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BIKE COMMUTING AND BIKE COMBINATION TRIPS IN COPENHAGEN TO ACHIEVE SUSTAINABILITY

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Abstract

A car-dependent society has a lot of implications and creates severe problems with congestion, pollution, carbon emission and health issues being some of the derivative effects.

Thus, a sustainable transition of the transport system is necessary. In this thesis, we will investigate the combination of bicycles and other means of transport and bike commuting as a sustainable alternative to automobile commuting in Copenhagen. It was possible to map the actors and make a network with the different actors using ANT. To do this analysis it was conducted several interviews (11) with different actors to understand their roles in bike commuting and bike combination trips. It was conducted an observational study for the station of Dybbølsbro using the Cykombi tool to screen this station. It was possible to see that it is still possible to improve combination trips and bike commuting and the relations between the different actors to make a better web of actors to create a sustainable future.

Keywords: Mobility, Bike Commuting, Bike Combination Trips, Actor-Network Theory, Sustainability

Preface

This thesis is the combination of four semesters of studying at Aalborg University in Sustainable Cities, MSc in Engineering program. The author chooses this program due to a big interest in shifting the mindset to a more sustainable future. Besides the previous training in Coastal and Marine Management, the knowledge together can be important to plan a coastal city with a broader view of the topics. The knowledge gained in this study program is important to understand how to plan a more sustainable future. For the thesis, the topic chosen is mobility and acquiring a lot of knowledge on the topic to them implement in other cities. The topic of Bike Combination Trips and Bike Commuting was chosen for the thesis due to the big importance of mobility to a sustainable city and a sustainable future. Furthermore, through this thesis, the author[1] takes the opportunity to contribute from the point of view of an urban planner.

Acknowledgements

The author of this thesis is grateful to have the opportunity to study other master's degrees and particularly, this interesting programme to become a master of Sustainable Cities with the ability to reflect on the conditions necessary to make our future world more sustainable.

Also, the author is grateful to all the companies who provided the possibility to collect data and give interviews with different companies and to the diversity of actors involved in the project for their valuable input to develop this thesis.

A special thank you to for help and support supervisor – Andres Pineda about the subject. During the last months, your insight, direction and pointed feedback have been valuable.

Last but not least important, I would like to thank, my family and my friends especially those who encourage me during the development of this thesis.

Glossary

ANT – Actor-Network Theory

Banedanmark is responsible for the railway tracks, signals, and safety systems properly maintained and for building new lines all over Denmark.

Danske Statsbaner is known as DSB and it is responsible for operating the trains in Denmark.

Kommunernes Landsforening is the National Association of Municipalities.

Metroselskabet is the company that runs the Metro in the Municipality of Copenhagen and Frederiksberg.

Movia Trafik also known as Movia is a mobility company that is in charge of operating a local railway and bus system for 45 municipalities in the region of Sjælland and Hovedstaden. The company is owned by all these municipalities and the 2 regions.

Gate 21 is a public-private non-profit partnership that works towards green transition and growth in Denmark. These partnerships can be with municipalities, regions, companies, and research tests while developing concrete solutions for a sustainable future in Denmark. The focus is to spread energy and resource-efficient solutions. Nowadays there are trying to reply Supercykelstier concept in the Region of Zealand with different changes and ways of viewing and more focused on recreational cycling and safety for kids to go to school.

GHG – Green House Gases

Region of Hovedstaden - The Region is under the task of the Ministry of the Interior and Health. The region is composed of Copenhagen Municipality and more 28 municipalities.

Supercykelstier is a collaboration between 31 municipalities and the Region of Hovedstaden to establish good connections across municipal borders.

Passengerpulsen is the Consumer Watchdog of public transport they are responsible for reporting to the operators the complaints of the users.

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Chapter 1: Introduction

The chapter will focus on understanding the problem of mobility in the cities and what is the actual state of Copenhagen regarding bike users and bike combination trips reducing car traffic to increase air quality and have health benefits for the population.

1.1 Actual State of Mobility

For a city, mobility is a very important foundation. The cities expanded throughout history with the improvement of transport. Firstly, with the railway and then the automobile. (Wegener, 2013) Nowadays, transport accounts for almost 25% of the world's total GHG (Greenhouse Gases) emissions and this has, actually, more than doubled since the 1970s. (Henderson & Gulsrud, 2019) In the European Union, the transport sector accounted for 45% in 2015. In addition, road transport accounts for 92% of the CO_2 from the transport sector. This makes the transport sector a key to moving towards sustainability. Transitioning away from a transport system that revolves around the use of private cars must start now and cycling is a seemingly promising alternative for this transition. This was reinforced in the IPCC's 2018 report as a way of reducing CO_2 emissions and largely improving urban environments. (IPCC, 2018) There is a need to employ deep structural changes in urban planning and sustainable consumption lifestyles to carry out this paradigm shift. These changes include redesigning streets to increase users' safety, creating a compact walkable environment, and encouraging biking to achieve a bicycle-friendly city. These changes, in combination with compact and mixed land use urbanism, and good public transport infrastructure with a high degree of connectivity and accessibility can reduce urban transport emissions worldwide by 20 to 50%. (Creutzig et al., 2016) (Henderson & Gulsrud, 2019) For these, the public transportation infrastructure needs to be prioritized, such as buses, rails, and bicycle paths provide easy mobility in the city without needing personal vehicles. (Mathiesen et al., 2015)

In 2016, 31.6% of the world's final energy consumption was used for transport mainly from non-renewable energy resources. (Holden et al., 2020) The cars occupy a big amount of space that is considered high-cost land. (Whitelegg, 2020) Besides this the same reason why road traffic injuries are very high and have a high cost either in terms

of treatments or loss of productivity (killed or disabled). This affects not only the victim but the victim's family members too that will have to assist them and take care. According to the World Health Organization (2021), most countries have a cost of 3% of their gross domestic product on road traffic crashes. So, the big cost is not only the large amounts of space they occupy but all the services that revolve around this such as health services, police, and courts. Not to mention other indirect costs like air pollution, climate change, congestion, and noise.

Air pollution and noise damage health, creating even more pressure and spending on the health care system. Additionally, with car use, there is a decline in physical activities that can lead to serious diseases such as obesity, cardiovascular diseases, and diabetes. Through 'Active travel' (walking and cycling) public wealth would most likely see an increase (Whitelegg, 2020). Several other health benefits come with 'Active travel', these are well documented by the World Health Organization, (2018) where several studies have shown what effects active travel can have on the population at large. This extra exertion contributes to the total weekly physical activities (Xiao et al., 2019) and can reduce several ailments like cardiovascular diseases and some forms of cancer (Patterson et al., 2020), obesity (Patterson et al., 2019), blood pressure and diabetes (Laverty et al., 2015), as well as reduce the stress levels thus increasing the overall quality of life (Gatersleben & Uzzell 2007; de Geus et al., 2008). All these benefits should be enough to convince car drivers to change their habits. However, it is hard to change people's mindset and convince drivers to start relying primarily on public transport or bicycles simply due to people not wanting to give up the comfort of using a car.

The reduction of private car use is one of the most critical factors is to create alternatives to private car use and make this the general population's last choice for everyday transport. Half of the car trips in Europe are under 4.8 kilometres and 30% are under 3 kilometres. (Henderson & Gulsrud, 2019) Most of these trips would be very accessible to do by bicycle and would take less than 30 minutes. The shift to biking and consequent reduction of car use would reduce petroleum demand, lower air, and noise pollution, and create fewer fatalities and injuries while improving public health due to the increase in physical activity. (Henderson & Gulsrud, 2019) Planning around cycling and public transport also prevents chronic congestion. All cities need to use other role models and

green mobility to promote cycling, walking, and public transport use as a measure for climate change mitigation. Some population centres were already able to implement this successfully, such as Copenhagen and various cities in the Netherlands. (Henderson & Gulsrud, 2019)

In Denmark's case, the target is to reduce 70% of the GHG by 2030 compared with the emissions from 1990. This reduction would place Denmark as a frontrunner in international climate mitigation efforts. It will also help the international objective of limiting the global temperature rise to 1.5 degrees Celsius. (Klimarådet, 2020) In 2019, each Danish citizen was producing 8.2 tonnes of CO_2 emissions per year. This value is slightly under the EU average (8.4 tonnes of CO_2 emissions per capita per year). The emissions in Denmark have decreased by 38% since 1990. (Klimarådet, 2020)

To achieve the national goal of a 70% of reduction of GHG, transport is key. And to increase mobility a high degree of strategic planning and control is required. Urban planners need to work out the best ways to combine all means of transport to waste less time, energy, and money, create less stress and use up as little energy as possible, increasing the people's welfare. Ultimately the objective is to reduce and possibly solve the congestion in cities that is becoming more and more of a major problem, mainly during rush hours. (Santos Canals et al., 2006)

1.2 Definition and difference between bike combination trips and bike commuting

Bike combination trips will be considered throughout this thesis as multimodal trips with the use of different means of transport (public transport) combined with the use of bicycles. Since the car will not be considered in this concept, this type of trip makes it more pleasant, attractive, and cheaper by contributing to the weekly personal activity by providing health benefits due to the use of an active leg trip. (Cobbold et al., 2022)

On the other side, bike commuting is a trip only focused on the trip to work or study, only done by bike and no other means of transport is used in this trip. It is even cheaper than bike combination trips. The health benefits also improve as well depending on the number of kilometres cycled.

1.3 Scope of the thesis

From 2008 to 2018 there has been an increase of 27% in privately owned cars represents a huge waste of resources. (Copenhagen Municipality, 2019) Cars are still a popular means of transport when the residents want to go out of the city. In the same period, there has been an increase of 5% in car traffic in and out of the city. From the people that do cross the municipality borders by car, 97% share the vehicle with only one other person. These commuter trips represent 30% of all car trips (Copenhagen Municipality, 2019).

Although there the mobility in Copenhagen is not only focused on cars, car use is still high. The car share in Copenhagen is 30% including the trips to, from, and in Copenhagen. This shows that the city is still largely dependent on car use and the goal is to improve and make cycling and bike combination trips even more attractive. The Municipality has set the objective of a maximum of 25% of car usage in 2012 in the Copenhagen 2025 Climate Plan. (Copenhagen Municipality, 2012) Copenhagen has relatively low car ownership and low rates of driving. The municipality reports under 200 cars per 1000 persons while other European cities have, on average, 500 cars per 1000 persons. (Copenhagen Municipality, 2019) Copenhagen has made efforts to achieve this goal and improve the conditions of cycling to reduce car use in Copenhagen. In the past 10 years, the City of Copenhagen invested 0,84 billion kroner (84 million kroner per year) to create a better and more cohesive cycling experience. Even with this, there is still plenty to improve. In the last year, the number of bicycle trips to and from work or education has been 35%. This percentage has been decreasing since 2018 when it achieves its maximum percentage (49%).

Although there has been a decreasing percentage previously mentioned, the rate of cycling is still high. The high rate of cycling is due to the good network of bicycle paths, car restrictions due to the decreasing of parking, and more automobile taxes and fees. With the increase in population in the city and suburbs over the last years there has been a subsequent increase in the number of cars too, especially in the suburban areas. (Henderson & Gulsrud, 2019) The distance and accessibility between residency and work areas significantly differ in the chosen means of transport. People often prefer to maintain their freedom and not become dependent on the buses or trains and their

schedules even though they can be frequent in some lines and areas. In suburban zones, biking is not so easy, quicker, and more comfortable means of transport as in the city where, for a lot of residents, biking is the preferred way to arrive at work or school. (Henderson & Gulsrud, 2019) The Supercykelstier are a good way reach to Copenhagen but, depending on where you live, it is still a great number of kilometres to do by bike which makes some people avoid their use in everyday life. For these long-distance travels, it might be hard to do with just basic work clothing and instead, specific bike clothing is preferable to make the journey quicker and more comfortable. This makes the general population avoid these trips because they would be very tired and sweating when arriving at their destination and would then need to spend extra time and effort taking a shower and changing into work clothes. (Henderson & Gulsrud, 2019) The bike combination trips can be a way of facilitating this. Bike combination trips only represent 3% when with the purpose of education or to work. (Region Hovedstaden, 2022)

To promote even more the use of alternative means of transport, it is not only important to have good alternatives, but there is also the need to make life harder for car users. Having fewer parking spaces in the city centre, higher taxes on cars, higher taxes on fossil fuels, and other measures that can be employed shortly. All these have already been applied by the government and have greatly helped reduce emissions. Even with these measures, passenger cars account for 60% of the transport sector's emissions in the country. (Simões & Victoria, 2021) Denmark wants to stop selling cars running exclusively on fossil fuels by 2030 and an upcoming tax reform is planned to incentivize the sale of low-emissions and electric cars. (Simões & Victoria, 2021) A lot of the Danish policies aim to move away from petrol and diesel-powered cars and instead increase the sales of electric cars with an expansion of the charging infrastructure and significant tax pay cuts. Having a lot of electric cars will only solve the problem partially. The energy use will increase and if the quantity of electric cars increases there will be the same issues such as car parking and traffic jams. The increase in energy use can be a problem too considering that Denmark is not self-sufficient and has to use non-renewable energies to fulfil the demand.

This shows that there is a need to create even more restrictions for car use inside of Copenhagen, incentivize the use of bicycles for commuter trips or make bike combination trips more enjoyable and more attractive for the population and increase the possibility of bike combination trips for longer distances journeys to increase the health and wealth of the city. At the same time, there is a need to improve bike parking as satisfaction is quite low. The report from the Copenhagen Municipality in 2022 showed a general satisfaction of 47% with bike parking so there is still a lot to improve in this area and it will be one of the focuses throughout this thesis.

1.4 Case study – Dybbølsbro

The station of Dybbølsbro is located in Copenhagen namely in Vesterbro. This station has 7 lines of the S-train and connects Copenhagen's inner city with the rest of the metropolitan area such as Hillerød, Klampenborg, Farum, Frederikssund, Høje Taastrup, Køge, and Hellerup. There is a bus station in Dybbølsbro (line 11) that connects Rådhuspladsen to Avedøre. Dybbølsbro is also the bridge that connects Yrsa Plads and Kalvebod Brygge.

In 2018, the station of Dybbølsbro has been ranked the worst station in all of Denmark according to its users regarding bike parking facilities. This study was developed by Passengerpulsen in the national passenger satisfaction survey where it was given a grade of 3,35 with all the data collected about the different parameters of the station. (Appendix 1)

Chapter 2: Research Design and Research Questions

To approach this topic, the following Research Questions and other 4 Sub Questions were idealised to guide us throughout this thesis.

Research Question (RQ): Past, Present, and Future of bike commuting and bike combination trips in Copenhagen.

Sub-Question 1 (SQ1): How have bike commuting and bike combination trips developed since the 2010s?

Sub-Question 2 (SQ2): What are the plans to improve bike commuting in the upcoming years?

Sub-Question 3 (SQ3): How can public transport and bicycle work together to improve mobility?

Sub-Question 4 (SQ4): How can the station affect the bike combination trip experience (Dybbølsbro)?

To answer the research question, first, we need to focus on the actual system and understand it. First, there is the objective of understanding the different actors and different responsibilities finishing it with the use of Actor-Network Theory. Sustainability will be used as well throughout this thesis as it is the main objective of the measures taken and the future. Then, different sub-questions will be investigated through interviews with different actors, document analysis and observation with the help of a screening tool.

In the SQ1 it will be used only the Document analysis to understand how bike commuting and bike combination trips as evolved throughout since 2010. Already in SQ2, the methods used were Document analysis and Semi structure interviews to see the upcoming plans for bike commuting and changes of planning in bike commuting for the next years. The SQ3 it was only used semi-structured interviews to understand the measures of the different actors and how they are and will work together to improve

the mobility between public transport and bicycles. In SQ4 the methods used will be Document analysis, semi-structured interviews, Observation and a Screening tool. The observation and screening tool will be the main focus of this sub-question with the help of semi-structured interviews to understand what changes can or cannot be done by the different actors, and a Document analysis to understand the plans of the municipality for the upcoming years. With the help of all the analysis and the different sub-questions, it will be answered the research question in the discussion. This is all explained in figure 1.

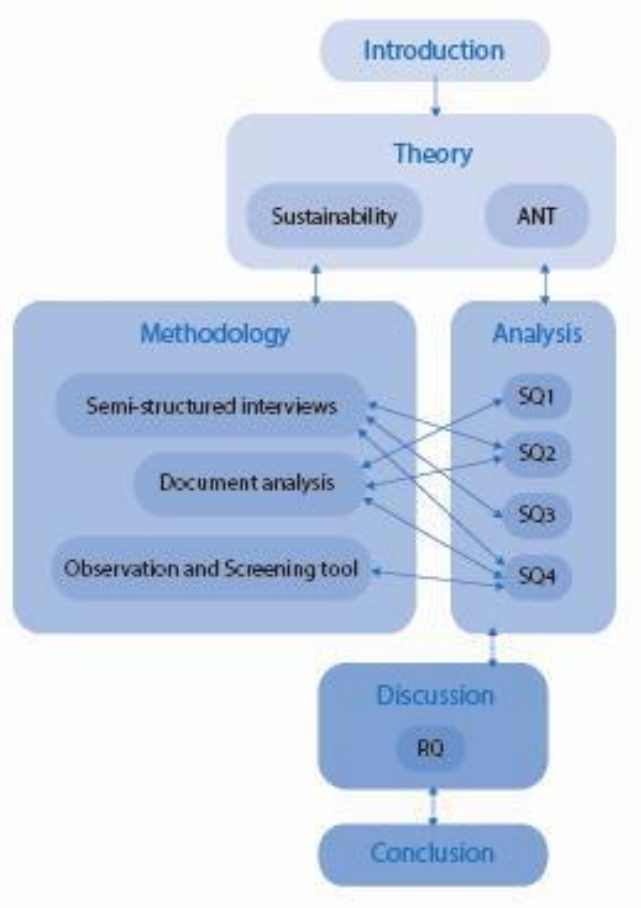

Figure 1 - Research Design

Chapter 3: Theory

This chapter will approach the theories throughout the thesis.

3.1 Sustainability and Mobility

Sustainability can be defined as the maintenance of general well-being over a long or indefinite period. Access to good natural resources guarantees the preservation of the environment and generates capital. The term Sustainability has been used worldwide by several actors. In the last 20 years, there has been a huge number of publications with a focus on sustainability. (Purvis et al., 2019) Even though, Sustainability is an open concept with several interpretations, the description of sustainability can be made with three interconnected 'pillars': social, economy and environment. These three pillars intersected the definition of sustainability according to several academic literature, policy documentation, and business literature. (Purvis et al., 2019)

There is an apparent conflict between environmental and social-economic goals as the latter can increase the human ecological footprint to benefit the global population. Randers et al. (2019), Cohen, (2018) and Sills et al. (2019) alert that if interested parties continue acting according to their 'business as usual' mentality, these goals will not have been achieved even by 2050. 'Business as usual' is asserted as the leading modus operandi since 1980, be it at the individual, corporate, national, or even global levels. (Randers et al., 2019) As such, to achieve sustainability, a profound structural change across all sectors of society will be required. (Sachs et al., 2019)

Regarding sustainable mobility, the city is the most sustainable urban form due to the number of people that it concentrates on in a small area (housing, work, leisure). The key parameters to create a sustainable city, according to the researchers, is over 25000 inhabitants but preferably over 50000 inhabitants with medium densities (more than 40 people per hectare). (Banister, 2008) To make it sustainable, there is a need to give preference to public transport corridors and highly public transport interchanges allowing to arrive at any place quickly and without using a car. With this scale, everything could be linked together to form agglomerations and create polycentric cities where it would be possible to have proximity to everyday facilities maintaining a distance to able

to walk and cycle modes. (Banister, 2008) The planning of the city would not prohibit the use of cars but it would be minimized and give alternatives with high-quality accessibility. (Banister, 2008) This approach requires different and innovative thinking about the city as it is something difficult to achieve. There is the reality of the city (where the city is already planned and built) and then there is the desire of the population to see it and what role can transport play to achieve these goals. Although this is hard to achieve, some cities have been working towards this.

In the mobility topic, which will be the focus throughout this thesis, change should happen to have better use of bicycles and public transport to reduce CO_2 emissions. Modifying our behaviours (keeping in mind that car use is still, to some degree, an inescapable part of the system) such as relying on public transport, using bikes, or bike combination trips. This exercise every day would promote better health, environmental quality, and general well-being (either because of a reduction in CO_2 emissions, improving air quality and reducing greenhouse gases, or because of physical exercise, which undoubtedly has a great positive impact on the immune system).

3.2 Actor-Network Theory

Actor-Network Theory (ANT) aims to understand the relationships between human and non-human actors, analysing them according to the actors' variable forms and competencies. (Callon & Blackwell, 2007) ANT does not have individuals on one side and technology on the other, this theory focuses on how things come together and how they interact and reinforce each other. For Latour, there is the principle of irreduction, and "what actors are and do is the effect of their relationships with other actors. In this way, all actors are also networks of other actors that constitute each other". (Storni, 2015, p. 169)

Through ANT, the objective is to assess the heterogeneous associations, and power dynamics of a network of concepts, and human and institutional actors and investigate the process. ANT portrays the different elements (human and non-human) symmetrically (with equity and reciprocity) all the actors, facilitating the analysis of networks that other theories cannot explain well. This makes it easier to understand

specific roles and treatments more objectively and accurately. (Wang & Yau, 2018) (Aka, 2019)

Knowing that Actor-Network Theory (ANT) has gained prominence in very diverse fields from social sciences, sustainability studies, and humanities to different types of studies in political science. However, from the engineer's point of view, the reality is “the result of an organized, fragile and laborious process of material articulation” (Muniesa, 2015, p. 80) where all elements/actors are important and cannot be seen as isolated. For Storni, the resulting motto of ANT is that there is no “innovation without participation”. This gives power to the other actors and users of the network to improve it. (Storni, 2015)

To improve urban planning, there is a need for collaboration between actors and involving multidisciplinary participation. Either between several actors from different areas and with different responsibilities or with everyday users of the service that knows what to improve for them. The use of ANT in this thesis aims to map the web of actors that are part of bike combination trips. The diversity of actors involved in the system will be identified, either directly or indirectly. The mapping of these relationships makes visible relations and actors that are not always visible but still are responsible and can contribute to improving the whole system.

The use of ANT in this thesis aims to map the web of actors that are part of the bike commuting and bike combination trips in Copenhagen. The diversity of actors involved in the system of bike communities in Copenhagen will be identified, directly or indirectly. The mapping of these relationships makes visible relationships and actors that are not always visible but are still responsible and can contribute to the improvement of the entire system of bike communities and the diversity of actors involved in the system will be identified, directly or indirectly in chapter 5.

Chapter 4: Methodology

In this chapter, it will be explained the different methods used throughout the thesis.

4.1 Semi-Structured Interviews

Detailing the subject of bike commuting and bike combination trips with a view to future improvements, due to the lack of specific information from the different companies that deal with this, it was conducted a series of interviews with the companies that control and influence public transport in Denmark. A total of 11 interviews were conducted with the different companies (Passengerpulsen, Banedanmark, Movia Trafik, Supercykelstier, DSB, Metroselskabet, Region of Hovedstaden and Gate 21). All these interviews were recorded and fully transcribed except the interview with DSB which is only transcribed.

The aforementioned interviews were conducted in a semi-structured format. The interviewee was motivated not only to answer the question, but also to elaborate more on the answers given and, at times, share new perspectives that had not yet been considered. This last point was especially important as it led to an expansion of perspective on the topic. (Louise & Alison, 1994) As such, the semi-structured interview was selected for the optimization of information gathering. While a more rigid structure might have improved time efficiency, the additional knowledge gleaned from these experts was seen as more valuable even though, these interviews can, at times, be considered less objective due to the nature of their format. Moreover, this route was preferred over a written interview for the ability to direct questions at the interviewees, honing down on the most relevant points of research. The interviewees were selected based on their work, their relevance, and their importance to the topic that is being studied.

The first interview was conducted with Passengerpulsen (Anders Albrechtsen, Project Manager and interview data collection with 15 years experience) to understand the passenger's point of view and what are their biggest desires for public transport. It gave a greater overview of the relationship between the different actors.

Passengerpulsen was the first interview and it gave a greater overview of the relationship with the different actors and how they work together with the different companies. Available in Appendix 2.1

The first interview with Supercykelstier was made to Sidsel Hjuler, Program Leader. It was conducted by a PhD student - Russel Cannon - from the University of Lund, and I had the opportunity (due to Supercykelstier's busy schedule and our similar topics) to attend and make some questions. It allowed an understanding of how the Supercykelstier is in the bike commuting and bike combination trips and their professional relationships. The second interview with Supercykelstier was with David Rønnov, Project Leader, where the objective was to understand the ideas behind Supercykelstier and what has been improved over the last couple of years, and changes that have been in mind in these future projects. Both interviews were held online. Available in Appendix 2.3 and 2.9

To know more about other operators, Metroselskabet was contacted (Uffe Nielsen, Team leader) to understand the actors that they already working with to increase bike combination trips and the potential to improve them. The interview was held online. Available in Appendix 2.4

The interviews with Movia Trafik were presential. The first one was with Joe Jensen, Project Manager, and Michael Hansen, Specialist, to understand the web of actors and the future objectives of Movia. The second interview was with Jens Toudal Jessen, Project Manager, to understand the priorities of the company and what have been the efforts to improve bike facilities and conditions for bike combination trips. Available in Appendix 2.2 and 2.6

In DSB, it was interviewed Niels A. Dam, the General manager to understand the plans by the company to improve bike combination trips, including what changes they are planning to do and the state of their current parking facilities. This meeting was presential and it was the only one that was not recorded but the Interview Guide and answer are available in Appendix 2.5. To better understand the relationships with the other actors, the DSB was contacted again but with no answer.

The Region of Hovedstaden was interviewed to understand their role in planning and what is their relation to the municipalities on this topic. Firstly, it was interviewed Helen Lundgaard (Chief consultant) and then Helen forwarded it to Morten Hass (Consultant) due to his better knowledge about bike parking and its difficulties to improve in the stations. Both interviews and held online. Available in Appendix 2.7 and 2.8

Gate 21, in the person of Frederik Hoedeman, was interviewed to understand their role to improve the sustainability of their previous projects and future projects that they have. The interview was presential. Available in Appendix 2.10

Then, Banedanmark's was the only written interview given their low influence on bike combination trips and their low influence on the stations and bike parking. Available in Appendix 2.11

The Copenhagen Municipality was contacted several times and it was not possible to hold an interview. Unfortunately, several consultant companies were contacted as well to understand their role in the planning of Copenhagen but no answer was received (Celis Consultant, Via Trafik, Niras, Gehl People). The Ministry of Transport, Danish Cycling Federation, and Cycling Embassy of Denmark were contacted but they forwarded to Copenhagen Municipality.

These interviews have given good inputs for the analysis and a foundation for the discussion due to the wide range of different views on the topic. All these actors' conflicting visions gave an insight into the issue at hand and how they plan to solve it, as well as what measures they have already begun implementing.

4.2 Document Analysis

There were some documents from the municipality that were analysed to understand the bike parking facilities in the city and the overall situation over the past years (Copenhagen City of Cyclists - The Bicycle Account 2014, Copenhagen City of Cyclists - The Bicycle Account 2016, Priority Plan for Bike Parking 2018-2025, Copenhagen City of

Cyclists - The Bicycle Account 2018, Copenhagen City of Cyclists - The Bicycle Account 2022, Mobility Report 2022). In these reports, they present the percentage of the means of transport that the population actively choose in their everyday commute. These reports show the current state and their goals for the future mainly focusing on bike users and the reduction of car use in Copenhagen. These bicycle accounts from the municipality were used in SQ1 and SQ4. The Mobility Report was only used in SQ1. The other document analysed was the Priority Plan for Bike Parking 2018-2025 to understand the strategy of the Municipality for the case study of Dybbølsbro in SQ4. Other documents from the Region of Hovedstaden and Supercykelstier were analysed. The Region of Hovedstaden was the data available in the Regional Cycle Plan for SQ2. From Supercykelstier, it was analysed the Vision plan 2021 to 2045 and important for the SQ2.

4.3 Observation and screening tool

In an attempt to better understand what makes users rate stations positively or negatively, the station of Dybbølsbro was visited, and conducted observation studies on different days in October and November at different hours of the day (either in rush hour or outside it). This qualitative research gave an insight into the conditions of the station complementing other methods like document analysis through reports and other biographical references. The researcher, when looking at the area, has the objective of seeing the area and make questions about it and where to improve. (Williams, 2007) These observations were documented with a set of photos that can be found in the case study of Dybbølsbro. The Cykombi tool was created by different partners such as Supercykelstier, Roskilde Municipality, DSB, Movia, Region of Hovedstaden, Region of Zealand, Kommunernes Landsforening (National Association of Municipalities) and Passengerpulsen with the support of 2 consulting companies (Celis Consultant and Via Trafik) and developed for the Tour de France 2022. This tool aims to understand the potential of combined trips and the current status at a specific station and should be used in the field to assist in the screening of transport hubs with a focus on bicycle users. The Cykombi tool gives urban planners and different companies a perspective on the current state of the station when used for combined trips. This tool

is used to measure 10 different parameters such as Trail connection/Accessibility, Access to platform, Bike parking, Route to bicycle parking and bus/train, Traffic information, waiting facilities, Lighting, Cleaning, Crossing Ratio, and Micro mobility solutions. The different parameters have several sub-parameters. The trail connection and accessibilities is mainly focused on cycle paths connections in the catchment area of the station; the access to the platform measures how close can you cycle to the entrance of the train when the person does the trip with the bike on the train and measures and if there is difference level from the street to the platform, the existence of elevators and bike ramps in the stairs, and information for the cyclists on where to wait; the bike parking screens the number of spaces for bike racks and measures the number of bike parking occupied and which type there is in the station for example if it is two storage bike parking or if it is covered or locked bike parking; the next parameter route for a person who park its bike in the station and then does its normal trip where it is measured how the bike parking is located in relation to the platform (how close it is) and if it is a naturally located to pick the bus or train; then there is the traffic information according with the information available for the travel either in the parking areas or in the arrival road; another parameter is the waiting area and if it covered, if there is an indoor room to wait and other waiting facilities such as toilets, kiosk, café or groceries; Lighting is another parameters and it only measures the light in the bicycle parking area and in the waiting area; Cleaning is another focus and it evaluates how clean the hub is, if the bins are empty or not and how accessible they are; Then there is the evaluation of the crossing area close by the station and if it has foots bridges or tunnels to pass the railway tracks and if it is possible to cycle in these areas; in last it is the micro mobility solutions where it is asked for the access to city shared bikes and electric scooters at the hub. All the grades given and answers to the questions of Cykombi tool will be in Appendix 3.

Chapter 5: Analysis

Before answering the Research Question and the different sub-questions it will be used the Actor-Network Theory to make an overview of the different interconnections between the different actors. The focus of the theory is how things come together and their interactions as it is not possible to see them alone. With this in mind, the Actor-Network Theory was used to report the current situation of the actors and their relations.

Banedanmark, Passengerpulsen, and DSB are under surveillance and financed by the Ministry of Transport. Passengerpulsen is independent while DSB and Banedanmark are state-owned. (Anders Albrechtsen, interview, 2022, Appendix 2.1) (Niels A. Dam, interview, 2022, Appendix 2.5) (Banedanmark, n.d.)

Banedanmark works more towards sustainability but they do not enter into the discussion about topics such as bike parking or the organization of the stations. (Banedanmark, email, 2022, Appendix 2.11)

Region Hovedstaden is responsible for the health system in the region as it is the main task of the region. The Region of Hovedstaden has no authority in planning the municipalities. The Region has other smaller tasks such as regional development and they incentivize and support the creation of partnerships and projects at a regional scale.

Movia holds meeting together with the different municipalities every year to prepare for the next year to make some changes in the lines according to the needs of the population and different requests.

Copenhagen Municipality is responsible for the planning in the City of Copenhagen. In the last years, there has been planning towards a more sustainable future with the different plans already elaborated.

Passengerpulsen is part of the Danish Consumer Council and financed by the Ministry of Transport, although independent. (Anders Albrechtsen, interview, 2022, Appendix 2.1) They give a voice to the passengers and their problems to create better public transport for users, being their advocate and an industry watchdog.

Metroselskabet is the company responsible for running the metro in the city of Copenhagen and its suburbs. The company is owned by the Ministry of Transport, Copenhagen, and Frederiksberg Municipality. Metroselskabet has overall responsibility for the operation of the Copenhagen Metro and for building new metro lines.

Supercykelstier is a cohesive network of bike paths to create better conditions for bike commuters where cycling conditions are a must and are a competitive means of transport for daily commuting. The objective is to connect 31 municipalities with the Capital Region making it easier and safer for bike commuters. The office of Supercykelstier works with the municipalities to establish connections between them making it easier for the commuters to connect the residential areas to their respective workplaces and educational institutions. Supercykelstier is owned by the municipalities, and the Region of Hovedstaden is financing them as well. (Helen Lundgaard, interview, 2022, Appendix 2.7)

DSB is an independent public company supervised, financed, and owned by the Ministry of Transport. As such, this corporation follows management guidelines highly connected with the expectations, requirements, and recommendations of the government. The DSB is in charge of operating the trains across the country and has the objective of providing a good journey to their customers, satisfying their needs, and having an

environmentally friendly means of transportation. DSB also holds quarterly meetings with the Minister on topics ranging from economic significance to political interests. (DSB, n.d.) Besides their transportation services, they have additional responsibilities. As the stations belong to them in cooperation with the Municipalities, Banedanmark (railways and tunnels), and private investors (concerning the outside areas of the stations), advocating for the appropriate maintenance of these, is also under their purview. (Niels A. Dam, interview, 2022, Appendix 2.5)

According to the different interviews, documents and websites of the different institutions, this ANT (figure 2) were possible to understand how the different companies interact and cooperate concerning the topic of bike communities (either bike commuting or combination trips). Several actors are in the network of the bike community and have big concerns such as the Region of Hovedstaden (booster of Supercykelstier), Copenhagen and Frederiksberg Municipality (several plans to improve cycling and bike infrastructure), Supercykelstier (bike paths across municipality), Movia (possibility of bike combination trips), DSB (possibility of bike combination trips), Metro (possibility of bike combination trips), NGOs (only focused on cycling and how to improve it), Cycling Embassy of Denmark (only focused on cycling and show new alternatives and ideas) and the Consultant Companies (several plans to improve cycling conditions). Besides the connection to bike communities, the Copenhagen and Frederiksberg Municipality are connected to the Region of Hovedstaden (the project of Supercykelstier is a partnership with the Region and funding to improve bike conditions and bike parking), the Cycling Embassy of Denmark as they are partners, the Ministry of Transport is connected to them as they have to follow rules from the Ministry of Transport when planning their routes and when they want to do changes in the roads, Consultant Companies as they help them to do the several reports published throughout the years, NGOs such as Cyclist Federation of Denmark which Copenhagen Municipality is part of their company members to improve conditions for cyclists in the city, the Metro is owned by Frederiksberg Municipality, Copenhagen Municipality and the Ministry of Transport, and Movia that is owned by the Copenhagen Municipality, Frederiksberg Municipality and 43 more municipalities and by the Region of

Hovedstaden and Zealand. The Cycling Embassy of Denmark has a lot of different partners such as the Ministry of Transport, the Danish Cycling Federation, DSB, Consultant Companies, Supercykelstier, Region of Hovedstaden, and Copenhagen and Frederiksberg Municipality (referred previously). The Supercykelstier are connected to the Danish Cyclist Federation as there have been made reports with knowledge from the Danish Cyclist Federation, and connection with the Ministry of Transport as they are connected for the planning road of the bike paths, besides the connection with the Municipalities and Region of Hovedstaden (where they only fund and do not participate in planning). The Metro, apart from the ownership of Copenhagen and Frederiksberg Municipality and Ministry of Transport, has a connection with Movia and DSB when planning the new stations and in this case the station of Copenhagen South. The Ministry of Transport finances Passengerpulsen, DSB and Banedanmark. Passengerpulsen is an independent company and DSB and Banedanmark are state-owned. DSB holds quarterly meetings with the ministry as referred previously. The Ministry of interior and health are connected in the figure due to the Region being under the task of the Ministry. Passengerpulsen is connected to all transport companies (DSB, Movia and Metro) as they are the voice of the passenger about their concerns about different topics such as tickets, accessibilities, schedules and other relevant themes that can change according to the different concerns. Banedanmark has no interest in the bike combination trips as they are only focused on maintaining the railway infrastructure and they are under the Ministry of Transport.

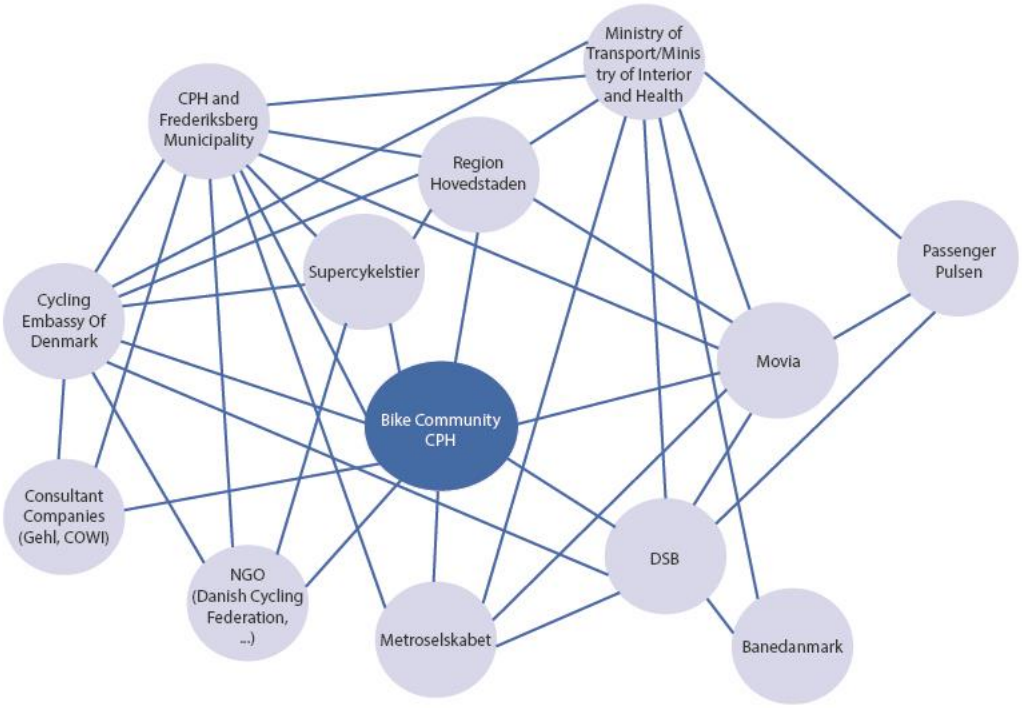

Figure 2 - Actor-Network Theory

RQ: Past, Present, and Future of bike commuting and bike combination trips in Copenhagen.

SQ1: How has bike commuting developed since the 2010s in Copenhagen?

In 2010, DSB decided to introduce the possibility for its users to take bicycles in the S-train free of charge. (DSB, 2012) This measure was a success which compelled the DSB to add an extra carriage to the train. (DSB, 2012) This was a booster in bike combination trips for Copenhagen. From the suburbs, the population was enabled to make their trips quicker by adding their bike to the train, which in many cases allowed for the replacement of car rides for a bike combination trip using the S-train. There was a significant increase in S-train use and the customers were happy with this implementation. In the period between 2010 and 2015, bike users accounted for more than a third of the total increase of users, a 17 million passenger increase. (CPH Post, 2016)

This measure created the possibility to make bigger travels without having to cycle the whole path. This can attract all types of users and create a more active population as they do already some sports while biking creating a better health user and reducing health care costs. Biking every day would ensure the recommended 30 minutes of physical activity. This activity every day would counteract the growing physical inactivity. In 2016 the population physically inactive was 28%. This can help this share of the population to change their habits. (Copenhagen Municipality, 2017a) With the already good infrastructure in Copenhagen to cycle, this boosted the use of bikes and oblige the city to create more and improve the existing infrastructure. Throughout the years there has been an improvement in biking conditions.

When looking at the data available there has been an increase in the number of kilometres cycled since 2010. In 2010 the Supercykelstier did not exist. This network of high quality just started in 2012 and the biking conditions were improved, mainly focused on long journeys. With the creation of Supercykelstier, the infrastructure improved considerably such as pavement quality, high maintenance, services (such as pumps for bike tires throughout the path and support infrastructure close to traffic lights to avoid put putting feet on the floor) and increased safety. Ultimately, keeping both the bike user and bike combination trip users in mind at every step of the process.

(Supercykelstier, 2019) There is a strong focus on the comfort of the trip and maintaining the users' physical safety by reducing the risk of accidents. The Supercykelstier paths provide a competitive transport alternative to private cars, thus creating a better urban environment, less congestion, and contributing to an increase in public health. (Supercykelstier, n.d.-a) The Supercykelstier is planned to be an alternative to cars on distances of more than 5 kilometres. Since then, there is a clear increase in the kilometres cycled regularly as the value increased from 1.21 million per weekday in 2010 to 1.45 million in 2021 per weekday. (Copenhagen Municipality, 2022a)

With all the facilities improved, the percentage of bike share has increased from 2010 to 2021 with some variations in this period. The bike share of trips to work or education in Copenhagen was 35% and the maximum percentage achieved was in 2018 at 49% but in 2021 the bike share reduced again to 35%. So, there is still a lot to improve especially due to this decrease in the bike share in the last few years. Car use maintained similar with a percentage of 32% in 2021. There can be some justifications for this decrease due to the Covid 19 restrictions and guidelines.

Knowing that the Municipality's objective is to reach a 50% bicycle quota in commuting to work and education, but there is still much to be done. However, at peak hours almost half of the cyclists in Copenhagen (48%) complain that there is a lack of space in the tracks. (Copenhagen Municipality, 2022a) There are no objectives of the municipality to change the status of this parameter. To improve cycling the municipality has the objective of improving and increasing bike parking in the whole city to achieve the satisfaction of 70% by 2025 (nowadays it is only 47%). There is a bike parking plan for 2018 to 2025 where it was analysed the amount of bike parking available in the different areas of the city according to the amount of cycle parking places available compared with the existing number of bikes in the area while having in mind the bikes that are out of parking spots due to lack of space. Several places were identified in the whole city due to the bike parking and to improve bike parking in these areas. One of the places was the station of Dybbølsbro which will be analysed in sub-question 4.

The maintenance of cycle tracks is another topic in which the municipality wants to improve their satisfaction rate to 80% by 2025, and nowadays the value is 68%. All these factors are important to continue improving the conditions and the satisfaction of the users and attracting more people to cycle every day. The cycling infrastructure in Copenhagen was 388 kilometres of cycle tracks, 33 kilometres of cycle lanes, 65 kilometres of green cycle routes, and 60 kilometres of Supercykelstier. (Copenhagen Municipality, 2022a)

In 2012, there was an increase of 50% in the feeling of security compared with 2008 due to the infrastructural upgrade and the increase of bicycles on the streets so the drivers had to be more careful about cyclists. (Copenhagen Municipality, 2015) In 2014, around 74% of Copenhageners cyclists felt safe when biking. (Copenhagen Municipality, 2015) and in 2022 this value was 79% and the objective is to achieve 90% by 2025.

There was a measure already taken before (besides all the changes in the infrastructures) to reduce the maximum speed by 10 km/h. (Copenhagen Municipality, 2022a) This measure reduces the number of fatalities and serious casualties. The feeling of security is one of the most important things to attract more bikers to the streets. Besides all these measures for cars, there is the need to have good cycling behaviour as well. So, all feel safe on the cycle tracks especially when there is a lot of traffic in these places.

Even with all these measures and conditions created to improve bike commuting and bike combination trips the percentage of privately owned cars has increased by 33% from 2012 to 2021 while the number of inhabitants has increased by 16% in the same period and the privately owned bikes just increase by 15%. Although this tendency is a bad sign the number of bikes in Copenhagen in 2021 accounted for 745800 and only 138600 cars for 638100 inhabitants. (Copenhagen Municipality, 2022b).

SQ2: What are the plans to improve bike commuting in the upcoming years in Copenhagen?

Supercykelstier has been fundamental to the improvement of bike commuting in the Region of Hovedstaden. The objective of this partnership is to create and improve bike facilities and to increase the number of bike commuters for their everyday trips.

The collaboration of Supercykelstier started in 2009 with the collaboration of 31 municipalities and the Region of Hovedstaden. The objective is to have 850 kilometres of Supercykelstier distributed by 60 different routes by 2045. (Supercykelstier, 2021)

Nowadays there are 233,3 kilometres in 14 routes (own counts using (Supercykelstier, n.d.-b) with the filter existing routes) of Supercykelstier in this collaboration between 31 municipalities and 60 kilometres only in the city of Copenhagen. (Copenhagen Municipality, 2022a)

This work across municipal and regional boundaries requires good cooperation between the municipalities. It is not always easy to create this as they have to agree on the routes and have the money to invest in it at the same time. The municipalities in the route of the bike paths subsidize their part and the Supercykelstier ensures that the paths are of the same quality across the whole path. (Sidsel Hjuler, interview, 2022, Appendix 2.3)

Besides all the routes already built, there are 4 routes already with funding allocated and prepared to be built. These numbers are already good but there is a lot to improve in the upcoming years and the plans and interviews show that there are good ideas to improve. There are around 42 routes to do until 2045 that will connect the whole region and improve the capacity and, hopefully, the number of users that bike commute. For the existing routes, the focus is on maintenance and here the citizens help us a lot and have the tools to report any problem.

When planning, the focus of Supercykelstier is on long trips. In the beginning, when they planned the Supercykelstier their objective was just to give the quickest path to the finishing point. Nowadays there are changes for the future in the planning of Supercykelstier. The new routes are being planned differently. When building the new bike tracks there are some guidelines that they did not have before and that will be used in the future. For example, when there is a train station less than 500 meters from the

cycle track planned, they see the connectedness from the main path to the station. According to the existing conditions, they will see what is needed to improve and ask the station to improve bike parking in the area. When planning this see all the details such as where is the parking and where is the station hub (which side of the street) in order to plan it in the best way possible for the users. (Sidsel Hjuler, interview, 2022, Appendix 2.3) For bus stations, the conduct is the same but only when the bus station is less than 100 meters from the cycle path. This can improve a lot of bike combination trips and make people change their way of commuting. (Sidsel Hjuler, interview, 2022, Appendix 2.3) (David Rønnov, interview, 2022, Appendix 2.9)

Besides these changes for the future, there have been already changes and improvements in the routes. In the existing bike tracks, there are pumps alongside the road, water fountains, and footrests in the stoppage of traffic lights. (David Rønnov, interview, 2022, Appendix 2.9) All routes planned can suffer small changes in the route in the next years because they only have the main path. This is something that is seen when they will be constructed. (Sidsel Hjuler, interview, 2022, Appendix 2.3)

This work to improve bike commuting (by doing Supercykelstier) is very helpful for the region due to the reduction of money spent on health, improves the environment and goes towards better sustainability, and reduces congestion. With the amount of CO2 emissions reduced, less space in traffic and more exercise will just contribute to a more sustainable city and region. In 2021 there were 7.1 billion kroner per year in health (Region Hovedstaden, 2022) The Region of Hovedstaden is in charge of health in the region so there has been a reduction of costs in the region and can be used in other priorities. The Region of Hovedstaden, which was the booster to Supercykelstier, can now invest in Supercykelstier.

SQ3: How can public transport and bicycle work together to improve mobility in Copenhagen?

Since 2010, when DSB turned it free to use bikes on the S-train, as referred to previously in sub-question 1, there have been some other measures towards bike combination trips.

Already this year, there is running a trial from the 1st of July 2022 until the 30th of June 2023 where in Movia buses it will be free to bring the bike in the bus. The maximum capacity is two bikes per bus although there are some restrictions according to the bus lines, and schedules such as rush hours or night-time. (Jens Toudal, interview, 2022, Appendix 2.6) These buses it is included the regional buses that can help improve bike combination trips and reduce long bike commuting trips. (Helen Lundgaard, interview, 2022, Appendix 2.7) In the harbour buses, it is free to bring bicycles as well and the maximum capacity is 8 bikes.

Regarding the metro, there is a fee of 14 kroner for the bike and at rush hour it is not possible. This is due to the lack of space on the platforms and inside the carriage. However, what the metro has been doing to improve combined travel over the years is asking the municipality to improve bike parking at metro stations. But sometimes after these improvements, the occupancy was not as high as expected as people did not use the bike parking. However, there can be several reasons such as bike parking far away from the station, bike parking on two floors, or underground parking. (Uffe Nielsen, interview, 2022, Appendix 2.4) Bicycle users do not want to walk very long so that is a problem to be solved when planning. The bike parking on two floors is a very good option in places with a lack of space and it is possible to be closer to the station but it has not been used as much as it could. Either due to the effort to use the second floor or lack of instructions to use them. Underground parking is not popular in Denmark as people feel unsafe in the park there. However, it is possible to see functional and safe underground parking in other countries like the fietsenstalling jaarbeursplein in Utrecht, Netherlands.

The Region of Hovedstaden has been promoting projects with Movia and the different municipalities to improve bike parking at the stations (local train stations and bus stations) (Helen Lundgaard, interview, 2022, Appendix 2.7) The Region cannot do it

alone as they do not have the authority to do it. The Region promotes projects with the different actors that are in charge of the stations. The municipalities are in charge of the bus stops. The Region can fund and be the project leader but there is the need for the authorization of the municipality and local authorities to change bike parking. When the Region has the money to improve bike parking, they enter into contact with the municipalities to upgrade them. According to Morten, when the Region has money to improve the bike parking facilities the municipalities are always interested in improving them. (Morten Hass, interview, 2022, Appendix 2.8)

Gate 21 has done several projects as well and promotes projects of green and sustainable mobility. This NGO creates a network with different actors such as citizens, corporations, authorities, and universities. (Frederik Hoedeman, interview, 2022, Appendix 2.10) Gate 21 previously has done cycling projects with companies in Copenhagen to improve bike facilities in the workplace such as bike parking conditions and bathrooms for bike users. (Frederik Hoedeman, interview, 2022, Appendix 2.10)

As referred to in sub-question 2, in the next plans, Supercykelstier will be aware if the train stations are within 500 meters and when the bus stop at less than 100 meters and see the connectedness and improve it and improve bike parking in the area. This measure can be very helpful to improve bike combination trips if there are improvements in the stations and their accessibilities this can be the step needed to boost the bike combination trips. But DSB reports that they do not see effects when increasing and improving the bike parking. This is not one of their big focuses. (David Rønnov, interview, 2022, Appendix 2.9)

As seen previously, upgrading a station is very hard due to the different interests and actors and different focus from the different actors. According to Niels Dam, there is a big competition about the square meter in every station to build parking facilities between cars and bikes. (Niels A. Dam, interview, 2022, Appendix 2.5) When the aim changes to new stations there are talks between all actors to plan it in the best way possible and think in all users. For bike combination trips and to have close and easy connections between the different transport. This specific case was brought up in the interview with Joe Jensen and Michael Hansen from Movia when talking about how future stations will be engaged with mobility to show that even though there is already

a lot of focus on cyclists and bike combination trips but it is still hard to plan to account with them due to the number of actors involved and interests. In the new station in Copenhagen (Ny Ellebjerg which will change its name to Copenhagen South) there will be a Bus stop (Movia), S-train station (DSB), Regional train (DSB), and Metro (Metro), and the railway infrastructure (Banedanmark). (Michael Hansen and Joe Jessen, interview, 2022, Appendix 2.2) They work all the time with those other actors and co-work with the municipalities. (Michael Hansen and Joe Jessen, interview, 2022, Appendix 2.2) But from the municipalities and the other actors such as DSB, there is not enough focus on bike parking and it is quite hard as there are many actors when we arrive at a station. (Sidsel Hjuler, interview, 2022, Appendix 2.3)

SQ4: How can the station affect the bike combination trip experience (Dybbølsbro)?

Dybbølsbro is a station that is very close to Copenhagen's central station. This station had a total of S-train departures in 2021 277988 with a total of 1596433 users in the same year (accounting for all the passengers using the travel card). (Trafikstyrelsen, n.d.) As mentioned previously in chapter 1.4, this station has 2 different platforms for the different lines that feed 7 different lines of the S-train. However, on both platforms, there is limited accessibility with only an elevator per platform and the stairs do not have bike ramps. The stairs are quite narrow (1,65 meters – own measures) for two ways (up and down) even using it for bike combination trips as is possible due to the number of S-train lines. See the stairs in figure 3.

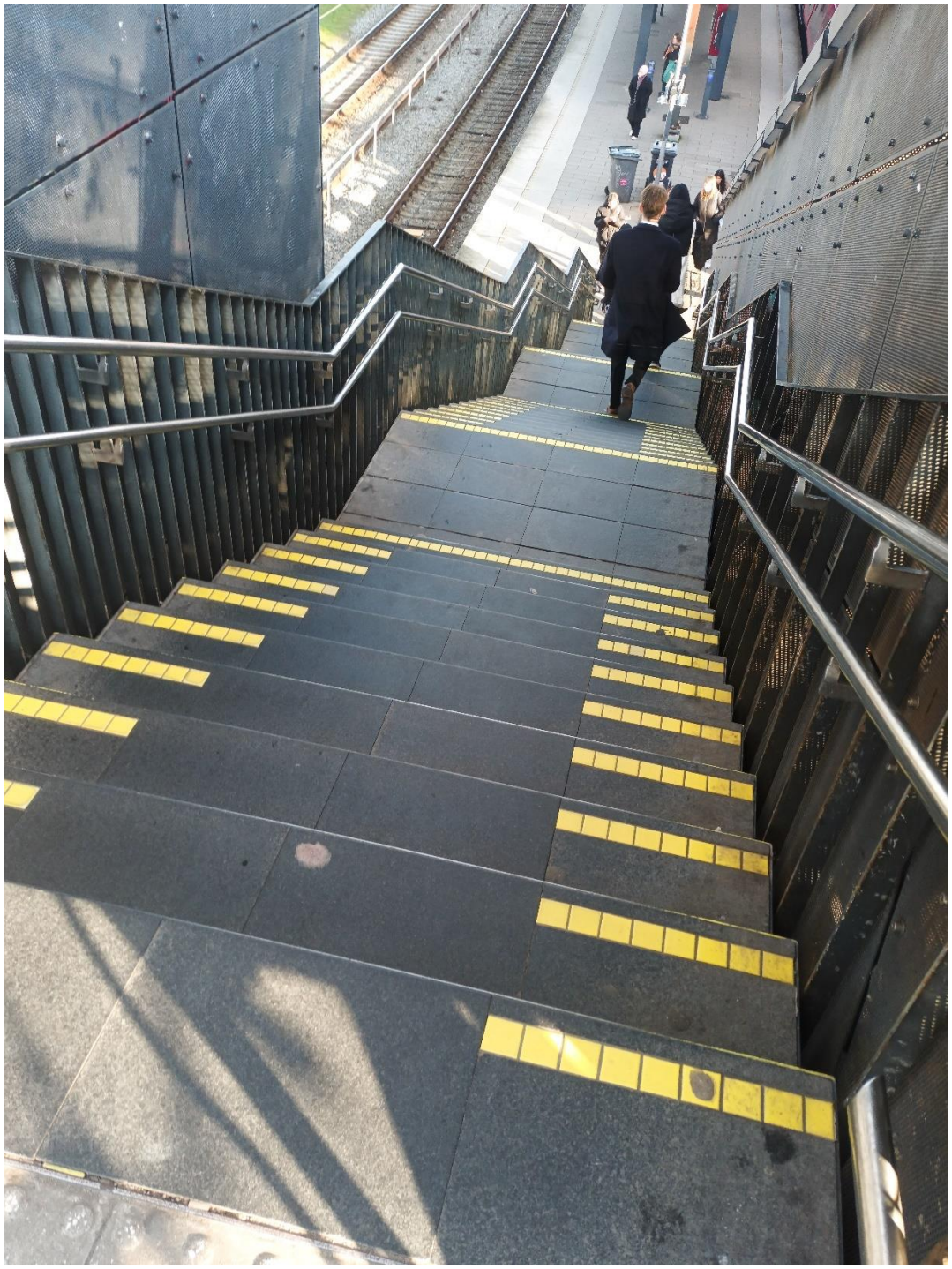

Figure 3 - Stairs in the station of Dybbølsbro

The bike parking is not good as well and during rush hour is overbooked. There is only a front wheel holder for bike parking in the station and it is not covered in figures 4,5 and 6. It is possible to see two bikes occupying one parking spot in figure 5 and some other bikes outside the bike parking area in figure 4 on the left side of the figure. Besides this, in figure 6 it is possible to see the amount of bike parking and bikes in the area not so close to the station. The evaluation in the national passenger satisfaction survey shows that the parking conditions here are not good as it was given a grade of 3,35 on a scale from 1 to 10. This ranking was made for the stations regarding bike parking. When the interview with DSB was made with Niels A. Dam one of the questions about this station was made to understand why the rating is so bad in this station in particular. The answer was that the bikers always want to park close to the platforms and sometimes it is not possible. (Niels A. Dam, interview, 2022, Appendix 2.5) And there is a big competition for these areas along the stations for all the square meters (either for bike parking or car parking) so it is hard to plan. (Niels A. Dam, interview, 2022, Appendix 2.5) The surrounding areas can be owned by different actors (municipalities or private landowners). There is still more to develop, according to Niels, as the synergies and communication between DSB and the municipalities could be better and there is a lot of work toward improving the stations. (Niels A. Dam, interview, 2022, Appendix 2.5)

Figure 4 - Bike parking in the Station of Dybbølsbro close to the bus station

Figure 5 - Bike parking close to the platform in the Station of Dybbølsbro

Figure 6 - Bike parking in the Station of Dybbølsbro away from the platform

As seen in Figures 4,5 and 6 Dybbølsbro is a problematic area where the parking spots are overcrowded. It has been already referenced in the Priority Plan for Bike Parking 2018-2025 made by Copenhagen Municipality. The new implementations for this station are: placing more traditional stands where there is room (on existing sidewalks and extension of sidewalks), capacity optimization of the parking area in the station and removing abandoned bikes, and new stands types such as vertical parking and two storage bicycle parking could be a solution to double the parking capacity but it would detract visually in this station. (Copenhagen Municipality, 2017b)

The Cykombi tool (screening tool - previously explained in chapter 4.3) was used to understand how the overall user experience is for a normal user of this station for bike combination trips in this station. In figure 7 it is possible to see the results of the different parameters with Cykombi. The overall grade for bike combination trips is 5,4 and the bike parking in the station is 4,9. According to the Cykombi tool, the index of bike parking should not be lower than 5. It can be easy to explain as there is no covered bike parking and there is only one type of bike parking (front wheel holder). Besides this, the parking is full and there are a lot of bikes out of the parking places as there is no space to park in the respective areas. Then another bad grade is the lack of good waiting facilities as they only have ticket machines, few seats and there is only a covered area without any toilet or any service. However, the station has the maximum grade in the parameter of micro-mobility as there is city shared bikes and electric scooters in the hub of the station. The other fine parameter is the route from the bicycle parking to the train hub as the distance is quite small and the location of the check-in stands is very well placed.

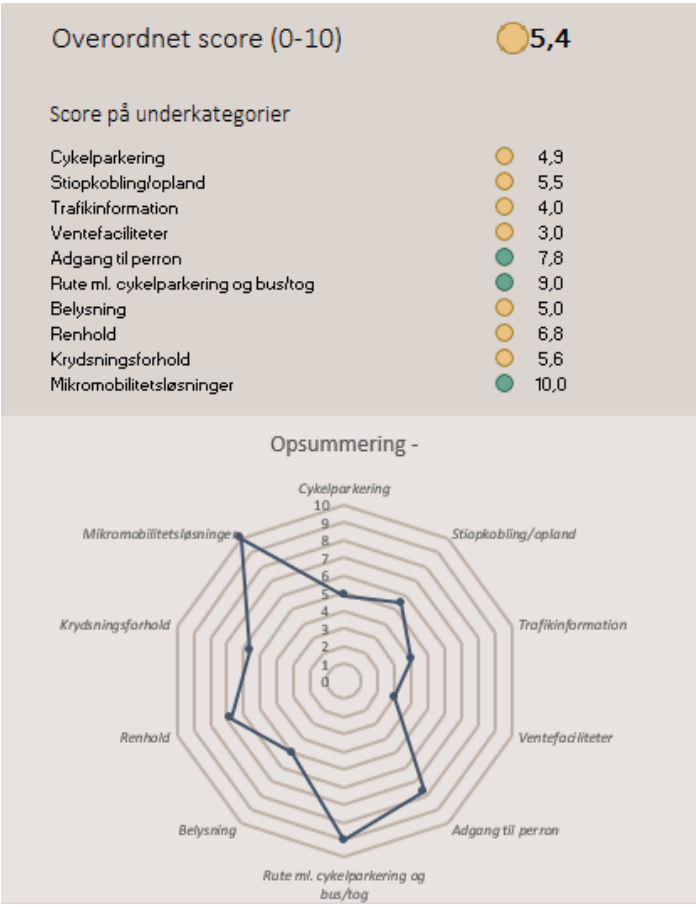

Figure 7 - Overall Score of the Station of Dybbølsbro according to the Cykombi tool

Chapter 6: Discussion

In this chapter, it will be discussed the analysis and answer to the Research Question

RQ: Past, Present, and Future of bike commuting and bike combination trips in Copenhagen.

Throughout the analysis, it was possible to approach either the topic of bike commuting or bike combination trips. Since 2010, different measures have been carried out by different companies but with a common objective: the creation of combined bicycle trips. These measures become relevant for users, increasing the number of passengers and changing their habits, reducing the participation of cars and CO2 emissions, and creating more sustainable mobility.

In addition to the different companies associated with transport such as DSB, on the other hand, the construction of Supercykelstier has improved the general conditions for cyclists and on the web where in the future it will allow users to make combined bicycle trips more easily. Knowing that the sense of security has increased in recent years is a good indicator of the potential for the future of cycling trips and combined cycling trips. However, one of the biggest concerns for the future is the updating of the different stations, as it would be important to increase combined bicycle trips and could decrease the car share in Copenhagen, creating a more sustainable city. In the case of Dybbølsbro station, it is not easy to make a combined bike trip to and from this station and measures are needed if the goal is to move towards sustainable mobility. From the interviews, it was possible to understand that the different priorities for bike combination trips and bike commuting from the different actors and owners make it hard to cooperate in these areas.

The measures taken by Movia (free bikes in buses with some conditions) still need time to be analysed if there was an increase in users as the measure is recent. With an increase in transport for bike combination trips, the number of 'active travels' will increase and the health of the users will improve as well. The use of cars will reduce even more and less space needed for cars with the possibility of changing the 'business as usual'. Improving and extending the Supercykelstier has helped this as well to this change and go against the modus operandi referred by Randers, 2019. For a sustainable form, cars should not be used and it would be easy to arrive at any place quickly without

using a car. To work towards sustainable mobility the municipality has to focus on this reduction. All the current projects and upcoming projects can improve bike commuting and bike combination trips and give a better environment and accessibility.

In sub-question 1, it was possible to see that the car share was maintained almost unchanged and car ownership increased over the last years. Although there are some good measures to improve bike commuting and bike combination trips as an alternative to cars. Projects like Gate 21 previous projects in Copenhagen are referred to in sub-question 3 where the companies improve their facilities (such as bike parking and changing rooms) in order to increase the conditions for bike commuters. The municipality is doing a project with the same mindset and only focused on bike parking which is still ongoing until 2025.

As referred previously to in sub-question 4, DSB reports a need to create better synergies to improve bike parking facilities and these relationships can have effects on other actors. As referred to previously in chapter 3.2 the principle of irreduction refers that "what actors are and do is the effect of their relationships with other actors. In this way, all actors are also networks of other actors that constitute each other". (Storni, 2015, p. 169). It is possible to see the lack of interest in bike parking by DSB and how it affects the relationships with other actors some actors report that bike parking is not a priority and that makes it harder to collaborate with DSB as reported by Supercykelstier. When looking at Movia and their focus on mobility the Region feels that their interest is the same and the municipalities want to make these changes as well. Even though this attitude can be even better and influence even more other actors and political powers to change their minds and allocate more funds to this area.

Another important agent to improve the collaboration and the measures of all actors is the inclusion of including more the passenger's voice. Although the municipalities and Passengerpulsen already do this, other companies such as Movia created a new tool to report about each trip (either to say good or bad about the trip), and Supercykelstier that it is possible to report problems in their routes with main focus on maintenance. The questionnaire by Movia is quite simple and possible to fulfil during the trip but the procedure by Supercykelstier is quite slow and asks for several steps and according to the different municipalities the steps are different. This procedure needs to be easier

and more intuitive for the user. An idea could be to attach this reporting tool to a web mapping platform for example Google Maps, City Mapper or Waze. The procedure would be with georeferencing and a photo of the problem in the road or a small description of the problem in that place. This would make the citizen feel some power to improve the system and the conditions for its trips.

Another idea to engage more the citizen with the help of a tool could be the identification of Supercykelstier in the map to be easier for the cyclist to plan the trip with the help of this tool and understand which tracks are Supercykelstier and choose which path to use according with this information. This would facilitate the users' task that if they want to use Supercykelstier they need to go to the website of Supercykelstier and see which paths are Supercykelstier. These two ideas would belong to the same app and could help bike commuters. The authorities could inform in the same app of the maintenance works in the different Supercykelstier and give different alternatives for the users. Nowadays, Supercykelstier only informs its users about maintenance in the tracks through Facebook. Another idea of feature could be for the app to give ideas of bike combination trips according to the path that the user would like to do. This tool could be helpful for wintertime when the weather is a bit worst (either because of rain or cold).

To improve even urban planning one measure could be a better interconnection between the different public transport companies where multidisciplinary participation is necessary. These actors are involved in public transportation from different areas and with different responsibilities to be more fluid in the trip and with fewer waiting times for its users. An integrated transport authority in Copenhagen could be a possibility to improve these synergies between the different means of transport with the same mindset and same objectives. Either with the upgrade of station hubs or with smaller waiting periods between the different transports.

As referred to in chapter 3.2, there is a need for collaboration between actors and involving multidisciplinary participation. This collaboration between the different actors that have different knowledge and different responsibilities. According to the previous ANT done it will be done a new ANT to create new relations that could improve the

whole system and create a better and strongest network with more actors working together to have more knowledge.

This new ANT in figure 8 has the new connection between DSB and Movia to Supercykelstier as it would be an important connection to improve bike combination trips and all actors working together with this mindset of improving the number of passengers through Supercykelstier. Although Passengerpulsen is only worried about public transport one focus of them should be the bike combination trips and measuring how it is in the Region for this matter, a connection with Supercykelstier would be important to receive feedback according to the users and what can be changed for an improved future. Another new connection with Supercykelstier should be DSB and Movia to improve the bike combination trips and increase the catchment area and better connections between these means of transport. The last connection suggested would be between the Cycling Embassy of Denmark and Movia as they are both worried about green mobility and a partnership between them could improve the bike combination trips and have better knowledge about it.

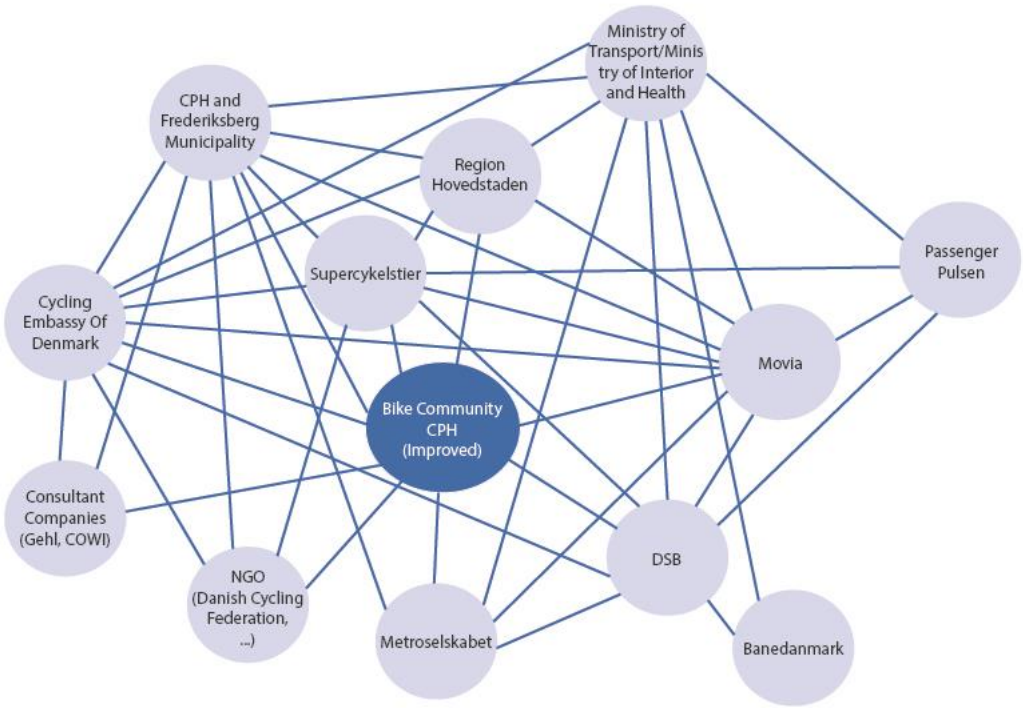

Figure 8 – Proposal of ANT

Chapter 7: Conclusion

To conclude, there are still improvements to make in bike combination trips and bike commuting, but there are good measures to be done in the future, although there is always room to improve and innovate measures that can be put into practice. Sustainability is still not close to their targets referred to in the Copenhagen 2025 Climate Plan due to the number of cars in the city and the amount of bike parking available as well.

Like the case study of this thesis, the bike parking is not good and needs a lot of improvement. Other places in Copenhagen are critical as well as the satisfaction with bike parking in Copenhagen is only 47% as referred to in chapter 5 in SQ1. The bike parking plan is not enough for the needs of the population and without a good improvement, this can cause a reduction in bike users (as already seen since 2019) as there is no bike parking available in certain areas of the city. The capacity of bike parking in Copenhagen should be doubled to face the issues with bike parking throughout the city and in the case study of this thesis which is Dybbølsbro.

Although tools like Cykombi are a recent tool, it is a very useful tool and can be used to track all types of stations to assess their conditions and their respective scores with small effort and are not time-consuming. This can help all municipalities to know the conditions of each season and prioritize which ones should improve in the meantime. More tools like this can go a long way in sorting out an entire city. However, it is also crucial to improve actor relationships and create a wider network as seen earlier in figure 8. It would help to have a closer connection and more knowledge to work towards more sustainable transport.

7.1 Limitations

Unfortunately, it was not possible to interview DSB a second time, the Copenhagen Municipality, the Ministry of Transport and some consulting companies that could give relevant insights into the topic of the thesis. It would be really important for the whole thesis and in the case study.

7.2 Future Research

Although tools like Cykombi is a recent tool, it is a very useful tool and can be used to track all types of stations to assess their conditions and their respective scores with little time spent on them. This can help all municipalities to know the conditions of each season and prioritize which ones should improve in the meantime. More tools like this can go a long way in sorting out an entire city. However, it is also crucial to improve actor relationships and create a wider network as seen earlier in figure 8. It would help to have a closer connection and more knowledge to work towards more sustainable transport

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