Take the bicycle

- a project concerning the potentials and challenges in the implementation of a new Bicycle Sharing System in Copenhagen

Roskilde University, ENSPAC, TekSam B1, 2011
Group 662 Dan Schou, Dorte Bech, Esther Kristensen, Luiza Brandao Rabelo & Pedram Yosefipor
Primary supervisor Øystein Leonardsen
Secondary supervisor Per Homann Jespersen

Typewritten characters 161,033 characters with space (67 pages of 2,400 characters with space pr. page)

Abstract

The scope of this project is to analyze and highlight potentials and challenges regarding the integration of a new Copenhagen bicycle sharing system with the public transportation, using the Copenhagen Climate Plan as our point of reference. Via a Critical Realist approach, we looked both at the physical and commuter aspects of the implementation, followed by a calculation on its expected usage and CO_2 reductions. We conclude that there exist potentials in the physical implementation of the new bicycle sharing system in Copenhagen, especially in areas where there appears to be gaps in the coverage of the public transportation. However, we see a small tendency where some stations do not necessarily have the required space above surface for bicycle sharing docking stations, thereby requiring other, possibly more expensive, approaches. When it comes to meeting the requirements of the commuters, we find that there exist challenges which can seemingly only be met by high standards in the whole system. If these challenges can be met, we assess an optimal commuter usage and CO_2 reduction of respectively 11,801 users and 6,099 t/year. Potentially we see that a new bicycle sharing system in Copenhagen can contribute to the achievement of visions for the transport sector set forth in the Climate Plan, but only if the observed challenges are taken into consideration, as a half-hearted approach does not seem to be gainful for the bicycle sharing system.

Resumé

Omfanget af dette projekt er at analysere og belyse potentialer og udfordringer i integrationen af et nyt Københavnsk bycykel system med den kollektive transport, hvor vi anvender Københavns Klimaplan som pejlemærke. Med en Kritisk Realistisk tilgang, kiggede vi både på de fysiske og pendler aspekter af implementeringen, efterfulgt af en beregning på dens forventede anvendelse og CO_2-reduktioner. Vi konkluderer, at der eksisterer potentialer (samt udfordringer) i den fysiske gennemførelse af det nye bycykel system, især i områder hvor der ses huller i dækningen af den offentlige transport. Desuden ses en mindre tendens, hvor nogle stationer ikke understøtter det nødvendige byrum påkrævet til docking stationer for bycyklen. Hvilket vil kræve andre, eventuelt dyrere, tilgange. Med hensyn til opfyldelsen af pendlernes krav ser vi, at der eksisterer udfordringer, som tilsyneladende kun vil kunne opfyldes ved at sætte høje standarder til hele systemet. Hvis disse udfordringer kan opfyldes, vurderer vi et optimalt pendler forbrug og CO_2-reduktion på henholdsvis 11.801 brugere og 6.099 t / år. Potentielt ser vi, at en ny bycykel i København kan bidrage til opfyldelsen af visionerne for transportsektoren - der er fastsat i Klimaplan - men kun hvis de observerede udfordringer tages i betragtning, da vi vurderer, at en halvhjertet tilgang ikke vil gavne implementeringen samt opretholdelsen af systemet.

Table of Contents

Chapter 1 - Introduction 4
1.1 Problem Area 4
1.2 Thesis Statement 6
1.2.1 Elaboration of Thesis Statement 6
1.3 Motivation & Pre-understanding 7
1.4 The project structure 8
Chapter 2 - Methodological Reflections 9
2.1 Reflections regarding Philosophy of Science - Critical Realism 9
2.2 Delimitation 10
2.3 Theoretical reflections 11
2.4 Empirical reflections 12
2.4.1 Introducing the interviewees 12
2.4.2 Introducing the physical implementation & secondary statistical data 13
2.5 Documents used 14
Chapter 3 - Transportation in Copenhagen 15
3.1 Visions for the transport sector 15
3.2 Bicycle culture and infrastructure in Copenhagen 16
3.3 The bicycle integrated with the public transportation 17
3.4 Current urban development plans 18
Chapter 4 - A New Bicycle Sharing System in Copenhagen 20
4.1 Bicycle Sharing Systems 20
4.2 Main actors and the current state of negotiations 21
4.2.1 Intentions of the main actors 22
4.3 Copenhagen BSS Competition 22
4.4 International experiences 23
4.4.1 OV-Fiets, Netherlands 23
4.4.2 Call a Bike, Germany 24
Chapter 5 - Physical Implementation 26
5.1 The Station Proximity Principle 26

5.1.2 Increasing the catchment area for stations ... 27
5.2 Analysis ... 28
5.2.1 The Basis Map - *Municipality Plan 2009: 2a. Location of business* ... 29
5.2.2 Map with highlighted catchment area of stations based on walking (600m radius) 30
5.2.3 Map with highlighted station catchment area based on bicycling (1,800m radius) . 32
5.2.4 Selecting key rail stations for the BSS ... 33
5.2.5 Potential station catchment area. Map with highlighted station catchment area based on Efficient Transit Hubs (1,800m radius) ... 37
5.2.6 Part Conclusion ... 37
5.2.7 Case stations ... 38
5.3 Conclusion ... 43
Chapter 6 - Potential number of users & CO_2 reduction ... 45
6.1 Potential number of users ... 45
6.1.1 Approach A: Potential market share of public transportation ... 47
6.1.2 Approach B: Change of Travel Patterns ... 50
6.2 Potential CO2 reduction ... 53
6.2.1 CO2 reduction from car usage ... 54
6.3 Conclusion ... 54
Chapter 7 - Analysis of commuters´ requirements ... 56
7.1 Commuters' requirements of the public transportation system ... 56
7.1.1 Reliability ... 57
7.1.2 Travel Time ... 57
7.1.3 Flexibility ... 58
7.1.4 Comfort & Price ... 58
7.1.5 Challenges and limitations of the public transportation system ... 58
7.2 Commuters' requirements for a BSS integrated with the public transport ... 59
7.2.1 Commuters' requirements applied to the BSS ... 61
7.2.2 Reliability ... 61
7.2.3 Travel time ... 61
7.2.4 Flexibility ... 61
7.3 Evaluating potential options of features to meet commuters' requirements ... 62
7.3.1 Comfort & Price ... 62

7.3.2 Bicycle Design ... 63
7.3.3 Payment and access ... 64
7.3.4 Parking and Docking ... 65
7.4 Conclusion ... 66
Chapter 8 - Discussion ... 68
Chapter 9 – Final Conclusion ... 73
Chapter 10 - Critical Reflection and Perspective ... 75
References ... 78

Chapter 1 - Introduction

1.1 Problem Area

Worldwide scientific and political discussions are occupied with the issue of climate change caused by greenhouse gas emissions such as carbon dioxide, commonly referred to as CO_2 emissions. In the light of that, the Municipality of Copenhagen - host of the UN Climate Change Conference 2009, COP 15 - launched the ambitious *Copenhagen Climate Plan 2025*, which aims at reducing CO_2 emissions with 20% by 2015 in Copenhagen, and make it the first CO_2 neutral capital in the world by 2025 (Climate Plan, 2009a). According to the Climate Plan, becoming CO_2 neutral implies that the net emissions of CO_2 are reduced to zero. This will be done by reducing CO_2 emissions as much as possible, and counterbalancing for the remaining emissions through CO_2 reduction initiatives outside the municipality. The Climate Plan consists of six areas of focus: *Energy supply*, *Transportation*, *Renovation & construction of buildings*, *Citizens & climate*, *City development* and *Adaption to future weather*. We will in this project focus on the initiatives and goals concerning the transportation sector.

According to the Climate Plan, 10% of the reductions by 2015 are to be attained by the transportation sector. Initiatives regarding this reduction aim at a more sustainable transport sector, where cycling alongside with walking should be the most accessible and attractive choice of transportation (ibid., p. 32). The main goal of these initiatives is to achieve a reduction in car use and thereby a decrease in CO_2 emissions, congestion, air and noise pollution. The initiatives can be grouped into two categories: promotion and creation of attractive alternatives to the car, such as cycling and collective transport modes (ibid., p. 34); and restrictive measures, such as congestion charges, establishment of car-free zones, parking restrictions, environmental zones and road relocation (ibid., p. 41). We will not further examine these restrictive measures but concentrate on the interaction between the two main alternatives to the car; cycling and the public transportation system[1].

The PTS is mainly associated with fixed routes and timetables, and is therefore often considered less flexible than the car. The independence and convenience of driving one's car

[1] Acronym: PTS

whenever and wherever is hardly achievable through public transportation, which has limited reach, longer travel-time and often require passengers to make several shifts along the journey. As opposed to other big cities, bicycles play an important role as a transport mode in Copenhagen. Although slower than motorized modes, the bicycle is a competitive and flexible mode for short trips due to the well-established bicycle infrastructure in Copenhagen – and it brings health and environmental benefits with it (TMF, 2009a). The importance of the bicycle in the transport network is recognized and appreciated by the Municipality of Copenhagen, which intends to promote Copenhagen as the world's best cycling city (Climate Plan, 2009a, p. 34).

While Copenhagen's cycling tradition dates back a century, the interest for bicycles as a mode of transport has first blossomed in other European metropolises over the past decade. Concerns about the environment and increasing congestion in urban areas underlie the increasing interest in promoting sustainable modes of transport. The implementation of bicycle sharing systems[2] has shown to be an effective way of introducing cycling as a mode of transport for urban areas. These systems basically consist of public access to a fleet of bicycles in inner urban areas, either for free or for a certain fee (Bührmann, 2008). Copenhagen was one of the forerunners of such concepts, being the first city to implement a formalized system: Copenhagen City Bikes (Da: *Bycyklen København*) back in 1995. The system is still operating, but if compared to newer BSSs operating worldwide, the City Bikes are considered outdated. Therefore, it will be substituted by a new system in 2013, which should reflect the Municipality's ambitions of becoming the world's best cycling city. The new BSS should, as opposed to the current one, not only serve tourists, but more importantly an entirely new group of users: commuters travelling into or within the city of Copenhagen for work or study (TMF, 2009b). As bicycle ownership is widespread and used as mode of transport by a considerable amount of commuters in the city of Copenhagen (TMF, 2009a), the BSS's potential for promoting sustainable mobility mainly lies in serving those who do not currently commute by bicycle. Therefore, part of the criteria for the new BSS lays in its interaction with public transportation modes, with particular emphasis on rail transport (TMF, 2009b). The Municipality is therefore currently negotiating the establishment of a new BSS with DSB[3]. In

[2] Acronym: BSS
[3] Danish State Railways: an independent state-owned traffic company managing the trains and S-trains

this way, the system could provide bicycles for the egress trips[4] for those commuting by train or metro, as an alternative to busses, cars or walking. As the BSS could provide the PTS with a fast and flexible individual link, it holds the potential for enhancing the attractiveness of rail-based transport. This applies both for those who already commute by train or metro and for those who currently commute by car. In this way, it could strengthen sustainable alternatives to the car for those commuting both into and within the city of Copenhagen.

1.2 Thesis Statement

How can the coming bicycle sharing system's integration with the public transport increase the current catchment area of rail stations in Copenhagen? Considering the challenges involved in meeting commuter requirements for this combination, what is the potential of its contribution to the achievement of the visions for the transport sector set forth in the Copenhagen Climate Plan?

1.2.1 Elaboration of Thesis Statement

The scope of the project is to investigate and highlight possible potentials and challenges regarding the integration of a bicycle sharing system with the public transportation system. To be more precise we have chosen to split the thesis statement into two parts, firstly:
How can the coming bicycle sharing system's integration with the public transport increase the current catchment area of rail stations in Copenhagen? Catchment area is here understood as the reachable area from rail stations within a fixed radial, which at the moment is 600 metres. This leaves gaps in some areas of the public transports coverage of the city. We will therefore analyze how a BSS, integrated with the PTS, can potentially increase this area by elucidating the physical integration of docking stations with rail stations in Copenhagen, whilst taking future developments into consideration.
Secondly: *Considering the challenges involved in meeting commuter requirements for this combination, what is the potential of its contribution to the achievement of the visions for the transport sector set forth in the Copenhagen Climate Plan?*
The second part seeks to estimate upon the potential amount of users and CO_2 reductions by calculating on various factors and secondary statistical data, such as; station proximity, travelling time and commuter interest. This will enable us to assess how much the combination, of the BSS with the public transport, can possibly contribute to the goals set for

[4] Trip at the activity-end of the journey (between end-station and destination)

the transport sector. There are however external factors, in this estimation, which cannot be taken into account. We will therefore analyze upon commuter requirements in order to find possible challenges and potentials of the actual usage of a BSS in Copenhagen. Hence, in order to enable ourselves to answer the thesis statement, three separate analysis chapters and a unifying discussion will be featured in the project. The three analysis chapters will respectively take the following research questions as their starting points:

1. *How can we illustrate the potential catchment area when integrating docking stations for the BSS and demonstrate potential challenges of such an implementation?*
2. *Which projection can we possibly derive in regards of usage and emission reductions of the BSS?*
3. *What are the commuters' requirements for the public transport system, both separate and with the BSS?*

The discussion will subsequently unite the three analyses and seek to answer the thesis statement with the Climate Plan 2025 as a point of orientation.

1.3 Motivation & Pre-understanding

We all followed COP 15 hosted in Copenhagen, and noticed the launching of the ambitious Climate Plan 2025 by the Municipality of Copenhagen. Curiosity regarding these remarkable visions led us to the exploration of the plan. We were especially interested in how they were planning to cope with the immense challenges of promoting and establishing sustainable mobility. In the context of Copenhagen cycling seems an obvious alternative to the car, and promoting this is also in our own personal interests as bicycle riders in Copenhagen. Out of research and personal experiences we regard the City Bikes as outdated and in need of optimization. We had a notion that a new BSS could almost flawlessly function as an extra link in the PTS possibly making it a viable alternative for the automobile. However, it was our pre-understanding that changing transport habits could be a challenge in itself; thus, we saw possible uncertainties regarding whether or not the commuters would actually use the system. As such, having commuters as the main target group for the BSS implied to us, that their requirements would have a strong impact on the usage and success of the system. Through the reflections we have made in the process, we have achieved a deeper insight into the potential problematics of an implementation, which are reflected in the final project.

1.4 The project structure

Chapter 1 ***Introduction***	In chapter 1 the project's subject area and problem is presented and elaborated upon. The thesis statement is introduced and the appertaining research questions are described. The chapter gives the reader an idea of the motivation behind the project.
Chapter 2 ***Methodological reflections***	In chapter 2 the methodological choices are gone over and the empirical reflections are introduced. This means that the reader will find a elaborating run-down of the approach we have taken with the theory of science and the delimitations. We will also argue for our theoretical choices and various literary sources. Finally, the interviews' most critical methodological choices are argued and the physical implementation is described along with the secondary statistical data.
Chapter 3 ***Transportation in Copenhagen***	In chapter 3 visions of the transportation sector in regards of the Climate Plan and CO_2 reductions will be presented as well as an introduction is given to cycling culture and infrastructure. Furthermore, the interaction between the bicycle and the public transportation system is elaborated on. This is done along with a presentation of urban development plans thereby, providing us with parts of the basic knowledge for the analyses.
Chapter 4 ***A new bicycle sharing system in Copenhagen***	In chapter 4 we will explain and provide knowledge of factors which are relevant for the understanding of the coming BSS, including previous bicycle-sharing systems, the Copenhagen BSS competition and the status-quo of the BSS project. With this chapter, along with the previous one, we will have laid a foundation for the analyses.
Chapter 5 ***Physical implementation***	In chapter 5 we will step-by-step go through a possible physical implementation. This will be done by means of visual representations of the Copenhagen transport network, ending with a potential illustration of how the whole of Copenhagen could be covered by way of the coming BSS. The analysis will also feature more in-depth descriptions of select stations. By ascertaining a potential full coverage of Copenhagen, we will on this basis be able to process statistical information of commuters in the following analysis.
Chapter 6 ***Potential number of users & CO_2 reduction***	In chapter 6 a processing of statistical data concerning commuters and CO_2 emissions will take place. This will be done in order to estimate a potential estimation of the usage regarding the shared-bicycles and the expected CO_2 emissions in relation to the goals set forth in the Climate Plan 2025.
Chapter 7 ***Analysis of commuters´ requirements***	In chapter 7 the commuters' requirements for the PTS are analyzed and we will strive to assess the possible challenges and potentials of the actual usage of a BSS. The analysis will provide us with the necessary information regarding commuter expectations, in order to carry on to the discussion.
Chapter 8 ***Discussion***	In chapter 8 we will discuss the findings from the different analysis' and their implications for our research question. This will lead up to the conclusion.
Chapter 9 ***Final Conclusion***	In chapter 9 the reader will get the answers to the questions introduced in chapter 1: *How can a new bicycle sharing system be integrated with the public transportation system? And how can the attractiveness of this combination be optimized for commuters, thereby contributing to the achievement of the visions for the transport sector set forth in Copenhagen Climate Plan?*
Chapter 10 ***Critical reflection and perspective***	In chapter 10 we will further respond critically to our methodological choices, which all have had an impact on the project's conclusion. We will in addition put other possible problem areas into perspective, which we have become mindful of through the work with the integration of a BSS with the public transport in Copenhagen.

Chapter 2 - Methodological Reflections

2.1 Reflections regarding Philosophy of Science - Critical Realism

For undertaking the investigation of how the coming BSS potentially can strengthen the attractiveness of the PTS, and thereby contribute to the reduction of CO_2 emissions within the transport sector envisaged in the Climate Plan, we chose to departure from a critical realist philosophy of science. This choice is grounded in the belief that this perspective is best suited for a project anchored in the greater field of study of the complex interactions between society and environment.

We follow Critical Realism's premises that there exists a reality independent of our knowledge of it; and that it is only possible to gain partial and socially determined knowledge about this reality (Danemark et al., 2002, p. 202). Although this knowledge is not absolute, it can be more or less truth-like, and thereby fruitful and worth pursuing.

By avoiding the epistemological naivety of positivistic approaches, and the ontological relativism of constructivist theories, Critical Realism allows us to "*conduct a well-informed discussion about the potential consequences of mechanisms working in different settings*" (ibid., p. 2) that does not involve universal claims, but still is able to identify tendencies which somewhat correspondent to actuality. In other words, we intend to discuss which mechanisms might play a vital role for the successful establishment of Copenhagen's new BSS.

We approach our field of study as an open system, where the mechanisms producing the social reality are constantly susceptible to new and external inputs, creating a reality where the mechanisms cannot be identified in their totality. Specifically, we have therefore throughout the project process taken new aspects into account and other aspects out, which we at the beginning necessarily did or did not plan to touch upon, but later because of the new knowledge decided to exclude or include. Examples of inclusions are Urban Development Plans and the extensive statistical processing of commuter numbers and CO_2 emissions in favour of theoretical material such as Mobility Management; the works of inter alia Wolfgang Sachs and John Urry. In relation to this, we are aware that there might be – and certainly are - other mechanisms which we cannot ascertain. For this reason we are neither capable of or intend to produce accurate predictions about the development and user-acceptance of the coming BSS, but only wish to point towards possible tendencies. We are therefore aware of the fact that elements other than the ones treated in this project are influential for how the future development will occur, reason for which we do not claim this study will give all the definite answers into how to design and establish an attractive BSS for commuters. Nevertheless, the themes treated in the project, such as user requirements and the physical establishment of the system, are seen as basic and crucial for the enhancement of attractiveness, and their relevance must not be overlooked. As such, throughout our analysis and discussion, we will strive to provide as complete a picture as possible of the observed reality, whilst still remaining mindful of the deeper and indirectly observable structures, such as organizational and economic structures.

2.2 Delimitation

Several approaches could have been undertaken in the tension field between the Climate Plan, Copenhagen, the Bicycle Sharing System and the Commuters. With this in mind, there were also many areas from economical to administrative factors which could have been the area of focus, but these were beyond our line of study.

Copenhagen as a geographic area was chosen due to our common interest in the Copenhagen Climate Plan, however, we chose to include the Municipality of Frederiksberg in our deliberations for a matter of reasons. Firstly, the Municipality of Frederiksberg is encompassed by the Municipality of Copenhagen, secondly, both municipalities are often included into calculations in what is categorized as the central municipalities, thirdly, Frederiksberg often co-operates with the Municipality of Copenhagen on many matters, and this is, according to our interviewee Jens Lerager, also the case for the new Bicycle Sharing System. We therefore saw no reason to exclude the municipality of Frederiksberg. Thus, the term central municipalities will be used when we mention Copenhagen.

A BSS aimed towards commuters is also underway in Odense. However, since these shared-bicycles aimed at commuters have not yet been implemented there are no experiences to draw from and this BSS project was therefore excluded from our scope. Our own geographical location was along with our first-hand experience and knowledge of the city considerable factors in the decision of choosing our focus for this project.

As such, we deliberately chose to use the Climate Plan 2025 as a point of orientation, thereby enabling ourselves to discuss the potentials and challenges of the BSS in relation to these visions. We could in this case have looked beyond the year 2025, but this would have left us in a disadvantaged spot with scarce information, leaving us with little room for manoeuvre. However, looking only at the targets for 2015 could have been a possibility. Although, we believed that there were a few interesting mechanisms which could only be covered in a timeline of 2025 e.g. Metro City Circle Line and some urban development projects. Once in operation, by 2018, the City Circle Line will further improve the connection between different parts of the city and for this reason we will take this line into consideration in our analyses.

Because of the actuality of a new BSS in Copenhagen, primarily orientated towards commuters, we found this group of users most relevant and with the most significant potentials concerning the visions of the Climate Plan. The BSS project is currently in its early stages, making it an area of interest with large amount of potentials. For the same reason, it is an area with a limited amount of information, opening an opportunity to potentially deduce unseen results.

The physical implementation of the BSS could have been approached in a number of different ways, but was in the end performed as an assessment of the potential catchment area of the whole transport network in Copenhagen. A more technical approach (such as the specific design of features on the bicycles) was unfavoured considering our own qualifications and the goals set in the thesis statement.

In our analysis of commuter's requirements for the PTS, the choice fell on already compiled information regarding these. In this case we could have used focus groups with the intention of gaining more in-depth information. Performing representative focus groups for all types of commuters, both within Copenhagen and those travelling into the city, would demand resources and time which we believe would affect the overall project negatively. This was unfavoured because of our broad focus of commuters and the already present empirical data which functions as a sufficient substitute.

2.3 Theoretical reflections

Concerning the theoretical choices, a selective approach has been utilized which in accordance with the theory of science have been subject to change throughout the process of the project. Acknowledging throughout the process that relevant literature for answering our thesis statement was primarily empirical, we decided to exclude several theories. Remaining elements of Malene Freudendal-Pedersen theory was settled on the basis of her interesting and extensive findings from interviews and research regarding mobility patterns and habits. Her theory was particularly relevant in relation to our analysis of commuters' requirements and regarding our study of potentially moving commuters from the car to the PTS. We are aware that the project could have gained from a more extensive use of theory, but due to the overwhelming amount of empirical material we chose to concentrate on the empirical sources. We made this decision in the conviction that the inclusion of general theories would not have applied to such a specific case and we believe that our inclusion of a wide range of empirical data was yet able provide a fruitful result.

2.4 Empirical reflections

2.4.1 Introducing the interviewees

This subchapter provides a short introductory list of our interviewees and what they add to our project followed by a brief description of our most crucial methodological choices and the motives behind them. Please view the Appendix 1 - Methodology, which features a complete description of the interview guide along with the deeper methodological reflections and arguments for the work with our qualitative interviews[5]:

Interviewees	Location	Purpose
Morten Heegaard, Co-ordinator for the internal process of establishing a BSS.	**The Technical and Environmental Administration Unit Road & Park, Islands Brygge 37**	Information regarding the Bicycle Secretariat's thoughts, plans and status of the new BSS, thus providing us with primary knowledge from the main actor.
Jens Lerager, analyst in strategies for access and egress trips.	**Main Office for DSB & DSB S-trains A/S, Sølvgade 40**	Information regarding DSB's thoughts, plans and status of a BSS aimed at commuters. Thereby giving us a greater insight into their intentions with the system and the co-operation with the municipality.

The purpose of the qualitative interviews is to achieve a greater insight into how the main actors approach and work with the implementation of a BSS in Copenhagen. In this context it is important to note that we for the purpose of preparation and overview chose to formulate an interview guide (confer the enclosed Appendix 1 - Methodology) (Kristensen, 2009, p. 285). The interview guide does not take form as a checklist, but rather functions as an anchor

[5] Both interviews were performed in Danish, since this was the mother-tongue of both Heegaard and Lerager.

for the interview itself. This was a deliberative choice we made in order to remain flexible and meet both the interviewees' needs and at the same time secure that our own intentions with the interview would be fulfilled. Our interviews strive to reach a combination of both being probing and in-depth, in order to gain detailed information on a subject area with otherwise scarce information (confer Appendix 1 for further deliberation upon this choice) (Ibid., p. 282). Our interviews are therefore semi-structured, avoiding a narrow and limited scope thereby providing the freedom for versatility in both the questions and their answers. As such we might gain productive results, which otherwise might have been lost (Ibid., p. 283).

The interviews were all done with two recording apparatus in order to secure the highest quality, thus providing us with the freedom to focus on the conversation itself (Kvale, 2009, p. 201). In regards to the transcription, we have chosen only to transcribe excerpts and references appearing throughout the project (confer the enclosed Appendix 2). Additionally, we have transcribed thirty seconds before and after for the sake of context and understanding (Ibid., p. 203). The full interviews have also been enclosed with the project on an ordinary CD as Appendix 3.

2.4.2 Introducing the physical implementation & secondary statistical data

Besides the qualitative interviews, we provide an analysis of the potential catchment area in Copenhagen in order to supplement the discussion about the establishment of the BSS. As with the methodology of the interviews, this will only be covered briefly consisting only of the most crucial points. An in-depth reflection can be found in Appendix 1.

The analysis itself takes basis on an original plan map by the Municipality of Copenhagen consecutively through the analysis, providing a scenario of the public transports' coverage with docking stations of a new BSS. We carried out the analysis manually with photo editing tools, and can therefore be subject to minor measurement errors. By reflecting on this matter, we came to the conclusion that this would not affect neither the validity nor the final result in any perceptible way, since the map is only meant as an illustration and not as an exact visual projection of the BSS's potential (confer Appendix 1).

With the use of the secondary statistical data, we will quantitatively roughly estimate the potential amount of new commuters and CO_2 reductions by comparing with the scenario created from the physical implementation. In this case we relied heavily on data from the National Travel Survey already treated in published reports, which in many cases cover a larger geographical area than we intended. Appendix 1 will provide a more thorough methodological explanation. Also, the specific methods used for the calculation are explained throughout the analysis itself.

2.5 Documents used

The bicycle sharing phenomenon and the Climate Plan 2025 have been subject to a broad range of reports, theses and other documents. A great amount of insight in the Municipality of Copenhagen's plans has been gained from reading the Climate Plan 2025, Green Accounts and Bicycle Accounts reports and other official publications.

The Municipality of Copenhagen's publication *Climate Plan 2025* has been relevant in order to understand what visions and goals has been set for the year 2025 specifically for the transport sector. The Climate Plan along with the interviews are used to create an overview for the plans regarding the BSS in Copenhagen. Finally, a various amount of traffic-, emission- and commuter related reports have been used from the Ministry of Traffic and different consultancy firms (e.g. Relation Lab, COWI etc.) in order to provide both qualitative and quantitative information for the analysis of commuter requirements (confer chapter 7) and the statistical data.

Chapter 3 - Transportation in Copenhagen

The purpose of the project is to investigate challenges and potentials regarding the implementation of the new bicycle sharing system. As our focus lies on its integration with the public transportation system in order to serve those commuting into and within the central municipalities of Copenhagen, we will introduce the city's public transport infrastructure, bicycle culture and infrastructure, and the most considerable urban development programs. But before that, we will start by expanding on the Municipality's visions for the transport sector, with special focus on CO_2 target reductions.

3.1 Visions for the transport sector

The following subchapter will account for the Copenhagen Climate Plan aims at achieving CO_2 neutrality by 2025. We will introduce this as our later estimation regarding CO_2 reductions gained from the implementation of a BSS in Copenhagen, will be evaluated according to the visions of CO_2 reduction in the Climate Plan.

The 20% reduction goal set for 2015[6] will be the most relevant for this project, as most of the initiatives for the transport sector aim at contributing with 10% of this target. In terms of amount of CO_2, the 20% target for all sectors within the city corresponds to a reduction of 500,000 tons CO_2/year (Climate Plan, 2009a, p. 9), which means that the transport sector is to contribute with a reduction of 50,000 tons CO_2/year. In 2005, the transport sector was accounted for 535,000 tons CO_2 emissions (KK, 2008). Thus, for contributing with 10% of the total targeted reductions, the transport sector has to emit approximately 10% less CO_2 if compared to 2005.

Road traffic was responsible for 74% of the total CO_2 emissions in 2005 (KK, 2008), which means that this is where the greatest potential for reduction lies. As the average CO_2 emission per car kilometre per passenger is the highest in Copenhagen compared to other modes of transport, the Municipality's initiatives concentrate in reducing car traffic either through restrictive measures or through the promotion of alternative modes (Climate Plan, 2009a, p. 34).

[6] Reduction targets are defined in relation to the CO2 emissions of 2005 (Climate Plan, 2009a, p. 9).

The alternatives to the car include cycling and collective transport. Initiatives for maintaining, improving and extending the public transportation system are also presented in the Climate Plan. As we intend to analyse the potentials of an initiative that will couple bicycles to the public transport, we will now present the current status and visions for each of the modes.

3.2 Bicycle culture and infrastructure in Copenhagen

The bicycle culture of Copenhagen earns its relevance due to the fact the new bicycle sharing system, once implemented, will become a part of it. The system will present a new way of utilizing the bicycle not previously seen to the commuter in Copenhagen. On one hand it might further develop and diversify the cycling culture in Copenhagen, on the other hand it might cause different conflicts of which we will elaborate upon in the final discussion. We will briefly introduce the bicycle infrastructure as this also has relevance for the establishment and usage of the new BSS, since a well functioning bicycle route network and adequate capacity on cycle lanes will ensure efficient mobility in the city.

Copenhagen is, as any other city, a unique city with its own history, culture and identity. This includes an old and well-established cycling tradition, which constitutes an important part of the identity of Copenhagen (TMF, 2009a). From a historic perspective the cycling culture of Copenhagen has undergone a massive development starting as a luxurious mean of transportation in the beginning of the 1890's, becoming a part of the mass production throughout the 1900's, threatened by the increasing amount of cars in the 1960's and winning its popularity back in the 1970's due to the oil crisis. Increasing the use of bicycles has ever since been on the political agenda of the Municipality of Copenhagen (ibid., p. 16).

At the present moment, the network of cycle routes comprises 350 kilometres of lanes and tracks across the city, and 41 kilometres of green cycle routes[7] (ibid., p. 3). The municipality plans to increase the amount and extent of cycle routes with further 110 km (ibid., p. 3).

The cycling infrastructure also includes bicycle-bridges over canals and roads as well as traffic lights that favours cyclist above cars. This extensive infrastructure makes cycling an efficient, convenient and flexible way of getting around in Copenhagen. Different studies shows that safety, a better cycling experience, comfort and the possibility to cycle faster on for example green cycling routes are ways of attracting more people to cycle (BTF, 2002, p. 17).

[7] The green cycle routes are nets of cycling and pedestrian paths that run separately and coherently through recreational areas across the city avoiding major traffic roads.

The 519,000 residents of the municipality own an amount of approximately 560,000 bicycles (TMF, 2009a, p. 17). This diverse cycling culture consists of all age groups riding different types of privately owned bicycles. Bicycling is seen as a legitimate mode of transportation, as it is socially accepted even amongst high-income and prestigious people, such as ministers and mayors (BTF, 2002, p. 5).

Currently, 37% of all those commuting into and within Copenhagen arrive at their workplace or educational institution by bicycle. According to the Climate Plan this number is to be raised to 50% by 2015 (TMF, 2009a). We will later assess the potentials and challenges for integrating the coming BSS to the public transportation and discuss how it might contribute to the achievement of this goal.

3.3 The bicycle integrated with the public transportation

This subchapter will seek to provide an understanding of the connection between the bicycle and the PTS which will elucidate the potentials of implementing the BSS with the PTS. Although rail transport is a sustainable alternative to the car, accessibility is a key limitation that compromises its competitiveness: the distances between point of departure and stations, and between end-station and final destination, enhance travel time and compromises convenience (Martens, 2006, p. 326). The use of the bicycle to cover the distances to and from stations can substantially reduce the door-to-door travel time of rail trips (Ibid., p. 327). The Municipality of Copenhagen seems to be well aware of this fact, since initiatives for improving the interaction between the bicycle and the public transport system figure in the Climate Plan, with focus on bicycle parking options and on creating good conditions for shifts between different modalities such as the train, bus, metro and the bicycle (Climate Plan, 2009, p. 32).

The combination of bicycle and train is already quite spread in Copenhagen. Rail passengers even have the possibility of bringing bicycles on the trains and metro for a fee of DKK 12, and for free on S-trains[8]. DSB have plans of launching a trail period with increasing capacity for bicycles on the S-trains (Laugesen, 2010, p. 6). The infrastructure for carrying bicycles on trains and metro varies both among modes (some have appropriate space, some have time restrictions, some are easier to jump on) and among stations (some have elevators, others have ramps). The convenience of taking ones bicycle in trains and metro is always debatable.

[8] This initiative is in its trial period, which has just been extended to include the year 2011.

On one hand this service can be a competitive element to the BSS, on the other commuters might find the BSS a great alternative for the inconvenience of bringing ones bicycle on the train.

The bicycle is mainly used for access trips between residence and rail stations, particularly for those who have a longer distance between these two. There is though a great difference in the rates of bicycle use for egress trips between station and the destination (Trafikstyrelsen, 2010, p. 36). It seems that people cycle more from home to station then from station to destination. This can be due to the fact that most people keep their bicycles at the home-end of their trips, used for purposes other than commuting. Another reason might be the chaotic and crowded bicycle parking infrastructure at train stations, which demotivates commuters that might be willing to invest in a second bicycle to be used for the egress trip – besides the considerable risks of getting the bicycle stolen (BTF, 2002, p. 28).In the view of that, people commuting into Copenhagen represent potential users for the BSS who, in present conditions, do not have a bicycle available for the egress trip. The possibility of cycling from station to destination might decrease the total travel time, thereby increasing the competitiveness of the rail trip. At the same time, it might avoid maintenance and risk of theft of a second bicycle, and the inconvenience of carrying ones bicycle onto stations and trains. This new service might enhance satisfaction of those already commuting with public transport, as well as making it more attractive for motorists.

3.4 Current urban development plans

As we believe that the BSS potentially can improve the PTS, we find it relevant to take future urban development's into consideration, as these might result in an increase of transport demands in specific areas. The BSS might therefore have a potential in assisting the PTS to meet these specific future developments by ensuring capacity for the possible increased demand. This section will therefore be based on the current proposal to a municipal plan strategy for 2010 (KK, 2010b). Much like the Climate Plan 2025, the Municipal Plan Strategy (DA: Kommuneplanstrategi) takes a back-casting[9] approach and focuses on different visions and strategies for the future development of five selected urban development areas in Copenhagen: *Ørestad, Sydhavn, Carlsberg, Nordhavn* and *Valby* (KK, 2010b, p. 37). These

[9] A reverse-forecasting technique which starts with a specific future outcome and then works backwards to the present conditions.

development plans include zoning for housing, commercial offices & services, institutions and industrial areas to a larger or lesser extent - dependent on the specific area. In our later analysis regarding the physical implementation of the BSS, we will consider the impact on the flow of commuters these developments might bring about, in combination with a judgement of how well the areas are covered by the PTS. We will therefore focus on *Nørre Campus, Sydhavn, Carlsberg* and *Valby*, as these areas seem to gain the most benefit from the establishment of a BSS integrated to rail stations.

Chapter 4 - A New Bicycle Sharing System in Copenhagen

We will in this chapter look at Copenhagen's visions and plans for the new bicycle sharing system. We start with a short introduction to the concept of bicycle-sharing systems including a brief historic outline of BSS's and general characteristics. This is done in order to establish a better understanding of the BSS, thus providing us with the basis to analyze on its challenges and potentials in Copenhagen. We will afterwards move on to the Municipality's visions for the system presented in the CPH Bike Share Competition, followed by an update of the recent decisions and a status of the project. This section ends with a short description of existing BSS that present some of the features envisioned for Copenhagen's new system, from which we can draw relevant experience.

4.1 Bicycle Sharing Systems

Bicycle-Sharing is sometimes presented as a trendy novelty, but its history dates back to the 60s. J. Paul DeMaio, an expert and consultant in bicycle-sharing programs, divides their development in three generations. We will follow his description since it seems to be the most recurrent and accepted one within the literature in the field.

The first bicycle-sharing program began in Amsterdam in 1965 (DeMaio, 2009, p. 2) and was known as White Bikes or Witte Fietsen, and consisted of ordinary bicycles painted white and placed on the streets for public free use. Despite the good intentions and originality of the program, it collapsed within days due to private appropriation of the bicycles and vandalism (Ibid., p. 2). First generation bicycle-sharing systems such as the White Bikes are characterized by no special design or technology, but instead by the use of ordinary bicycles; free and anonymous access and no parking infrastructure.

The first large-scale second generation BBS was launched in Copenhagen as the City Bike or Bycyklen in 1995 (Ibid., p. 2). The concept of the program remained basically the same as Amsterdam's White Bikes: to provide free public use bicycles for people to transport themselves between destinations within the city. The general characteristics of second-generation BBSs are the special and robust design of the bicycles, which distinguishes them from ordinary bicycles; free and anonymous access through a coin deposit; specific parking locations and infrastructure and formalized financing and management of the program. The City Bikes running in the central area of Copenhagen are still subjected to a high degree of misuse, theft and vandalism due to the relatively low value of the deposit required, and to the anonymity of the users (Ibid., p. 2).

Theft and vandalism problems experienced in the previous BBSs, gave rise to a third generation, where high-tech solutions were incorporated to the bicycles and the systems in general. According to DeMaio the systems and the bicycles have been smartened, and were therefore named by him as Smart-Bikes. This system shared some of its features with the previous generation, such as special bicycle design and parking infrastructure. The novelties were the changes in modes of access which include smart cards and integration with IT systems, such as smart phones or the internet; which include user registration, credit card deposit to cover any possible loss or damage, and the introduction of antitheft mechanisms.

4.2 Main actors and the current state of negotiations

In this section we will describe which actors are involved with the BSS and their intentions will be accounted for. We will furthermore introduce the current state of negotiations.

TMU decided in May 2008 to close down the current BSS and substitute it with a new and modern BSS (TMU, 2008). The advertising contract between the Municipality of Copenhagen and AFA JCDecaux for the present BSS will expire by the end of 2012. As a result, it was decided by TMU that a new system should be ready by the end of 2013 (TMU, 2010).

The municipality of Copenhagen is the main actor who initiated the plan of replacing the current sharing bicycle. In co-operation with the Municipality of Frederiksberg (Morten Heegaard, 28:40) they contacted the traffic company DSB as another primary actor for the project. TMF will intensify the negotiations with DSB with the purpose of clarifying whether the present cooperation has potential for becoming a formal partnership and if so, will propose to TMU a final cooperation agreement and business model for procurement.

Politically it will be presented in the first half of 2011. Thus, it is expected that a final decision regarding price and quality can only be taken when the offer is available, probably at the end of 2011 or beginning of 2012 (TMU, 2010, p. 3-4)(Morten Heegaard, 02:33).

Though, if this partnership is not successful, they will establish the BSS by themselves. In the end it is up to the city council and TMU to decide (Morten Heegaard, 47:00).

4.2.1 Intentions of the main actors

The Municipality of Copenhagen's intention is in co-operation with the Municipality of Frederiksberg to secure a new BSS by January 2013. According to TMF[10], as Copenhageners have more than one bicycle in average, seen in a traffic-related context, the overall goal is a system primarily linked to traffic junctions where commuters arrive by train, metro and bus from other parts of the region (TMU, 2010, p. 1). An easy access to a bicycle of a reasonable quality will improve the overall travel experience for commuters. TMF estimates that it is in Copenhagen municipality's interest that it is DSB and/or another transport company which is placed with the task to manage the implementation and operation of the system, and furthermore function as the contractor between the provider/operator of the system. The municipalities of Copenhagen and Frederiksberg would then function as lead partners (Ibid., p. 1-2).

As a transport company, DSB is interested in such collaboration because a BSS would serve as an extra mobility service to their current clients and as Jens Lerager expresses it: "*(...) det er flere kunder, det er helt oplagt.*" (Jens Lerager, 04:15*).* The project is situated under DSB's access and egress strategies, which means that DSB is exclusively interested in a system that will supplement train trips, and not in single-mode bicycle trips (Ibid., 03:15). At the moment they are considering a bicycle sharing system with 5,000 bicycles (Ibid., 14:00); however the technological design is not decided. If they implement a BSS with docking stations they place them at train and metro stations, and approximately 10 docking stations just for bus junctions (Ibid., 14:30). Jens Lerager mentions that the bus companies, such as Movia, might see the new BSS as a competition rather than a supplement, as the bicycle is especially a competition on smaller trips. DSB wish to own the idea and the coming marketing rights of the new BSS (Ibid., 11:50). Jens Lerager further mentioned that DSB see challenges regarding the partnership with municipality, the organizational shape, the limited space around train stations and the political acceptance.

4.3 Copenhagen BSS Competition

In this subchapter we will outline features of some of the winning concepts which we will use in a later analysis regarding commuters' requirements. In order to gather ideas for the

[10] The Technical and Environmental Administration

Copenhagen's coming BSS, the municipality launched an open international design competition from September to November 2009. The competition was considered a success. Out of the 127 competition entries, two were awarded first prize, one second prize, one third prize and one a special prize (TMF, 2009c, p. 1). As this was an open competition, the awarded concepts are not necessarily becoming Copenhagen's new BSS, but will serve as inspiration for it. For that reason we will not present each of the winning concepts, but highlight some of the features we consider to be of relevance for this project.

Common to all winning concepts are the innovative solutions for parking the bicycles that take into consideration the scarcity of space for bicycle parking in Copenhagen. Most of the concepts proposed automated underground or silo storing facilities for space saving. Some proposed docking stations where bicycles are coupled to each other. This means that the space taken by the docking stations correspond to the number of parked bicycles, and that the docks have, in principle, unlimited capacity, avoiding the problem of users not finding an available docking station to return the bicycles. All concepts also proposed real time tracking GPS systems, which enables analyses of user patterns and eventual relocations. In one of them, the GPS-device is coupled to a booking system over the internet. One of the entries proposes a mode of access and payment integrated with the public transport system, where the same card used to travel in trains and busses is used to access the bicycles. This solution is especially interesting for a BSS aimed at commuters coming into the city by train. Later on in the report we will discuss which of the proposed solutions best suit the needs of commuters.

4.4 International experiences

It has been observed that BSS's have experienced more success and greater acceptance in cities without a strong bicycle culture, where one of the roles of the system was to introduce the bicycle as an urban transport alternative. Considering Copenhagen's bicycle culture, it could be questioned whether the system will be embraced by the users. We have for this reason chosen to include two systems from the Netherlands and Germany respectively. Furthermore, these are particularly relevant due to their integration with the public transport system with focus on rail commuters.

4.4.1 OV-Fiets, Netherlands

OV-Fiets in the Netherlands is a system that aims at making the bicycle a part of the public transport system, with rental facilities in 41 rail stations across the country providing fast and easy access to bicycles through smart cards. The system is designed for frequent users, mostly rail commuters, which can hire the bicycles for a longer period of time (up to 60 hours) if compared to most other systems with a higher rental frequency. The fee is €2.75 for 20 hours, and the payment is deducted monthly. Frequent users, such as commuters, pay a monthly amount that allows them access to bicycles in any of the stations. The system originated from collaboration between the Dutch Railways and the Cyclist union, and was subsidised by the government in 2004 where the level of rented bicycles reached 100,000 (Bührmann, 2005a). This gives an average of around 270 rentals a day. The bicycles have no special features or design, which keeps the price low thereby allowing a flexible number of bicycles. Surveys show that trips with OV-Fiet bicycles have especially replaced trips by bus, tram or metro, but also to some degree taxi and private car (Ibid.). Most of the trips are non-recurrent business trips, which suggest that it might be more attractive to recurrent commuters to purchase a second bicycle for the egress trip. Furthermore, the high share of business trips suggests that the combination of train and bicycle can compete with the car in terms of comfort and travel time (Martens, 2006). Nevertheless, an example such as this, not used by regular commuters, shows the need for a further investigation of the requirements of the commuters - an issue which will be dealt with later on in the commuter analysis.

4.4.2 Call a Bike, Germany

Call a Bike in Germany also brings into focus the interconnection between the bicycle and the public transport. The program is run by DB Rent, which is a subsidiary company of Deutsche Bahn (DB, German Rail). This makes it an especially relevant example, considering that, at the present moment, DSB seems like the most likely candidate to offer a BSS service in Copenhagen.

"Call a bike" started in October 2001 in Munich and has been expanded to Berlin, Cologne and Frankfurt. 4,200 bicycles are available for rent from spring to fall. The bicycles are not bound to a rack but can be left at the nearest crossing in a defined core area, as they have a lock mechanism installed at the bicycles themselves. Users access the bicycles, after registration, by calling a number displayed on the bicycle and receive a code that unlocks the bicycle. The destination once reached, users lock the bicycle to a fixed object and submit a return code as well as the location of the bicycle. The fees are €0.07 per minute - €0.05 for holders of a rail discount pass, and €15 for 24 hours rent. The system is not financially self sustaining, but it is seen as an innovative service that attracts more costumers to the rail transport net and positively affects the image of German Rail. In 2004 there were app. 70,000 registered users, who undertook around 380,000 trips during the same year. This gives a modest average of around 90 rentals per bicycle per year. Most users are frequent public transport user between 18 and 35 (Bührmann, 2005b). This example shows that it is quite possible to run a BSS integrated with the PTS with a wide usage but that it can be financially difficult to maintain.

Chapter 5 - Physical Implementation

In this section we will look into an actual physical implementation of the bicycle sharing system. With the current and future public transport system and urban development plans in mind we will analyze what potentials and challenges there are for the integration of docking stations with rail stations in Copenhagen. Although before doing so, we will briefly introduce the Station Proximity Principle.

5.1 The Station Proximity Principle

We will in this section shortly describe the Station Proximity Principle and analyze how its effect can possibly be increased by the inclusion of a BSS. This section is fundamental, as it gives us the ability to analyze what potential the BSS has for the public transport systems' coverage in Copenhagen.

Because of the societal value gained in reducing the traffic, emissions and pollution, the Station Proximity Principle was made a policy back in 1989 and further adjusted and refined in the Finger Plan 2007[11]. The new definition of the policy is therefore as such: All major commercial offices development, regional orientated institutions along with other larger destinations should be placed in walking distance from well operated stations. Research shows that the most optimal effect is gained within walking distances of up to 600 metres from the stations (Finger Plan, 2007, p. 18). In other words, the catchment area of stations has a radius of 600 metres if walking. Above all, this encompasses office buildings with over 1,500 metres floor space, which municipalities are required to ensure placement of within the 600 metres of a station as long as other urban planning considerations are safeguarded. Placement of commercial offices or the like with over 1,500 metres of floor space outside the 600 metres requires supplementing methods e.g. Mobility Management and decrease in availability of

[11] The *Finger Plan 2007* is national plan directive formulated by the Danish Ministry of Environment. The directive is a clarification of the Danish planning laws' decree for the metropolitan area. Its aim is to future-proof the original urban "*Finger Plan*" back from 1947, and provides a shared foundation for the local planning in the 34 metropolitan municipalities. The plan supersedes the overall guidelines for the original HUR (Greater Copenhagen Authority) Regional plan 2005 (Finger Plan, 2007)

parking spaces (Finger Plan, 2007, p. 18-25). Concurrently, this instrument is toll free and based on the individuals' freedom of choice concerning the preferred mode of transport. Commuters without a car gain more mobility, and motorists are offered a viable alternative form of travel.

To the contrary the same cannot be said concerning a close-proximity placement of bus stops (or bus terminals for that matter). The project leader of the metropolitan areas planning - Lic.techn. Peter Hartoft-Nielsen - explains that the traffic behaviour for workplaces near bus terminals resembles the behaviour for workplaces outside the station proximity range (Hartoft-Nielsen 2001, p. 465). Because of this we will in the coming analysis solely focus on the establishment of docking stations at rail stations.

As mentioned earlier, The Finger Plan established the guideline of 600 metres as the maximum walking distance given that the station proximity effect is optimal within this area. However there is no distinction between the access trips (trips between residence and station) and the egress trips (trips between station and activity). A report based on data from The Danish National Travel Survey (DA: Transportvaneundersøgelsen / TU) suggests that - if the subject is to convince commuters to select public transport - the maximum distance of access trips (if walking) is 900 metres, while the maximum distance of egress trips is only 400 metres (if walking)(Litman, 2005). When regarding attracting new commuters to public transport, this indication gives good reason for establishing a BSS levelled at commuters arriving by train, as it emphasises the importance of the travel distance of the egress trip.

5.1.2 Increasing the catchment area for stations

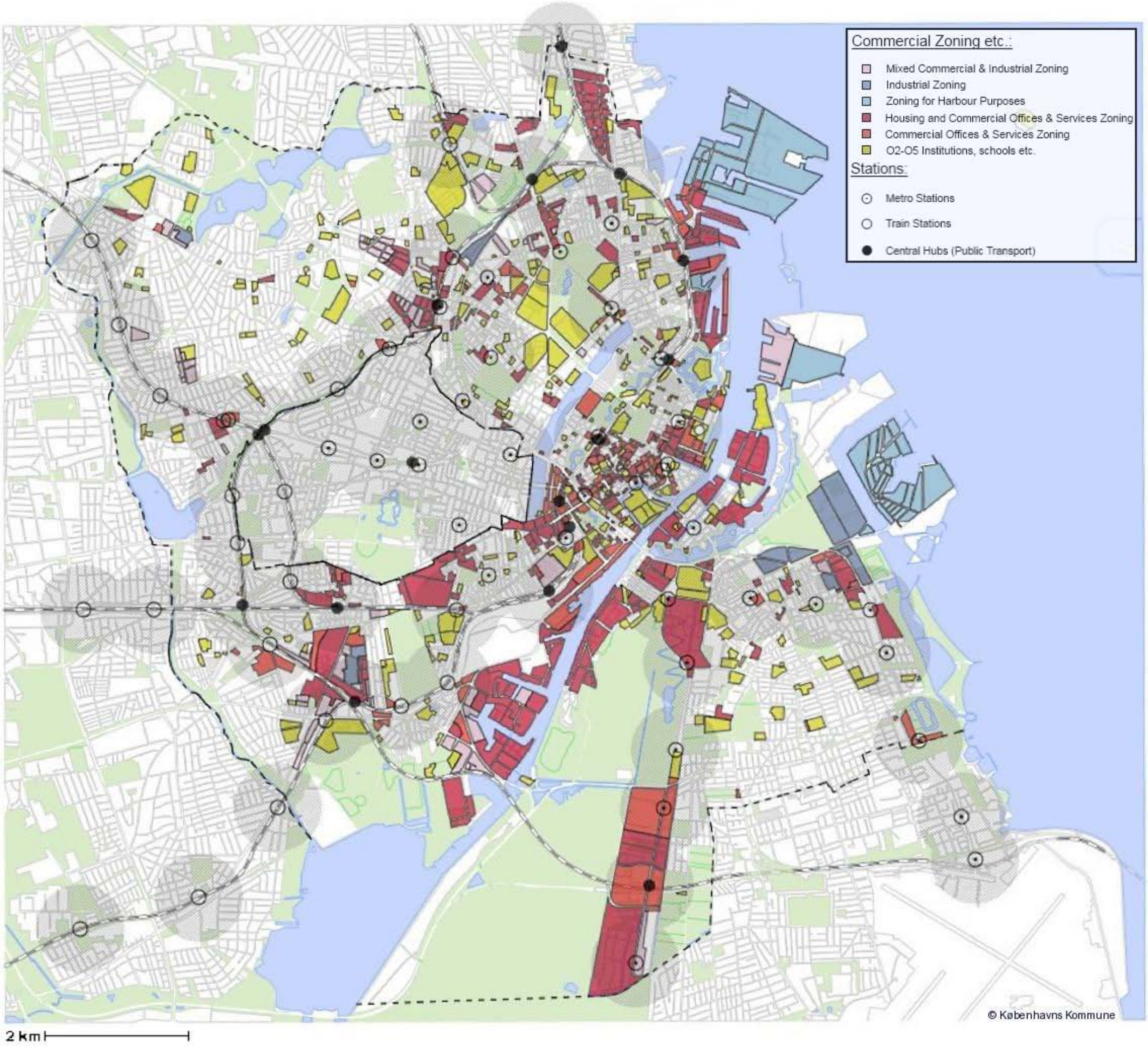
We now attempt to describe a possible increase of the catchment area for stations by way of bicycles, and not change the station proximity principle itself. This is critical for the analysis that follows.

As mentioned earlier, the Danish Ministry of Environment defines the max walking distance as 600 metres (Fingerplan, 2007), but a max "bicycling" distance is not defined. However, the average cycling speed in Copenhagen is 16.2 km / h in 2008 (KK, 2010c). Comparing this to an average walking speed of 5 km / h, cycling is approximately three times faster; therefore a cyclist should be able to cover three times the distance in the time-frame as a pedestrian. In other words, since we have defined the catchment area for stations by walking as 600 metres, we assess that cyclists can traverse three times the distance – which makes the radius of catchment area for stations if taking the bicycle 1,800 metres.

5.2 Analysis

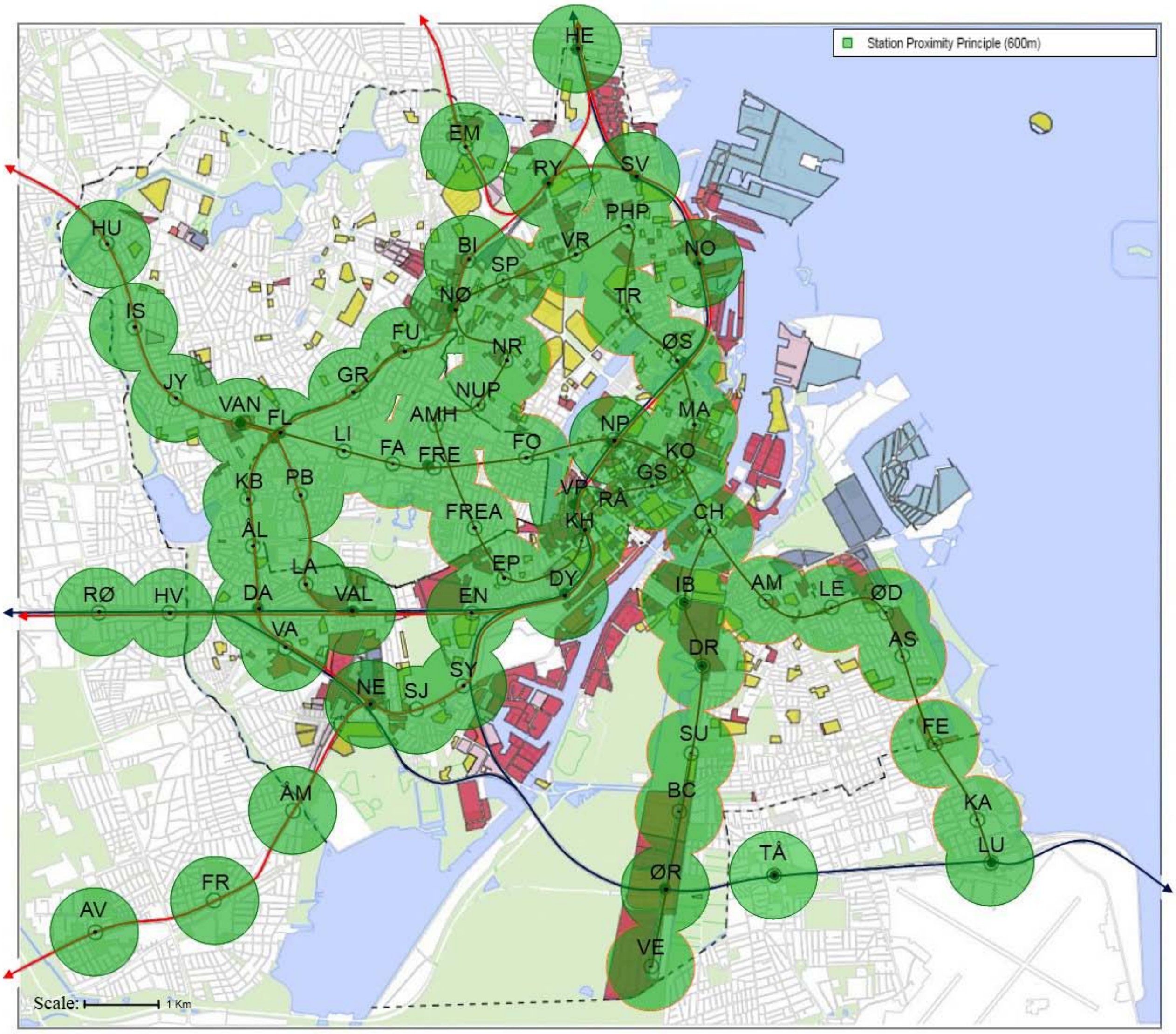
With our previous sections regarding station proximity and urban development plans as our starting point, we will in the following pages undertake an analysis of the Copenhagen transport networks' coverage[12]. This will provide us with the basis to present a potentially new coverage of Copenhagen, through the integration of a BSS with existing and coming infrastructure.

[12] Confer the Methodological Reflections chapter 2 and Appendix 1 for the methodological choices



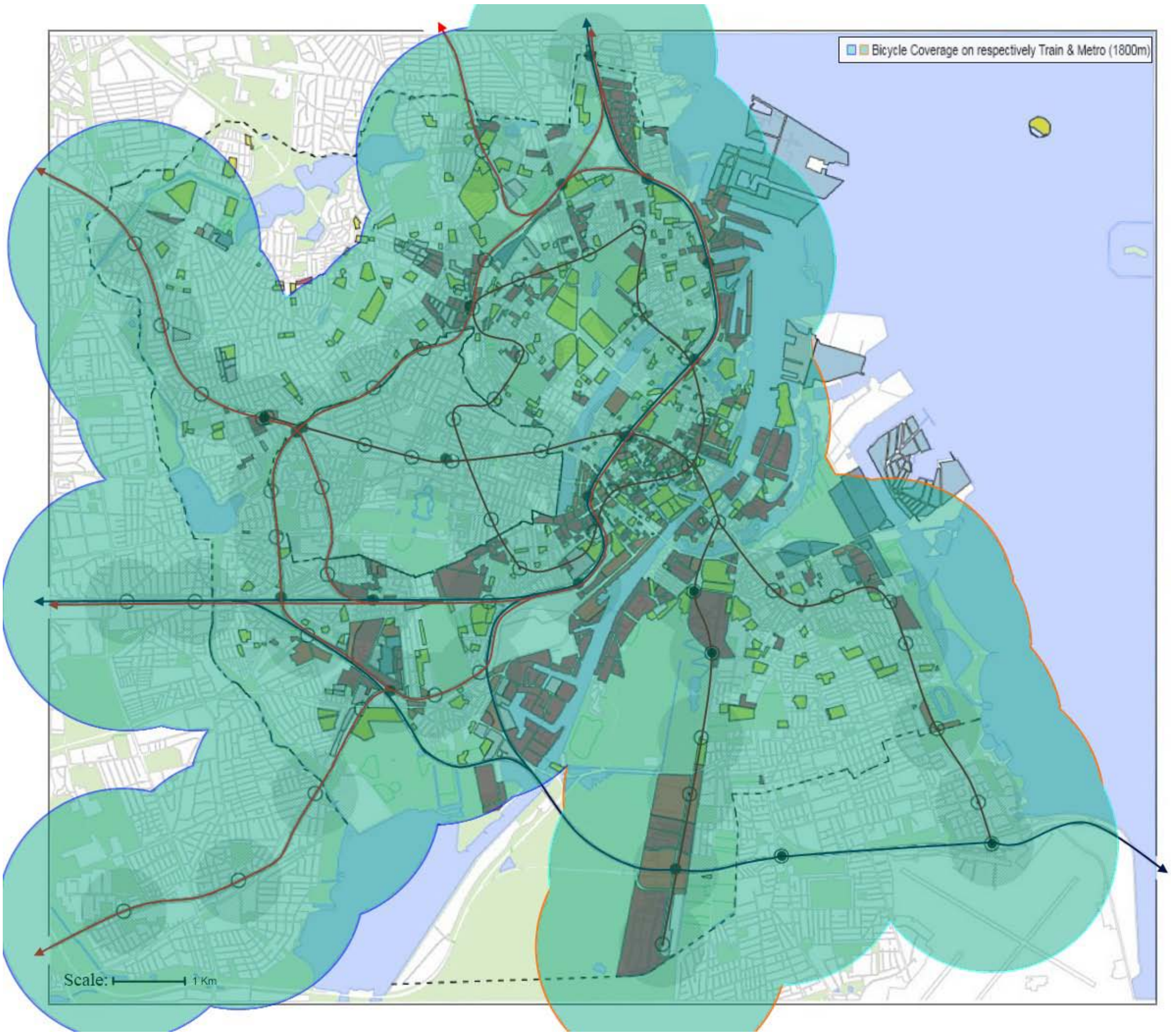
5.2.1 The Basis Map - *Municipality Plan 2009: 2a. Location of business*

This map represents the original source from which we will conduct our physical implementation on. The colored areas are a representation of institutional, industrial and commercial zoning. The transparent circles placed on the map represent the area the municipality of Copenhagen has planned for location of business and institutions in accordance with the principles of the Fingerplan 2007. The circles have a radius of 600 metres, with its center on the train stations, including the upcoming Metro City Circle Line. Confer the legend for a quick rundown of their meaning.



5.2.2 Map with highlighted catchment area of stations based on walking (600m radius)

Information on map: Based on the original map, we added lines of the regional trains, S-trains and the Metro. Furthermore we have highlighted the catchment area of stations based on walking, corresponding to the already present transparent circles (representing the area of station proximity principle). Lastly, we placed abbreviations of all the station names on the map. It is important to note that the Metro City Circle Line will first be finished by 2018, leaving a 5 year window after the implementation of the BSS. But, as it will be apparent in the fourth map, the area in which the City Circle Line covers with its catchment area, can be covered. Since the catchment area of stations are of a great significance to the analysis, we chose to highlight the already present transparent circles, as it corresponds to it, and include new ones where they were missing (e.g. Tårnby st.). This map shows the holes in the station coverage. Quite alarming, this is mostly areas of high density commercial zoning such as Sydhavn, from Holmen all the way to Refshaleøen, Nordhavn and the northern part of



5.2.3 Map with highlighted station catchment area based on bicycling (1,800m radius)

Information on map: Here we removed the station catchment area for walking, and placed the new station proximity based on bicycling.

If we use the distance that can be managed by bicycling (confer section 5.1.2), the coverage of the station proximity area will increase as shown in the map. This means that almost the whole of Copenhagen has a potential of being covered if there are shared-bicycles available.

5.2.4 Selecting key rail stations for the BSS

On the previous map we saw that the catchment area of the rail stations can be expanded to cover the whole of Copenhagen if all rail stations are provided with docking stations. Considering that the demand will not be the same for all stations we will analyze which stations should be prioritized in the establishment of the BSS. Thereby not saying that the other stations should be excluded, but that some should be prioritized above all else. This would as an example be a feasible option if there were not a limitless amount of funds.

When regarding current coverage, demand and space, different docking solutions can therefore be considered for the various stations. Hence, we have selected a number of stations that can be designed in a way that enables the commuter to transit from the train system to the BSS (and reverse) in an efficient and problem-free manner, making transit as quick and easy as possible - these stations are named Efficient Transit Hubs.

Steps for selecting the Efficient Transit Hubs:

From the 65 stations mapped on the map, we excluded the stations that are outside the central municipalities as we have our focus here. Then we excluded the stations which are not yet in function (City Circle Line stations). We then excluded the metro stations located in southern Ørestad and around the airport as businesses and institutions are already well covered by the catchment area of the stations by walking.

For the remaining stations, we have set some criteria that will help us prioritize and single out for the final selection of the efficient transit hubs, these are as follows:

1. Coverage of stations

Stations that with their catchment area by bicycle can cover large areas of commercial development and institutions which is already not covered by the catchment area by walking. In accordance with the station proximity principle, we judge that a coverage of areas currently not inside a stations catchment area, will be beneficial in drawing more commuters to the PTS.

2. Mode of transport at stations

Stations that have more than one mode of transport, i.e. stations with both S-train (S) and regional train (R), or S-train and Metro (M). We have especially chosen to include stations that serve commuters arriving with regional trains from west (Roskilde direction) and north (Helsingør direction), so they do not need to change to a mode of transport before reaching an Efficient Transit Hub. We believe that this focus might be able to encourage even more motorists to commute with the public transport system, since some drivers coming into Copenhagen from afar, might see it as more practical to commute with the automobile.

3. Efficient journey

It is also necessary to consider the placement of the Efficient Transit Hubs vis-a-vis the specific zoning areas in order not to increase the total length of the journey. As an example, if we would be to place a hub at Dybbølsbro st. and not at Sydhavn st. where there is a high density of commercial development. Commuters working outside the 600 metres catchment area around Sydhavn st. and coming in from the South and West, might not see it as efficient if they take the train passed Sydhavn st., stop at Dybbølsbro st., and take the shared-bicycle from there in order to cycle back again to work.

4. Avoiding stations with a fine-meshed transport coverage

We judge that stations located in areas with a fine-meshed coverage as low priority since you most likely will not gain any time by taking the bicycle. Also, with a multitude of busses and trains available there are only few areas that you cannot go with the public transport. A station such as Nørreport is a good example of this point. Jens Lerager also states that this is an important factor to consider: *"Vi tror ikke at Nørreport bliver aktuelt, dels fordi omkring Nørreport der er det kollektive simpelthen så tætmasket allerede (…) den tid det tager ved at gå op, tage en cykel og låse den op, den er ikke vundet ved den korte afstand der er mellem stationen hertil* [Sølvgade 40, which is located very close to two rail stations], *Østerport ligger lige herovre, Vesterport lige den anden retning, så i virkeligheden er det helt tæt* (...)"(Jens Lerager, 32:00)

5. Avoiding congestion at stations

Stations with an overwhelming amount of passengers on a daily basis will be less prioritised in favour of stations with less usage nearby. We have chosen this criteria since we believe that this will prevent additional congestion at the already "popular stations". We also assume that a less populated station has a better possibility to be designed / redesigned for the purpose of making an efficient transit.

6. Efficiency transit and space for infrastructure

In order to enable an efficient transit between trains and bicycles, a short walking distance between the facilities is needed. In order to achieve this, an area of space for building the infrastructure of the bicycle sharing system closely to the train platform is necessary. We looked for stations with possible areas nearby for constructing at least 3 sets (20 each) of bicycle docking stations. We judge that minimum three docking units as a starting point will be a sufficient amount to both satisfy the demands within limits, keep the immediate costs down and thereby function as a good test in order to regulate supply and demand in later phases.

Selected key rail stations for the BSS:

1. Hellerup st. (S+R)	2. Nordhavn st. (S)	3. Sydhavn st. (S)
4. Østerport st. (S+R)	5. Nørrebro st. (S)	6. Husum st. (S)
7. Flintholm st. (S+M)	8. Valby st.(S+R)	9. Dybbølsbro st. (S)
10. Lergravsparken (M)	11. DR-byen (M)	12. Christianshavn (M)

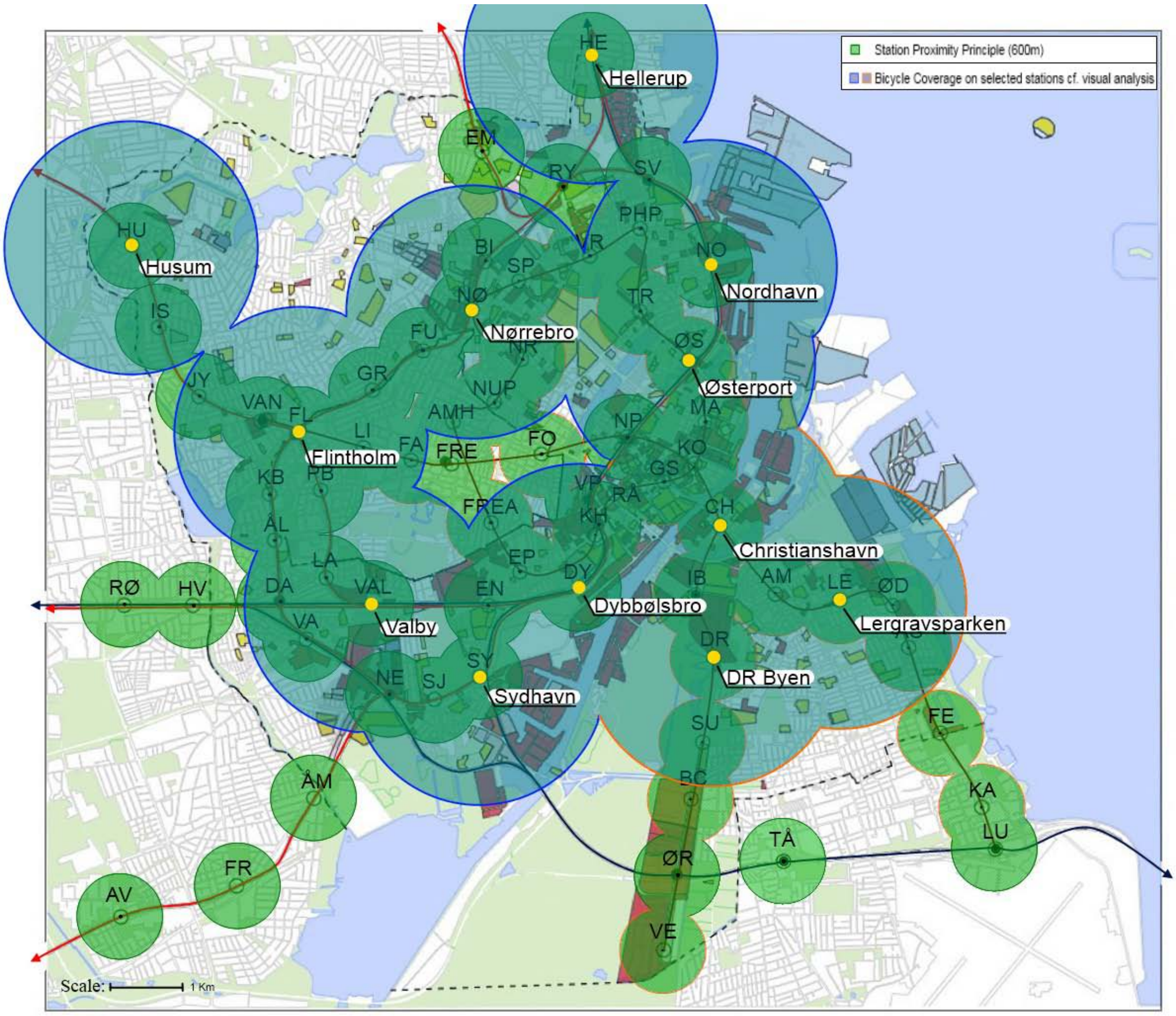
Description:

With basis on the abovementioned criteria we chose to place Efficient Transit Hubs at the above listed stations. It is important to mention that the criteria function as our starting point, as such each hub is placed with assorted priorities. **Hellerup st.** was a relevant choice in order to cover the zoning in Northern Østerbro, and functions as a good nerve centre with connections to the regional lines and the S-trains.

Nordhavn st. was a choice made, based on the lack of coverage around the station. Furthermore, as mentioned earlier the whole of Nordhavn will see a massive development in the future, an increasing amount of commuters is therefore only to be expected.

Østerport st. currently connects the regional trains and the S-trains. In the future the City Circle Line (metro) will also be another mode of transport, thereby increasing its value as a nerve centre. Furthermore, the development of North Campus (University of Copenhagen) mentioned earlier (which currently is not covered by any station) is also a factor to consider -

Østerport st. coupled with Nørrebro st. will provide this coverage. As such we deem it necessary to provide a Efficient Transit Hub.
We deemed **Husum st.** as a necessary Efficient Transit Hub, because of the strong lack of any coverage for the mixed zoning in the area.
Much like Husum st., **Flintholm st.** was chosen in order to cover the mixed zoning in the area. But it has one important factor that makes it even more relevant. It is a station that provides S-trains for both the transverse line F (going through Nørrebro st.) and some of the lines leading into City (C & H), it also has the M1 & M2 metro lines, and is therefore an important nerve centre.
Valby st. was mainly selected because of its range of available modes of transport. It offers both the S-train lines B, C & H and access to the Intercity and Regional trains, thus providing access to and from North Zealand, the Frederikssund city finger, West Zealand and Jutland. There is more of less also a lack of coverage in the zoning around the area and future developments (including urban developments at Carsberg) will only increase this lack of coverage (confer Current Urban Developments and the pictures below).
Dybbølsbro st. might seem as an odd location to place a larger transit hub, giving the fact that both Sydhavn st. and DR Byen st. is nearly able to cover the zoning around Dybbølsbro st. What was an important factor here was the Quay Bridge (Da: Bryggebroen) which functions as a bicycle bridge leading to the opposite side of the bank, thereby providing ample transportation opportunities with the bicycle. Also, commuters might not be willing to stop at e.g. Sydhavn st., in order to take the bicycle over to the area around Dybbølsbro st., where the commercial zoning is not covered by the current station catchment area.
The metro stations **Lergravsparken st.**, **DR Byen st.** and **Christianshavn st.** were all deemed as important stations. With all three, the whole of Christianshavn and the Northern part of Amager can covered by the bicycle sharing system, providing coverage for a large number of both smaller and bigger institutions, industrial zoning in Amager East and commercial zoning in Amager West and Christianshavn.
Sydhavn st and, **Nørrebro st.** will be treated in the section, since both stations will be used to provide an example of a potential physical implementation.



5.2.5 Potential station catchment area. Map with highlighted station catchment area based on Efficient Transit Hubs (1,800m radius)

Information on map: Here we combined the current coverage with the possible future coverage from the prioritized stations.

5.2.6 Part Conclusion

What we are able to draw from this map is how potentially well the central municipalities can be covered by a bicycle sharing system integrated with the public transportation system. As viewable above, nearly all the zoning in Copenhagen (excluding housing) can be covered only by including the Efficient Transit Hubs. This conclusion gives us the ability to derive a projection of the BSS' potential, since we now can see that the system can span almost the entirety of the central municipalities. Chapter 6 will thereby look deeper into how many commuters the full coverage can potentially draw and how this ultimately leads to reductions in the CO_2 emissions. However, we will first examine two cases in order to identify potential challenges, as we expect that even an integration with the Efficient Transit Hubs can have its limitations and challenges.

5.2.7 Case stations

The following two stations are chosen on different basis, with the intention of representing contrasting cases of implementation. This is done in order to show, regardless of the conditions, that an integration with the BSS is possible. The cases are selected in order to represent two types of stations with different challenges regarding the docking possibilities; limited space at a nerve centre (Nørrebro st.) and stations surrounded by large areas of high density institutional, industrial and/or commercial zoning (outside the catchment area of walking) with large amounts of space (Sydhavn st.).

The cases will feature a short overview with information regarding the station, a passenger arrival table and a street & satellite view. To supplement the discussion of docking station placement, the satellite view will feature coloured areas which show currently reserved areas for bicycle parking and potential areas for docking stations, the former being *green* and the latter *red*. Exits will be marked as yellow dots on both the street and satellite views. Each case will include a short background description arguing its relevance followed by a discussion of possible BSS implementation.

Furthermore, the stations will all be compared to the size of Vesterport st. and the commute that goes through there. The comparison is essential as it enables us to argue the capacity of the two case stations (confer the following page).

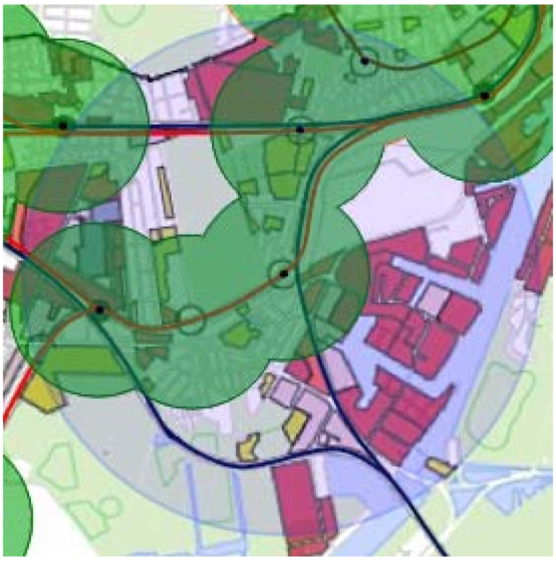
Vesterport st.

For measuring the passenger handling capacity of the stations, whether they can handle an extra amount of passengers when an Efficient Transit Hub is implemented, we will compare the passenger amount to one of the busiest yet relatively small stations in Copenhagen, Vesterport st. (Area including platform and station building is roughly 2000 square metres., based on measurement from satellite image on Krak.dk)

Vesterport	Passengers arriving
All day	11,589
7:00 - 9:00 (2 hrs, morning rush-hour)	3,882
6:00 - 10:00 (4 hrs)	5,100

(DSB, 2008a)

5.2.6.1 Sydhavn st.



Type of station: Flag stop

Platform: 1

Tracks: 2

Address: Ernst Kapers Vej 1, 2450 Copenhagen SV

Modes of transport:

S-train: Line A, E

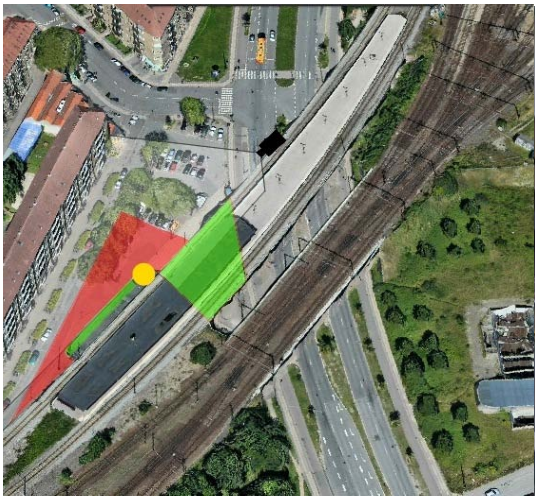
Bus: 10, 3A

Sydhavn st.	Passengers arriving
All day	2,678
7:00 - 9:00 (2 hrs, morning rush-hour)	618
6:00 - 10:00 (4 hrs)	880

(DSB, 2008a)

Background:

We chose Sydhavn st. as a case for a matter of reasons. First and foremost, it is presently one of the stations surrounded by the most high density commercial development, without any proper station coverage. However, on the map of the transport network in The City Plan 2009 (kk.dk), a location within an area for a potential new station is marked. Although no other information on the subject is available it can potentially cover the areas which Sydhavn st. does not. In any case, Sydhavn is also subject to even further development in the near future, although mainly housing orientated it can still cause an increase in the commute going in and out of the station. These factors are important to keep in mind, since an increased station catchment area can cover nearly all the commercial zoning in the area, giving access to a large amount of workplaces through the public transportation system, and potentially removing the need for a new station. Secondly, it is a simple flag stop station but with ample space for large docking stations (confer the pictures below). This opens up for an increased amount of possibilities when considering the physical placement. If looking at the capacity of handling passengers, compared to Vesterport, Sydhavn st., roughly 2,300 square metres (krak.dk) only receives about⅙ of passengers during the morning rush -hour (confer passenger count). Third, it has direct S-train connections to City and the Køge bugt finger, and indirect connections to the other city fingers thus having a well logistical basis for an increase in commute. Considering all these points, we view Sydhavn st. as the station in Copenhagen, with the highest potential in drawing more commuters to an integrated bicycle sharing system. Below will be an in-depth explanation of possible ways to implement a bicycle sharing system.



Implementation

The station has a well amount of space to ensure a good and large placement of docking units. Therefore in order to both make the access easy and its implementation as inexpensive as possible, dependent on the design of the shared-bicycle, an ordinary docking unit with either bicycles interlocking with each other, round docking stations or just a simple docking station with bicycles parked in line are all possible solutions.

Considering the potential high density commercial zoning which can be covered, a start-up of at least three to four docking units could be implemented. Thereafter, if the demand increases more docking units could be added (confer Efficient Transit Hubs).

In accordance to the commuters' needs and demands for the public transportation system (confer commuter chapter), the docking stations should be placed as close to the exit as possible (see pictures above). The green areas are currently all reserved for ordinary bicycles, and should therefore not be replaced (only moved if it becomes necessary). The red area is where we judge as potential areas for docking units. In this case landownership could be a problem which should be taken into consideration when implementing the BSS. Most of the marked red area is reserved for car parking, and this could either be owned by the property connected to the station, the municipality or a traffic company such as DSB. If the property is owned by a party not involved in the project, negotiations or a higher cost of implementation could be the case.

5.2.6.2 Nørrebro st.

Type of station: Flag stop

Platform: 2

Tracks: 2

Address: Nørrebrogade 253, 2200 København N

Modes of transport:

S-train: Line F

Bus: 66 69 4A 5A 350S 863 81N 84N

A City Circle Ring station in 2018

Nørrebro st.	Arriving
All day	5860
7:00 - 9:00 (morning rush-hour)	1209
6:00 - 10:00	1613

(DSB, 2008a)

Nørrebro st. is a unique selection in the way that it is placed at a nerve centre for both public and private transport, but offers little in modes of transport, capacity and space. The F line is the only train that goes through the station, thereby only providing a transverse way of transport. Although we must also keep in mind, that by 2018 the station will be connected to the network of Metro lines, giving it access to the rest of the city. Also, at about the same size as Vesterport st., both roughly 2,000 square meters (krak.dk), the station's capacity is not fully utilised as it only handles $^1/_3$ of the amount of Vesterport st. However space for implementing a large set of docking stations is limited. Providing ample docking stations seems to be a problem that cannot be solved on ground level, but something that could be done underground. This of course is not inexpensive, but coupled with the ongoing underground work which is being done with the new Metro going through the station, might be a way to decrease the expenses. But there is not only a negative side to an implementation on Nørrebro st. Already there is abundant zoning which is not covered by any station catchment area, leaving large institutions at Nørre Campus such as universities and libraries and other commercial development without coverage. Especially regarding the future plans for Nørre

Campus (confer sub-chapter 3.4) which could increase the transport demands in the area. Considering Nørrebro st. as a current and future nerve centre, it is by our judgement therefore a relevant station to take an in-depth look at.

<u>Implementation</u>

Space for implementing a large set of docking stations is quite limited on Nørrebro st. Providing an ample amount of docking stations is a problem that cannot be solved on ground level, but something that can be done underground. This of course is not inexpensive, but coupled with the ongoing underground work which is being done with the new Metro going through the station, it might be a way to decrease the expenses. The red marked area on the picture above provides space to implement an underground silo parking for bicycles (confer sub-chapter 4.3). Landownership does in this case not seem to be a problem, as the area in front of the station could either be owned by the municipality, DSB or Banedanmark. Regarding the amount of available bicycles it might be a good idea to have this figured already from the start when considering the time and expenses that go into the placement of a underground docking station. Also bearing in mind that Nørre Campus plus some smaller pockets of commercial development is currently not covered by any catchment area and Nørrebro st. function as a nerve centre, a start-up of at least four docking units would be beneficial.

5.3 Conclusion

The catchment area of the Efficient Transit Hubs, along with the current catchment area, showed that nearly the entirety of the Copenhagen zoning can be covered (minus housing) with only a select number of stations prioritized. This indicates that a new BSS in Copenhagen has great potentials of providing the public transportation system with a considerable enlargement of its current catchment area. Furthermore, the two cases provided us with an insight on which possible challenges an actual implementation can hold, showing further that various stations demand different approaches. Thus, an actual implementation is as mentioned possible, but it will require a varying amount of resources.

We judge that there are several aspects other than an actual physical implementation to be considered. The physical implementation is only one part of the implementation, not guaranteeing an actual usage of the sharing bicycles. In accordance to our thesis statement, we will therefore in chapter 8 analyze the requirements of the commuters. However, we will firstly calculate the amount of potential users of the coming BSS. From this we will be able to estimate a potential amount of CO_2 reductions.

Chapter 6 - Potential number of users & CO_2 reduction

6.1 Potential number of users

In the following chapter we will first attempt to calculate an estimation of potential amount of users of the bicycle sharing system using data from the Traffic Survey. However, as Morten Heegaard mentioned, even though a qualified estimate based on these data can be made, such an estimation cannot forecast the actual usage as transport behavior is difficult to predict (Morten Heegaard, 22:25). We are aware that DSB currently use the amount of 5,000 shared-bicycles as their business case, however the amount is only used on calculating the economic aspect of the project (Jens Lerager, 21:10). We will of this reason not include this number in our calculations.

The city of Copenhagen is like many other cities characterized by its large amount of commuters, if counting both people commuting into the central municipalities and people commuting within it[13], numbers from The Danish National Travel Survey (TU) is shown in table 1:

Table 1: Market-share of transport modes for commuting traffic to and within the central municipalities, measured in number of trips.

Main mode of transport	Grouping	Amount of commuters
Cycling and walking	41 %	212,107
Public transport	25 %	129,936
Car	34 %	177,901
Total	100 %	519,994

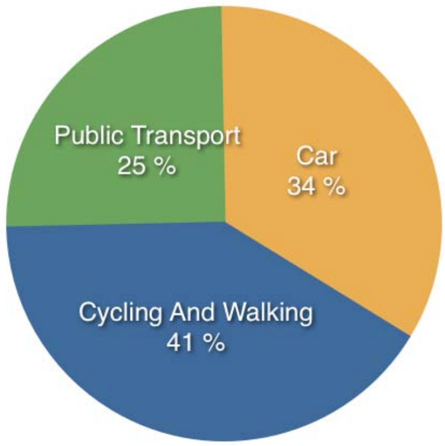


Table is taken from Region Hovedstaden (2009, p. 11): Table 1: Market share of commuter traffic, measured in number of trips. Source: Traffic Survey 2006 & 2007, Danish Transport Authority. Data on pie chart corresponds to the table.

[13] Frederiksberg Municipality is an independent municipality within the border of Copenhagen municipality; we took data covering both municipalities as these are the ones available.

It is also important to take note, that the percentage shown in the table is based on what the main mode of transport is, i.e. the transport mode that covers the majority of the distance of the journey. If we take the group of 41% whom cover their main part of their journey by *Cycling and walking*, the number should not be confused with the bicycle targets set by the Copenhagen Municipality, where the goal is 50 % of commuters bicycling to work or education. The municipality's calculations are based on the percentage of commuters that arrive to destinations with a bicycle, regardless of the prior journey (TMF, 2009a). This means that commuters cycling, on their access trips, to stations or bus-stops, and hereafter, in their egress trip, walk or take the bus to their destinations, are not included in the municipality's calculation. However, if they chose to use a shared-bicycle for their egress trips after using the public transport, they will be included into the score.

As the BSS is levelled at commuters mainly arriving by train, the main part of their journey from residence to destination is most likely to be carried out by train. Though the commuters will bicycle within the municipality, they will, according to table 1, be categorized in the group of *Public transport.* It is important to take notice that the group *Public Transport* includes many different modes of transport, not differentiating between bus, metro and trains. Even though we are not able to distinguish between the amount of passengers within the *Public transport* segment, we will only target commuters arriving by train. We have therefore identified three target groups of commuters to switch to the usage of public transport and a bicycle sharing system. These groups are commuters who have:

- *Cycling and walking* as their main mode of transport.
- *Car* as their main mode of transport.
- *Public Transport* - or more specifically, Train, as their main mode of transport, and who use bus or car for the egress trips from station.

As we can see, while one target group comprises those who already commute by collective modes (25%), two of the target groups comprise those who do not currently commute with the *Public Transport* (*Car* 34% + *Cycling and walking* 41%). Two approaches will be used in order to determine the potential amount of users from respectively outside and within *Public Transport* (25 %). For the target groups that are currently categorised in *Cycling and walking* (41 %) and *Car* (34 %), a calculation is made to determine the potential increase of the market share of *Public Transport* in relation to station proximity, and thereby determine the amount of users that could be transferred from other modes; this calculation is stated as Approach A. Defining the target groups within *Public Transport* (25 %), data of transport habits within the Metropolitan Copenhagen for egress trips will be applied to the amount of rush-hour passengers arriving at DSB stations within the central municipalities - this calculation is stated as Approach B.

6.1.1 Approach A: Potential market share of public transportation

In the following table, based on data from the National Travel Survey, a clear correlation can be observed between the market share of public transportation and station proximity (Nielsen & Landex, 2009). The shorter the distances of access and egress trips to stations are, the higher the share of public transportation. As it appears from the table, the market share for the most station-near journeys (0 - 400m) is as high as 31%, while the percentage drops to only 11% for the station-remote journeys (800 – 2,000m). Even though the data is presented as the relation between station proximity and the public transportation in general, the effect cannot be measured at bus stops (Confer chapter 5), we will regard it as applying to rail based transport only, i.e. trains and the metro.

Table 2: The market share of public transport in relation to station-proximity (Metropolitan Copenhagen)

Distance from station to work (egress trip)	Distance from residence to station (access trip)		
	0 - 400 m	400 - 800 m	800 – 2,000 m
0 - 400 m	31 %	25 %	26 %
400 - 800 m	25 %	24 %	22 %
800 – 2,000 m	27 %	16 %	11 %

Table is taken from Nielsen & Landex (2009, p.105): Table 4: Key ratios of the importance of station-proximity for commuter trips (based on extracts from the Traffic Survey). Note that in the original table, the author did not specify the area as Metropolitan Copenhagen, however it is described as such in the text.

In the following table we have inserted the travel time by walking and by cycling corresponding to the travel distance.

Table 2.1: Adjusting table 2, adding travel time by cycling from 5-8 mins to 5-9 mins.

Travel time by walking				< 5 min.	5 - 10 min.	10 - 25 min.
	Travel time by cycling			< 4 min.	< 5 min.	5 - 9 min.
		Egress trips	Access trips	0 - 400 m	400 - 800 m	800 – 2,000 m
< 5 min.	< 4 min.	0 - 400 m		31 %	25 %	26 %
5 - 10 min.	< 5 min.	400 - 800 m		25 %	24 %	22 %
10 - 25 min.	**5 - 9 min.**	800 – 2,000 m		27 %	16 %	11 %

Note: Walking speed is set to 5.0 km / hr, and cycling speed is set to 16.2 km / h, which is the average cycling speed in Copenhagen (KK, 2010c). An average pick-up and parking time of 1.8 minutes is added (Christensen & Jensen, 2008, p. 88).

As we concluded in the previous chapter, regarding the physical implementation, the majority of the commercial workplaces can be covered by the BSS. As such, when looking at the journey from station to workplace, the travel time will all be around 5 to 9 minutes for distances within 2,000 metres from the station. This will eliminate the long egress trips between 10 - 25 min (800 – 2,000m) that presently are carried out by walking. So, when excluding egress journeys longer than 10 minutes (marked red), the market-share of train and metro should vary from 22% to 31%, depending on the distance of the access trips and egress trips.

Assuming that the coming BSS will not contribute in reducing the current general market share of public transport of 25%, the data regarding travel-time on the table above allows us to conjecture that the BSS, at its maximum, has the potential for inducing an increase in that share for up to 31%. That means a potential increase between 1% and 6% - if there is any increase at all[14]. In order to estimate what such an increase means in terms of number of passengers, we will present the possible market share of commuter transport based on a 1% and 6% increase in the current *public transport's* rate of 25% in the following tables.

[14] This is dependent on the success of the system, as we believe there is a slight risk that the system will not have its market-share increased at all. We have set the minimum increase to one percent, in order to ease our calculation.

Table 3.1: The present and potential market-share of transport modes for commuting traffic to the central municipalities, based on 1% increase in the *public transport* market-share. Note that the diminution in other groups are fabricated as we do not have substance on the matter.

Main mode of transport	Present grouping	Amount of commuters	Potential grouping	Potential amount of commuters	Differential in grouping	Differential in amount of commuters
Cycling and walking	41 %	212,107	(41 %)	(212,107)	(0 %)	(0)
Public transport	25 %	129,936	26 %	135,198	+ 1 %	+ 5.200
Car	34 %	177,901	(33 %)	(171,598)	(- 1 %)	(- 6,303)
Total	100 %	519,994	100 %	(518,903)		

Table 3.2 The present and potential market-share of transport modes for commuting traffic to the central municipalities, based on 6% increase in the *public transport* market-share. Note that the diminutions in other groups are fabricated as we do not have substance on the matter.

Main mode of transport	Present grouping	Amount of commuters	Potential grouping	Potential amount of commuters	Differential in grouping	Differential in amount of commuters
Cycling and walking	41 %	212,107	(41 %)	(212,107)	(0%)	(0)
Public transport	25 %	129,936	31 %	161,198	+ 6 %	+ 31,262
Car	34 %	177,901	(28 %)	(145,598)	(- 6 %)	(- 32,303)
Total	100 %	519,994	100 %	(518,903)		

In a 1% increase scenario, we can see that it means an increase of 5,200 commuters to the public transport segment, and in a 6% scenario, an increase of roughly 31,000 commuters. Even though we are aware that not all of the diminution will happen in the *Car* segment, as commuters who at present cycle all the way to work might also choose to commute by train combined with the BSS, in order to calculate the maximum span of CO_2 reduction, this potential amount of 'new users' will be used. We will proceed to the calculations based on the potential of transferring motorists to the PTS, as cyclists and pedestrians emit much less - if any CO_2 at all - since the main distance of their commuting trip is carried out by cycling and walking. However, the span between 5,200 (1%) to 31,000 (6%) extra passengers represents the potential market-share increase generated through the extension of the catchment area of stations according to travel-time by bicycle, and it disregards the change of mode involved in such a move. As not every commuter can be expected to adjust transport patterns, we will further narrow it to commuters that show an interest in a bicycle for the journey between station and destinations.

For this purpose we will make use of a report made by The Danish Ecological Council in Hillerød Municipality (Det Økologiske Råd, 2010). In a survey[15] employees at four workplaces in Hillerød (the municipality, the hospital, ATP and Novo), were asked whether they were interested in having a shared-bicycle available for their egress trip. 18% (16 out of 88) of those who commute by car (during summer) answered they were interested, against 61% (14 out of 23) of those who commute by collective modes (Ibid., p. 27). Hence, considering we are focusing on commuters currently travelling by car, we will base the calculation for potential amount of users on those 18% who show interest in a bicycle for covering the distance between a station and their work-place. We are aware that these numbers are not representative due to the small sample. Nevertheless, this data seemed as the most relevant for these calculations. We would therefore like to stress that calculations based on this survey will not be exact, but merely an estimate. The percentage in relation to the span from the prior calculation is shown below:

- 5,200 (1%) x 18% = 936 (1%)
- 31,000 (6%) x 18% = 5,580 (6%)

We have hereby estimated the amount of commuters that could switch to commuting by public transport (combined with the BSS) to be between 936 and 5,580.

6.1.2 Approach B: Change of Travel Patterns

In this calculation we will determine the amount of potential users for the BSS who already have public transport as their main mode of transport. As mentioned earlier, the group of *public transport* (25%) in Table 1 includes many modes of transport, and as this calculation is based on the extension of station catchment area, which does not seem to apply to bus stations and stops (confer chapter 5), we will here narrow it down to commuters taking trains. The train operators in the central municipalities, DSB and Metro, both have passenger

[15] As the figures are read off a bar chart, they might be slightly inaccurate.

counting of their own. DSB's Østtælling was manually done once a year until 2008, counting passengers arriving and departing at all stations while taking transfer within the DSB system into consideration (counting-tickets are handed in at the passengers' destination-station). Metro's passenger count on the other hand is done automatically by sensors at the entrances of the trains, while not taking transfer between line M1 and M2 into consideration (as when the lines split at Christianshavn st.). However many commuters switch between the two systems during their trip, and as the metro only serves commuters within the central municipalities, we will use passenger count from DSB.

Table 4: Amount of passengers arriving at DSB stations in the central municipalities

Time interval	Duration	Amount of passengers arriving
7:00 - 9:00	2 hours	56,095
6:00 - 10:00	4 hours	78,803
4:00 - 4:00	24 hours	218,434

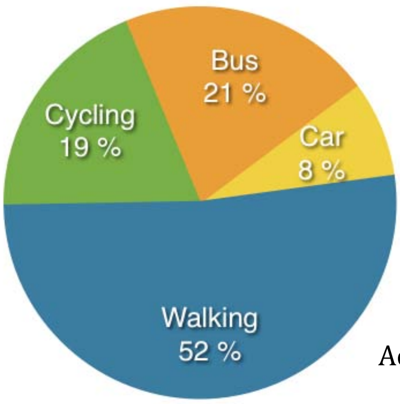
Table shows the total amount of passengers arriving to 32 DSB stations within the central municipalities. Note that some stations have two mode of transport, e.g. Østerport has both S-train station and long distance trains. These are counted for as separate stations. Data is from DSB (2008b)

To specify the amount of commuters among all of DSB's passengers during the day, we use passenger counts (arriving to station) from 7 a.m. and 9 a.m. as this is where the passenger number peaks and is defined as *Morning Rush Hour* (DSB, 2008a). With the figure of 56,095 passengers (26% of the whole day) arriving at a DSB station during morning rush hour as the basis, we then looked for the patterns of egress trips in general in Metropolitan Copenhagen.

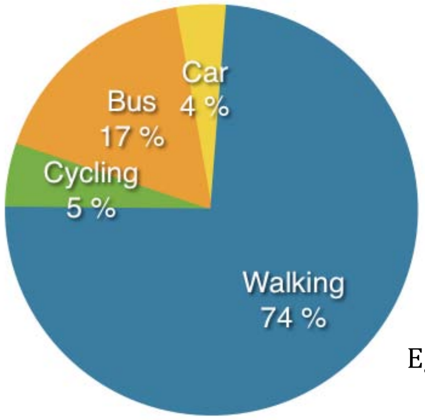
Chart 1: Travel patterns of access trips and egress trips of stations in Metropolitan Copenhagen

	Walking	Cycling	Bus	Car	Total
Access trip	52 %	19 %	21 %	8 %	100 %
Egress trip	74 %	5 %	17 %	4 %	100 %

Pie charts are based on graphs in Trafikstyrelsen (2010, p. 37): Figure 12: Transport between residence and station, and Figure 13: Transport between station and destination (Source: Traffic Survey 2000-2008, Danish Transport Authority). Note that percentage might not be accurate as they are based on reading from graph. Data on pie chart correspond to the table.



Access trips



Egress trips

As we can see, the majority of people arriving at stations in Metropolitan Copenhagen carry out their egress trips by *walking* (74%), while 5% by *Cycling*, 17% take the *Bus* and 4% travel by *Car* (this includes driving, getting picked up or taking a taxi). We have chosen to leave out those who travel by *Cycling* as they are most likely to maintain their practice. We then assume that the length of the egress trips for those who are *walking* today are beneath their pain threshold, and therefore the bicycles sharing system has very little chance to substitute these walking trips, hence we will also leave the *walking* (74%) out of account. Even though we are aware that the share of passengers who are *walking* from station may be greater in the central municipalities - as the station proximity is more dense than outside these two municipalities - we will apply the general pattern to the morning rush hour commuters:

- 56,095 (total) x 17% (bus) = 9,536 (bus)
- 56,095 (total) x 4% (car) = 2,243 (car)

And as mentioned earlier, not every commuter can be expected to adjust transport patterns, we will further narrow the figure according to those who might show an interest in a bicycle for commuting. The percentages of interest from the Ecological Council survey will be used for the calculation (confer section 6.1.1):

- 9,536 (bus) x 61% (interest rate of public transport commuters) = 5,817
- 2,243 (car) x 18% (interest rate of car commuters) = 404

Putting these numbers together we have 6,221 potential users for a bicycle sharing system within the *public transport.* Adding the span of 936 to 5,580 potential users from outside the *public transport,* we estimate the total potential user for the system to be between 7,157 and 11,801.

6.2 Potential CO2 reduction

In the following section we will strive to give an estimate of the potential CO_2 reduction through the implementation of a BSS in Copenhagen. For this purpose, we will calculate the differential between the CO_2 emissions of the present and future travel patterns of potential users of the system. We earlier identified two groups of potential users that can switch from other modes of transport to a mode of transport that imply commuting by public transport along with the BSS (confer sub-chapter 6.1). As these two groups of potential users' present transport mode are different, two separate calculations should be made for the purpose of the calculation of CO_2 reduction. However, a switch to the usage of the shared-bicycle for the egress trip, instead of the bus, achieves a very insignificant CO_2 reduction, unless the bus line is terminated or the departure frequency is lowered. Based on an expectation that the bus lines will not be affected by the decrease of 5,817 daily users (potential BSS users that at present ride the bus), we believe that present users of the *Public transport* will not reduce CO_2 emissions if they utilize the BSS, however they might reduce their individual CO_2 emission, by not riding the bus.

Now looking at the potential CO_2 reduction for the users who have *Car* as their main mode of transport, the differential is found between the present CO_2 emission from car usage and future CO_2 emission from train usage. However, like the limited impact on bus transport, an increase of train passengers will generate insignificant CO_2 increase unless more wagons are added or departure frequency is raised. Even if departure frequencies for trains are raised or more wagons are added, it indicates that the occupancy rate is high during rush hours, and as occupancy rate reaches 70% and beyond, average CO_2 emission, per passenger by train, is stable at about 20 g / km (only about 10 g / km for S-trains)(Trafikstyrelsen, 2010, p. 49). Looking at CO_2 emissions for an average car commuter, with only 1,3 passenger per car during rush hour (Ibid., p. 48), i.e. an occupancy rate of 26% (full capacity is 5), the emission lies between 140 g and 160 g per km (Ibid., p. 49). With the average emission of a train commuter only being $^1/_7$ or $^1/_8$ of a car commuter, and as the overall emission from train will not see a significant increase, unless the current capacity is maxed out, we decided that the potential CO_2 reduction should solely be based on the decrement of CO_2 from the car usage.

6.2.1 CO2 reduction from car usage

Being aware of the many substantial variables that can affect the following calculation, e.g. travel distance, working days, type of car engines, occupancy rates, driving habits, congestion etc., we have used averages of these data where possible. If an average data was not available, data that would result in a more conservative estimate is used. Note that the average CO_2 emission for cars below is based on the average occupancy rate, i.e. using the daily average of 1.54 passenger per car, even though the average passenger per car during rush hour is only 1.3.

- Avg. working days (w): 227 days / year (2010 number)(Konsulent-net.dk)
- Avg. commuting distance (c): 38.2 km / day (National avg.)(Statistics Denmark, 2010)
- Avg. CO_2 emission of car (e): 126 g / km / car (Trafikstyrelsen, 2010)

Calculation of the avg. CO_2 emission pr. person pr. year when commuting by car (R) is as follows:

$$w \cdot c \cdot e = R$$

$$227 \text{ days / year} \cdot 38.2 \text{ km / day} \cdot 126 \text{ g / km} \approx \underline{1{,}093 \text{ kg / year}}$$

In calculating the total potential of CO_2 emission reduction of the BSS per year, we will insert the estimates of potential users who at present commute by car (confer 6.1.1):

$$\mathbf{1.093 \text{ kg / year}} \cdot 936\ (1\%) = 1{,}023{,}048 \text{ kg} \approx \underline{1{,}023 \text{ t. / year}}$$

$$\mathbf{1.093 \text{ kg / year}} \cdot 5.580\ (6\%) = 6{,}098{,}940 \text{ kg} \approx \underline{6{,}099 \text{ t. / year}}$$

Based on our commuter estimates from the previous chapter, we calculate the yearly CO_2 emission reduction contributed by the BSS, to between 1,023 t and 6,099 t.

6.3 Conclusion

We undertook two approaches in order to estimate the potential amount of users from outside and from within the municipalities. Based on the data from the National Travel Survey, of the market-share of the public transportation in relation to station proximity, we calculated a potential increase between 5,200 (1%) and 31,000 (6%) extra users to the public transportation, if the BSS is implemented due to the increase of the catchment area of the rail stations. From a survey by The Danish Ecological Council, we considered that not all car users are interested in switching to the PTS if a new BSS is implemented. Based on data from this source, we were able to narrow down the potential increase of users from the PTS, dependent on their level of interest. This means that the potential amount of car commuters switching to the PTS, with the integration of a BSS, lies in the span between 936 and 5,580 commuters.

Within the central municipalities, we applied the amount of morning rush-hour passenger (assuming they are commuters) arrivals at DSB train stations to the transport habits of egress trips, and were capable of estimating the amount of car and bus users (for the egress trips) who instead could use the new BSS. Considering the interest of users we estimated the potential amount to be 6,221. Adding the span of potential commuters switching from the car segment, the estimated total amount of users lies between 7,157 and 11,801 users.

We assessed that the most considerable amount of CO_2 would be reduced by changing the transport habits of the current car users. Furthermore, we chose to exclude the small amount of egress trips done by car, since there were too many conflicting variables. Using three variables; the average amount of CO_2 emissions of cars, average commuter distance and average working days pr. year, we estimated the yearly CO_2 reduction between 1,023 and 6,099 CO_2 tons / year. We will discuss this point further in the discussion to come.

According to our estimations, there are considerable CO_2 reductions in the integration of a BSS with the PTS. However, as we accounted for throughout this analysis, there are several significant variables and uncertainties regarding our calculations and their results; which should only be seen as estimations. Consequently, these estimations imply a quite immense amount of docking stations and bicycles in order to meet the demands of the commuters arriving and departing from the rail stations. As we concluded in the previous chapter, there is a considerable amount of challenges regarding the physical implementation which should also be considered. We will in the following chapter look deeper into what requirements commuters have for the BSS integrated with the PTS in order to identify how the attractiveness of this combination can be optimal.

Chapter 7 - Analysis of commuters´ requirements

We will now present data about commuters' expectations, requirements and preferences regarding the public transport system as the success of this system depends on acceptance and satisfaction among its users. This will help us to analyse whether and under which circumstances a bicycle sharing system can contribute in making the PTS more attractive to commuters. This includes an analysis of what requirements the BSS shall live up to for the particular physical and technical features of the system using information from chapter 4. Throughout the analysis, we will identify and investigate potential challenges in meeting user acceptance and satisfaction, to some of which possible answers will be outlined. Alongside the two previous analysis chapters this will lead us to the final discussion.

7.1 Commuters' requirements of the public transportation system

All travellers have requirements and expectations for the public transport system. Some of these are general and common to all users, such as requirements regarding punctuality and reliability, security, accessible price, comfort, reasonable travel-time, frequency, consistency and an extensive and interconnected system (Nielsen & Landex, 2009). The different travellers' preferences vary mainly in how they prioritize the different criteria, which normally depends on the traveller's age and life-situation and on the purpose of the trip. The requirements differ for example for commuting trips and recreational trips. Commuters represent more than $^1/_3$ of the public transport users (Students 16% and workers 27%) in the Metropolitan Copenhagen (Region Hovedstaden, 2009a, p. 14). Therefore, if the public transport is to be seen as a product, the aforementioned criteria must be well functioning. Based on Metropolitan Copenhagen surveys, we have identified the following categories under which these requirements will be evaluated: reliability, travel-time, flexibility and price & comfort. These are, in other words, the fundamental requirements the PTS generally has to live up to in the eyes of the commuter. It is important to stress that the categories in which the requirements are grouped, are by no means separated, but in most cases overlapping. Punctuality, for example, is a requirement that affects both travel-time, reliability and, it could be argued, flexibility. The categorization which will be presented below must therefore be seen as an analytical tool, where the most crucial criteria identified are grouped in a way that eases their application regarding the BSS.

However, it is important to stress that the requirements regarding the public transport do not differ from motorists to users of the public transport (Ibid.). This further suggests that motorists do not demand the PTS to achieve the same requirements as they have for the car, particularly regarding flexibility. They are well aware of the fact that the fixed routes and stops, fixed timetables and lack of privacy, that characterize a collective system, represent limitations if compared to a private mode. For this reason, we will not distinguish between what motorists and public transport users shall find attractive.

7.1.1 Reliability

The most important factor for commuters regarding the PTS is reliability. This includes consistency, punctuality, and reliable information. A consistent system is a system that runs with a minimum degree of irregularities and offers proper and reliable connections. For commuters who already travel by public transport, irregularities have shown to be a key factor for them to abandon it (Region Hovedstaden, 2009c, p. 10). In other words, in case the commuters are to shift between two modes, e.g. train and bus, there must be a guarantee that there will be a bus connection at the rail station (Ibid.). Besides that, commuters have high requirements regarding punctuality: whether it is busses, trains or metro, the lines have to departure at the expected time. This includes a system that delivers reliable, consistent and updated information, especially in case of irregularities (Ibid.).

7.1.2 Travel Time

Commuters value their time highly. Short travel time is therefore one of their main priorities in regards to the PTS (Ibid.). In order to attract motorists, studies show that the PTS must provide a competitive travel-time (Ibid., p. 10). This includes not only speed, but also brief waiting and shifting time in the case of multi-mode trips. Commuters have an aversion to waiting time which specially intensifies in cases of irregularities and delays. Shifting time is neither very appreciated. It is therefore important that the time-tables between different modes are coherent, in order to minimize waiting time. The shift must also be quick, smooth and within short walking distance (Ibid., p. 11).

7.1.3 Flexibility

Commuters require a certain degree of flexibility from the PTS. This includes a good coverage, which allows them access to a large number of destinations, as well as a high frequency of departures, which grants them a more flexible choice of when to travel.

7.1.4 Comfort & Price

Needless to say, all commuters expect a minimum degree of comfort for an affordable price. Nevertheless, what is considered to be comfortable and affordable can vary greatly. In this case, there is generally a distinction between students and workers: the first do not mind giving up comfort in favour of cheaper fees, while the latter would rather pay more for comfort. This could be explained by the fact that although comfort is valued by both groups, students usually have less economical means than workers, who would rather pay a little more and use their valuable time comfortably and productively under their trip. Furthermore, experiences indicate that a price-raise usually repel more passengers than a price reduction is able to attract (Region Hovedstaden, 2009a, p. 10).

The categories listed above must not be considered as the only requirements. There are also motivation factors, which might further satisfy users and motivate travellers to choose the public transport as their main mode of travel (Ibid., p. 11). These include design, extra services (e.g. televisions, WiFi or beverage sales in trains), the image of the system or the service provider (e.g. environmentally friendly, secure), and loyalty programs (e.g. frequent user discount). The requirements that are perceived as either fundamental or extra are generally the same for all commuters. Nevertheless, the line between the two categories is tenuous, in the sense that some might consider a comfortable seat in the train as a precondition, while others might not mind about the seats and instead emphasise the design, maintenance and neatness of the stations as crucial. However, identifying the different expectations of all users goes far beyond our scope, and the general factors outlined bellow should be sufficient for analysing what commuters would fundamentally expect and require from a BSS.

7.1.5 Challenges and limitations of the public transportation system

Summarizing, the PTS has to be punctual, coherent, offer a good coverage, a competitive travel-time, reliable information and a certain level of comfort at an affordable price, in order to satisfy the fundamental requirements of the commuters. This indicates the fact that it is not worth building cheap and flawed transportation systems (Ibid., p. 9). Moreover, a "rail-factor" among commuters can be observed: rail transport seems to better fulfil commuters expectations regarding reliability, efficiency, flexibility and comfort than busses (Nielsen & Landex, 2009). This might explain the fact that commuters are more willing to take trains than busses. Studies show that even current motorists commuting to a workplace might be willing to take trains if the travel-time is competitive in relation to the car, but the same does not apply to busses (confer subchapter 5) (Ibid.). This grants the BSS a great potential, since it might be an alternative for those who need a connection from their end-station and refuse taking busses and this might even optimize the overall travel-time.

It seems that the PTS has limitations when fulfilling the expectations for mobility from the modern and freedom orientated citizens of today's society (Region Hovedstaden, 2009c, p. 9). The people of today prefer to decide their exact time of departure and to be independent of other travellers. As we have explored, people do not expect that the PTS should be able to deliver the same advantages as the car, however it is important to stress that the modern day individualists seek freedom and independence. The public transportation is therefore worldwide struggling to maintain its current passengers, and to win more passengers is a great challenge (Freudendal-Pedersen, Forthcoming, p. 4). In a Copenhagen context this can be seen as the total passenger mileage of the PTS is decreasing (Region Hovedstaden, 2009b, p. 4).

We must take into consideration that people do not simply go straight to work and then straight back home. There are several stops along the way of everyday duties. The PTS must therefore have coverage, good coherence and competitive travel-time on all these trips in order to compete with the car. If it does not accomplish just one of these trips people are likely to choose the car (Nielsen & Landex, 2009, p. 17).

With these expectations and limitations of the PTS in mind we will now explore what a new BSS in theory can contribute with to the overall system. Hereafter we will analyze the practical challenges and possible solutions in a Copenhagen context.

7.2 Commuters' requirements for a BSS integrated with the public transport

As this project is centred on a new BSS as an extra link of the PTS we presume that the commuters have similar criteria regarding this combination. We will now examine how the BSS can strengthen the public transport system in terms of meeting the presented commuters' demands. Subsequently, we will analyze what these requirements means for the BSS in itself as well as outline possible challenges and solutions regarding the design of the BSS.

The establishment of a BSS does not seem, in itself, to considerably strengthen the reliability of the PTS. Except in situations where the bicycles could serve as a backup in case of a delayed or cancelled connection at the end station, the BSS cannot affect the punctuality or regularity of trains, metro or busses. Neither can it improve the reliability of information related to those.

In terms of optimizing travel-time and flexibility, the use of a bicycle for the egress trip seem to be promising. As mentioned in chapter 1, cycling is a competitive and flexible way of covering short distances within Copenhagen, as well as providing better accessibility to the central areas of Copenhagen than any motorized transport.

In previous chapters we mentioned that people in general use a bicycle on the access trip and very few on the egress trip. Reasons for this are numerous; such as difficulties to maintain a bicycle when it is far from home, difficulties to bring bicycles onto the public transportation or fear of theft and vandalism (Nordjyllands Trafikselskab, 2002, p. 3). Practically the BSS gives an alternative to commuters´ egress trips in Copenhagen. Besides this, the bicycle would also allow the commuter to determine the time of departure, the route, the location, amount and duration of stops, avoiding thereby the inconvenience related to waiting time and unnecessary detours and stops.

Thus, firstly, a BSS to would be competitive regarding travel-time as the overall travel-time can be shortened with its usage. Secondly, it would also potentially increase flexibility, since the decisions regarding routes, stops and cycling speed can be taken regardless of other travellers. Jens Lerager argues that a new BSS will give a more door-to-door experience, increasing the flexibility of the over-all trip (Jens Lerager, 46:18).

The fulfilment of these potentials will, however, depend on whether the BSS can live up to commuters' requirements. As there have been no extensive surveys or studies regarding commuters' requirements for a BSS, we have chosen to deduce these from their requirements to the PTS. The fulfilment of these requirements will depend on several practical and technical features of the coming BSS, which are not yet decided. We will in the following chapter focus solely on the BSS and how it should live up to the deducted requirements.

7.2.1 Commuters' requirements applied to the BSS

It is worth highlighting that although we deduce the commuters' requirements to the BSS from the PTS, these requirements vary, e.g. commuters do not require that a bicycle can realize the comfort of a roof, as one does for a train. We will therefore indicate how the listed requirements presented in the previous section are to be deduced to a BSS before we move on to evaluating how the options presented for the different features of the system might affect the satisfaction of commuters' requirements.

7.2.2 Reliability

Although the BSS cannot substantially strengthen the reliability of the public transportation system, it is crucial that it is reliable itself in order to meet the requirements of the commuters. In the case of a BSS, reliability revolves around the availability and maintenance of bicycles. In other words, commuters must be able to locate the docking stations and find an available and well functioning bicycle. As a commuting journey is a roundtrip, the commuters need available bicycles for both egress trips between the station to the destination.

7.2.3 Travel time

We have seen that switching to the sharing-bicycle in principle does not involve waiting-time. However we look at it, using a BSS will in most cases still require a shift of transportation, which, results in shifting time. This transit consists of following steps; getting off the public transportation mean, walking to the docking stations, finding an available bicycle, paying and unlocking a bicycle and then driving off. In our calculation of potential user amount we have taken this into consideration by adding an average pick-up and parking time of the shared-bicycle. Finding and accessing the bicycles must be fast, smooth and as easy a task as possible in order to minimize shifting-time.

7.2.4 Flexibility

To which degree the BSS will be able to strengthen the flexibility of the PTS, will depend on how flexible the system itself will be. This includes extending the area of the system as much as possible, so that commuters do not experience inconvenient restrictions, regarding the amount of locations they are able to reach with the bicycles. The use of the current *Bycyklen* is limited to the very central area of Copenhagen. In order to meet commuters' requirements regarding flexibility, the area of the coming BSS should be substantially extended.

The level of flexibility also depends on rental-time, the possibility for errant stops along the way (e.g. for shopping) and the possibility of returning the bicycles at a different location from where it was hired.

We consider these listed requirements to be fundamentally fulfilled of the coming BSS in order to attract and satisfy commuters. Yet, several of these requirements and the satisfactions of them depend on the physical design of the BSS. For that reason, we will analyse the aptness of possible solutions regarding the different features of the coming BSS in the following chapter.

7.3 Evaluating potential options of features to meet commuters' requirements

Commuter requirements concerning reliability, flexibility and travel time have shown to be of great importance when commuters decide their mode of transportation. The previous sub-chapter showed that the BSS can potentially satisfy certain commuter requirements. Thus, this potential depends on the actual physical and technical design of the BSS. Because of the collaboration on the BSS still being in an early stage, the design has not yet been established. As a consequence, we will evaluate on certain designs' possibility of satisfying commuters. We will focus on the options from the Dutch and German examples (confer chapter 4) and on the winning concepts from CPH Bike Share Competition. To ease the understanding and reading, we have chosen to divide this part of the analysis into four sections; *Comfort & Price*, *Bicycle Design*, *Payment & Access*, *Parking & Docking*.

7.3.1 Comfort & Price

Needless to mention, the comfort criteria for a bicycle differ substantially from those for train or busses. A person riding a bicycle will, under any circumstances, be exposed to the weather. This represents both a strength and a weakness of the system: pleasant weather will usually boost the enjoyment of a bicycle-ride, while harsh weather will make it unpleasant and generate a decrease in users of a bicycle sharing system (Nordjyllands Trafikselskab, 2002, p. 12). The comfort of the bicycle depends mainly on the position users ride it on, and this will depend on the design of the bicycle which we will elaborate on in the next section.

Price has also shown to be of importance, especially for students, and surely the price for the new BSS should be well competitive with the price for other public means of transportation.

7.3.2 Bicycle Design

The design of the bicycle itself has implications that go far beyond aesthetics. It is indeed crucial for the fulfilment of the commuters' requirements regarding comfort, reliability and flexibility. One way to enhance the comfort of the bicycles is to incorporate seat and handlebars adjustable in height. Adjustable seats feature already on the current *Bycyklen*, and most of the smart bicycles of other bicycle sharing systems. The challenge is to design a system that, without lessening safety, is extremely fast and easy to adjust, needing no physical strength or tools, but yet taking no more than few seconds. In case it takes much longer, this will increase the shifting time between other modes of transport and the bicycle, which the commuter experiences as inconvenient, as seen in the above section. Another component that should be considered in order to offer the user a minimum of practicality is a basket or small luggage compartment. Commuters usually carry bags etc., which they need to transport safely and comfortably during their journey. A carrying-compartment might also affect the flexibility experienced by the user, since it allows them to shop, e.g. for groceries, under way and carry their purchases on the bicycle. This also depends on whether users have the possibility of locking the bicycles for short periods of time outside of the docking stations, while they shop for example.

The design is also utterly significant for the travel-speed. The bicycle must be able to achieve average speeds close to those of a common bicycle (average bicycle speed in Cph in 2008: 16.2 km/h) (KK, 2010c, p. 49); otherwise the commuter might experience it as not competitive enough. According to the Mayor of TMF, Klaus Bondam, the new system should regarding to design and form, present an innovative system that would strengthen sustainable mobility in the city through robust and elegant designs that provide a good riding experience. (TMF, 2009c). This might represent a challenge, since it can be difficult to design a both fast and robust bicycle.

Maintenance is also a key issue. The shared-bicycles must be well maintained and commuters should always be able to find well functioning bicycles. In the same way as irregularities in the public transport system chase users away; bad-functioning bicycles might threaten the reliability of the whole system. This is absolutely crucial for the success of the system, since, as we saw in the previous section, reliability is the commuters' most essential requirement.

The inclusion of a GPS-tracking device in the bicycles, as proposed by all winner concepts of CPH Bike Share Competition (cphbikeshare a,b,c,d & e), is also of relevance for several reasons: Firstly, it enables analysis of users' usage patterns, facilitating further development of the system in accordance with these. Secondly, besides tracking missing or stolen bicycles, it also allows information-systems to provide real-time data about the location and availability of bicycles to users, enhancing thereby the reliability of the BSS. Information systems might also enable users to book bicycles, and thereby ensuring the availability of a bicycle where and when they need it. The option suggested by one of winning entries of the competition (cphbikeshare a), of having an information/booking-system accessible through the internet seems to be the most flexible one, as users can access it both through computers and smart-phones. The option of integrating the BSS into the public transport travel plan system *Rejseplanen*, seems to be optimal: it simplifies the commuters' access to information at the same time as it grants the BSS visibility. Most people are familiar with the '*rejseplanen'*-system; therefore providing information about the BSS through this channel might attract users. This does not exclude that the BSS should have its own channel on the internet with more detailed information.

7.3.3 Payment and access

The registration of users should significantly improve the reliability of the system since this should hinder, or at least minimize, misuse and theft, thereby avoiding the problem experienced with the current *Bycyklen*. Thus the registration should be a simple and quick task, which should be available both over the internet and on-site at the docking stations. This increases the flexibility of the system, meeting the needs of frequent users who plan their journey and wanting to optimize shifting time. New or non-frequent users who will randomly make use of the system, will also benefit from a simple and quick registration and payment.
Based on the needs of these two groups of users, the payment solution mentioned by Jens Lerager seems to be reasonable: he suggested combining the possibility of on-site payment for casual users with a monthly subscription for frequent users, which would allow them unlimited access to the system (Jens Lerager, 25:25 – 27:03). As mentioned above, the fees should be competitive to the prices of other public transport modes. Optimally, the BSS should share the same payment solution as the PTS on equal terms, as suggested by one of the winning entries at CPH Bike Share Competition (cphbikeshare b). The barrier in this case is that the electronic payment solution for the whole public transportation system in Denmark, *Travel Card* (Da: Rejsekort), is still under development and, according to Jens Lerager, will not

be ready any time soon (Jens Lerager, 17:20). When and if the Danish transport system develops a common electronic payment solution, it would be advantageous for the BSS to be integrated to this, not only because of price competitiveness but also in order to simplify and smoothen the shift from train, bus or metro to a shared-bicycle. In case the BSS reaches the streets before the *Travel Card*, the optimal solution for accessing the bicycles seems to be a smart-card. This is ideal for commuters, who quickly would be able to access a bicycle. Yet, this might be more complicated in the case of new or non-frequent users, as it might not be possible to issue a smart card on-site. An option to that would be the possibility of registration and payment through credit-cards at selected docking stations.

Access can also be granted through a code system. It is in our opinion that the system used by Call a Bike in Germany, involving phone calls and text-messages, is too complicated and time consuming. Therefore, it does not seem to satisfy commuters' requirement regarding quick and easy access. In case a code system is employed, the option of providing frequent users with a personal code should be considered as it simplifies the access and avoids time-wasting related to getting access to a different code every time.

7.3.4 Parking and Docking

Considering that the current decision-making process of the BSS is partly in the hands of DSB, and as they have a preference for a BSS with docking stations to attract customers to their business, we will exclude the option of a fluctuating system (with no docking stations).

As distance and walking time between the sharing- bicycle and the public transportation e.g. train platform or the bus stop must be at a minimum to reduce shifting-time, docking stations should be placed as close to the stations as possible. However, as Jens Lerager points out, availability of space at train stations can be limited (Jens Lerager, 30:00). The challenge regarding the scarcity of available space at stations could be overcome by adopting elevated parking systems (under or above the ground), as proposed by all winning entries of the CPH Bike Share Competition (cphbikeshare a,b,c,d & e). Another important issue regarding the docking stations is the need to insure that commuters can always find available bicycles at their end-stations, as well as available docking stations to which they can return the bicycles. This is crucial for the reliability of the system and for the flexibility it grants its users. One possible solution for this issue was also presented by some of the entries of the Competition: to employ docking stations with unlimited capacity, where the bicycles can be coupled to one another (cphbikeshare d). Besides avoiding the problem of finding an available docking station for returning the bicycle, it also eases the relocation of bicycles among stations, ensuring that the number of bicycles at each location corresponds to user demand. Optimally the system would be a combination of the aforementioned parking solutions according to the availability of space and amount of bicycles.

The issue of availability of bicycles for returning to the rail or bus-station could be solved in two ways: by placing docking stations close to working places and educational institutions, and/or by allowing commuters to rent the bicycles for whole-day periods. The first option seems very reasonable, as DSB is interested in inviting companies to implement docking stations at their main offices (Jens Lerager, 21:10). But it might be difficult to implement docking stations close to every institution in town. It might also involve conflictual negotiations about the use of public and private space for the purposes of establishing docking stations. The second option ensures reliability, as the commuter will use the same bicycle for coming from and to stations. However, this option also has its disadvantages: Firstly, the risk of theft increases the longer time the bicycle is unattended outside of a docking station calling for efficient anti-theft mechanisms as for example the one employed by Call a Bike, where the bicycles can and must be locked to a fix object with the provided lock when left unattended. Secondly, longer rental periods mean low frequency of use and the amounts of bicycles must therefore be higher in order to meet the demand, the overall cost of the BSS is due to increase. In this case, Jens Lerager suggested the possibility of producing cheaper bicycles, with less electronic increments (Jens Lerager, 27:20). Although this might be a solution, it must be considered very carefully as it might have a negative impact in the BSS's ability for fulfilling commuters fundamental requirements.

7.4 Conclusion

We have explored that there are certain common requirements, for travellers regardless of them using public transportation or car. We identified four main categories of which we used throughout this analysis. Reliability and travel-time are two highly prioritized requirements of the PTS, closely followed by the need for flexibility and comfort. We interpret the decreasing amount of total passenger mileage of the PTS in Copenhagen, as a consequence of the PTS presently not fully satisfying the requirements of travellers and as such, neither the commuters. We identified two main challenges of the PTS concerning especially flexibility and independence. These challenges have shown to be the exact advantages the bicycle sharing system can provide for the PTS, with the potential of decreasing travelling time. In order to achieve these, the BSS must as a system of its own offer available and well-maintained bicycles at easy, visible and accessible docking stations with a minimum of transit time. Furthermore there are several requirements regarding information and booking which must be of high quality.

To sum up, it seems that a BSS in Copenhagen theoretically have promising potentials of fulfilling requirements of the commuters and thereby improve the public transportation system as a whole. We must however consider the point derived in the previous chapter 6; that there are considerable uncertainties regarding whether commuters will actually use the BSS if provided. Due to a minimum of literature and little amount of studies and extensive shared-bicycle experiences, regarding actual usage of the systems, we cannot conclude on a guarantee of the commuters using the system. Furthermore, we have explored that if the requirements of commuters should be met, the bicycles must be of high quality. This means that DSB should be willing to invest heavily in the system, but according to Jens Lerager they might be planning to implement lower-quality bicycles (Jens Lerager, 27:20). We will not discuss this financial aspect, but merely mention it as a possible challenge.

In the following chapter we will discuss the findings of our three analyses'. By doing so, we will identify the most significant challenges and possible potentials of the coming BSS' integration with the PTS.

Chapter 8 - Discussion

In this discussion we wish to unite our three analyses and with this foundation identify and discuss what we consider to be highly significant challenges and possible potentials of implementing a Bicycle Sharing System. This will be done in order to discuss the possible fulfilment of the visions set forth in the Climate Plan.

As we evaluated the potential effect of a BSS regarding catchment area of the public transportation system in Copenhagen in chapter 5, we considered the relation between walking speed and cycling speed, and found that the use of shared-bicycles for the egress trip can triple the distance covered by walking while travel-time remains constant. Extending the distance commuters can cover within the same time span is probably the most significant contribution of a BSS to the fulfilment of commuters' requirements regarding public transportation. As we saw on the fourth map (5.2.5), any destination within Copenhagen could in theory be reached within 10 minutes of cycling from a rail station if the selected rail stations are provided with Efficient Transit Hubs. Reflecting upon the findings in the previous analysis (confer chapter 7), an optimization of commuters' highly valuable travelling time and extension of their flexibility for reaching a greater variety of destinations is of high importance for commuters. In this context, the city's physical conditions must not be overlooked: barriers such as buildings, bridges, canals and railways generally hinder journeys from station to destination to be covered in a beeline. It is important to keep in mind that the catchment area drawn on the maps does not take account for the physical conditions around the stations, which have great implication for their actual catchment area as well for the actual travel-time from station to destination.

The analyses of a possible implementation of docking stations, on its turn, took account for both the physical conditions of the selected rail stations as well as for the commuter requirements regarding smooth and efficient shift between transport modes, exemplifying the potential for Efficient Transit Hubs. As shifts between trains and the shared-bicycle should involve a minimum walking distance, we highlighted possible locations for the establishment of docking stations on two selected stations. The two cases indicated that a physical implementation can vary considerably according to location. At stations with sufficient available space, such as Sydhavn st., the actual placement will mainly depend on land ownership around it, while at stations with scarcity of space the challenge of building underground or silo docking stations is added. Theses parking alternatives are certainly more costly, but, keeping in mind that commuters' requirements should not be overlooked, they must be considered in order to attract commuters.

Considering the enhancement of station catchment area achieved through the availability of shared-bicycles for egress trips at end stations in Copenhagen, the establishment of the BSS could indeed improve the attractiveness of the public transportation system in the eyes of commuters whose destination lie beyond 600m from a rail station. This includes those currently commuting by train, who undertake their egress trip by bus or car, and those who commute their whole journey by car. According to our estimation of the potential amount of users, interested in using a shared-bicycle for their egress trip, the numbers lie between 936 and 5,580 for current motorists and 6,221 for current users of the PTS. These estimations have a huge span which might be partly because of the considerable variables of the used data. However, this indicates that it is quite difficult to make an accurate estimate of commuters who are interested in a BSS –and more so actually utilize it. We discovered the knowledge within this area of study to be scarce and extensive user surveys alike. As argued in the previous analysis the usage is also highly dependent on meeting the requirements of the commuter.

In terms of contributing to the achievement of the Municipality's visions for the transport sector, the most significant potential certainly lies in drawing those who currently commute by car. But, as revealed through the large span between minimum and maximum amount of current motorists, the new BSS might potentially attract, there are great uncertainties regarding their willingness to substitute a daily trip, by car, with the combination of train and shared-bicycle. There are several factors that might explain that. Firstly, the combination of public transport with the BSS might still not fulfil the transport needs of those who commute long distances between several destinations, and/or of those who transport heavy working equipment and/or of those whose access trip to the nearest station is too far. Secondly, there is a social status attached to the car that might influence motorists' unwillingness to change transport pattern (Freudendal-Pedersen, 2009, p. 131). On the other hand, the fact that the shared-bicycles will represent a real alternative to the bus for the egress trip, might also contribute in attracting motorists that are willing to commute by train but refuse to take busses - as the bicycles do not carry the low popularity associated to busses. Looking into the future one might guess that an increase in the level of congestion around and within Copenhagen in the rush-hours might motivate motorists to switch to collective modes once their egress trip is optimized. Another scenario would be that the increasing amount of focus on environmental issues will escalate the association of the car with lack of sustainable responsibility and thereby attract motorists with a possible bad conscious: However, combining all these and many further factors that might influence motorists' decision of changing transport mode seems too complex – if not impossible – a task. We have therefore decided to take these uncertainties into consideration and for that reason keep the rather ample interval between the estimation of minimum and maximum amount of motorists that might come to use the BSS for part of their commuting journey. Consequently, there is also a large span in our estimation of potential CO_2 reduction; spanning from approximately 1,000 tons of CO_2 to 6,100 tons of CO_2 per year – if any reduction at all. In relation to the 50,000 tons of CO_2 reduction per year the Municipality has envisioned for the transport sector, our maximum amount of CO_2 reduction would account for approximately 12% of the reduction. This is however a great overestimation considering the numerous uncertainties we have identified. These include the fact there the numbers of which we have calculated with do not consider that currently DSB is considering 5,000 sharing bicycles, but presume that the potential amount of users can be provided with a sharing-bicycles. Furthermore there are uncertainties regarding the data of which we have build our calculation on due to several variables (confer chapter 2 and appendix 1). The unpredictability of the actual usage of the BSS and how the system will interact with coming initiatives should also be taken into account. Based on these uncertainties we estimate that the reduction of CO_2 is more likely to be closer to 1,000 tons of CO_2 pr. year than the 6,100 tons of CO_2 pr. year - if not lower.

We have seen that commuters' requirements for the BSS itself are likely to be very demanding, while the price they are willing to pay for it seems to be very low. Consequently, user-fees are unlikely to be sufficient for sustaining the system financially. In this regard, the decision taken by TMU of having an independent tender process for the implementation and operation of the system; and for the outdoor advertisement contract that will finance it (TMU, 2010, p. 1) seems very reasonable, as it insures transparency around the financial aspects of the system while concurrently keeping user-fees low.

Although commuter requirements are utterly subjective, it was possible to draw a general outline for what they might require for the different features of the system. The more flexible, reliable, time-efficient and cheap the system is, the more users it will attract. We are aware that other factors, such as the economy and the physical features of the city, will influence the final layout of the system. Crucial in this context is the fact that quality should not be sacrificed in the name of economy. In other words, commuter requirements should be prioritized when taking decisions regarding the design of the bicycles, the layout of the system and the financing models, as its success depends, mainly, on user-acceptance.

Copenhagen's strong bicycle tradition, presented in chapter 4, might play an ambiguous role for the embracement of the coming BSS. On the one hand, cycling infrastructure is extensive and well developed; bicycles are a legitimate and socially accepted mode of transport; and the users of the coming BSS are likely to be familiar with this transport form. On the other hand, Copenhageners familiarity with bicycles might bring about even higher requirements to the BSS; preferences regarding bicycles are very diverse, reflecting the variety of bicycle designs on the streets of the city. Different people prefer, and might even identify themselves with different types of bicycle. This implies, firstly, that the quality of the shared-bicycles will be put up against that of private bicycles and, secondly, that it might be difficult to satisfy all potential users with one and the same design. Furthermore, the existing BSS, being old and outdated, might have a negative influence on the user acceptance of the new BSS. Therefore, a further challenge regarding user embracement might be to disassociate the new BSS from *Bycyklen* in the marketing process.

Apart from the BSS contributing with CO_2 reductions, it can further contribute to the promotion of sustainable mobility, by incorporating, reflecting and symbolizing the bicycle culture and promoting Copenhagen as the world's best cycling city. It can additionally contribute to the achievement of the goal of increasing the number of commuters travelling by bicycle to 50%. As this number considers those who arrive at their work places or education facility by bicycle, the availability of shared-bicycles for the egress trip can considerably contribute to its enhancement. The realization of these potential contributions will though depend on the actual layout and scale of the system: the higher the amount of bicycles and the higher the quality of the system, the more it might contribute with.

Since the BSS is not the only initiative that will influence the future development within the transport sector, we would like to discuss how other infrastructural projects and restrictive measures might play a role for the potential success and embracement of the BSS. A major project that in the long term might influence the success of the BSS is the establishment of the new metro City Circle Line. This project can be grouped under the same category as the BSS, namely promoting alternatives to the car by strengthening the public transportation system. Once established, by 2018, the City Circle Line might reduce the attractiveness of the BSS, as the several new stations will encompass areas that are not currently within the station proximity coverage by walking. In the meanwhile, from 2013 to 2018, the BSS will probably stand for part of the coverage of those areas, as the only alternative to the bus. Considering the relative low cost of the BSS (if compared to the metro), it constitutes a very efficient and quick way of expanding the coverage of the public transportation system in Copenhagen. The 5-year span between the establishments of the two projects entails that the BSS, if fulfilling commuter requirements, might have time enough to establish itself as an attractive element of the PTS, and be embraced by commuters who value the flexibility and vitality provided by a shared-bicycle.

As mentioned in chapter 3, in addition to the initiatives for promoting alternatives to the car, the Municipality also aims at introducing restrictive measures for limiting the car use. The combination of these initiatives might be characterized as a 'stick-and-carrot' strategy. In this sense the BSS can be seen as a 'carrot', or an incitement for diminishing car use. 'Sticks' will comprise congestion charges, parking restrictions and the establishment of car-free zones. As these initiatives will reduce the flexibility, efficiency and attractiveness of commuting by car within and into Copenhagen, they are likely to boost the attractiveness of using shared-bicycles within the city. However, there are no predictions for when the restrictive measures will be established, as they are subjected to approval by the Danish parliament. If introduced before the establishment of the BSS, they are likely to increase the interest of the project; if introduced after, the establishment of the BSS will probably help 'compensating' the motorists for the restrictions and, most importantly, help the PTS to cope with the potential increase in amount of passengers that restrictive measures are very likely to bring about. Either way, measures restricting car use seem to be the most promising external factor for the success of Copenhagen's new bicycle sharing system.

Chapter 9 – Final Conclusion

The project's point of departure was to assess on the future integration of a new Bicycle Sharing System within the central municipalities, thus enabling us to explicate on the potential commuter usage and CO_2 reductions in its wake. Specifically, our attention was in the relation between the physical implementation of the system, and the requirements of the commuters whilst having the Climate Plan 2025 as our point of orientation. This approach was the defining factor for the structure and formulation of our thesis statement:

How can the coming bicycle sharing system's integration with the public transport increase the current catchment area of rail stations in Copenhagen? Considering the challenges involved in meeting commuter requirements for this combination, what is the potential of its contribution to the achievement of the visions for the transport sector set forth in the Copenhagen Climate Plan?

In accordance to our theory of science - Critical Realism - we will not deduce any definitive results or ascertainable conclusions. However, we will strive to reveal underlying tendencies in the influence of commuters' requirements on the usage of the BSS and thereby the reduction in CO_2 emissions.

In order to answer the thesis statement, we chose to perform three linked analyses and a final discussion. With the first analysis of the BSS' physical implementation in the central municipalities, we ascertained that a BSS with docking stations implemented at 12 rail stations could potentially increase the catchment area of rail- and metro stations, covering almost the entirety of the central municipalities. We furthermore proceeded with a more profound examination on a physical implementation of docking stations at two stations, exemplifying various challenges and potentials all dependant on the urban context. We found that a lack of space at rail stations could emerge as a challenge that can only be met with more expensive solutions; in addition there are larger or smaller physical urban contexts which the station catchment areas do not take account for, such as the crossing of canals. This would affect the catchment area, possibly decreasing its radius since a non-beeline route increases the time spend going from point A to B.

In order to get an idea of how the BSS could possibly contribute to the achievement of the visions set forth in the Climate Plan 2025, we undertook a range of calculations to provide an estimate. With the affirmation of possible full transport coverage in the central municipalities, we estimated a potential usage and CO_2 reduction in the city of Copenhagen. As profoundly discussed in the previous chapter, there exists a significant amount of possible factors and variables which could have an effect on our calculations. However, our estimations showed us a usage amount in the span between approx. 7,000 – 12,000 commuters. Our estimations regarding CO_2 reductions, based on these commuter numbers, revealed a span, starting from approx. 1,000 and going all the way up to approx. 6,000 tons CO_2 pr. year – if any at all, depending on the success of the BSS. In this context, the unpredictability of the actual usage of the BSS that we identified should be taken into consideration. If calculating with our highest estimated reduction, the BSS will contribute with 12% of the envisioned 50,000 tons of CO_2 reductions pr. year within the transport sector.

In the analysis that followed, we sought to investigate this uncertainty, by looking at the commuters and their requirements for the PTS and the BSS. Through this analysis we derived that there exists a great potential in the optimization of the PTS and thereof the following contribution to the achievements of the visions in the Climate Plan. However, it appears that this potential can only be achieved if the commuters' lofty requirements are met with powerful ambitions for the project. Moreover, in the previous discussion we derived that investments in quality material is a necessity when meeting the commuters' demands. We therefore see a tendency, were a half-hearted approach would not be beneficial at all for the attractiveness of the system. Considering the diverse challenges in meeting the requirements of the commuter we do however see a tendency that it could contribute to the achievements of the visions set forth in the Climate Plan. However, uncertainties regarding usage, final design of the BSS and the stakeholders make it difficult to gather a clear estimation of its potential. Nevertheless, the BSS does have the prospective of promoting sustainable mobility, creating alternatives to the fossil fuel driven car, improve the interaction between public transportation & bicycles and contribute to the achievement of increasing the number of commuters travelling by bicycle to 50%.

To sum up, we can conclude that a new Bicycle Sharing System in Copenhagen can cover almost the whole of the central municipalities and contribute to the achievement of the visions for the transport sector set forth in the Climate Plan 2025. Nevertheless, all depending on the final layout, commuter acceptance and future urban and infrastructural developments, the amount of CO_2 reductions are, like our estimated broad spans indicate, hard to predict.

Chapter 10 - Critical Reflection and Perspective

This chapter will serve as a reflection for the conclusions drawn throughout the project, and also for any adjacent new issues which could have been relevant to examine in relation to the treated subject. We will therefore firstly make suggestions to how our conclusions might have stood stronger if we methodologically had taken other choices. Secondly, the reflections regarding new issues will have the purpose of contributing with suggestions to how the subject could otherwise have been treated, thus giving ideas for future projects.

Our methodological choices have naturally had a crucial impact on our conclusions. We therefore judge that some of the methodological choices could with advantage have been different. In correlation with Critical Realism, we see that a strengthening of our theoretical basis may well have been advantageous. In this regard, we could have taken a more social orientated focus, and could have included more of Malene Freudendal-Pedersens writings. Her writings regarding the relation between space, behaviour and values might have been knowledge we could have used to gain a deeper understanding of why people choose their means of transportation - and from this – we might have equipped ourselves with of a stronger theoretical foundation and thus strengthening our conclusion.
Furthermore, it is fair to say that Mobility Management could have helped us in understanding how we in the short- and long run can increase and maintain the usage of the BSS. This includes different initiatives such as behavioural modification through campaigns and parking policy. In accordance to our methodological reflections (confer chapter 2), we saw the above along with many others, as less crucial elements to include.
Another methodological aspect is our estimation of the potential amount of commuters using the BSS and thereby the expected amount of CO_2 reductions it might result in. We can here be self-critical on a couple of points: inter alia that we primarily argue for a basis on two station catchment areas, 600 metres by walking and 1800 metres by cycling, but later calculate with data from the National Travel Survey regarding the effect of station proximity, which works with intervals between 0-400, 400-800 and 800-2000 metres. Moreover, we estimate a minimum and maximum potential of the expected amount of new commuters with a reverse calculation, calculating the potential increase of the *Public transport* segment, and only draw

these commuters from the *Car* segment. This is only done for the sake of calculating a maximum CO_2 reduction, since we cannot estimate where the potential BSS commuters might come from. Overall we can criticize ourselves for not using data from the same source, as the different sources we have used in our estimation, apply different approaches and cover different extents of geographical areas. In this regard we should have contacted specific sources from the beginning of the process, in order to get hold of data from the same source. But as it became apparent to us later, we discovered that a fast processing of data would require economical resources. All in all it is crucial to point out, that these calculations are only meant as an estimation of the potential usage and emission reductions, meant to give the reader an idea of what tendency we can expect to see with a BSS.

When reflecting in general upon the interviews, it is in our belief that an inclusion of the Danish Cyclists Federation could have been beneficial for our conclusions. More specifically the commuter analysis might have been strengthened by providing the representative view of the cyclists. In this relation, the inclusion of DSB's Commuter Club could also have provided us with even further first-hand knowledge, thereby increasing our empirical foundation of the commuters.

Last but not least, we are aware that there were a few technical terms which we could have taken into use but were unable to translate from their Danish term, given that our knowledge of the field mainly stems from Danish sources. Danish terms covering specific phenomena's were thus translated directly, if the respective word in English could not be found, such as *transportarbejdet, landsplan direktiv, kommuneplan strategi* etc.

All the above is only an extract of the critical aspects which might have optimized the project - the rest of our critical reflections regarding the methods are mentioned in the methodology and, where relevant, the specific chapters or appendixes.

Through our in-depth work with the field of study, we have discovered a various amount of other mechanisms which also could have been interesting to work with. It could among other things have been appealing to work with possible conflicts of interest between DSB and the Municipality of Copenhagen. The municipality views the BSS as a branding potential for the city with a sharing-bicycle orientated mainly towards the commuters to reach the vision of 50% citizens commuting to work or study facilities within the municipality. In the contrary, DSB's agenda is to place the BSS under their name, and brand it primarily as a commuter bicycle for their customers, but also functioning as shared-bicycles for other errands. Possible conflicts of interest and their outcome would basically define the design of the BSS and potential commuter-orientated loyalty programs. It has also come to our attention, that the individual conflict between being eco-friendly versus the feeling of freedom and individualism could be an interesting area of focus.

We have throughout the course of the whole project found our problem area exciting and challenging to work with, especially when regarding scarcity of first-hand knowledge in the area. In the light of the whole project, it is our opinion that we have brought new insight into this field of research and as such illuminated some important aspects seen from a commuter and implementation aspect.

References

Articles

- Laugesen, L. M. (2010). *Flere cykelpladser I S-togene*, in S-Pressen nr. 42.
- DSB Presse (2008). *Pressebagrund Fakta om fordelingen af opgaver og ansvar mellem DSB og Banedanmark*

Reports

4. Bührmann, S. (2005a). *OV Fiets: Public Bicycles in The Netherlands.*
5. Bührmann, S. (2005b). *Call A Bike: Public Bicycles in Germany.*
6. Bührmann, S. (2008). *Bicycles as public-individual transport – European Developments* (Meetbike Conference, Dresden 2008)
7. Christensen, L. & Jensen, T.C. (2008). *Korte ture i bil - Kan bilister ændre adfærd til gang eller cykling?* DTU Transport.
8. DeMaio, P. (2009). *Bike-Sharing: Its History, Models of Provision, and Future.*
9. Det økologiske Råd (2010). *Hvordan fremmer vi brug af cykel mellem station og arbejdsplads? Arbejde-stationscykel Hillerød.* Copenhagen: The Danish Ecological Council.
10. Finger Plan – Miljøministeriet (2007). *Fingerplan 2007 – Landsplandirektiv for hovedstadsområ dets planlægning*
11. Litman, A-S (2005). Tilgængelighed Til Kollektiv Trafik I Hovedstadregionen. Center for Trafik og Transport, DTU.
12. Nielsen, O. A. & Landex, A. (2009). *Hvordan får man bilister til at bruge kollektiv transport? - Gennemgang og vurdering af Initiativer for Hovedstadsområdet.*
13. Trafikstyrelsen (2010). *Med tog, bus & færge - beskrivelse af opgaver og roller i den kollektive trafiksektor i dag.*

14. *Transportministeriet (2010).Værdisætning af transportens eksterne omkostninger - Rapport.*

Municipal reports

BTF - Bygge- og Teknikforvaltningen, Københavns Kommune (2002). *Cykelpolitik 2002-2012.*

Climate Plan – Københavns Kommune (2009a). *København CO2-neutral i 2025, Københavns Klimaplan.*

Climate Plan – Københavns Kommune (2009b). *Københavns Kommunes Klimaplan, Virkemiddelkatalog – Transport.* Rambøll.

KK - Københavns Kommune (2008). *CO2 regnskab 2008.* Cowi.

KK - Københavns Kommune (2010a). *Trafikken I København 2009*. Copenhage: Teknik- og Miljøforvaltningen.

KK - Københavns Kommune (2010b). *Grøn Vækst og Livskvalitet – Investeringer og handlinger i Københavns byudviklingsprojekter*, Rødgaard Grafisk, Clement, juli 2010

KK- Københavns Kommune (2010c). *Københavns Miljøregnskab - Hjemmesiden i printvenlig udgave.* Dokumentet afspejler indholdet på hjemmesiden om Københavns Miljøregnskab pr. 11. november 2010.

Region Hovedstaden (2009a). *Udvikling i den kollektive trafik i Region Hovedstaden.*

Region Hovedstaden (2009b). *Før biltrafikken står stille - Hvad kan den kollektive transport bidrage med?*

Region Hovedstaden (2009c). Kollektiv trafik i hovedstadsområdet - Arbejdsnotat om interviews med nøgleaktører.

TMF - Teknik og miljøforvaltningen, Københavns Kommune (2009a). *Copenhagen City of Cyclists – Bicycle Account 2008*

TMF - Teknik og miljøforvaltningen, Københavns Kommune (2009b). *Open Design Competition - A New Bike Share System For Copenhagen – Competition Programme. (31/08/2009)*

TMF - Teknik og miljøforvaltningen, Københavns Kommune (2009c). *Jury Report - A New Bike*

Share System for Copenhagen - Open International Design Competition. (07/12/2009)

TMF - Teknik og Miljøforvaltningen, Københavns Kommune (2010). *Trafikken I København 2009.*

TMU – Teknik og miljøudvalget, Københavns Kommune (2008). *Procesplan For Bycykler i København (2008-104193)(29/10/2008)*

TMU – Teknik og miljøudvalget, Københavns Kommune (2010). *Section 13. Proces for nyt bycykelsystem (2010-80806) in agenda of The Technical and Environmental Committee meeting 21.06.2010.*

Other (Papers, pamphlets, printed literature etc.)

1. Danemark, B., Ekström, M., Jakobsen, L., & Karlsson, J.C. (2002). Explaining Society – Critical Realism in the Social Sciences.
2. DSB (2008a). *Østtælling 2008 DSB og DSB S-tog, bilag 3: Oversigt over afrejste og ankomne passagerer.*
3. DSB (2008b). *Østtælling 2008 DSB og DSB S-tog*
4. Freudendal-Pedersen, M. (2009). *Mobility in daily life : Between freedom and unfreedom.* Surrey*:* Ashgate.
5. Freudendal-Pedersen, M. (Forthcomming). *Cycling in the sustainable city.*
6. Hartoft-Nielsen, P. (2001). *Hvad betyder nye boligers og arbejdspladsers lokalisering i bystrukturen for persontransporten?* (Trafikdage på Aalborg Universitet2001)
7. Kristensen, C. J. (2009). Interviews med enkeltpersoner in Fuglsang, L., HageDorn-rasmussen, P. & Olsen, P. B (edited by Roskilde Universitetsforlag) 1 udgave 2. oplag Kvale, S. & Brinkmann, S. (2009). *Interview – Introduktion til et håndværk.* 2.udgave.
8. Martens, K. (2006). *Promoting bike-and-ride: The Dutch Experience.* Tel Aviv University.
9. Nordjyllands Trafikselskab (2002). *Udlejning af pendlercykler - Evaluering af et Trafikpuljeprojekt.*

10. Statistics Denmark (2010). *Nyt Fra Danmarks Statistik: Mange vest- og sydsjællændere pendler langt.*

Web reference

- Krak.dk – http://map.krak.dk/ - Tegn & Mål – Et areal

- kk.dk- Københavns Kommune (n.d.). Kommuneplan 2009: 4c. Byens net og Metro. Retrived November 17, 2010 from http://www.kk.dk/sitecore/content/Subsites/KP09/SubsiteFrontpage/Kort/Retningslinier/4BeliggenhedAfTrafikanlaeg/4cByensNetOgMetro.aspx

- Konsulent-net.dk: Konsulent-net (13/02/2010). Ansættelsesforhold for Konsulenter. Retrived from http://www.konsulent-net.dk/_ansat.htm

- Cphbikeshare a - Grundahl, K. & Engel, M. (n.d.) Retrived November 17, 2010 from http://www.cphbikeshare.com/pdf/18119.pdf

- Cphbikeshare b – Kristensen, J. & Agerskov, M. (n.d.) Retrived November 17, 2010 from http://www.cphbikeshare.com/pdf/33211.pdf

- Cphbikeshare c – Lots Design, Koucky & Partners, Green Idea Factory (n.d.) Retrived November 17, 2010 from http://www.cphbikeshare.com/pdf/28630.pdf

- Cphbikeshare d – Coulbeaut, T. (n.d.) Retrived November 17, 2010 from http://www.cphbikeshare.com/pdf/25007.pdf

- Cphbikeshare e – Jung Geun Tak & Shinhyun Kang (n.d.) Retrived November 17, 2010 from http://www.cphbikeshare.com/pdf/81103.pdf

Illustration reference

- KK illustration - Københavns Kommune (n.d.). Kommuneplan 2009: 2a. Lokalisering af erhverv. Retrived November 17, 2010 from http://www.kk.dk/sitecore/content/Subsites/KP09/SubsiteFrontpage/Kort/Retningslinier/2BeliggenhedAfOmraader/2aLokaliseringAfErhverv.aspx (Note: Compounded from 9 screenshots taken from the webside)

Krak 3D overview

- Sydhavn 3D – Krak.dk (n.d.) Retrived December 15, 2010 from http://map.krak.dk/m/IZZPP
- Valby 3D – Krak.dk (n.d.) Retrived December 15, 2010 from http://map.krak.dk/m/IZZga
- Nørrebro 3D – Krak.dk (n.d.) Retrived December 15, 2010 from http://map.krak.dk/m/IZZ5Z

Google Streetview

- Sydhavn illustration – Google Streetview (n.d.). Enghavevej, Copenhagen, Danmark. Retrived November 17, 2010 from http://maps.google.dk/maps?f=q&source=s_q&hl=da&geocode=&q=Sydhavn&sll=55.693403,12.583046&sspn=0.209758,0.609741&ie=UTF8&hq=&hnear=Sydhavn&ll=55.655343,12.538067&spn=0.001652,0.004764&z=18&layer=c&cbll=55.655345,12.537814&panoid=KO0SY1ENSPbkDMXugVoszQ&cbp=12,245.86,,0,5

- Nørrebro illustration – Google Streetview (n.d.). 3 Frederikssundsvej, Copenhagen, Danmark. Retrived November 17, 2010 from http://maps.google.dk/maps?hl=da&q=n%C3%B8rrebro+station&ie=UTF8&hq=&hnear=N%C3%B8rrebro+Station&ll=55.70107,12.537591&spn=0.013107,0.038109&t=h&z=15&layer=c&cbll=55.70107,12.537591&panoid=vNf1M5zy9YvJbHV0hgZ1xw&cbp=12,196.91,,0,5
- Valby illustration – Google Streetview (n.d.). 60 Lyshøjgårdsvej, Valby, Danmark. Retrived November 17, 2010 from http://maps.google.dk/maps?f=q&source=s_q&hl=da&geocode=&q=Valby+Station&sll=55.70107,12.537591&sspn=0.013204,0.038109&ie=UTF8&hq=&hnear=Valby+Station&ll=55.663366,12.513835&spn=0.00656,0.019054&t=h&z=16&layer=c&cbll=55.663367,12.513719&panoid=-DlKaq6hPnLQ1RqmXx_BYA&cbp=12,41.26,,0,5

Appendix 1 - Methodology

This chapter will account for the motive behind the inclusion of qualitative interviews along with the methodological deliberations made for the execution of the interviews. A critical reflection is also included. Furthermore we will discuss the methodology behind our analysis regarding physical implementation, and the secondary empirical data in the form of the statistical information regarding commuters. Thereby providing a deeper elaboration of what was only introduced in Chapter 2.

Appx.1.1 Interviews

Regarding the execution of the interviews, the choice fell on Steinar Kvale's and Svend Brinkmann's 7 stages for the qualitative interview (Kvale, 2009, p. 119). This was done in order to achieve a greater insight in the methodology of the scientific interview. The following perspectives exist within this aspect; thematization, design, interview, transcription, analysis, verification and reporting (Kvale, 2009, p. 122). Although in this project we have chosen not to draw a hard line between the different stages, since they will be gone over dependent on relevancy.

Hence, the purpose of the qualitative interviews is to gain a greater insight into how planners approach and work with the implementation of a bicycle sharing system in Copenhagen. Kvale articulates that it is a strength if the interview reaches beyond the mere spontaneous exchange of opinions, which according to him occurs in the "daily" conversation. Thus, the interview becomes a mindful, enquiring and hereby a listening method (Kvale, 2009, p. 19).

Appx.1.1.1 Description of the Interviewees

The choice fell on two qualitative interviews in order to cover the two main actors' views, insight and work on the implementation of the bicycle sharing system. Below is a short introduction to the interviewees and their relevance for the project.

It is important to note, that we for all the interviews decided to use an interview guide. This was for the purpose of preparation before the interview, and in proportion to which knowledge we wanted to achieve throughout the sessions. Additionally, the guide functions as an important checklist for the interviewer (Kristensen, 2007, p. 285). In correlation with our project, the interview guide does not take form as an actual check list, since we for the specific interviews have remained flexible. We have therefore both listened and asked, in order to meet the interviewees' needs and simultaneously secure our own intentions with the interview. The interview guide for each of the interviewees will appear later in this appendix.

Morten Heegard
We chose to do an interview with Morten Heegard from the Municipality of Copenhagen. He works in the Bicycle Secretariat belonging to the administration unit Road & Park, and is employed to work with a bicycle sharing system. He points at that he mainly functions as a co-ordinator for the internal process. We saw him therefore as the most qualified representative of the municipality and their work with the bicycle sharing system, thereby giving us the municipalities' opinion on the matter.

Jens Lerager
We furthermore decided to do an interview with cand.scient.soc. Jens Lerager from the traffic company DSB – currently employed as an analyst. He works with access and egress strategies i.e. bicycle/car parking, commuter bikes and transport times in a new department utilized for work revolving around things not concerning trains. We contacted Jens since we also saw him as the most qualified representative for the bicycle sharing system, just from the traffic company DSB's point of view. It was furthermore an opportunity to get a greater insight into DSB's intentions and purposes in the co-operation with the municipality

Appx.1.1.2 The reason behind the interview strategy

Since we have decided to operate with Kvale as our primary source in the understanding of interviews, as such we are aware of his focus on the lifeworld. However, this can smoothly be utilized with our interviews, since these can be categorized as elite interviews. Kvale argues as such,"*Eliteinterview er med personer, der er ledere eller eksperter, og som sædvanligvis beklæder magtfulde stillinger"* (Kvale, 2009, p. 167). In relation to our interviewees in DSB and the municipality, these can also be categorized as elite interviews, since they can be regarded as the most qualified (read: experts) in the application of a bicycle sharing system.
As such, when choosing to perform an elite interview, it is methodologically important to master the technical terminology and be aware of their social situation. This will more or less ensure power symmetry in the specific interview situation (Kvale, 2009, p. 167). Thus, we

have worked constructively to acquaint ourselves with the interviewees' field of work, enabling ourselves to ask precise and relevant questions.

Appx.1.1.3 Considerations on the execution of the interviews

The purpose with performing qualitative interviews in our project is hence to gain a professional view on the implementation of the bicycle sharing system. In the book "*Teknikker i Samfundsvidenskaberne*", the author distinguishes between a probing and an in-depth interview, which can be applied separately and in combination (Kristensen, 2007, p. 282). A probing interview seeks information regarding a subject with scarce information, while the in-depth looks for detailed information within a specific subject. We wish to achieve a combination of the two in our project, since the interviewees both have practical and professional experience in the field of bicycle sharing systems.

Our interview form is semi-structured, firstly, since the interview guide features themes for the interview, and secondly, as there concurrently is openness for the interviewee to sheer the conversation in a direction that suites both their interest and their knowledge (Kristensen, 2007, p. 283). This means that our interviews are free of an otherwise narrow and limited scope, giving the freedom for questions and answers to be versatile in their own manner. As such we might gain productive results, which might have been lost otherwise. In relation to this, it is relevant to mention that we had one primary interviewer and 2-3 observing interviewers, which stood for additional and clarifying questions during the interviews.

Appx.1.1.4 Practical execution and processing of the interviews

The interviews themselves were done with a both a laptop and a smart phone functioning as a dictaphone, which provided room for us to focus on the subject and the drive in the conversation (Kvale, 2009, p. 201). We chose to employ two recording apparatus, in order to ensure at least one recording with proper quality. Kvale argues in proportion to the transcription itself: "*Selv om der ikke er nogen universal form eller kode for transskription af forskningsinterview, er der nogle standard valg, der bør træffes*" (Kvale, 2009, p. 203).

As such, we have chosen only to transcribe the excerpts which appear throughout the project. In addition, thirty seconds before and after the excerpt will be transcribed. This is done in order to ensure full understanding of the context which the excerpt appears in. Yet, if it is relevant for the understanding, a longer transcription might be the case. The transcriptions will therefore be appended as appendix 2. The interviews themselves will furthermore be appended as sound files on cd's as appendix 3.

The two interviews have a length between 50-65 minutes. The interviews are all done in locations preferred by the interviewees. As an example, the interview with Jens Lerager was done in a meeting room at DSBs Main Office on Sølvgade.

The analysis method is Kvale's meaning condensation (Danish: *meningskondensering)*. This means that after the interview the recording has been listened to and essential comments have been noted. This ensured easy access to the main points (Kvale, 2009, p. 227-228). In the processing of our interviews, after an excerpt has been written, at least two group members have listened to the same excerpt, in order to check for any irregularities. If this has been the case, the same piece has been transcribed twice followed by a comparison (Kvale, 2009, p. 206).

Appx.1.1.5 Critical Reflection

There are a number of critique points in our interviews which are important to be mindful of. We note that all the points of criticism revolve around the practical execution.

Our interview with Morten Heegard has a number of critical points to mention. Firstly, the interview was interrupted a few times, thereby disrupting the focus on the conversation for brief moments. This was caused by the fact that the interviewer was necessitated to leave in the middle of the conversation because of external obligations, thereby causing a switch in interviewer. An observing interviewer also arrived late in the interview, which might have caused another disruption in focus. Secondly, after evaluating on the interview, we believe that we should have been better at asking more probing questions and remain more independent of the interview guide. It is our impression that the interviews' placement in the early phases of our project might have been one of the reasons for this, when keeping in mind, that we evolved and learned more about the field of study throughout the process. Also, the change of interviewer is also believed to have a play in this. Overall it can be said, that the interview with Morten Heegaard should have been planned better, thereby eliminating the sudden switch of interviewer during the interview and giving us a better idea of the areas to prepare in.

The interview with Jens Lerager was delayed quite a while because of problems with finding a suitable meeting room. This might have had an impact on possible stress factors in our interviewee. It came to our knowledge during the interview, that Lerager had a meeting immediately after the planned time span, and this might have been a stressing factor when considering a delay of up to thirty minutes.

Appx.1.1.6 Interview Guide - Morten Heegaard

Guiding questions	Relevance	Phantom answer
Kan du kort ridse nogle af de udfordringer op du ser ved implementeringen af bycyklen i København henvendt til pendlerne?	This was to get an understanding of what challenges the municipality itself had considered.	That the use of the bicycle in Copenhagen was already widespread contrary to other major cities with a BSS along with economical problems.
Kan i (og vil i) trække nogle erfaringer fra det nuværende bycykelsystem?	At that point we were still considering if we would include a description of the current BSS, as such, getting the municipality's opinion on this matter was of relevance.	They would indeed build upon the current and foreign ones.
Hvordan arbejder i videre med vinderforslagene fra design konkurrencen?	This was both to get a impression of the contests importance, and get an understanding of its influence.	Only as inspiration.
Hvordan påvirker det et bycykelsystem når det skal være rettet imod pendleren? Hvordan ville det adskille sig fra et almindeligt bycykel system. Og hvilke krav og forventninger kan pendlere have til en bycykel?	We sought to understand what the municipality identified as the needs of the commuter and how they were planning to design the commuter bicycle in order to meet these needs.	It should be easy to use, accessible, not too costly, and above all be well implemented with the rest of the public transportation system.
Hvad gør TMF for at kunne lokke flere pendlere til det kollektive transportsystem/et kommende bycykelsystem? Og hvad bidrager bycyklen med som et ekstra led i det kollektive? Ville det kunne trække bilister over?	The goal was here to probe further on the previous question, and get an idea of the municipality's ambitions with the commuter bicycle. Would it strengthen the collective transport system and how?	That the bicycle could provide flexible access for areas previously hard to get to from train stations, thereby giving an alternative for some motorists.
Undersøgelser viser, at flere tager cyklen mellem bopæl og station end mellem station og destination. Mener du at	An in-depth question meant to get the municipality's opinion on the matter. A very basic question in accordance	Yes it possibly could.

bycyklen kan være med at til at ændre dette?	with our analysis.	
Hvorfor er der i øjeblikket kun et samarbejde mellem kommunen og DSB, og ikke de andre trafikselskaber? Kunne dette være med til at skabe interessekonflikter?	Conflict of interest was a subject that might have had a larger presence in the project - in that case, this would have been an essential question.	That Movia and Metroselskabet were not interested in a co-operation. And that the municipality did not deem it as decisive for the project.
Er det et problem for bycyklens succes, at ejerskabet af en almindelig cykel er så udbredt som det er i København – Vil pendlere have lyst til at bruge den? Og hvordan ville københavnere som ikke bruger bycyklen, reagere på at der fremkommer en ny "konkurrent" om cykelpladsen?	Taking the current inhabitants and their formidable use of privately-owned bicycles into consideration was essential for our findings throughout the analysis and discussion.	There would probably be some protests, but there is a challenge in itself to implement docking stations without "stealing" space.
Tages stationsnærhedsprincippet til overvejelse?	To probe and see if they had considered an increase in station catchment area.	Some areas had better coverage than others, this would be in their considerations.
Cykelsekretariatet har flere cykelprojekter tilknyttet. Er der nogen form for samspil mellem disse?	Would the implementation of a BSS co-work or be supplemented with other bicycle projects.	That it would be beneficial for their whole purpose but a small problem exists with different timelines.
Har i nogen erfaringer omkring hvad det er der motiverer folk til at cykle ? Har du nogen mening om hvordan man eventuelt ville kunne motivere forskellige målgrupper til at bruge bycyklen som en pendlercykel ?	Relevant in the design and physical implementation of the BSS along with the pleasing of the commuters' needs.	Since the bicycle secretariat's purpose was to work with bicycles, we expected to hear about possible different motivational factors to attract commuters to the (commuter) bicycle.

Appx.1.1.7 Interview Guide - Jens Lerager

Guiding questions	**Relevance**	**Phantom answer**

Hvad er DBSs interesse i at beskæftige sig med et projekt som dette?	Relevant in understanding their background and motivation with the project.	The possibility to gain more market-share in regards of commuters.
Kan du forklare hvorledes bycykel samarbejdet mellem DSB og Københavns Kommune er bygget op, og hvordan det er forløbet indtil nu? Og hvad er status-quo?	There was scarce information regarding the state of negotiations along with the status of the project.	That it was a mutually beneficial partnership, but with different intentions, and that they weren't far in the proces.
Hvorfor er der i øjeblikket kun et samarbejde mellem kommunen og DSB, og ikke de andre trafikselskaber? Og hvor meget ansvar har DSB - kunne der være interesse for inddragelsen af flere aktører?	To know how much DSB actually might influence the outcome of the project. And if they are willing to share this influence.	The other transport companies weren't interested in the project as much as DSB. Although this didn't mean that it couldn't be of an interest when regarding implementation.
Har i nogle planer om hvordan bycyklen skal integreres, fungere og bidrage som et ekstra led i det kollektive transportsystem? Har i desuden lavet nogle omkring den mere tekniske del?	To get an idea of what DSB's thoughts are on physical implementaion, docking stations etc.	That docking stations should be a part of the train stations in Copenhagen and possibly large destinations (workplaces etc.), but that the technical aspect still was open to discussion.
Hvem tænker i på som mulige målgrupper til det nye bycykelsystem?	This question was basicly to verify that DSB was interested in commuters.	Commuters and possibly members of their different costumer services.
Hvilke krav og forventninger kan pendlere have til en pendlercykel? Og kan du kort ridse nogle af de udfordringer op du her ser ved implementeringen af bycyklen i København?	To understand which of the commuters' preferences DSB saw as a priority, and thereby what the challenges might be.	The cost would have high expectations but also be a challenge. Implementation would not be cheap, but using the bicycle should.
Har DSB planer om at lave nogle Mobility Management projekter (el. lign. kampagner mm.) for at understøtte implementeringen af bycyklen? Hvilke typer pendlere vil det i så tilfælde være rettet imod? Og hvilke	This question seeks to provide an impression of DSB's ambitions with the project, while simultaneously looking for the possibility of supporting initiatives.	That they indeed would combine the commuter bicycle with commercial campaigns and other customer benefits. Of course then targeted at their own customers and possible new ones.

faktorer vil i spille på?		
Hvilke projekter og erfaringer vil i trække på fra jeres pendlercykel projekter?	The question seeks to clarify which past efforts might be relevant for the coming BSS, and which specific factors can contribute.	This question would essentially start a discussion of the various projects, giving us the chance to probe into specific experiences.
Undersøgelser viser, at flere tager cyklen mellem bopæl og station end mellem station og destination. Mener du at bycyklen kan være med at til at ændre dette?	An in-depth question meant to get DSB's opinion on the matter. A very basic question in accordance with our analysis.	The commuter bike would essentially mean that the start and the end of the trip could be done by bicycling, first with a private bicycle, afterwards with the commuter one.
Er det et problem for bycyklens succes, at ejerskabet af en almindelig cykel er så udbredt som det er i København? Og hvordan ville københavnere som ikke bruger bycyklen, reagere på at der fremkommer en ny "konkurrent" om cykelpladsen? Hvordan vil i trække disse cyklister til bycyklen?	Taking the current inhabitants and their formidable use of privately-owned bicycles into consideration was essential for our findings throughout the analysis and discussion.	Possibly a challenge, but the issue of space would depend on the docking stations. Still there are many commuters coming from outside Copenhagen whom might need a bicycle at the end station, and some Copenhageners only take their own bicycle at the access trip.

Appx.1.2 Empirical Data

This section will cover the methodological reflections and choices made for the empirical data. We will therefore touch on the basis of the physical implementation - which will be part of the analysis - how it was made possible and possible critique points for its validity. Furthermore we will give reasons for the inclusion of the secondary data , the sources and how it plays a vital role in the project.

Appx.1.2.1 Physical Implemenation

In the first phase of the visual analysis, we chose to manually draw in all the transit lines in and around the central municipalities – including the Metro Cityring, but excluding the bus lines – in order to show how the different stations connect, and to provide a greater understanding of the network as a whole. Confer the legend in the specific maps for the different meanings.

The analysis of the physical implementations goal is to argue and illustrate an actual implementation of the bicycle sharing system in Copenhagen. We will take advantage of the latest versions of the photo editing tools *Paint.NET* & *Microsoft Office Picture Manager* plus a plan map in order to analyze the Copenhagen transport networks' coverage and how this can be augmented by the integration of the BSS.

This will be done through a range of steps, starting from point one, ending at point six, thereby ensuring the reader a full understanding of how a potentially future BSS will function with the transport network. Each step will include a rundown of the information on the map, a description of the changes and what we can draw out from the specific map.

Because of the way the original plan map was integrated onto the Municipality's website, we had to manually take screenshots with "pieces" of the map, and then afterwards connect these pieces similar to a puzzle, in order to have a complete map of Copenhagen. The plan map includes a scale on the bottom left and a copyright on the bottom right - these are also pieces taken from the original image and thereafter placed into their rightful spot. A legend is also included which is self-made. Although it is based on the legend from the original map. All the other maps have basis on the plan map and are edited by us, thus a non-existing Municipality copyright icon.

Regarding the validity of the visual analysis, there are a number of points which should be taken into consideration. The "re-assembling" of the plan map was not done automatically. This means we had to manually align the pictures so they would create the final map you see in the project. The naked eye has its constraints, and so there is a small chance that some pieces of the puzzle might have been placed inaccurately up to a millimetre.

When calculating the size of the 1800 metres catchment area, we had to manually take the original 600 metre catchment area (which the Municipality of Copenhagen already had included), and make them three times their size. Without getting into unnecessary detailed descriptions, we had to place multiple 600 metre catchment areas alongside each other, in order to find the proper size. Given the tools used for the analysis, this could only be done manually and therefore might have caused a small measurement error.

Reflecting on these two small measurement issues, we believe that it does barely have any perceptible effect on the final result. Possible errors would only cause millimetres of change on the map. As such, when keeping in mind that the maps are only meant as a representation and not an exact visual replication of the transport networks' coverage, we judge that the validity of the visual analysis is in fact intact.

Appx.1.2.2 Commuter numbers, travel patterns and effects of station proximity

In order to estimate the potential amount of users for the bicycle sharing system, we applied data from the Danish National Travel Survey (DA: TU / transportvaneundersøgelsen) which is carried out by DTU Transport. The survey maps the Danish population's travel behaviour, and therefore includes information needed to fulfil our calculation. These information includes: Amount of commuters that commute to Copenhagen, the market-share of public transport in relation to station proximity, and travel patterns of access trips and egress trips of stations. We find TU as an reliable source as all the reports regarding travel patterns and commuter amounts we have encountered during our research heavily rely on TU data. However specific data limited to the geographical area of our calculation (central municipalities) are not processed in the reports we were in possession of, therefore we sent a request to DTU Transport regarding these datas. As the survey is based on more than 230.000 individual questionnaire surveys and therefore very complex, specific data must be pulled out manually by the staff of DTU Transport. As we were not willing to pay for such a data-pull (DKK 5.000 – 10.000), the request could not be handled within the limited time. Therefore we relied on data that were handled in published reports which in many cases covers a larger geographical area then we intended.

For the purpose of estimating the potential amount of users among the public transport, we needed a figure of amount of commuters arriving by train to the central municipalities. Data we rely on here is the passenger amount taken from Østtælling 2008 (DSB 2008b) – DSB's annual count of passenger traffic east of the Great Belt. The passenger counting is executed once a year on all of DSB's stations on the second Thursday of november. Passengers received a "counting card" at the beginning of a trip at a DSB station, and hands it in when they arrive to the final DSB station of their one way trip, hereby taking transit into consideration. As the main report of Østtælling available from DSB's homepage only reveals the summarized results, more detailed information is needed to determine the amount of commuters. A more specific account of passengers arriving to stations – which is the appendix 3 of the report (DSB, 2008a) - was provided to us by Jens Lerager. In this document, a very detailed account of amount of passengers departing and arriving at each DSB station (distinguishing between

S-train stations and regional train stations). The counting of passenger is divided into 42 intervals during the 24 hour count; hours between 6 - 10 a.m. And 2 – 7 p.m. are diveded into intervels of 20 minutes each, while others are counted hourly. As we wanted to identify the amount of commuters arriving by train to the central municipalities - with guidance of Jens Lerager - we aimed our focus on those passengers arriving between 7 – 9 a.m. assuming that the majority of these passengers are commuters as the intensified traffic is identified as morning rush hour by DSB. We selected 32 DSB stations within the border of central municipalities (note that stations as Østerport are divided between a S-train station and a regional train station), and added up the passengers arriving within the 2 hour morning rush hour interval from all these stations. We also counted passengers arriving in the interval 6 – 10 a.m. To give a apparent picture of the intensification of traffic during the morning rush hour.

Appendix 2 – Transcription

The following is an overview of the transcription structure and the transcriptions of the relevant parts of the two interviews carried out during the project.

Appx. 2.1 Structure

All transcriptions are divided into subsections under their corresponding interviewees. These are placed in an alphabetical order. Every interview reference or quotation is identifiable by the applied reference throughout the project, and the order is dependent on when it appears in the interview. This means, if for instance a part of the interview with Jens Lerager is referenced to 03:15 minutes, the transcription will appear at the top, here in the subsection Jens Lerager. In accordance to the earlier described methodological choices, thirty seconds before and after the reference will be transcribed. This only functions as a principle, since the transcription also depends on what occurs throughout the interview. As such, if the conversation steers into another direction only fifteen seconds after the referenced part, what follows will not be transcribed as it has no relevance for the context.

Finally, dependent on which user platform used (PC, Mac etc.); the referenced minutes can be inaccurate with up to 8-10 seconds. Throughout the project we used a PC with Windows 7 operative system and Windows Media Player 12 to place the time. Consequently, there should not appear any problems if the same platform is used.

Appx. 2.2 Interviewees

Appx. 2.2.1 Jens Lerager

Jens Lerager, 03:15 (Appx. 3, 00:02:51 - 00:03:45)

JE: Jeg er fuldmægtig ansat, og så er jeg analytiker, hedder min titel herinde.

PE: Analytiker, er det noget specifikt eller?

JE: Det startede med at jeg lavede passeger-flows analyser og projektledelse for vores passager-tællinger, indtil 2008, så tog jeg over til Spanien og lavede lidt småting dernede fra, og kom så tilbage og arbejder nu primært med det vi kalder for tilbringer strategi, det vil sige cykel-parkering, bil-parkering, pendlercykler, korrespondance med bus-tider og den slags tid, i en afdeling som blev oprettet sidste år omkring juletid, ja omkring et års tid siden, under Lone Billehøj, hedder min chef, og den afdeling beskæftiger sig i høj grad med alt andet end tog sådan set, hvad der foregår fra stationsbygningens mursten også ud, det vil sige vi giver også input til lokalplaner og den slags ting.

PE: Okay.

Jens Lerager, 04:15 (Appx. 3, 00:03:45 – 00:04:55)

JE: Hvis der er nogen som siger at "vi vil gerne lave en parkeringsplads her", så siger vi "nej", så skal I lave noget højt byggeri, der ligger en station.

PE: Jeg spørger bare lige hurtigt, hvad var grunden til at de først laver det nu, i stedet for..

JE: Det har ligget i andre afdelinger tidligere, S-tog har haft sin egen selvstændig analyse og planlægnings afdeling hvor jeg egentlig kommer fra, som i forbindelse med en organisationsændring blevet lagt over i *planlægning og miljø*, hvor vi sidder nu, og så blev der herefter oprettet en afdeling, som hedder *planlægning og information*, tror jeg det hedder, det bliver hele tiden lavet om.

PE: Det er det der med at holde styr på de der navne. Nå men, Jens, hvad er jeres interesse i at beskæftige med et projekt som dette?

JE: Det er flere kunder, det er helt oplagt, det der er med toge det er, i sig selv er det fra station til station, med et pendlercykel projekt kan vi i højere grad gør den kollektive fra dør til dør, og noget af det som er vores øvelse det er.. vi har sådan et overskrift i min afdeling som jeg arbejder med, stort set alle projekter vi arbejder med, som vi kalder for *den grønne rejsekæde*, som handler om at se rejsen som et samlet stykke, fra du træder ud af din dør, eller i virkeligheden fra før du begynder at planlægge din rejse derhjemme, og så til du er ved dit mål, og så kalder vi det *den grønne* fordi det er sådan vi markedsfører os i DSB.

Jens Lerager, 11:50 (Appx. 3, 00:11:23 - 00:12:50)

JE: I vores øjne er det i hvert fald transport, og det er vores gebet på en eller anden måde. (**PE:** Okay.) Vi har så fået et overblik nogenlunde over det, og er begyndt at stable forslag til hvordan vi kan organiserer det, "hvem skal eje det?", "hvem skal udvikle det?", "hvem skal markedsfører det?" og "hvem skal drift det?" osv.

PE: Så I forhandler også lidt, man sige, I er vel interesseret i at eje det på en eller anden måde, et eller andet punkt?

JE: DSB er interesseret i at eje udviklingen af det, markedsføringsrettighederne, det man kalder for *intellectual property rights*, IPR, det vil sige idéen, konceptet vil vi gerne eje, fordi vi har meget stor interesse i og koble det her sammen med vores.. vi har sådan nogle forskellige loyalitets programmer, *S-more*, *+more* og *workmore* og sådan noget hedder de, og koble sammen på pendlernes mådenskort, som måske giver rabat hvis man har et pendlerkort, så derfor er vi interesseret i at eje det, og ikke i at drive det, altså flytte rundt på cyklerne, lappe og sådan nogle ting, det er sådan set ikke vores del, det er vi ikke særlig gode til. Men det har vi så et forslag til nu, som stadig er på skitse, som vi så præsenterer til Københavns Kommune og Frederiksberg Kommune, de har været med til at udvikle det i øvrigt, det er ikke sådan at vi kommer med.. og det gør vi så i eftermiddag, og så skal de selvfølgelig, deres embedsmænd skal så sige, "jamen er det her interesant eller er det ikke interesant", der skal sikkert rettelser til kunne jeg forstille mig, og så præsentere de det for deres politiker som så skal nikke til det..

Jens Lerager 14:00, 14:30, 14:50 (Appx. 3, 00:13:40 – 00:15:28)

(part 1: 00:13:40 – 00:14:44)

PE: Så selve projektet i det hele taget, når det kommer over et vis beløb, så skal man så til [red: udbud]

JE: Ja, det er ikke engang mange penge, det er to komma.. to komma et eller andet millioner, hvis man laver indkøb over det i hele projektets løbetid, så skal det i EU-udbud hvis man er DSB i hvert fald. (**PE:** Okay) Og det er det selvfølgelig over, fordi vi taler omtrent, Frederiksberg og Københavns kommuner taler på nuværende tidspunkt 5.000 cykler, så alene det, så er der alle mulige betalingsstandere, og udvikling og så videre, så det løber over 2 millioner med det samme.

PE: Det bliver i hvert fald ikke noget problem, kunne I have.. hvis man nu siger at det kun er Frederiksberg Kommune, Københavns Kommune og jer, kunne I have en interesse i at have nogle andre trafikselskaber med som..

JE: Både Movia og Metro.. som det er nu, de her 5.000 cykler som vi arbejder med som udgangspunkt, de er dels fordelt på S-tog stationer, eller på tog stationer i det hele taget, på metro stationer, og så tror jeg vi arbejder som udgangspunkt med 10 kun-bus knudepunkter, hvor der er mange busser, men ikke.. hverken metro eller s-tog.

(part 2: 00:14:44 – 00:15:28)

PE: Ja, okay, så Movia og Metroselskabet er også inddraget?

JE: De er sådan set ikke inddraget endnu i planlægningen indtil videre, men tanken er at vi danner et aktieselskab, som hedder "Pendlercyklen" eller "Bycyklen" eller hvad det nu skal hedde, hvor der så er forskellige aktører som køber sig ind i, blandt andet kommunerne, blandt andet DSB, dvs. det bliver et aktieselskab under DSB, men DSB skal også købe sig ind i det, fordi vi sælger det til kommunerne, vi sælger det til DSB, vi sælger det til S-tog som er et selvstændig ejet selskab, vi sælger det til Movia og til Metro, så det er alle som kommer til at have disse cykler stående, køber sig ind i det her aktieselskab, det er sådan konstruktionen er, og så er det så DSB der ejer aktieselskabet.

Jens Lerager, 17:20 (Appx. 3, 00:16:30 – 00:17:48)

PE: I har i hvert fald en hel del midlertidig planer for det skal implementeres.

JE: Ja ja, og jo flere der ville lege med jo bedre.

PE: Ja, selvfølgelig. Jeg tænker på jeres pendlerkort og sådan noget, altså der kommer jo det her elektroniske pendlersystem snart.

JE: Rejsekortet?

PE: Rejsekortet, lige præcis, det er mig som ikke er så god til navne.

JE: Det halter også lidt med rejsekortet. Rejsekortet har været undervejs rigtig længe..

PE: Kunne I finde på at integrerer det med bycykel systemet?

JE: Ja, det vil være helt oplagt at gøre, jeg kan forstille mig at bycykel systemet kommer op at køre før Rejsekortet.. (**Alle** griner) Men nej det kan det sagtens være, Rejsekortet har haft rigtig mange problemer..

PE: Men det er noget med forhandlinger?

JE: Ja.. det er nogle tekniske ting, hvordan man kan lave data-udtræk, der er alt alt muligt som skal falde på plads, det er ikke noget jeg arbejder med overhovedet, men der er alle mulige former for ting der har været problemer med, jeg ved ikke hvordan status er lige nu, men det er ikke sådan noget som er lige om hjørnet. Og vi skulle gerne være i stand til at udrulle bycykel projektet her per januar 2013, og der er i hvert fald ikke en fuld udrullet Rejsekort til den tid, det tror jeg ikke.

Jens Lerager, 20:50 (Appx. 3, 00:20:26 – 00:21:04)

LU: Og det inkluderer også docking stationer? Eller ej?

JE: Eh.. der findes jo forskellige systemer, Deutsche Bahn har et som fungere stort set uden docking stationer, eller kan fungere uden docking stationer hvor cyklen en kæde.. (**PE** & **LU:** Ja.) I kender den? Okay, alle tiders, det er bestemt en mulighed, og så er der også nogen med docking stationer, Deutsche Bahns kan også fungere som kombi så vidt jeg forstår..

PE: Men altså det lyder som om at I i hvert fald er fastsat på at der skal være docking stationer? Altså..

JE: Nej.. problemet med docking stationer er at de optager byrum, for det første, og de kan også være dyre at etablere. Nej vi har ikke.. den tekniske løsning har vi ikke nogen fast beslutning om endnu.. så

Jens Lerager, 21:10 (Appx. 3, 00:21:04 – 00:22:40)

PE: Gælder det også antal cykler og sådan noget? Er det noget I har.. . er I fastsat på de der 5.000?

JE: Em.. de 5.000 arbejder vi med som vores business case, altså vores forsøg på at regne kan det her betale sig eller kan det her ikke betale sig, og hvor meget kommer det her til at koste os, så kan vi så hente pengene ind på nogle andre måder forhåbentligvis, gennem flere kunder og så videre (grin), og der arbejder vi med 5.000, og det er ud fra.. det er i høj grad nogle slag på tasken, fordi et af vores problemer har været at.. selve teknikken, selve cyklerne har du, software og sådan noget, det fungere alle mulige andre steder i alle mulige andre lande osv., det kan vi sådan set hugge, låne, eller købe.. det behøver vi ikke at teste så meget på forhånd, noget af det vi ikke ved så meget om, det er bruger vaner, altså hvordan vil man bruge dem? Og det er nok svært tænker vi at overføre fra andre lande fordi Danmark er sådan lidt cykel specielt, alene det.. københavn er særlig cykel specielt. Infrastrukturen er bedre, alle folk har en cykel i forvejen, i hvert fald i den ene led af deres rejser, og derfor er det måske ikke oplagt at hente erfaringer fra Washington eller fra London, men man kan måske hente fra Utrecht eller andre steder i Holland kunne måske være.. det sidder vi også og kigger på og sådan noget, med derfra til, at kunne sige hvor mange vil egentlig bruge de her cykler? Og hvor mange gider at have dem? Hvor mange gange vil den køre om dagen? Vil de dele dem? Vi inviterer også virksomheder til at være med, så de kan få en docking station eller en stand, hvad det nu bliver, ved deres hovedkvarter, eller hvad det nu er.. og så bliver cyklen brugt to gange per dag og ikke kun en gang.. så der er meget stor uvished omkring brugen af cyklerne.

Jens Lerager, 23:00 (Appx. 3, 00:22:40 – 00:23:49)

PE: Kan det være et problem for jer sådan rent økonomisk, hvis man tager den fra stationen og så tager man den til arbejdspladsen, og så holder den der indtil man skal hjem igen?

JE: Nej, for det er sådan set den løsning vi arbejder på nu, som vores grundløsning, og det skal kunne løbe nogenlunde rundt..

PE: Så det kan betale sig..

JE: Det er den model vi regner med, og så siger vi okay, så må det koste det som det vil koste med den model, så hvis cyklerne.. jo hyppigere cyklerne bliver brugt, afhængig af hvordan betalingsformen er, jo bedre for os, Men hvis.. det kommer også an på.. hvis du betaler et månedlig abonnement der hedder 200 kr. eller et eller andet, og du så har rådighed over cyklen når som helst du vil, jamen så gøre det ikke nogen forskel. Men hvis man laver en kombi-løsning, hvor nogen betaler 200 kr., hvor andre betaler med kreditkort, betaler en 20'er for at låne den i 2 timer eller lign., så er det pludselig interesant hvis den begynder at køre flere gange, bliver stillet og bliver brugt af en anden osv. De her 5.000 cykler vi arbejder med som udgangspunkt, det er sådan, det er baseret på at det er en reel pendlercykel mere end en bycykel, altså en pendlercykel hvor man tager cyklen fra stationen, kører den på arbejdet, lade den stå, og kører den hjem igen.

(00:23:49 – 00:24:23)

LU: Og det er sådan set oplagt?

JE: Det er det der er vores.. for det første er det.. pendlercykelen er fed hvis den kan fungere som bycykel også, fordi så kan man bruge den til så meget mere, og det giver en ekstra funktionalitet, og det giver grobund for at have flere cykler i omløbet i virkeligheden, men vores primære interesse er naturligvis at servicerer pendlerne, fordi det er dem der er vores kunder, og det er det med at gøre det kollektive lækre og det er det vi kommer til at tjene penge på, hvis vi kommer til at tjene nogen. Og det er ikke så meget på at der kommer en turist til at køre til det kongelige teater eller noget andet.

Jens Lerager, 25:25 (Appx. 3, 00:24:56 – 00:26:04)

JE: [red: mht. pris per bycykel] Ja, altså, 20.000 – 30.000 kroner.. der er rigtig rigtig mange bud på hvad forskellige ting koster, jeg tror 20.000 – 30.000 der er fra London projektet kunne jeg forstille mig, som er ret dyrt, men jo flere.. den primær indtægtskilde for DSB.. eller for en pendlercykel, det er egentlig ikke den enkelte tur, det er ikke ad-hoc brugeren, det er dels flere kunder i butikken, dels det her månedlig abonnementsbeløb som er uafhængig af hvor mange gange du bruger cyklen i løbet af dagen. Og så er der også noget med hvordan man internt, mellem trafikselskaberne beregner hvor mange penge man hver især tildeler, man har jo fælles takst system i hovedstadsområdet, så alle billetpenge bliver samlet i en stor pulje, og så bliver det delt ud bagefter, og hvis folk de vælger at køre med cykel til stationen, eller fra stationen, altså ikke køre med bus eller metro, så får DSB en større del.. så får DSB flere penge for den rejse end hvis man tager bussen først også hopper over på toget. Hvorfor det ved jeg ikke.

Jens Lerager, 27:20 (Appx. 3, 00:26:41 – 00:28:08)

JE: Der er også indtænkt opstillinger eller cykler til docking-stationer eller hvordan man nu vælger den tekniske løsning, som er på steder hvor der ikke er kollektiv trafik, som er sådan et typisk turist sted. Så tanken er egentlig at lave bycykel og pendlercykel i samme system, og så justerer på betalingssystemet, så en turist betaler med sit kreditkort, og en pendler med sit abonnementskort.

LU: Men kunne det så betyde.. det at cyklen måske bliver væk i 8 timer, eller hvad det nu er, og bliver brugt 2 gange, kunne det så betyde at man får nogle cykler der måske ikke er så fancy som dem man har andre steder henne, som rent teknologisk..

JE: Ja ja, altså jo mindre cyklen bliver.. jo færre gange, jo mindre indtjening der er på cyklen per dag, og det afhænger jo typisk af antal ture, jo dårligere må cyklen per definition altså blive, fordi det koster at få lavet en ordentlig cykel, så ja, selvfølgelig, det er afhængig af det.

PE: Har I arbejdet med hvilken krav og forventinger en pendler kan have til sådan en bycykel?

JE: Ja.. Vi har prøvet at hente så meget viden ind som vi nu kan fra de eksisterende løsninger og hvad der har været af tidligere projekter, der har ikke været så forfærdeligt meget i danmark. Vi planlægger at lave sådan en.. men det er i virkeligheden ikke så meget hvilke krav og hvilke ønsker, det er mere i virkeligheden "hvor mange gider at bruge det her?", planlægger vi at lave en interview-undersøgelse, spørgeskema-undersøgelse som foregår i toget, om morgen på vej til København [...]

Jens Lerager, 30:00 (Appx. 3, 00:29:40 – 00:31:10)

JE: [mht. bycykel systemet] Rent teknisk, er jeg sådan rimelig fortrystningsfuld, men vi er selvfølgelig heller ikke nået til det endnu, men de problemer er ikke begyndt at komme up til overfladen endnu, rent teknisk, er jeg sådan relativ fortrystningsfuld, fordi de her systemer findes rundt omkring, og fungerer. Så er der sådan noget, helt grundlæggende som bygningsplads, at de arealer, der hvor det er interesant at have bycykler, en udlejningscykel eller en bycykel stående, i relation til stationerne, det er meget meget tæt på perronen, i virkeligheden, folk gider ikke at gå, de gider ikke at gå først den ene vej op af en trappe og så op på en cykel, og så køre den retning de egentlig skulle. Det gælder om at have det tæt på, og de arealer der er der, de er interessante på alle mulige måder, de er interessante til cykler, vores type og til cykel-parkering, de er interessante til butikker fordi der kommer mange mennesker forbi og den slags ting, så rum i virkeligheden, alene til at opstille det her (bycykel system) kan være en mangelvare.

PE: Men det er DSB der ejer stationsforpladserne rundt omkring i København, er det ikke?

JE: Der er rigtig mange forskellige løsninger på det, nogle steder er det Bane Danmark som ejer det, rigtig mange steder er det kommunerne som ejer det, og nogle steder er det DSB, og indenfor DSB er det så i øvrigt, der er DSB hovedbutikken, som så har en række underselskaber, blandt andet S-tog som er et selvstændig selskab. Og DSB Ejendom, som forvalter vores ejendomme, og så er der nogle som hedder DSBs ejendomsudvikling, som står for at frasælge en række grunde som man tidligere har brugt til jernbane driften som ikke længere er interesant til jernbane driften men så er interesant til at bygge butikker eller hvad ved jeg på. Så der er rigtig mange aktører ind over.

Jens Lerager, 32:00 (Appx. 3, 00:31:31 – 00:33:11)

DA: Nu nævnte du 5.000 cykler, har I tal på hvor mange docking-stationer der så skal være? for at kunne..

JE: Nej, det har vi.. jo, jeg tror vi arbejder med 20 cykler per docking-station, som udgangspunkt. Men som sagt igen, den tekniske løsning ligger ikke fast, men med det koncept vi arbejder med indtil videre, hvis primær rolle ikke er at finde den tekniske løsning, men hvis primær rolle er at finde et bud på hvad kommer det her til at koste, der arbejder vi med enheder af 20 cykler, og typisk 20 cykler på en station, og så er der selvfølgelig en række stationer som måske skal have to eller tre enheder, enten hvis man skal både fra den ene og den anden side, Flintholm station er et typisk eksempel, der både på Frederiksberg og København siden vil være et behov, eller ved bare en stor station med mange der går igennem, så skal der være flere cykler. Ja.

PE: Så I tager klart udgangspunkt i hvor mange passager der går igennem stationen med hensyn til cykel..

JE: Ja, det er.. og så er der nogle andre ting, vi tror for eksempel ikke på at Nørreport bliver aktuelt, dels fordi at omkring Nørreport der er det kollektive så.. det er så, simpelthen så tætmaskede allerede så, du hopper ikke bare af på Nørreport, og hopper over på en cykel og cykler herover for eksempel, fordi så kan man lige så godt bare gå eller.. den smut tid du har vundet ved at.. den tid det tager ved at gå op, tage en cykel og låse den op, den er ikke vundet ved den korte afstand der er mellem stationen hertil, Østerport ligger lige herovre, Vesterport lige den anden retning, så i virkeligheden er det helt tæt, så er det måske ikke interesant at have en.. i hvert fald ikke en pendlercykel, så kan det være at der skal stå en bycykel op af én af sidegaderne hvor pladsen ikke er så træng. Det er den ene ting, og så er der alle mulige andre ting der er interessante at bruge pladsen på Nørreport.

Jens Lerager, 46:18 (Appx. 3, 00:44:34 – 00:46:40)

JE: Jeg tror på at cyklen kan fange nogle som bussen ikke fanger, mængden, det er svært at.. vi arbejder også med at der sker en eller anden overflytning, måske særligt mellem København og Frederiksberg, fordi herinde er det bøvlede med bil. Så hvis cyklen rent faktisk er en nogenlunde, cykel og tog, fordi det er ikke nok at cyklen er god, fordi tog-produktet skal altså også fungerer, hvis du ikke kan komme ind til din cykel, så er det jo ligemeget om.. så hvis den kombination er god nok, så tror jeg på at der kan ske en reel overflytning. Men begge dele skal fungerer, og den skal fungerer derudefra hvor billister kommer, med den skal også fungerer inden de hopper over på cyklen. Så, jo det tror jeg godt, der er også nogen der taler om at cyklen faktisk er, der er nogen der foretrækker cyklen frem for bus eller.. at bilister typisk foretrækker cyklen frem for bussen fordi den er et privat transportmiddel og ikke et kollektivt transportmiddel. Men det er sådan noget jeg høre.. det er bare sådan noget man går rundt og snakker om, på cykel-konferrencer (**Alle** griner).

PE: Man kan måske også sige at kollektive transport er et kollektiv svar på individuelle behov, er det ikke noget som bycyklen så kan dække? Altså det her individuelle behov, man bestemmer simpelthen selv..

JE: Jo til dels, noget af det, men du er stadig tvunget til at sidde ved en eller anden som hoster og har våd jakke på i en kold vintermorgen, der er nogle ulemper med det kollektive, som cyklen ikke.. som etableringen af cyklen ikke ændre på, du er stadig nød til at dele med nogle andre, og finde dig i at der sidder en mærkelig en ved siden af, det kan vi jo ikke afhjælpe med en cyklen, det vi kan gøre det er at vi kan forsøge at gøre det kollektive mere dør-til-dør, i virkeligheden, det er sådan set det.

PE: Så det handler mest om fleksibilitet, ikk?

JE: Ja, ja ja, og så også rigtig mange andre ting, man kan skælde det kollektive ud med at den ikke kan bringe en derhen til hvor man vil, og når man vil, det kan det her hjælpe lidt på. Man kan skælde det kollektive ud for at være ubehageligt og trist og grimt og alt muligt andet, det kan vi ikke gøre noget ved. (**Alle** griner). Kun om sommeren måske.

Appx. 2.2.2 Morten Heegaard

Morten Heegaard, 02:33 (Appx. 3, 00:02:08 – 00:03:19)

DO: Men hvad er det så nogle udfordringer I ser lige nu? Altså i den process I er i nu?

MO: Jamen altså man kan sige vi har en plan A som også.. det mandat vi fik fra politikerne det er jo at.. vi prøver at indgå et samarbejde med DSB, det er sådan vores plan A nu, og plan B det er, hvis det ikke lykkes at blive enig med dem om en ordning, så må vi i gang selv, så lige nu.. så der er udfordringen.. det er at se om vi kan få en aftale op at stå med DSB, og få den godkendt politisk i det nye år. Hvis man skal sige sådan med implementering generelt så er det jo når den tid kommer, så er det jo i høj grad et spørgsmål om kommunikation overfor borgerene og de potentielle brugere, men også i forhold til at sikre at der er et samspil med resten af den kollektive trafik, at det fungere, og det er hvis man skal snakke omkring implementering, så er det der, vil jeg sige.. der. (pause)

DO: Ja.

Morten Heegaard, 00:00 (Appx. 3, 00:21:25 – 00:22:25)
ES: Men det der var lidt paradokse det var jo at det ligesom viser at folk er så villige til at tage deres cykler I enden af deres rejse, eller sådan.. og så virker det sådan lidt modsigende når man siger at der er de her undersøgelser, alligevel så stiller vi det her til rådighed, så er det lidt som om at man har lavet nogle antagelser om at det ville kunne ændre det, eller kunne lokke folk.. eller I stedet for at tage bussen det sidste stykke, så man kunne tage cyklen, eller sådan.. Jeg tror bare det var en tanke om at.. om der er gjort nogle.. om det kan sådan.. det kunne ændre på det.

MO: Em.. altså, jeg tror ikke der er nogle der forstiller sig at ved at indføre et bycykel system I København, eller pendler system, at man så laver en større revolution, altså at..

ES: Så cykler de alle sammen..

Morten Heegaard, 22:25 (Appx. 3, 00:22:25 – 00:22:47)

MO: Det er jo.. det er jo svært at regne med hvor mange.. altså, Man kan jo ikke forudse præcis hvor mange vil bruge det her. Man kan godt stille nogle antagelser op og så prøve at lave et skøn over hvor mange.. tror vi vil bruge den her pendlercykle. Men altså, det viser sig også ofte når man laver sådan nogle beregninger, skønner man forkert I begge retninger.

(00:22:47 – 00:23:35)

MO: (fortsat) Men altså det er selvfølgelig rigtigt at.. altså når folk.. der er også nogle undersøgelser der viser når folk for eksempel skal skifte mellem transportformer, så.. altså, så skal det være.. det skal gå.. altså folk vil ikke vente, folk har måske ikke så meget imod ved at skifte, så længe at man kan gå lige over I den næste transportmiddel ik' så.. og hvis man kan lave et system hvor der er en cykel, som man ved at den står lige her, den står 500 meter fra hvor jeg står af, eller.. gerne kortere selvfølgelig, og den står der når man kommer, så skal man ikke vente på en bus der måske først kommer om 5-10 minutter.

(00:23:35 – 00:24:52)

ES: Ja..

MO: Altså så kan det være man kan vinde nogen.

ES: Ja..

DA: Men det her med et skøn kan ende ud I begge retninger, I kommer jo til at lave et skøn før I kommer til at implementere nogle cykler?

MO: Altså.. Som det er lige nu, så er det faktisk en opgave som ligger ved.. Selvfølgelig vi laver også et arbejde der hedder "hvor mange tror vi vil bruge det her" og "hvor mange cykler har vi brug for", men det er også noget som DSB er I gang med. Og så må vi jo så se hvor vi kan mødes, og så er det udover det, ås kan man jo sige, det er jo altid et politisk spørgsmål, hvor meget er.. at politikerne er villige til at spille ind af midler, I forhold til at.. hvor mange cykler kan vi få, og hvor stort skal vi slå det her system op. Og hvis man siger at politikerne.. at det koster et eller andet, jeg ved ikke.. hvad er det.. 200 millioner de har brugt I London på de her 5.000 – 6.000 cykler, altså.. så tror jeg måske nok lige at de ville træk vejret en ekstra gang, og sige "okay det kan godt være vi ikke skal have et helt så ambitiøst system". Så det er jo også et spørgsmål om hvad kan man få for hvad der er rigelig at bruge på det.

Morten Heegaard, 28:40 (Appx. 3, 00:28:07 – 00:29:46)

MO: Og det er så det DSB er i gang med, og vi kontaktede dem, og så sideløbende har vi så kontakt til de andre.. til metro selskabet og Movia. Men man kan sige at det er i høj grad, men kan sige, DSB der har sagt, jamen det her, det vil vi gerne gå ind i, og så er det sådan bolden den ligger nu, og så må vi jo se om vi ikke kan blive enig med dem, så ligger der også i den indstilling, at så må vi gå videre selv, og formulere et udbuds-koncept, eventuelt i samarbejde med Frederiksberg.

DA: Altså metroen dækker jo godt på Amager og Frederiksberg, mens DSB så har bæltet her i midten, kommer der så også til at være bycykelsystemer på metro stationer? Hvis det er DSB som..

MO: Altså ud fra sådan en, altså hvis vi skal lægge et pendlersystem, byggede op på at.. pendler skal tage en cykel ud.. så er det relevant for.. det er i københavns kommunes interesse at metro stationer også er dækket ind, så det er jo også sådan noget vi vil arbejde videre med, der er også andet.. nogle stationer, omkring metro stationer.. så altså det er ikke kun i vores interesse at det bliver så godt som muligt.

Morten Heegaard, 47:00 (Appx. 3, 00:46:40 – 00:48:00)

MO: Men altså hvor mange penge man har tænkt sig at spytte ud i et bycykelsystem, det er jo også.. det er ikke helt til at sige, altså det er på niveauet det er, vi fra politikerne.. måske at de kan vælge mellem en lille og en stor model, hvad kan man sige.. "Vil I have den her model der koster det her med det her antal cykler, og det her område er dækket? Eller vil I have den helt store, eller større.. model hvor der er flere cykler, og dækker et større område, og koster noget mere?" det er sådan det vi har i tankerne om at præsentere til politikerne på et tidspunkt.. og så er det jo op til politikerne at sige, jamen, vi vil gerne prioritere.. vi vælger den helt store, eller sige.. jamen det her er vi ikke helt tilfredse med, som måske ikke er helt så ambitiøst, eller hvad man kan sige.

DA: Så i sidste ende er det teknik- og miljøudvalget som tager den beslutning?

MO: Altså i aller sidste ende, der er det borgerrepræsentationen, men altså.. det er altid sådan lige et spørgsmål om.. hvem beslutter hvad, altså ligegyldigt hvad så skal den igennem teknik- og miljøudvalget, om den så skal hele vejen til borgerrepræsentationen, det er lidt usikkert, altså på et eller andet tidspunkt, der skal hele borgerrepræsentationen havde sagt god for den.. hvornår det så bliver, det kan vi ikke rigtig sige nu.