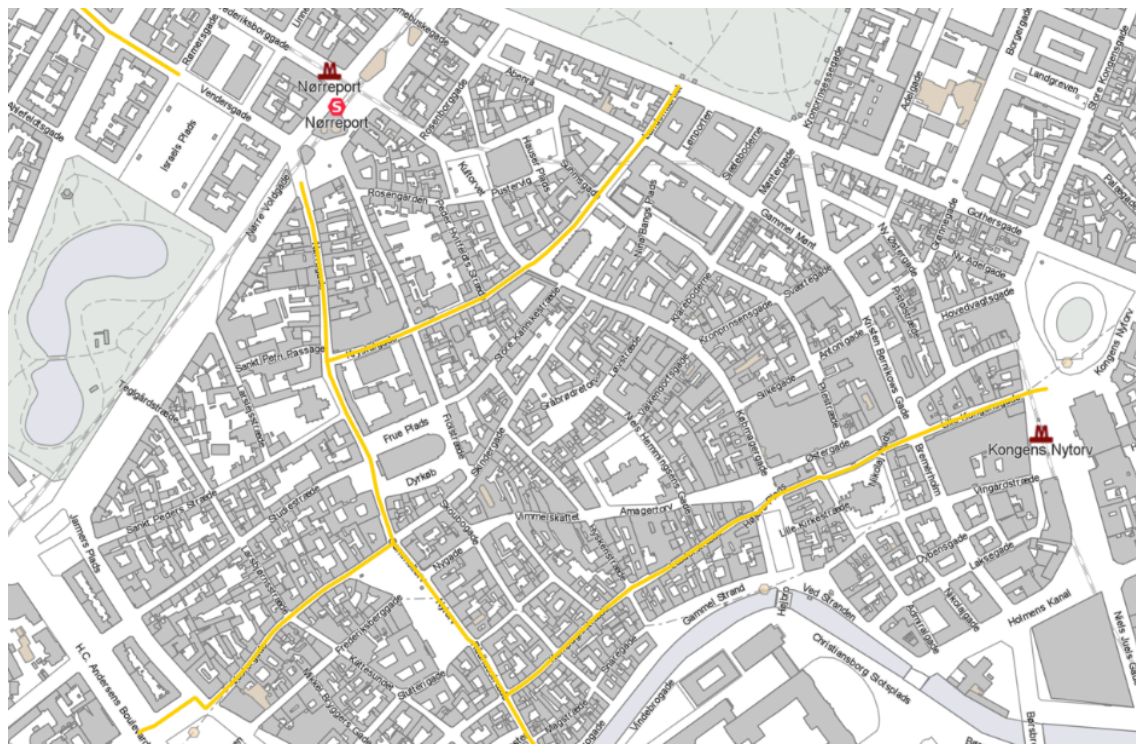
- Segregated bike lanes
- Prioritization of cyclists over cars
- Wide mix-used pathways protected from motorized traffic

In the next subchapter every measure will be analysed in relation to the situation in Middelalderbyen and the possibilities for adapting those in a Danish context.

6.2.5 Middelalderbyen

Some consider Copenhagen as the world’s best bicycle-friendly city, which means that the City of Copenhagen puts a lot effort in improving the conditions for cyclists (Copenhagenize, 2015). In recent years, the City of Copenhagen has improved the capacity and passability through measures such as wider bike lanes, bicycle bridges and exemptions from one-way streets. Today, more than 60 per cent of all residents in Copenhagen commute by bike to work or school (Københavns Kommune, 2014b). In addition to this, greater Copenhagen consists of a high-quality cycling network, which will be elaborated even further in the seventh principle concerning compactness.

By looking at the area of Middelalderbyen, this mentioned high-quality network is lacking. The narrow street design is not providing any space for separated bike lanes or at least bicycle-friendly streets. As it is now, cyclists and car users are sharing the road space. This solution is not safe for the cyclists, even though, a safe and complete cycle network can be achieved through various cycleways and not only through separated bike lanes (ITDP, 2014). However, Figure 18 outlines the possibilities for a future implementation of segregated bike lanes on the main roads throughout Middelalderbyen. This implementation will provide a safe cycling network across Middelalderbyen, and moreover, make cycling more appealing because of the increased safety and passability.



■ Bicycle-friendly streets

Figure 18: Possibilities for segregated bike lanes (Københavns Kommune, 2016)

Likewise important as passability is bicycle parking in Copenhagen. It has not been outlined in the reference cases due to lack of information. However, it is only Bologna that functioning as a central urban area as Middelalderbyen but without a great bicycle culture yet, while Vauban and GWL both are neighbourhoods. In continuation of the possibilities to reclaim parking spaces from the first principle (walk), the free spaces could be allocated as bicycle parking (see Figure 19). From the observations, many bicycles were parked on the already narrow sidewalks or outside the bicycle parking, which make it even more difficult for pedestrians to walk (Appendix B).



Figure 19: Previously parking spaces turned into bicycle parking

6.3 Connect

Connectivity is about creating the shortest and most direct route for non-motorized means of transport such as walking and cycling. This principle is linked to both the first and second principle (walk and cycle), however it concerns other important aspects beyond shortness and directness such as safety, activity and comfort. In relation to this, a highly connected network includes paths and streets around small, permeable blocks that slow down traffic and makes walking and cycling more direct, varied, interesting and attractive (ITDP, 2011). The following will describe the implemented measures in order to improve connectivity.

6.3.1 Bologna

The extension of the semi-pedestrian areas and the implementation of a bicycle ring road are connecting the city centre with the surrounding areas (see Figure 20). The greater pedestrian area is located in the centre of the old town, which is perfectly connected with the cycling network. In

addition to this, the old building structure from the Middle Ages with small, permeable blocks makes walking and cycling more interesting and attractive.

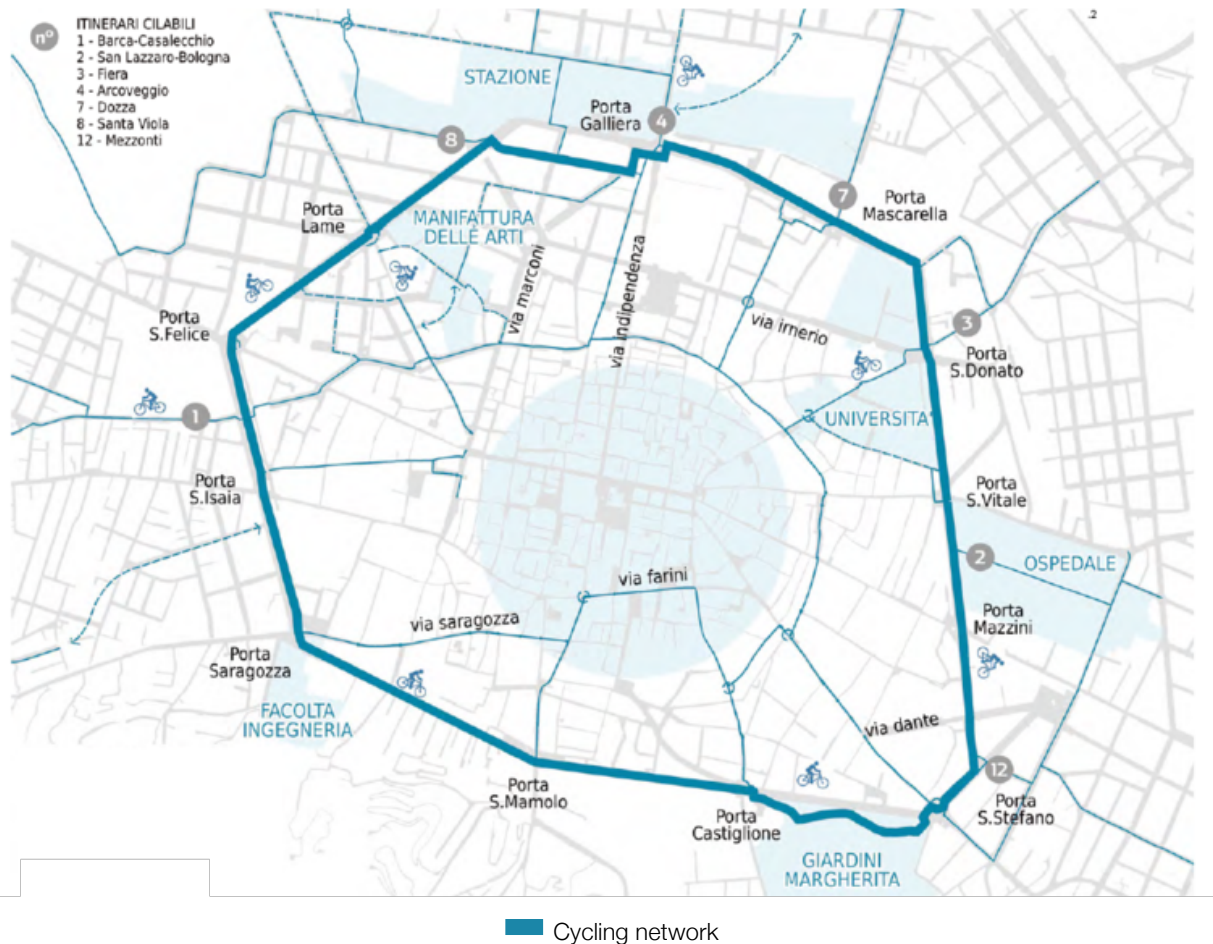


Figure 20: Cycling network in Bologna (Urban Center Bologna, 2014)

6.3.2 Vauban

To ensure a high connectivity in Vauban an extensive, high quality non-motorized transport infrastructure was developed (see Figure 21). This was developed to make walking and cycling more convenient than car use within the district. At intersections with residential or other streets, fixed posts prevent unauthorized access by vehicles on these pathways (Foletta & Field, 2011).

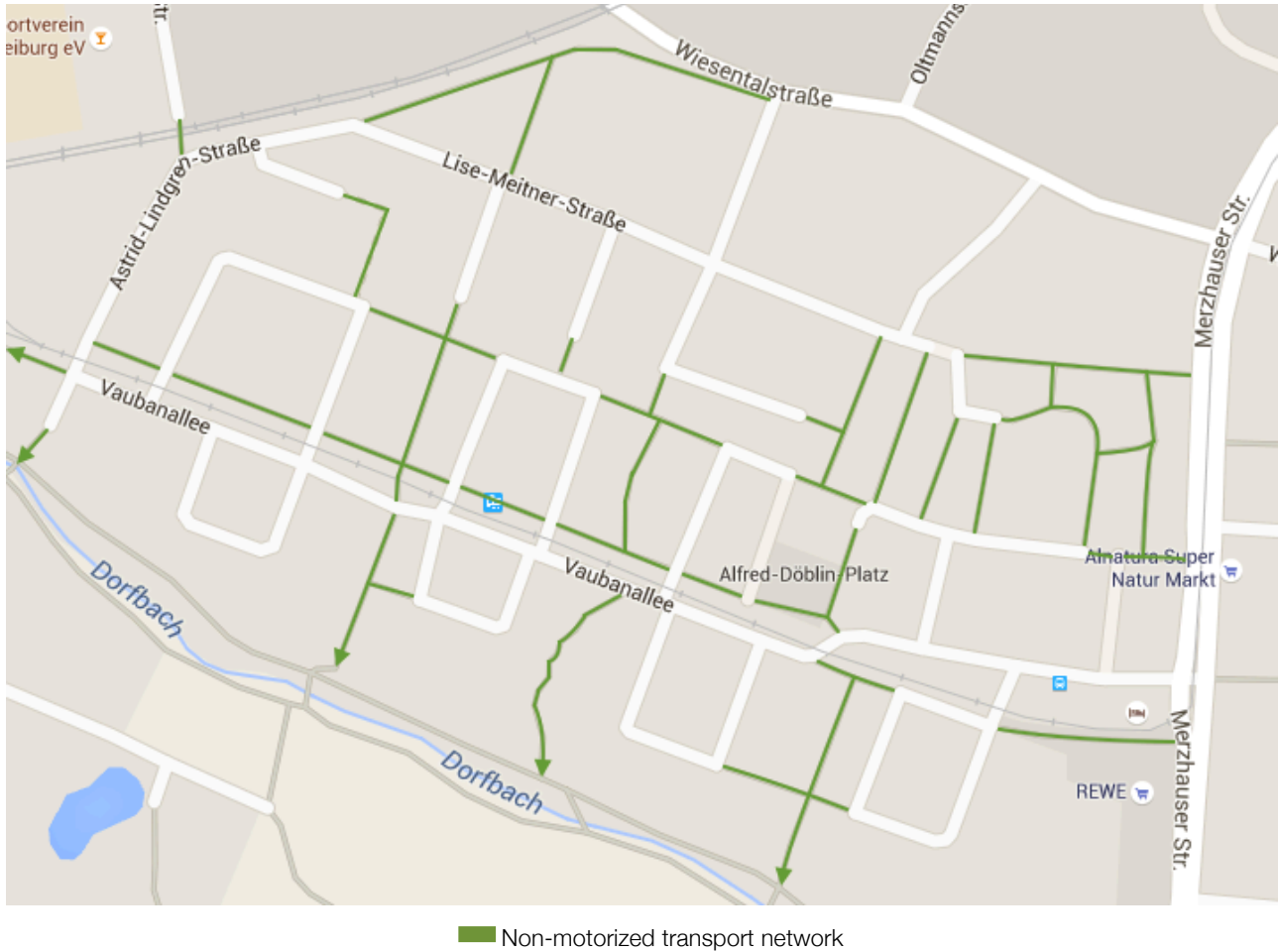


Figure 21: Non-motorized transport infrastructure in Vauban (Google Maps)

Moreover, the district of Vauban is connected with the neighbouring districts through pathways only accessible by non-motorized transport modes. In addition, the district is connected with the city of Freiburg just 3 kilometers away, providing good on-road and sidewalk bike lane. This means that walking and cycling routes are short, direct and varied, where the car has to drive a detour (ITDP, 2014)

6.3.3 GWL Terrain

Since GWL Terrain only encompasses an area of 6 hectares, the connectivity within the area is quite high. Given the fact that the entire area is car-free, walking and cycling becomes the only possible means of transport. In addition, the shared pathways create a system of varied routes and connect all buildings, and protected from motorized vehicles as shown in green in Figure 22.

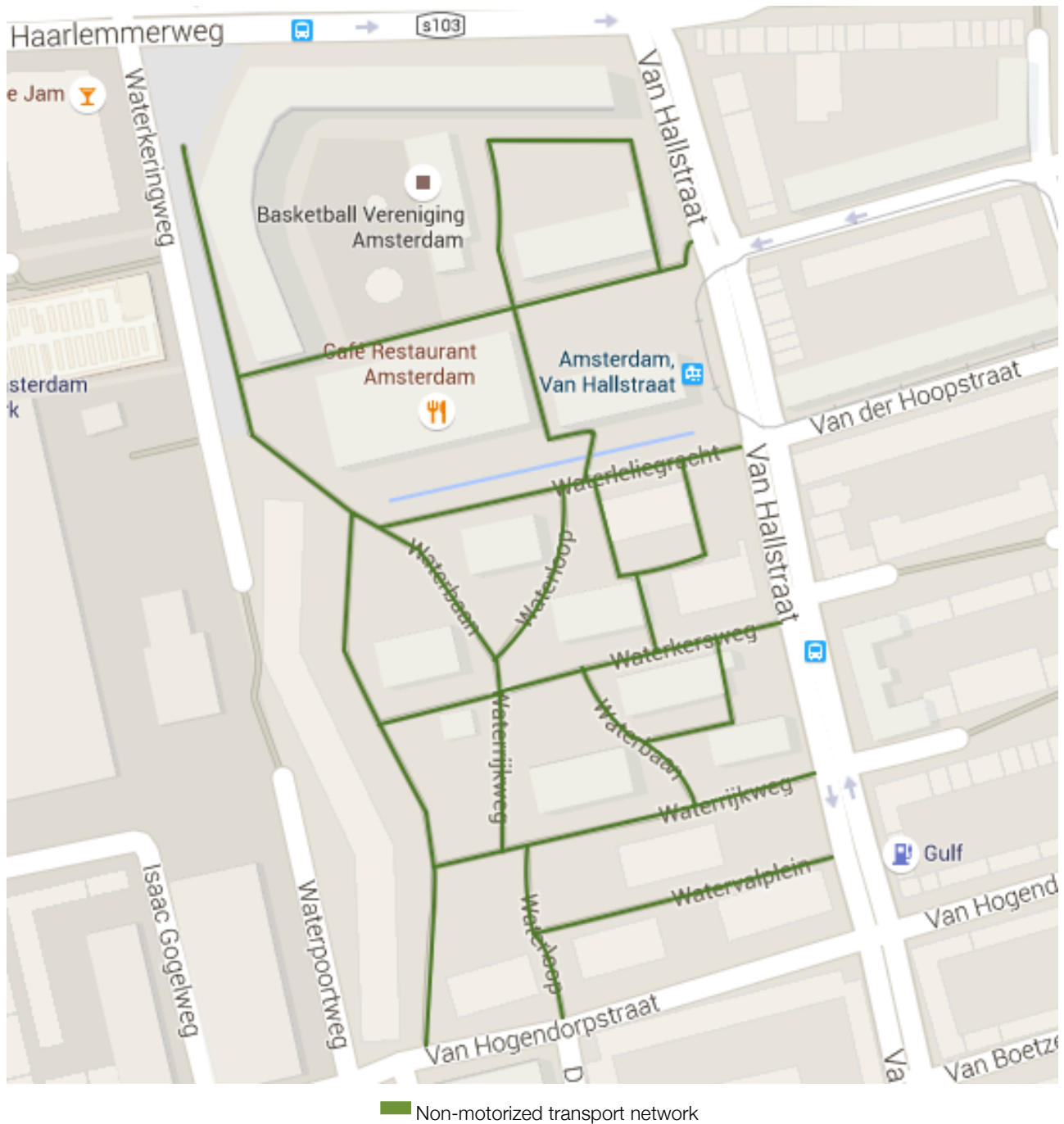


Figure 22: Shared pathways for pedestrians and cyclists in GWL Terrein (Google Maps)

Moreover, the location of GWL Terrein just 3 kilometres from the city centre of Amsterdam makes it possible to reach by bicycle within 10-15 minutes.

6.3.4 Potential Measures to Improve the Connectivity in Middelaalderbyen

The different implemented measures to improve the connectivity as presented above in the three reference cases are summarized below in bullet points:

- Segregated walking and cycling paths
- Walking and cycling routes becomes the shortest and most directly
- Shared pathways protected from motorized vehicles

In the next subchapter every measures will be analysed in relation to the situation in Middelalderbyen and the possibilities for adapting those in a Danish context.

6.3.5 Middelalderbyen

The building structure of Middelalderbyen consists of short blocks and streets, which mostly provide direct and varied routes to pedestrians. In relation to this, the old buildings are offering different shortcuts beyond the conventional and often used streets. However, you have to be aware of many of them first. Accordingly, T. M. Sandau introduces many of the existing shortcuts on his webpage (www.indenforvoldene.dk) (Sandau, 2015). One of the most well known is Jocks Passage, which connects Skindergade with Fiolstræde. A more unknown one as shown in Figure 23 could be Klostergangen, which connects Vimmelskiftet with Læderstrædet. By making these more obvious to the public or creating new ones, pedestrians and cyclists gets the opportunity to explore the city's small secrets.



Figure 23: Lyrical pictures of Klostergangen at Strøget

If returning to the overall picture of Middelalderbyen, the car is still dominating many of the streets. This means that the pedestrians and cyclists have to look for possible crossing cars at the various crossroads in Middelalderbyen. However, the streets in Middelalderbyen are mostly one-way car traffic, while cyclists are excepted from those rules. In relation to this, segregated walking and cycling paths takes up a lot of space, and are only needed if the car still has to play its dominant role as today. By giving the priority to other road users than the car as already mentioned in the two above principles, the segregated paths are not a must. More interesting is the shared pathways, which also can be used by delivery vehicles during certain times of the day or in emergency situations by emergency vehicles.

6.4 Transit

Transit is about the accessibility to high-quality transit systems or other local services by foot, and how these connect and integrate distant parts of the city. Short distance to public transit systems is critical for changing the existing pattern of car usage and making walking more appealing. The maximum recommended distance for local services is 500 meters and 1 kilometre for high-capacity transit stations (ITDP, 2014). The following will describe the implemented measures in order to improve the accessibility to public transit systems.

6.4.1 Bologna

One of the key aspects of the implementation of the traffic-limited zone (ZTL) back in the late 1980s was to improve the public transport system, not just within the old town but also on main routes throughout the city. This included measures such as upgrading bus lanes, minibuses and trolleybuses. The combination of access control and improvement of the public transport system led to more frequent bus trips with shorter travel times due to less traffic on the bus routes (Topp & Pharoah, 1994). Ever since, the public transport system in Bologna has undergone constant development in order to make it more convenient than the car.

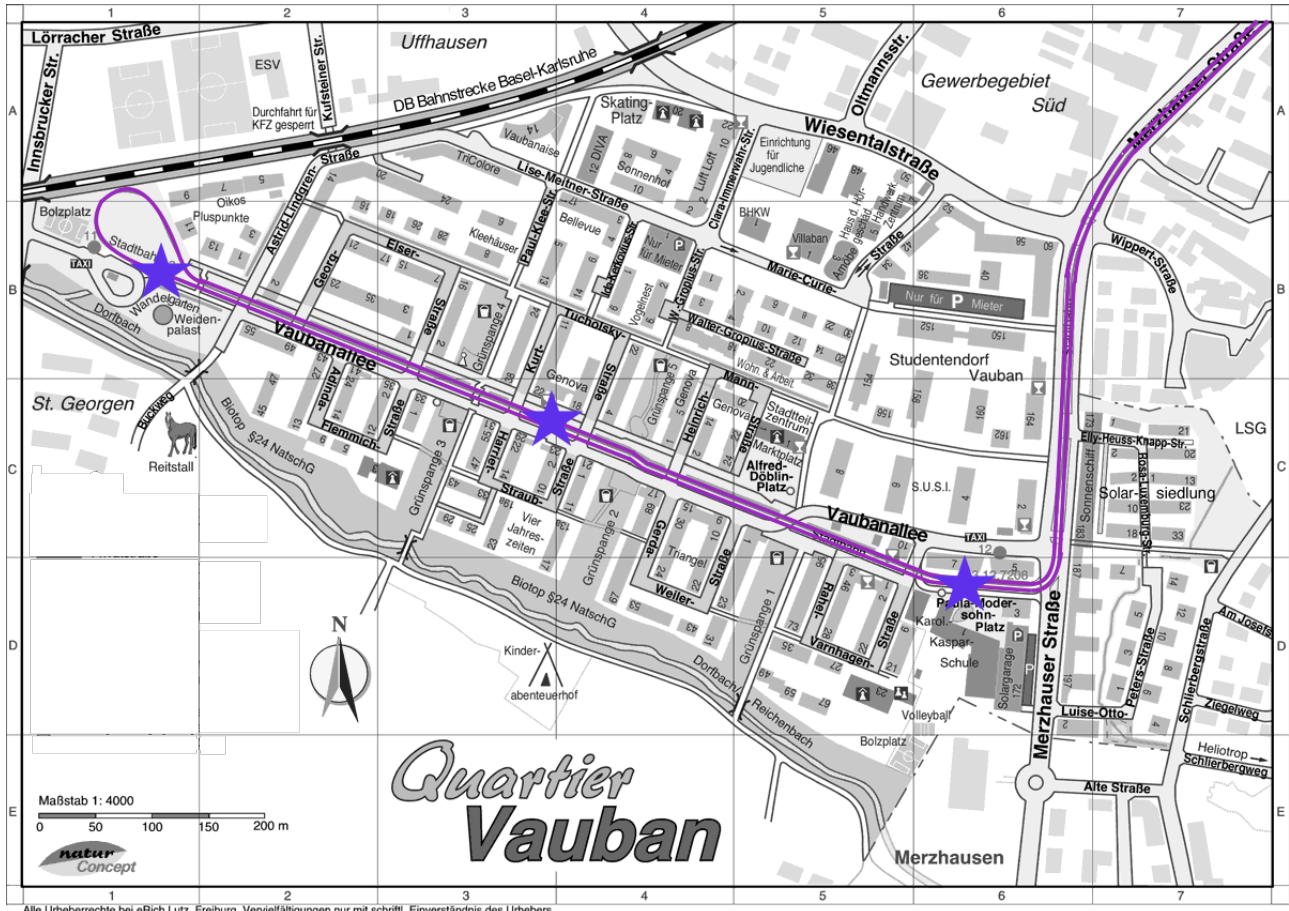
Given the fact that the old town of Bologna encompasses an area of 430 hectares, the coverage by foot can be difficult. The walking distance from city centre to Bologna Centrale (central station) in the northern part of the old town is about 1400 meters, which is longer than the desired maximum. However, several bus lines or trolleybuses provide direct service between those two locations, and other destinations inside and outside the old town (see Figure 24). This provides accessibility to high-quality transit or direct transit services for all persons within very short distance.



Figure 24: Short-cut of the public transport system in the old town of Bologna (TPER, n.d.)

6.4.2 Vauban

To support the ideal of car-reduced living in the district, the tram system from Freiburg was extended in 2006. This provided the residents access to a tram stop within a maximum of 400 meters from their homes (see Figure 25). The extension of the tram system connects and integrates the district of Vauban with the city centre of Freiburg and the central station within 14 and 18 minutes respectively. Moreover, the residents have access to two bus lines running at the edge of the district in the western and eastern part.



■ Tram line ★ Tram stop

Figure 25: Tram line service with stops in Vauban (Vauban, 2014)

The outcome of this extension has not been examined. However, findings from a survey before the tram system was extended shows that access to local transit is important for the choice of day to day mobility and the potential shift from the car for medium to longer-distance journeys (Foletta & Field, 2011).

6.4.3 GWL Terrain

To support car-free and sustainable living in GWL Terrain, the tram system from Amsterdam was extended as part of the development of the area. According to car-free households in GWL, the access to public transit makes owning a car superfluous for the day to day mobility (Foletta & Field, 2011). The tram terminates at the edge of the area on the eastern side, which provides the residents access within a maximum distance of 300 meters from the most distant residence in the area. The travel time to Amsterdam Centraal (central station) is about 15 minutes. This connects and integrates the area to the rest of the city of Amsterdam, and makes it easy and convenient to live without a car.

6.4.4 Potential Measures to Improve the Accessibility to Public Transit in Middelalderbyen

The different implemented measures to improve the accessibility to public transit as presented above in the three reference cases are summarized below in bullet points:

- Provision of short distance to public transport systems

In the next subchapter the measure will be analysed in relation to the situation in Middelalderbyen and the possibilities for adapting those in a Danish context.

6.4.5 Middelalderbyen

By looking at Middelalderbyen and the accessibility to public transit, Nørreport Station is located north of the area just 500 metres from the city centre of Middelalderbyen. Nørreport Station is one of the biggest transit hubs in Copenhagen and serves S-train, Metro, bus, Regional train and Sound train (Øresundstog). In addition to this transit hub, a metro station is located at Kongens Nytorv in the eastern part of Middelalderbyen. These two stations are mainly covering the northeast area of Middelalderbyen. However, two new metro stations will be opening in 2019 as part of the new city circle metro line. Gammel Strand and Rådhuspladsen will become the new stations. By this, the accessibility to public transit will be even better from the whole area. The future coverage is shown in Figure 26.

(The figure appears at next page)



Figure 26: The range of reach within a radius of 500 metres from the surrounding stations of Middelalderbyen (Københavns Kommune, 2016)

In addition to the different train services, several bus lines are serving the peripheral of Middelalderbyen, which means that no buses pass through the area, even though it could be possible on some of the main roads.

6.5 Mix

Mixed-use is about creating a well-balanced mix of complementary use and activities within a local area. This refers to the combination of residences, public spaces, workplaces and local retail commerce. The placement of these functions within walking distance will contribute to that many daily trips will remain short and walkable, which furthermore will reduce car usage. However, the available information related to this principle varies from case to case. In relation to this, some of the indicators

have to be elaborated on in further research, which means that the description of the implemented measures will be very brief.

6.5.1 Bologna

The old town of Bologna is functioning as the central urban area of the city. This means that the area provides a wide range of shopping, entertainment, employment and residential options. Since about 54,000 people live in the area and around 80,000 work there, the mix of functions and activities must be good. But given the fact that the information about the mixed land-use has been difficult to find, no statistics can be shown.

6.5.2 Vauban

The mix of use is an important factor in the district of Vauban. In relation to the key principle of the development, which is about to make walking and cycling more convenient than car use, a well-balanced mix of complementary uses and activities within the district are required. To ensure this, the district of Vauban provides a wide range of shops and service-related functions along Vaubanalle, which has resulted in that a majority of the residents prefer to do daily grocery shopping within the district (Foletta & Field, 2011). In addition to this, the district does also provide large green and recreative areas, which also contributes to minimize the need for traveling out of the district to find pleasant areas.

Given the fact that Vauban is home to 5,000 people and workplace for about 600, the majority of the residents work outside the district. However, the location of Vauban gives residents easy access to the city centre of Freiburg, where many jobs are located. The distance between Vauban and Freiburg of 3 kilometres makes it possible to access by bicycle. This short distance to the city centre contributes to the ideal of car-reduced living in the district.

6.5.3 GWL Terrain

The area of GWL Terrain itself does not provide the residents with a wide range of shopping, entertainment and employment options. However, the area consists of a gym, offices, a café and a famous restaurant. In relation to this, several grocery stores, shops, pharmacies and cafés are accessible in the surrounding neighbourhoods, which means that the residents of GWL do not have to go far to run their daily errands and can be done bicycle or waking (Foletta & Field, 2011).

According to the number of residents (1,400 people) and employment options (216 employees) in the area, most of the residents have to work outside GWL. The location of GWL just 3 kilometres outside the city centre of Amsterdam, where the majority of jobs are located, makes commuting by bicycle easy and convenient. This contributes to the ideal of car-free and sustainable living in the area, even though workplace, shopping and entertainment options is located in the surrounding areas.

6.5.4 Potential Measures to Ensure the Balance of Mixed-use in Middelalderbyen

The different implemented measures to ensure the balance of mixed-use as presented above in the three reference cases are summarized below in bullet points:

- Well-balanced mix of residential units, business and commerce within short distance

In the next subchapter the measure will be analysed in relation to the situation in Middelalderbyen and the possibilities for adapting those in a Danish context.

6.5.5 Middelalderbyen

Middelalderbyen does already consist of a well-balanced mix of uses in relation to its function as the central urban area of the capital, workplace and home. This mix of uses provides residents with shopping, entertainment and employment options as the cases about Bologna, Vauban and GWL Terrein do. However, it is important to notice that not all of the residents are working in Middelalderbyen or the opposite that not all of the employees are living in the area, even though it is possible. In addition to this, the well-balanced mix is also substantiated by the great diversity of which the area provides. Figure 27 shows the distribution of grocery stores and shopping opportunities in Middelalderbyen. The distribution outlines that daily errands can easily be done within short distance for both residents and employees.

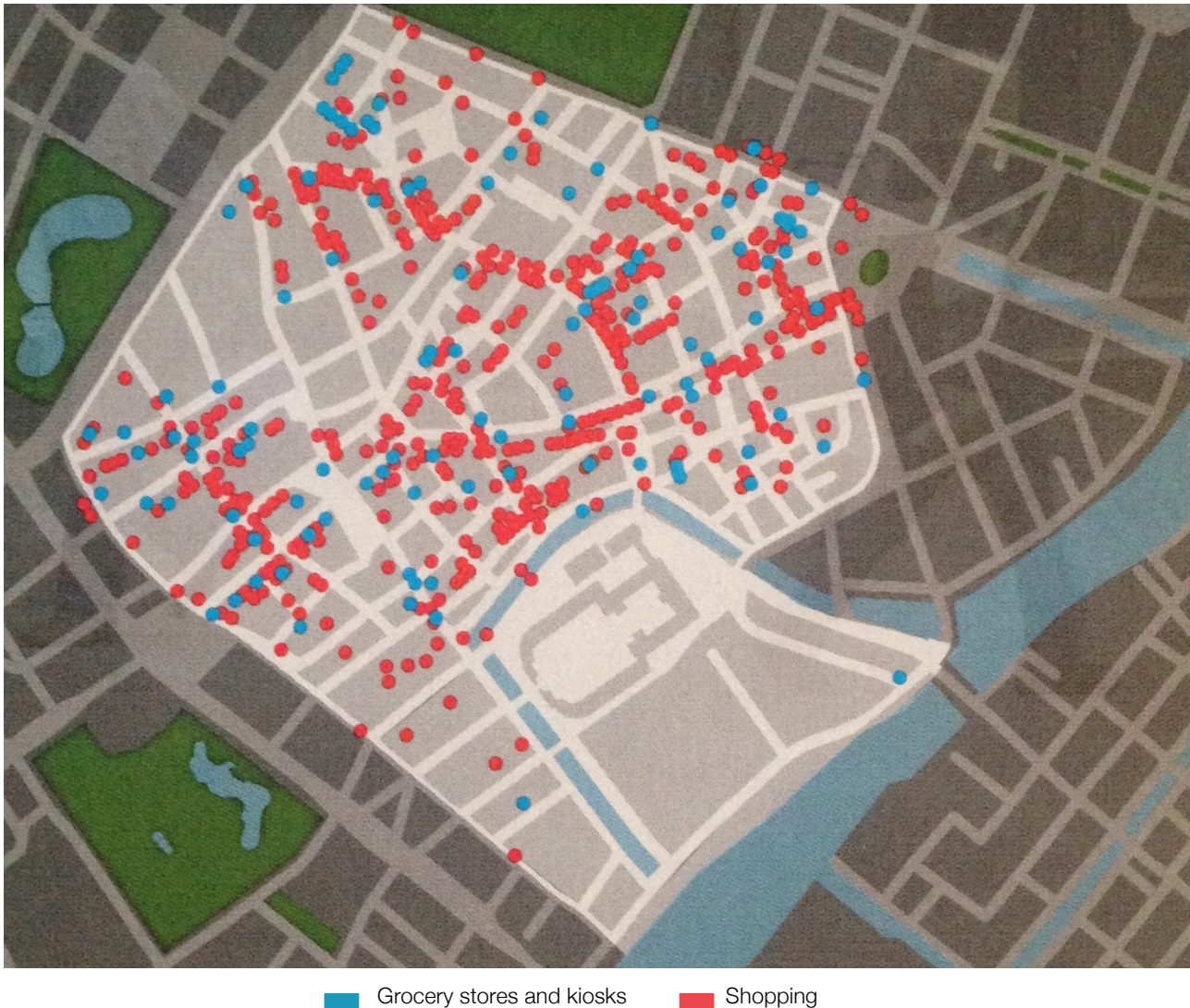


Figure 27: Distribution of grocery stores and shopping opportunities in Middelalderbyen (Københavns Kommune, 2007)

By saying that Middelalderbyen has a well-balanced mix of uses does not necessarily mean that it should be excluded from further study. Moreover, it is important to maintain this mix of uses in the future, which means that planners have to have an eye on the distribution of offers when developing the area. In addition, this mix of uses may call for a more individual and detailed survey to outline potential weak points or areas for improvement. That means if the individual needs are fulfilled through the great diversity in Middelalderbyen.

6.6 Density

Densification is about creating a compact and dense urban area by growing vertically instead of horizontally. By doing this, urban sprawl will be limited. Furthermore, the placement of residential units

and job opportunities near public transit or local service will contribute to a more dense and compact city, and reduce the need for a owning a car. However, a densification of Middelalderbyen is not possible due to the fact that the area is worth preserving. The cases about Vauban and GWL Terrien are something special in relation to this principle given the fact that these have been built on abandoned sites. This constellation makes it possible to focus on densification and building homes on land that would otherwise been used for parking.

6.7 Compact

Compactness is about creating compact regions with short commutes. By promoting densification and redevelopment of previously developed land, and ensuring high connectivity between those through high-quality public transit network, rural land can be preserved from being developed. This can make public transit easy and more convenient than travelling by car. The following will describe the implemented measures in order to improve the compactness of the area.

6.7.1 Bologna

The improvement of the public transport system as mentioned earlier was not just related to inside the old town, but also on main routes throughout the city. Where urban bus lines connect parts of the city centre and suburban bus lines connect neighbouring areas with the city centre. The more regional destinations are connected to the city centre through Bologna Centrale (central station), where the metropolitan rail system and high-speed train runs from. The Metropolitan Railway System connects almost all cities and provinces of Emilia Romagna region, while the high-speed train connects Bologna with larger cities such as Florence, Milan, Venice, Rome and Bari (see Figure 28). Florence can be reached in 30 minutes, while Bari is 6 hours away.



Figure 28: The high-speed train network in Italy (Trenitalia, 2015)

6.7.2 Vauban

The previously mentioned extended tram line in the fourth principle about transit is part of a greater tram network, which connects all suburban areas in the City of Freiburg. The accessibility to the tram line provides the residents of Vauban with further connection to more regional destinations from Freiburg Hauptbahnhof (central station) (see Figure 29). This contributes to making public transit more easy and convenient than the car.

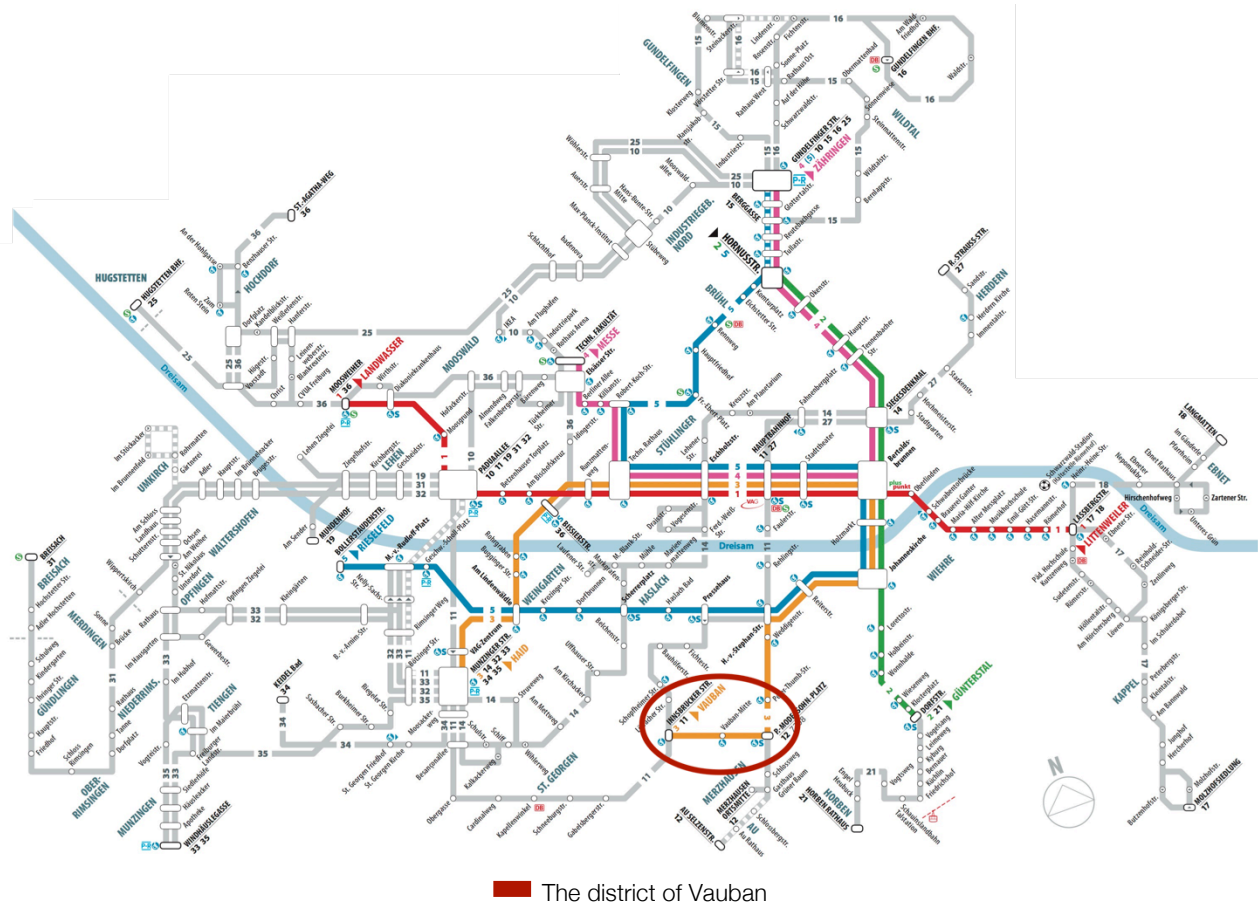


Figure 29: The tram system of Freiburg (VAG, 2015)

6.7.3 GWL Terrain

The tram line terminating outside GWL provides the residents further connection to the greater system of tram and metro lines serving the city of Amsterdam (see Figure 30). Moreover, it connects GWL with Amsterdam Centraal (central station), where the more regional destinations are served by regional train services. In addition to this, the two bus lines provide the residents direct services to Amsterdam Centraal or Sloterdijk Station.



→ GWL Terrein

Figure 30: The tram and metro system of Amsterdam (GVB, 2014)

6.7.4 Potential Measures to Improve the Compactness in Middelalderbyen

The different implemented measures to improve the compactness as presented above in the three reference cases are summarized below in bullet points:

- High connectivity between central and regional destinations

In the next subchapter every measures will be analysed in relation to the situation in Middelalderbyen and the possibilities for adapting those in a Danish context.

6.7.5 Middelalderbyen

Greater Copenhagen consists of a well-functioning S-train service that connects distant parts of the city (see Figure 31). This S-train network is based on the famous Finger Plan, which was developed back in the late 1940s. As mentioned earlier, Nørreport Station is located in the northern part of Middelalderbyen. From here it is possible to reach several suburban as well as more regional destinations. In addition, several bus lines are serving urban and suburban areas. However, the access to public transit services are still lacking in the outskirts of Copenhagen, which can be the reason why some people choose to take the car all the way into Middelalderbyen. One of the interviewed people stressed that he did not use public transit because it does not make sense with his home address, workplace location and visiting friends (Interviewee 9, Appendix A). However, another one made it clear that he was willing to consider using the public transit system if there was a direct S-train line near his address (Interviewee 5, Appendix A). This emphasizes that the surrounding areas are as important as Middelalderbyen in the attempt to reduce car traffic and the creation of a car-free environment.



★ Nørreport

Figure 31: The S-train network in Greater Copenhagen (DOT, 2015)

In addition to the public transit system, the Municipality of Copenhagen has had focus on creating a bicycle network that connects some of the greater suburban areas with the city centre. Today, the bicycle network connects Albertslund, Farum with the Inner City of Copenhagen. However, the Municipality of Copenhagen is about to extend the network with connections to among others Allerød, Ishøj and Værløse (Supercykelstier, 2016a). The existing and future Cycle Superhighways are illustrated in Figure 32.



Figure 32: The Cycle Superhighway network in Greater Copenhagen (Supercykelsti, 2016b)

6.8 Shift

The last principle is about minimizing the land that cars occupy. Reducing the availability of the car contributes to a reduced car ownership rate, which frees up urban space that can be reclaimed from unnecessary roads and parking, and be reallocated for more socially and economically productive

uses (ITDP, 2014, p. 26). Different from the other seven principles, this principle is directly related to car use. The following will describe the implemented measures in order to make private car usage less convenient.

6.8.1 Bologna

In the old town of Bologna indicators of traffic congestion, lack of parking spaces and air pollution have long time been a problem for the city. This resulted in the implementation of the traffic-limited zone (ZTL) in 1989, which has since been supplemented with several other measures in order to reduce car traffic. Only authorized vehicles can enter the zone between 7:00 am to 8:00 pm. To prevent unauthorized access the zone is monitored by SIRIO cameras, which record license plates and fine car owners that are not on the authorized car list (CIVITAS, 2013c).

In order to reduce the number of private cars in the old town, car-sharing and park-and-ride services were implemented as part of the ZTL. These solutions were furthermore implemented to overcome traffic congestion, lack of parking spaces and air pollution caused by the high number of private cars (CIVITAS, 2013b). This car-sharing service was one of the first in Italy. The service is located both inside and in the periphery of the old town as shown in Figure 33.

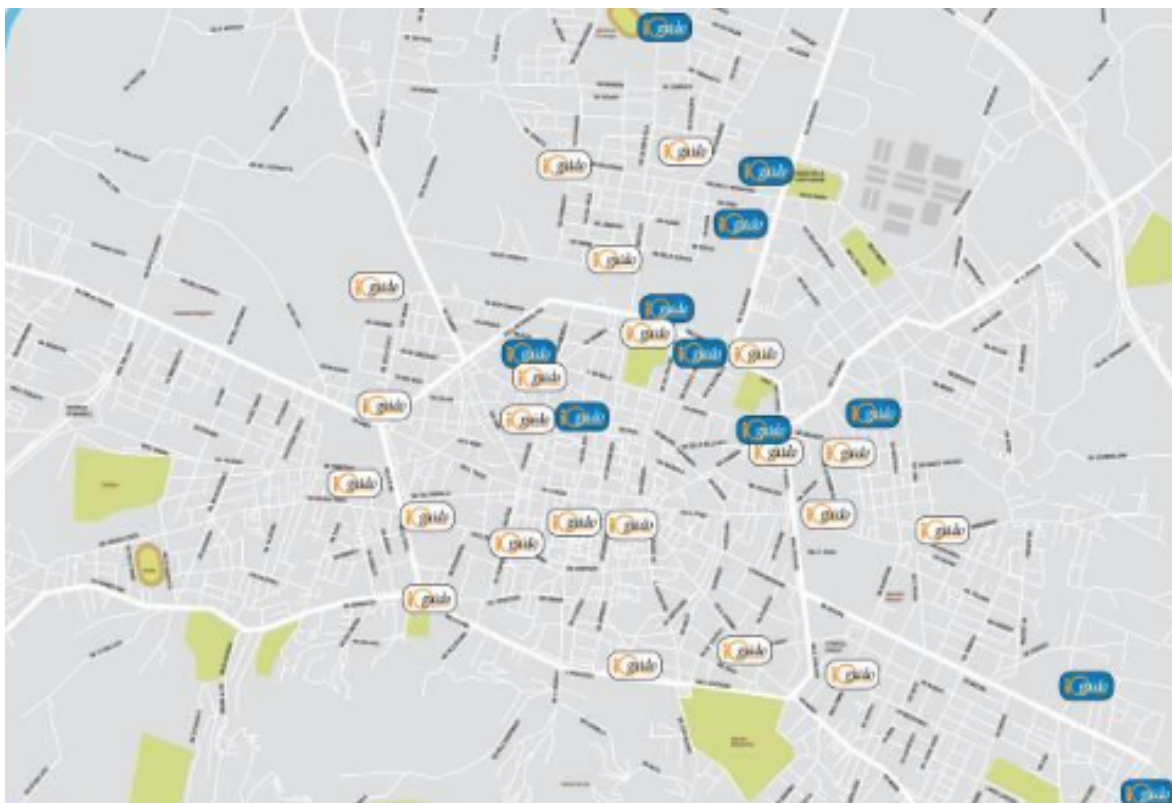


Figure 33: Car-sharing locations in Bologna (Nassisi et al., 2013)

Related to the reserved parking spaces for car-sharing members, the Municipality of Bologna developed different systems for the protection of car-sharing locations against unauthorized parking. This gives advantages to the car-sharing users that almost everywhere have access to a free parking space close to their final destination.

Another measure is the park-and-ride structure, which also contributes to less car use. At different locations in the peripheral of the old town, the park-and-ride structure offers free car parking if you shift to either public transport, bicycle or public bicycle, or taxi for the remaining travel time to the destination inside the old town. This implementation increases use of public transport and bicycle, furthermore, it reduces on-street parking, traffic congestion and air pollution in the old town (Carlini, 2014).

6.8.2 Vauban

In the district of Vauban, a special street design was developed to support car-reduced living and make private car ownership less convenient. Cars are still permitted on the residential streets, but they are not allowed to park on them. In addition, the car has to be parked in the communal car parking at the edge of the district. The special streets have a width of 4 meters including drainage channels and signed 'play streets' (blue sign) as shown in Figure 34. A play street means that the primary use is walking and playing, which gives the priority to other road users rather than the car.



Figure 34: Parking-free residential streets (Vauban-im-bild, n.d.)

But, recently there has been a significant and growing problem with illegal parking on the parking-free streets, which Figure 34 illustrates (Foletta & Field, 2011). This problematic situation is caused by the new generation that wants to have 'the best of both worlds', which is challenging the key principle of the district of making car use less convenient than other alternatives. Furthermore, lacking interest from the Municipality of Freiburg makes it difficult to implement remedial actions, which means that it is the residents themselves who have to enforce the laws opposite one another.

The car-reduced living in the district of Vauban is also supported by car-sharing service, which are both available for car-free and car-owning households. This service counts 12 cars. A survey from 2002 shows that 59 per cent of car-free households and 11 per cent of car-owning households take part in car-sharing. In relation to this, about 70 per cent of those without cars responded that they use car-sharing more often than before moving into Vauban (Nobis, 2003). One could say that this the result of the parking concept due to the fact that more than half of the car-free households were persuaded to not own a car because of the unique combination of carrots and sticks offered by the district (Foletta & Field, 2011)

6.8.3 GWL Terrein

To make car ownership less convenient in GWL Terrein, the area provides a limited number of parking spaces. Despite the fact that the entire area is car-free, none of the 600 residential units have parking spaces on-site. This means that car-owning households have to share the 122 on-street parking spaces.

In addition to the limited parking, the area provides the residents access to five car-sharing vehicles belonging to two different organisations. According to the umbrella organization Koepelvereniging, the provision of car-sharing is an important factor to reduce car ownership in the long term, due to the fact that it provides residents access to a car without having to own one (Foletta & Field, 2011). As advantage for car-sharing users, the cars have their own parking space among the already limited parking spaces for private car owners (see Figure 35).



Figure 35: Reserved parking for car-sharing vehicles (Google Maps)

6.8.4 Potential Measures to Make the Private Car Less Convenient in Middelalderbyen

The different implemented measures to make the private car less convenient as presented above in the three reference cases are summarized below in bullet points:

- Provision of car-sharing service with advantages over private ownership
- Park-and-ride services
- Parking-free streets
- Limited parking spaces

In the next subchapter every measures will be analysed in relation to the situation in Middelalderbyen and the possibilities for adapting those in a Danish context.

6.8.5 Middelalderbyen

In Copenhagen, nothing extravagant has yet been done to reduce the amount of cars. As introduced in *Chapter 5 – Case Study*, the area of Middelalderbyen is located in the most expensive parking zone, which should make people think twice about alternative transport modes to the car. However, as one of the interviewed people declare, the inconvenience and high cost does not make her change

transport modes due to the fact that she dislikes public transport and would always choose her car (Interviewee 6, Appendix A). Moreover, the special rules for resident's license should also get the residents to consider the need for a car when living in the area of Middelalderbyen. In relation to reducing the amount of cars in Middelalderbyen, some parking spaces here and there have been repurposed for bicycle parking. However, many parking spaces could also easily be abolished.

As mentioned in some of the previously principles, there are plenty of ideas and solutions for different use of the streets, if the cars were left out of Middelalderbyen. At the time when Middelalderbyen was developed, the main means of transport was walking which emphasizes the potential for reclaiming the urban space from unnecessary roads and parking. When talking about future solutions, it is important to keep in mind that today at least delivery and emergency vehicles have to have access to the streets. But this differential treatment will at some point create a huge debate as it did in Bologna with the ZTL, because everyone wants to have access, especially residents, businesses and tradesmen. In addition to this, Figure 36 shows an example of a possible restructuring of the street design, which is based on inputs from residents, businesses and local authorities (Københavns Kommune, 2013). Within this solution, vehicles can still access the street if needed.

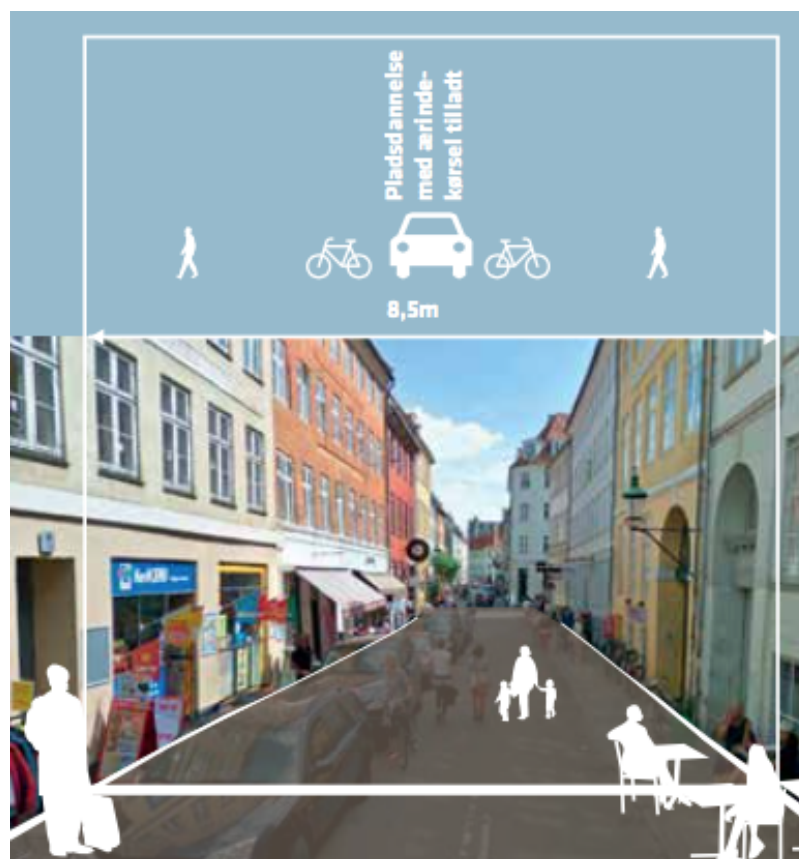


Figure 36: Restructuring of the street design (Københavns Kommune, 2013)

Parking-free streets or not, car-sharing services has to be promoted even more in Middelalderbyen given the fact that it contributes to reduced car use and car ownership. Today, car-sharing organisations such as Hertz Delebilen, DriveNow and Letsgo are operating in Copenhagen. Hertz Delebilen and Letsgo are operating as other car-sharing services, where you book the car if needed. DriveNow is a little different; they are more likely functioning like bike-sharing services. By reserving parking spaces for car-sharing services, it will become more attractive than the private car (see Figure 37).



Figure 37: Example of reserved parking spaces for car-sharing services in Vanløse, Copenhagen

The sign at Figure 37 states that the two parking spaces are reserved for car-sharing service with special car-sharing license. By this, members of a car-sharing service will have a better chance to find a free parking space.

6.9 Summary

In this chapter, the 8 Principles for Transport in Urban Life have been analysed in Middelalderbyen. This has been done to improve the conditions in Middelalderbyen in order to develop a car-free environment in the long run. Based on experiences from the three reference cases about Bologna, Vauban and GWL Terrein, different possible measures have been outlined. As the principles outline themselves, the potentials for creating a car-free environment in Middelalderbyen are not only depending on how the individual principles work itself, but also on how the principles work together.

In addition to this, it is likewise important to emphasize the surrounding cities as well as Middelalderbyen, when developing a car-free area. The surrounding cities and their connections to Middelalderbyen are crucial for a change. If the accessibility to alternative transport modes in the outskirts is not satisfying the needs of the people living there, they will still continue taking the car. The idea of developing a car-free environment in Middelalderbyen is not just about moving the car traffic problem further out, but instead about getting people to consider their daily choices of mobility practices. This development calls for a coherent overall planning process.

According to the outcome of the 8 principles, Middelalderbyen has a good starting point for developing a car-free environment. Given the fact that the area dates back to the middle ages, it is not a surprise at all. At that time, the main means of transport was walking. That created a very dense area. However, a further densification today is not possible due to the fact that Middelalderbyen is worthy of preservation. The already existing densification has to be maintained, while the other principles as to be improved in order to create a car-free environment in Middelalderbyen.

Last but not least. Any changes will somehow affect the daily mobility patterns of residents, businesses, tradesmen and visitors in Middelalderbyen. As in Bologna, Vauban and GWL Terrein, the changes will create some debate, which cannot be avoided. Here the politicians have to demonstrate their leadership and their commitment to make a different.

7 DISCUSSION

The aim of this project is to identify the essential actions for the development of a car-free environment in Middelalderbyen. There are several possible actions, which can be implemented within the area of Middelalderbyen – and in the surrounding cities. It is possible to see make changes in people's mobility practices, if the focus is just on only the area of Middelalderbyen. But this will increase the risk of just pushing the car traffic problem further out, which is not the idea of developing a car-free environment.

As the *8 Principle for Transport in Urban Life* outlines, the actions are related to the areas concerning walk, cycle, connect, transit, mix, densify, compact and shift. In order to develop a car-free environment these principles do not only have to be achieved individually, but also together. Related to this, the seven first mentioned principles can be categorized as pull factors, which means that improving the people-oriented transport modes (walking, cycling and public transit) will attract former car users. While the last principle about shift can be categorized as a push factor, which means that making car driving more difficult will push car drivers over to the alternative transport modes. Once again, the car cannot just be removed without being replaced with accessibility to alternative transport modes.

In contrary to this, the *Staging Mobilities* framework outlines that the development of a car-free area is not only about making changes to the built environment. According to this, mobilities do obviously take place in the designed physical settings and material spaces, but the mobile self and their decisions equally affect the situational mobility practice. People have different needs and reasons for choosing the car as the primary transport mode. For instance, tradesmen uses the car to carry all kinds of tools, businesspeople use the car to drive between their many meetings around the city, while others use the car to move them from point A to B, because they find it more easy and convenient than travelling by alternative transport modes. This emphasizes that any changes to the built environment will affect people differently, which is an important consideration when deciding the final measures to be implemented to reduce car usage and the number of cars in Middelalderbyen. However, a quantitative impact study of the individual performance of the mobile self will be a far-reaching process, which is the reason that this project has mainly focused on the physical measures from above.

When identifying possible actions for Middelalderbyen, neither the planning nor implementing processes are taken into account. This means that the transition processes in Bologna, Vauban and GWL Terrein have not been analysed or considered as an aspect of the essential actions for the development of a car-free environment in Middelalderbyen. In relation to this, it has only been the physical measures, which have been described in the reports about the car-free development of the three reference cases. In continuation of this, this project do not emphasize any specific solutions for Middelalderbyen given the fact that further research is needed to find the best solutions for the area and its many functions.

Recommendation for Further Research

As this project has an explorative research design, the findings here are just a fraction of the bigger picture. This means that the research question of this project can provide the basis for further investigations. In relation to this, numbers of new research questions can be formed based on this one. The focus on these can be both technical as more detailed exploration of the existing research question.

For further research, it could be interesting to map the mobility patterns of residents, employees and visitors of Middelalderbyen. A research like this will be useful in the understanding of why people chose to take the car instead of alternative transport modes. Moreover, which possible improvements that could make them consider using alternatives transport modes instead of a car.

Another angle of the research question could be the planning and implementation processes which lay behind the physical measures in the existing car-free developments. This will provide an insight in the decision-making process and the involvement of different actors. Moreover, how a top-down approach, a bottom-up approach or a mix of these approaches affects the transition process of car-free developments. However, these topics are rarely described, but are, at least, as important as the physical measures.

8 CONCLUSION

In relation to the growing interest in developing car-free cities around the world, the aim of this research has been to gain more knowledge about the essential actions for reducing car traffic. This research takes point of departure in the historic city centre of Copenhagen, which is termed Middelalderbyen. The name refers to the time period where it was developed. The building structure and foundation of Middelalderbyen has been analysed in order to outline the essential actions, which have to be developed in order to make the area car-free. Below, the research question is outlined again:

What actions are essential for developing a car-free environment in Middelalderbyen in a sustainable urban development context?

From the very beginning, the Municipality of Copenhagen was interested in collecting experiences from other car-free developments projects. They wanted to know how and what those cities had done to reduce the use and amount of cars. However, their focus on this was only on one factor - the car. As this project concludes, the essential actions in car-free developments concern multiple factors including the car. Car-free developments are not just related to one simple action, but a combination of several actions that in one way discourage car use and in another ways encourage the attractiveness of walking, cycling, public transit and car-sharing services. This means that the actions are a combination of push and pull factors, which basically *push* people away from the car and *pull* them towards alternative transport modes. The application of the *8 Principle of Transport in Urban Life* illustrates the importance of this, when shifting from the old, unsustainable paradigm of car-oriented urban developments toward a new paradigm where people-oriented transport modes are closely integrated in the urban development. In addition to this, the planning process has to include the surrounding cities as well as Middelalderbyen due to the many functions of the area (home, workplace, historical centre, shopping streets etc.)

The project outlines several potential improvements that could be implemented in Middelalderbyen, some more useful than others. In relation to this, Middelalderbyen contains a sound basis to develop a car-free environment given the fact that walking was the main means of transport at the time when the area was developed. The special architectural and historic interest with scarce and valuable urban spaces from the middle ages is just waiting to be reclaimed from unnecessary roads and parking. By

giving the priority to other road users, the land occupied by motor vehicles will become available for more socially and economically productive uses such as improving walking, cycling and the access to public transit. In relation to this, delivery and emergency vehicles requires access to Middelalderbyen, which sets some limitations to the restructuring of the area. This favouring will create a debate about who should have permission to access Middelalderbyen and why. An issue like that has to be taken into consideration at an early stage in the planning process of Middelalderbyen in order to avoid the same problems as in Bologna with the implementations of the traffic limited-zone and the huge amounts of permissions.

Another important measure of car-free development is the provision of car-sharing services. Given the fact that a car-free environment would not happen from one day to another, this service is crucial in the first step towards a reduction in car traffic. By giving benefits to the members of this service, people might begin to reconsider the importance of owning a car themselves. The private car will be superfluous as the alternative transport modes get improved and become more easy and convenient.

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APPENDICES

APPENDIX A: Interviews of Parkers in Nørre Kvarter

11. april 2016, kl. 12:00 til kl. 13:00:

Interview 1:

Midaldrende mand, hvis ærinde var at dekorere et butiks vindue i området. Bilen var valgt som transportmiddel, da han selv kører rundt med rekvisitterne, og derved besværliggøre at benytte anden transportform.

Interview 2:

Kinesisk familie på ferie i København, hvis ærinde var sightseeing. Bilen var valgt som transportmiddel, da deres hotel lå dårligt i forhold til metroen, hvorfor det var nemmere at leje en bil og kører rundt.

Interview 3:

Midaldrende mand, hvis ærinde var et møde i området. Bilen var valgt som transportmiddel, da han havde flere møder samme dag, hvis location havde dårlig forbindelse til det offentlige transport system. En metro på Østerbro ville måske få ham til at overveje anden transportform. Dog tilføjede han, at han til hver en tid ville vælge cyklen, som desværre fornyligt var blevet stjålet, da de få og altid optaget pladser gør det besværligt at finde en parkeringsplads i Middelalderbyen.

Interview 4:

Midaldrende kvinde, hvis ærinde var et møde i forbindelse med hendes job som udekørende sælger. Bilen var valgt som transportmiddel, da hun typisk har mange møder i løbet af en dag, hvilket også var begrundelsen for at hun ikke har tænkt over anden mulig transportform.

Interview 5:

Midaldrende mand, hvis ærinde var et møde med nogle venner på Nytorv. Bilen var valgt som transportmiddel, da han bor i Jonstrup og ikke har adgang til direkte offentlig transport. Dog lagde han vægt på, at han ville overveje det offentlig transport system, hvis der var en direkte S-togs linje ved hans bopæl.

11. april 2016, kl. 17:00 til kl. 18:00:**Interview 6:**

Midaldrende kvinde og hendes moder, hvis ærinde var en tur i teater. Bilen var valgt som transportmiddel, da hun (datteren) hader at benytte sig af det offentlige transport system, og hellere end gerne ville bruge tid på at lede efter en parkeringsplads. Moderen tilføjede dog at hun ofte brugte det offentlige transport system, da hun synes det var besværligt at have bilen med ind til byen - men nu datteren tilbød at køre, sagde hun gerne ja.

Interview 7:

Ældre mand, hvis ærinde var en tur i Troelstrup (herretøjsbutik) for at købe lidt nyt tøj efter fyraften. Bilen var valgt som transportmiddel, da han kom direkte fra arbejde i Høje Taastrup. Ydermere, på grund af besværligheden og den ekstra tid det ville tage at benytte sig af det offentlige transport system. Endvidere tilføjede han, at han havde beboerlicens til området, da han bor på Nansensgade, hvilket gjorde at han kunne parkere 'gratis' i Sankt Peders Stræde efter kl. 17.00 og derfor ikke tog cyklen eller gåben til butikken fra hjemmet.

Interview 8:

To midaldrende mænd, hvis ærinde var et møde i området. Bilen var valgt som transportmiddel, da de synes at det offentlige transport system gik for langsomt.

Interview 9:

Ung mand, hvis ærinde var at besøge en ven i Larslejsstræde. Bilen var valgt som transportmiddel, da han kom direkte fra arbejde i Ballerup. Han tilføjede at anden transport ikke blev benyttet, da det offentlige transport system og hans bopæl ikke hang sammen.

Interview 10:

Ung mand, hvis ærinde var at hente rensede tøj i Sankt Peders Stræde. Bilen var valgt som transportmiddel, da kombination af at skulle mange gøremål og cyklen ikke hænger sammen. Han tilføjede også at han ikke benyttede sig af det offentlige transport system, uden videre begrundelse.

APPENDIX B: Observation Note in Nørre Kvarter

Samtidig med indsamling af interviews d. 11 april 2016, blev området i Nørre Kvarter observeret. Nørre Kvarter er et af de største boligkvarterer i Middelalderbyen. Området omfatter følgende stræder: Larslejsstræde, Teglgårdsstræde, Sankt Peders Stræde, Larsbjørnsstræde og Studiestræde. Går man rundt i disse stræder, ses en tydelig struktur med butikker i stueetagen og lejligheder i de øvrige etager. Man vil også lægge mærke til at gaderne er meget smalle, hvilket er karakteristisk for byggestrukturen fra middelalderetiden, hvor byer blev bygget kompakt for at opnå en kort afstand til byens funktioner, da den primære transportform var til fods. I dag dominerer bilen i disse stræder, hvilket har gjort at fodgængere er blevet til side sat. Bilen kræver kørebane samt parkeringspladser, som tager størstedelen af det i forvejen smalle stræde. Som det fremgår af figur 38, er det næsten umuligt for to mennesker at passere hinanden uden at det er nødvendigt at træde ud på kørebanen. Dette er ikke optimalt for fodgængerne og deres sikkerhed.



Figur 38: Eksempel på de smalle fortove, Larsbjørnsstræde

Kørebaner samt parkeringspladser inviterer bilerne ind i stræderne. I tidsrummet mellem kl. 8.00 til kl. 16.00 var området meget belastet af håndværkere og deres store firmabiler. Det kunne tyde på at de har særlige tilladelser til at parkere, da der i området er time-parkering. Der blev endvidere observeret mange gennemkørende taxa'er. En af disse taxa'er havde en ældre dame som passager. Da hun så ud til at være svært gående blev hun kørt helt hen til døren. Dette fremhæver et hvis behov for nogle mennesker, hvilket skal medtænkes i processen mod et bilfrit Middelalderbyen.

Efter kl. 16 var det som om området ændrede karakter. Stræderne følte lige pludselig mere rolige og behagelige. Der var ikke lige så stort pres på parkeringspladserne som tidligere. Håndværkerne og de store firmabiler var væk. Fokuset blev på en eller andet måde fjernet fra de få biler der var tilbage og over på cyklerne – de parkerede cykler. Figur 39 og 40 illustrer problemet. Manglende parkeringskapacitet for cykler er et generelt problem for København, men på et i forvejen smalt område skal der ikke mange cykler til før det bliver kaotisk. Som det fremgår af begge figurer, er der cykler parkeret uden for selve stativet, enten på fortovet eller næsten på kørebanen. Disse cykler besværlig gøre fremkommelighed for fodgængere og særligt farligt for både cyklister som billister, der færdes på kørebanen.



Figur 39: Cykelparkeringsproblem, Teglårdsstræde



Figur 40: Cykelparkeringsproblem, Sankt Peders Stræde

En sidste interessant observation, som desværre ikke er billedokumenteret af mig selv, var på Larsbjørnsstræde, hvor en af butikkerne havde indtaget en af parkeringspladserne på gaden. Der var stillede borde og stole ud, og folk sad og hyggede sig i solen blandt de andre parkerede biler. Figur 41 illustrerer opsætningen, dog uden anvendelse. Dette giver også anledning til en genovervejelse af nedlægning af parkeringspladser i området, for at få mere liv i gaderne.



Figur 41: Udeservering blandt de parkerede biler (Google Maps)