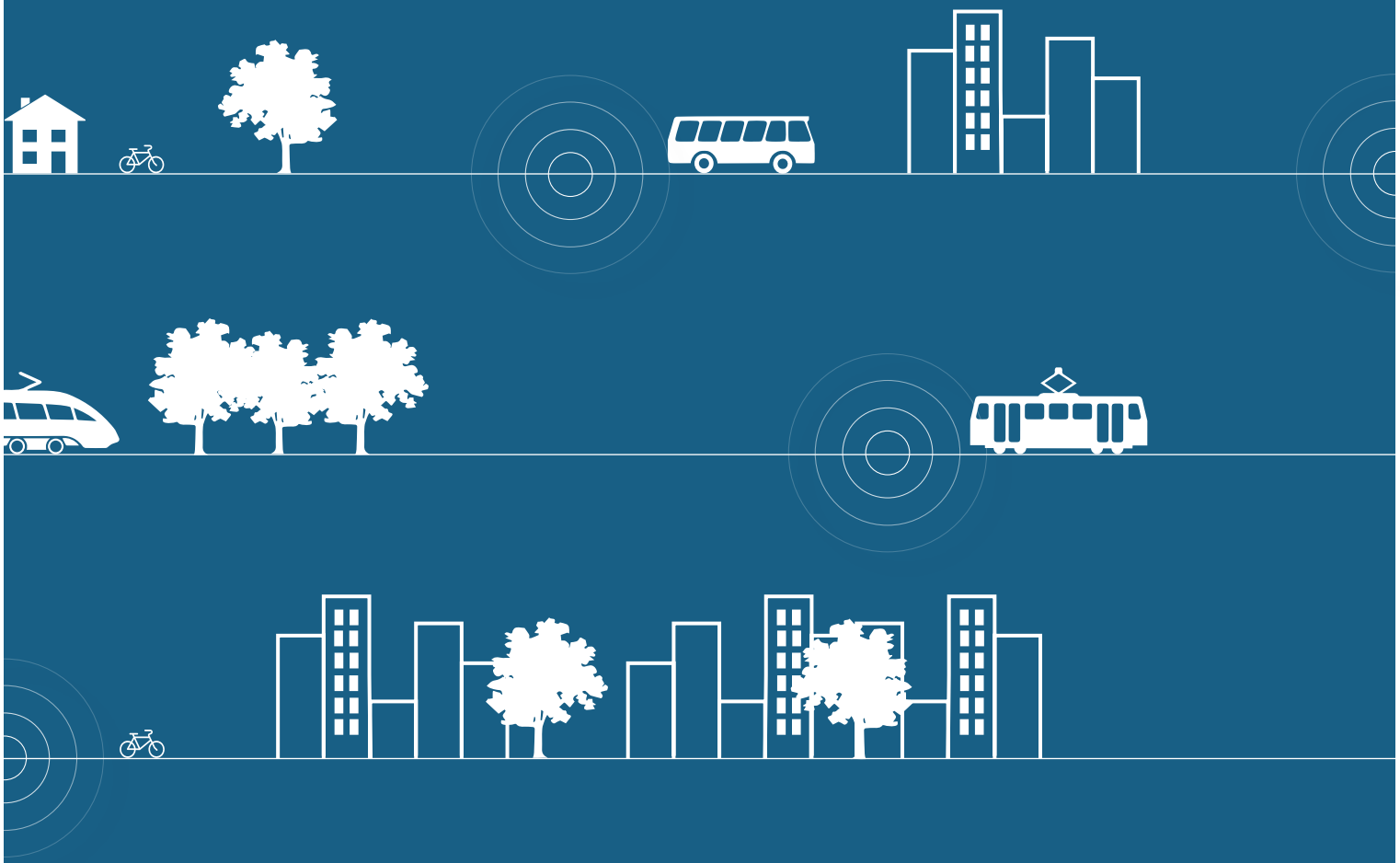
Backcasting in transport planning

The potential of backcasting to create a long-term vision and improve coordination across public transport companies in the Greater Copenhagen Area



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Sustainable Cities
Master's Thesis
9th of June 2017

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Abstract

Urbanisation, increasing transport demands, and car-dependent mobility patterns constitute severe challenges for cities that aim to ensure sustainable transport systems and liveable urban environments in the future. Additionally, many cities experience a lack of integration not only between different transport modes, but also between the key actors who are responsible for strategic planning and coordination. Key actors within transport planning should collectively discuss and address how to develop sustainable transport futures.

Through a case study of coordination between public transport companies in the Greater Copenhagen Area the aim of this thesis is to investigate the opportunities and challenges regarding the use of backcasting to create a long-term vision in order to contribute to improving coordination. To do so, we have constructed an example of a backcasting scenario containing a normative vision and the measures to reach that vision. Through the perspectives of Actor-Network Theory we have focused on the needed actor configurations and potential controversies related to each measure when presenting the scenario to key actors. This way backcasting worked as an *interessement device* by encouraging discussions with key actors on their identities and roles in developing long-term visions and improving coordination.

Based on these discussions, we suggest that including key actors as active participants in a participatory backcasting study can contribute to improving coordination across actors within transport planning in cities. Additionally, we suggest that identifying and describing actor configurations is a useful approach to specifically address aspects of coordination when undertaking a backcasting study.

Acknowledgements

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Introduction

The transport sector is one of the biggest contributors to global warming across the world (Urry and Dennis, 2009). Even though the focus on sustainable development is constantly increasing both politically, in scientific research, and among the general public, the transport sector has not seen the same decline in emissions as other sectors. At a European level, emissions only started to decline as late as in 2007 and still remain higher than in 1990 (European Commission, 2017).

In cities increasing populations and densities put substantial pressure on mobility systems with a projected 66% of people living in cities by 2050 (United Nations, 2014). Consequently, increasing transport demands in urban settings as well as the lock-in to car dependency (Driscoll, 2014) result in local air and noise pollution, greenhouse gas emissions, increasing road congestion and urban sprawl. In effect, cities in particular face severe challenges in terms of developing sustainable transport systems in and for the future. This requires stronger integration both between transport modes and between key actors involved in strategic transport planning (May et al., 2006). Therefore, there is a need for key actors to collectively address the future role of transport systems in cities.

In Denmark there is also a lack of action among key actors to reduce emissions, despite the ambitious national goal to become free of fossil fuels by 2050 (Klima- og Energiministeriet, 2011). Here the transport sector is heavily dominated by fossil fuels, which currently cover 95 % of the total energy demand for road, rail and air transport and will only drop to 92 % in 2030 based on current extrapolations (Energistyrelsen, 2017). Additionally, traffic volumes on Danish roads increased by 2.8 % in 2016, along with record high sale of private cars, resulting in increasing CO_2 emissions for the third year in a row (Bredsdorff, 2017).

The Greater Copenhagen Area serves as one example of an urban context where a lack of key actors collectively addressing sustainable transport futures can be identified. The area faces many future challenges, since rapidly growing populations and increasing transport demands put substantial pressure on urban mobility systems resulting in negative environmental, economic and social effects, such as greenhouse gas emissions, noise and air pollution, congestion, and unattractive urban environments (Trængselskommissionen, 2013a).

Since technological development alone will not solve these issues (Banister, 2008), there is a need for a transition to more sustainable modes of transport in urban areas. One important element of this transition is the potential to strengthen, expand, and increase integration of public transport systems in urban agglomerations in order to reduce automobile dependence (Newman and Kenworthy, 2006). As cities grow in scale and in density, public transport offers a sustainable and efficient alternative to private cars (Newman and Kenworthy, 1999).

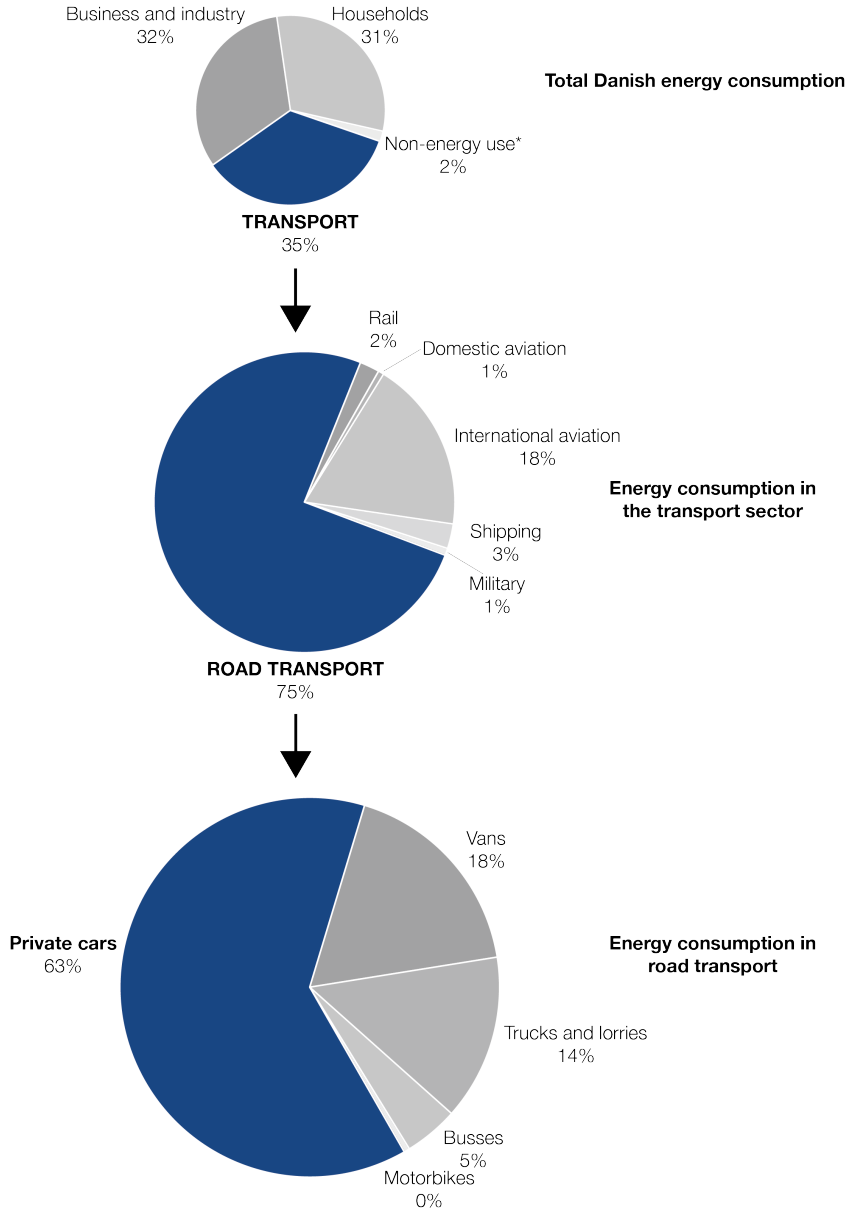
To improve public transport in the Greater Copenhagen Area, there is a need for key actors to collectively address the future role of public transport. However, this is challenged by the current configuration of actors in which responsibility is divided between three public transport companies lacking a common long-term vision at a strategic level (Jespersen et. al, 2017). This implies that strategic transport planning tasks and investments are not necessarily coordinated across transport modes and consequently across public transport companies (ibid.). To achieve this coordination on long-term goals and visions, actors must start working collectively towards a desirable and sustainable future (Banister and Hickman, 2013). One way to create such long-term normative visions and to provide the measures to achieve those visions is through a backcasting approach. To backcast is to work backwards from a desirable future in order to determine what policy measures are required to reach that point (Robinson, 1990). More specifically, participatory backcasting can work as an approach to actively involve actors in collectively developing shared directions for the future (Wangel, 2011a).

The aim of this thesis is therefore to investigate the opportunities and challenges regarding the use of backcasting to create a long-term vision across public transport companies in the Greater Copenhagen Area in order to contribute to improving coordination. As part of this, the aim is to initiate discussions on the future role of public transport among key actors in the field by showing an example of a backcasting scenario through which these actors can collectively address sustainable transport futures.

Problem analysis

Current challenges of the transport sector in Denmark

Denmark has by some been characterised as a pioneer country of sustainable transition due to wind power production (Auken, 2002) and the ambitious national goal to become free of fossil fuels by 2050 (Klima- og Energiministeriet, 2011), among others. However, the transport sector in Denmark has not seen the same decline in emissions as other sectors and is still heavily dominated by fossil fuels, a trend that based on current extrapolations will not change substantially towards 2030 (Energistyrelsen, 2017). As visualised in Figure 1, the transport sector constitutes about one third of the total energy use in Denmark with road transport accounting for 75% and aviation for 19% (ibid.). In terms of road transport, private cars make up 63% of total energy use thus private road transport is the biggest single contributor to energy use in the transport sector (ibid.).



*Non-energy use covers use of other petroleum products such as white spirit, paraffin waxes, lubricants, bitumen and other products.

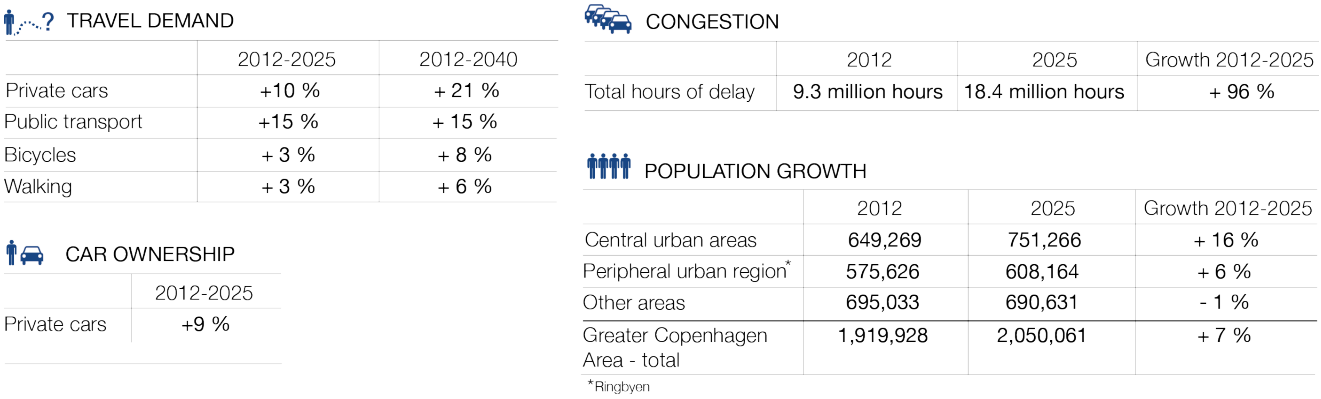
Figure 1. Transport energy consumption at a national level in Denmark in 2016 (Based on Energistyrelsen, 2017).

At a national political level, the main focus is currently on expanding road capacity to overcome congestion (Lorentzen, 2017) explicitly formulated by the Spokesman of Transport in the political party Venstre:

> "Venstre has a clear general priority, that from now on primarily roads are next."
>
> (Lorentzen, 2016)

It is, however, broadly recognised that increases in road capacity will only lead to induced traffic and subsequently congestion (Ladd, 2012). With nothing on the political horizon aimed at changing these negative figures, a lack of action can be identified at a national political level to address the issues in order to facilitate a sustainable transition of the transport sector at a national level.

In metropolitan regions like the Greater Copenhagen Area challenges become even more severe due to the strong concentration of private road transport resulting in local noise and air pollution, congestion and unattractive urban environments. Extrapolations of the Greater Copenhagen Area reveal a somewhat equally negative picture as visualised in Figure 2. Based on 2012 extrapolations, the travel demand for private cars will increase by 10 % in 2025 and by 21 % in 2040 whereas car ownership will increase by about 9 % in 2025 (Tetraplan, 2013; Trængselskommissionen, 2013a). The substantial increase in car ownership and travel demand will put pressure on the transport system, and congestion is therefore expected to increase by 96 % from a total of 9.3 million hours of delay in 2012 to 18.4 million hours in 2025 (Trængselskommissionen, 2013a). This increase will have severe environmental as well as socio-economic effects – something which was thoroughly studied and discussed by the Congestion Commission in 2012/2013, whose suggested initiatives like road pricing, improved coordination across transport modes, designation of public transport hubs etc. were, however, never implemented at a large scale (Petersen, 2017). Furthermore, demographic changes will influence the transport system as the overall population will increase by 7% in the Greater Copenhagen Area towards 2025 – but the population growth will not be distributed evenly (Trængselskommissionen, 2013a). Urbanisation will thus favour the central urban areas where population will increase by 16% (ibid.) putting a large pressure on transport systems in these areas. These projections highlight the need for increased implementation of trend breaking policies and initiatives to support a sustainable future transport system in the Greater Copenhagen Area.



TRAVEL DEMAND

	2012-2025	2012-2040
Private cars	+10 %	+ 21 %
Public transport	+15 %	+ 15 %
Bicycles	+ 3 %	+ 8 %
Walking	+ 3 %	+ 6 %

CAR OWNERSHIP

	2012-2025
Private cars	+9 %

CONGESTION

	2012	2025	Growth 2012-2025
Total hours of delay	9.3 million hours	18.4 million hours	+ 96 %

POPULATION GROWTH

	2012	2025	Growth 2012-2025
Central urban areas	649,269	751,266	+ 16 %
Peripheral urban region*	575,626	608,164	+ 6 %
Other areas	695,033	690,631	- 1 %
Greater Copenhagen Area - total	1,919,928	2,050,061	+ 7 %

*Ringbyen

Figure 2. 2012 extrapolations of travel demand, car ownership, congestion and population in the Greater Copenhagen Area. (Based on Tetraplan, 2013 and Trængelskommissionen, 2013a)

A sustainable transport system requires more than technological development

One considerable challenge for developing a sustainable transport system is the need to address not just technological development since it is well acknowledged that this alone cannot solve the severe challenges (Banister, 2008; Teknologirådet, 2012). Even though many discussions on transport futures are currently centred around new technologies like driverless cars, it is argued that driverless cars cannot replace public transport in the Greater Copenhagen Area (Metroselskabet and Hovedstadens Letbane, 2017). Banister (2008) identified how a sustainable mobility paradigm requires several changes to current systems and transport planning practices (of which technological innovation is only one part): reducing the need to travel, fostering modal shifts from private to public transport, reducing trip distance by integrating transport planning with land development, and increasing energy efficiency of vehicles.

Public transport holds potential to increase both social, economic and environmental sustainability in urban areas (Vilhof, 1994). Therefore, this thesis is concerned with the potential to improve and expand the public transport system in the Greater Copenhagen Area as one element in a sustainable transition of the transport sector, because this can strengthen the alternative to private road transport and thereby foster a modal shift and reduce automobile dependence. As capacities of public transport modes are way larger than those of private cars (see Figure 3), public transport can make more effective use of the available space in urban areas (Banister, 2008). Furthermore, calculations show that when transit replaces car travel it appears to substitute between 5 and 7 kilometres of car travel for 1 kilometre of transit (Newman and Kenworthy, 1999). For the public transport system in the Greater Copenhagen Area to serve as an attractive alternative to private cars there is a need to address the future role of public transport in a sustainable transport system, both 20, 30, 40 and 50 years ahead (Banister and Hickman, 2013) – and to ensure that these long-term goals are coordinated across actors within the sector.

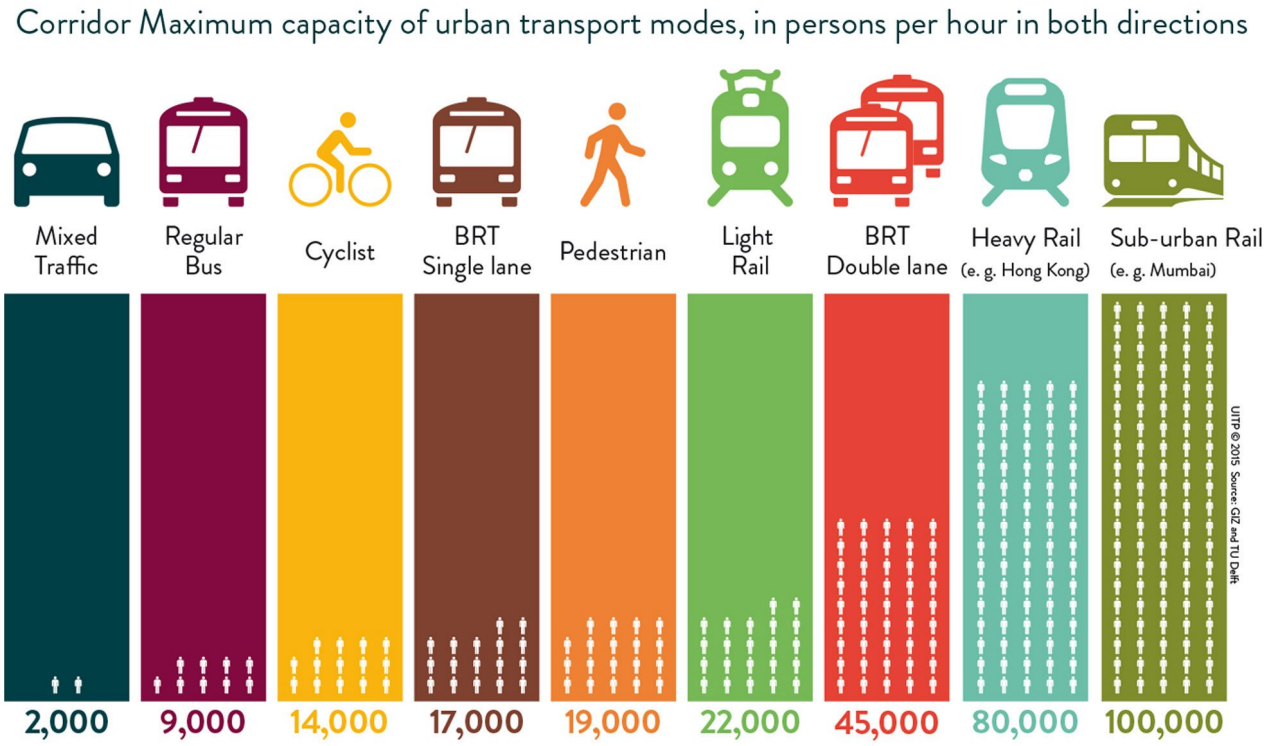


Figure 3. Maximum capacities for different urban transport modes. (UITP, 2015)

The need for coordination in building a strong public transport sector

One of the challenges for sustainable transition of the transport sector is the need for coordination. Sjöblom (2011) identifies a rising interest in coordination in the transport sector. He highlights the ubiquity of the discourse of coordination and argues that coordination should be treated as an object of study in order to bridge conflicting interests rather than merely as an analytical category (ibid.). In accordance with this, Sager and Ravlum (2004) argue that elements from three primary governance structures shape coordination of inter agency transport planning: market, hierarchy, and network, even though these are rarely found in their 'ideal' forms but rather co-exist in society. Coordination is thereby constituted by both competition in markets, power relations in hierarchies and the ability to cooperate in networks (ibid.).

These aspects appear to have an effect on public transport in the Greater Copenhagen Area. Here one of the challenges for improving public transport is precisely the lack of coordination between key actors including the lack of coordinated planning efforts across transport modes, and consequently across transport agencies. Furthermore, Jespersen et al. (2017) have identified a lack of strategic coordination between planning of individual and public transport. Compared to other metropolitan regions, the public transport sector in the Greater Copenhagen Area is constituted by many actors as all administrative levels of the Danish political system – the state, the regions and the municipalities – play a role in the field of transport planning. Furthermore, three public transport companies – DSB, Movia and Metroselskabet – plan and operate public transport in the Greater Copenhagen Area.

In comparison, London is constituted by one main agency, Transport for London, a local government organisation responsible for all main aspects of London's transport system (Transport for London, n.d.). Compared to other cities, Copenhagen performs poorly in overall customer satisfaction in the Benchmarking in European Service of Public Transport (BEST) survey as seen in Figure 4. Jespersen et al. (2017) suggest this stems from the lack of cooperation among public transport companies at both operational and strategic levels. The many actors thus challenge inter agency transport planning coordination and thereby also long-term visioning in the public transport sector.

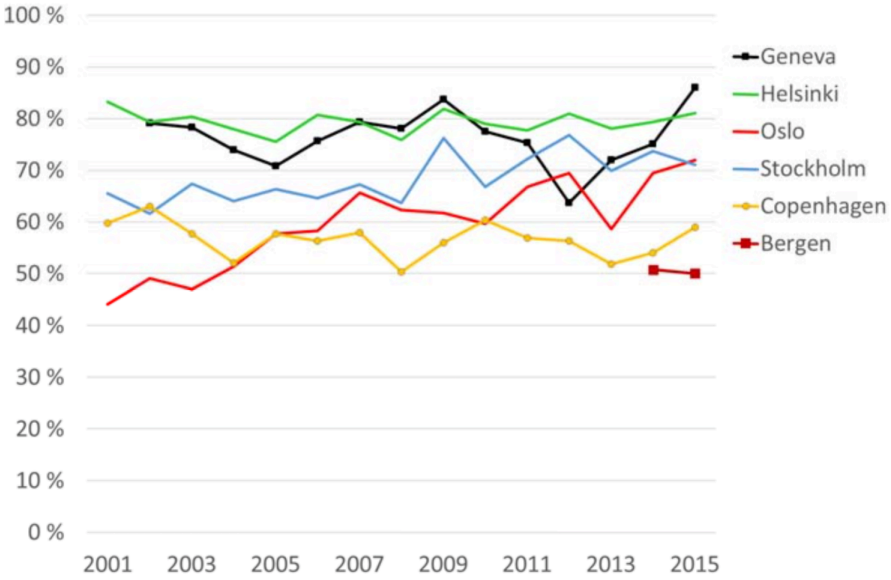


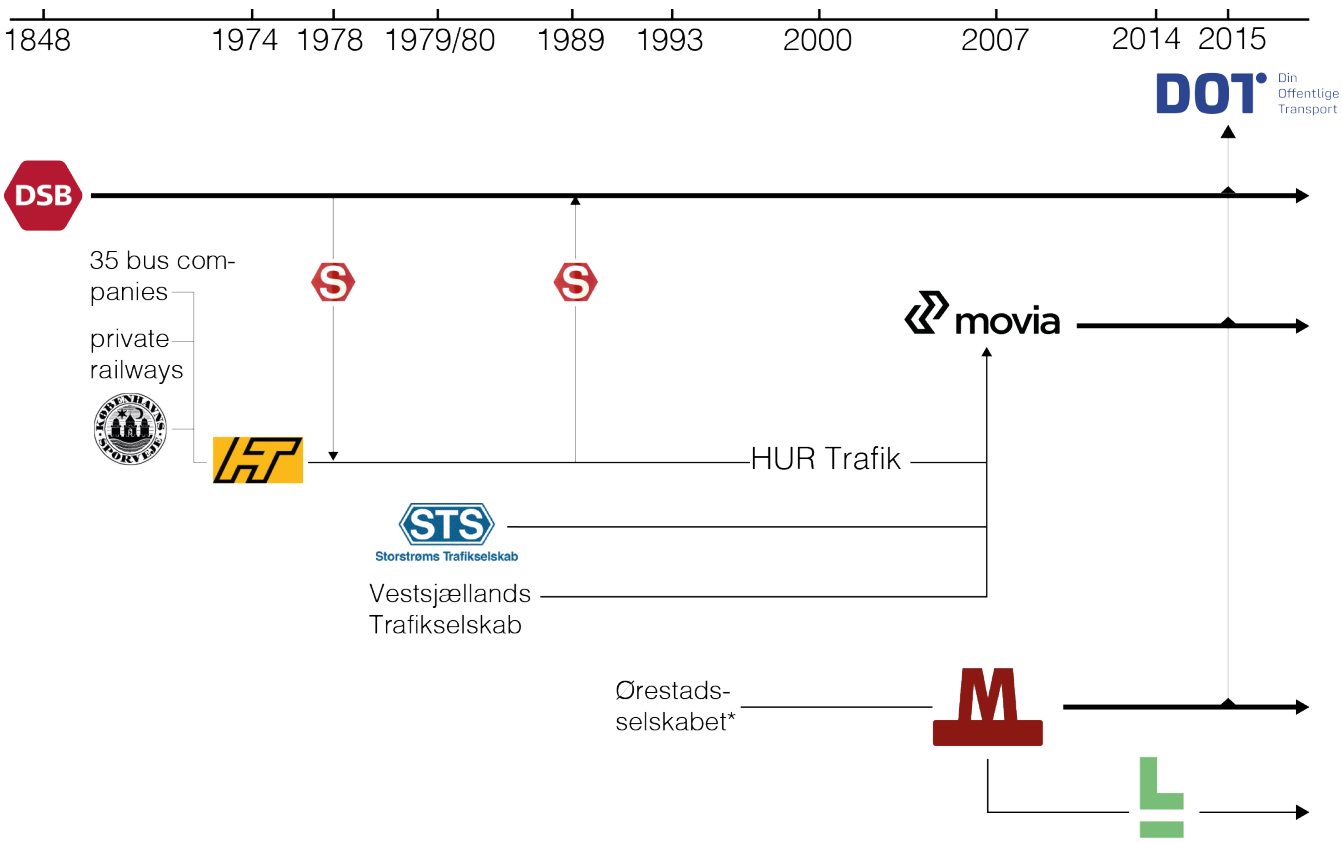
Figure 4. Development in overall satisfaction from BEST-survey 2015 among both users and non-users of public transport (BEST, 2016).

Actors and coordination in the public transport sector in the Greater Copenhagen Area

Historically there have been attempts to improve coordination and create more concentrated efforts in the public transport sector in the Greater Copenhagen Area. One of the first attempts was in 1974 through the establishment of Hovedstadsrådet as an administrative entity to undertake regional development including

public transport planning. Before 1974 public transport was divided between many actors: Københavns Sporveje, DSB, the private railways, and 35 public and private bus companies (see Figure 5). The establishment of Hovedstadsområdets Trafikselskab (HT) was a turning point since it assembled planning, construction and operation of buses and from 1978 also the S-trains under one entity that nevertheless caused many controversies between DSB and HT (Marcussen, 1996). Coordination in this period was ensured through regional plans. When Hovedstadsrådet was put to an end in 1989, public transport was "replaced by a structure with more actors and without common goals" (Marcussen, 1996, p. 4). The last contribution of Hovedstadsrådet was the plan proposal "Kollektiv trafikplan 1989" which offered suggestions for the future cooperation between HT, DSB and the private railways (Hovedstadsrådet, 1989).

The next attempt to improve coordination was when Hovedstadens Udviklingsråd (HUR) was established in 2000 as a sort of replacement of Hovedstadsrådet. HT was abolished, and instead HUR Trafik was given the responsibility of planning and operating buses and the former private railways at a regional level. However, HUR only managed to develop one regional transport plan before it was abolished in 2007 as part of the municipal reform (Hovedstadens Udviklingsråd, 2000). In its response to the hearing request of the municipal reform, HUR recommended the establishment of "one common transport company for the Greater Copenhagen Area with responsibilities for both bus, S-train, metro and local railways" (Hovedstadens Udviklingsråd, 2004, p. 2) – a recommendation which, however, was never adopted. Instead the bus and local railway company Movia was established by merging the three former bus companies on Sjælland (HUR Trafik, Storstrøms Trafikselskab and Vestsjællands Trafikselskab) into one company (see Figure 5).



* was in 2007 split in two: One company responsible of metro named Metroselskabet and one company responsible of building Ørestaden named Arealudviklingsselskabet (By og Havn from 2008)

Figure 5. Timeline showing the large amount of public transport companies and how they have been merged through time. The graph shows how S-trains was at some point part of HT and not DSB, and it shows how the current public transport companies – DSB, Movia and Metroselskabet – are part of the collaboration in DOT.

Responsibility of public transport provision in the Greater Copenhagen Area is thus currently divided among four public transport companies; DSB, Movia, Metroselskabet and Hovedstadens Letbane. Hovedstadens Letbane, which is organisationally placed under Metroselskabet, is currently only responsible for construction and not for any operation. Each of the other three companies is in charge of planning and operating one certain transport mode within a delimited geographical area. DSB is responsible for trains at national and regional levels, Movia for buses (and a few local trains) at the regional and local level, and Metroselskabet for metro locally – see Figure 6.

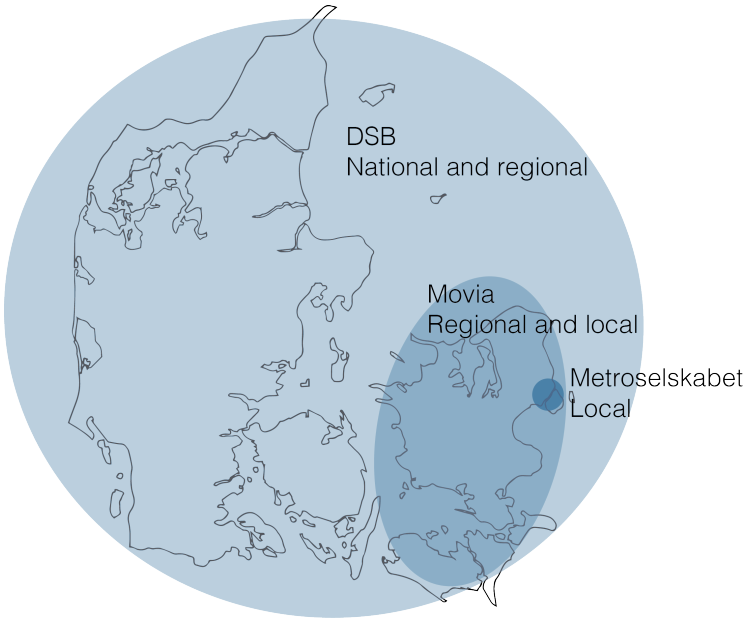


Figure 6. Interests of the three public transport companies at a geographical level.

Apart from covering different geographical areas the three companies are owned by different authorities which complicates coordination. DSB is a nationally owned company under the Minister of Transport, Building and Housing with a long history dating back to 1848. Movia was, as already mentioned, formed due to the municipal reform in 2007 and is owned by Region Hovedstaden, Region Sjælland and 45 municipalities. Metroselskabet dates back to 1993 but was established in its current form in 2007 and is owned by the state through the Ministry of Transport, Building and Housing (41.7 %), the Municipality of Copenhagen (50%), and the Municipality of Frederiksberg (8.3 %).

This division of responsibility between several actors challenges the potential for a stronger public transport sector in several ways. One of the main challenges within the current system is that each public transport company has an interest in optimising its own system rather than the overall public transport system (Petersen, 2017; Jespersen, 2017). Increasing passenger numbers in one part of the system may therefore derive from a decrease in other parts, and this is not necessarily coordinated across the three companies.

Coordination across public transport companies is manifested through Din Offentlige Transport

Since the abolishment of HUR Trafik there have been different attempts to improve coordination in the Greater Copenhagen Area. In relation to the municipal reform in 2007 *Law on transport companies* obliged the transport companies on Sjælland to collaborate to ensure a coherent public transport system in the Greater Copenhagen Area (Transport- og Bygningsministeriet, 2005). In practice, this work was undertaken in the not very formalised "Direktørsamarbejde". In 2014, this collaboration was formalised by means of a new *Law on transport companies* and the umbrella organisation Din Offentlige Transport (DOT) was established in January 2015 (see Figure 5) (Transport- og Bygningsministeriet, 2014). As visualised in Figure 7, DOT consists of DSB,

Movia, and Metroselskabet and covers the area in which Movia operates, however this thesis is only concerned with public transport in the Greater Copenhagen Area since challenges of public transport are very different from urban to rural areas. The main responsibility of DOT are customer related activities like ticket sales and customer service (see Table 1) and thus no long-term visioning at a more strategic level takes place in DOT. DOT is organised through a board in which the director of customer relations of the three companies is represented.

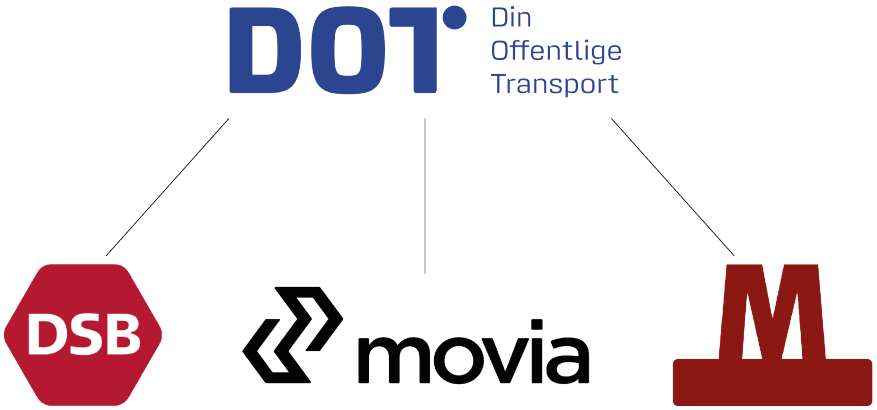


Figure 7. Visualisation of DOT as an umbrella organisation for the three public transport companies

DOT must be responsible of*:	DOT can be responsible of:
• Ticket sales • Customer service • Administration of lost property • Travel regulation • Traffic information • Marketing • Communication *The companies are not allowed to manage these activities autonomously outside DOT	• Fare systems • Revenue sharing • Coordination of timetables • Analysis and benchmarking

Table 1. What DOT must and can be responsible of according to Law on transport companies (Based on Transport- og Bygningsministeriet, 2015).

Since its establishment DOT has been criticised from different sides including Region Hovedstaden who complained about the low level of integration and decision-making power in DOT (Struensee & Co, 2016). Furthermore, the many actors at the owner level, the different organisational forms, the different decision making processes and the many different financial sources makes it difficult to increase coordination of public transport (ibid.). In a press release it is argued that "even though DOT is one step on the right track, it basically does not address the massive congestion challenges that the Greater Copenhagen Area is facing" (Region Hovedstaden, 2016). Something that is agreed upon in an editorial of the Danish journal Ingeniøren:

> "The reality is that car traffic is just growing and growing while the society invests billions in new signals, metro excavation, railway lines, electrification, and light rails. This happens without any real coordination of activities or common success criteria of the public transport companies that are rather caught in an eternal fight for ticket revenues from the passengers. It simply has to get better if we have to justify the huge amounts of money that we invest in public transport."
>
> (Ingeniøren, 2015)

Words are not translated into actions

Currently, the public transport companies generally work with rather short term visions (4-12 years) that do not address the challenges of sustainable transition 30 or 40 years ahead (Movia, 2016; DSB, 2014; Metroselskabet, 2014). In interviews with the actors of the public transport companies, demographic and technological changes are mentioned as elements which will influence the transport sector in the future, but current plans show a lack of actively taking these developments into account. Only Metroselskabet has recently pointed towards the need for discussing the future public transport sector through a recent study on megatrends and the future role of public transport (Metroselskabet and Hovedstadens Letbane, 2017), but generally there is a lack of these discussions among the companies and no discussions like these take place in the context of DOT. Additionally, each company has its own vision which is not necessarily aligned with the visions of the other companies.

To address the complex challenges within the transport sector in the Greater Copenhagen Area there is a need to improve coordination across the public transport companies. This coordination need not just be addressed in the short term on single aspects like customer related activities, but rather there is a need to substantially increase coordination at a more strategic level to be able to address the considerable challenges that the Greater Copenhagen Area is facing. This requires both immediate action but also calls on the public transport companies to employ a more long-term approach, including coordinated long-term visions for the future role of public transport in a sustainable transport system.

Addressing long-term challenges through backcasting

There are many ways in which a more long-term approach can be employed and the field of *future studies* provide several approaches. Future studies can be divided into three main categories, wherein Vergragt and Quist (2011) argue that most scenarios are forward looking by extrapolating from present day towards the future:

1. Trend extrapolations and business as usual scenarios – what *will* happen
2. Forecasting, foresighting and strategic scenarios – what *could* happen
3. Normative scenarios, desirable futures and visions – what *should* happen

(Based on Vergragt and Quist, 2011)

In line with this, Börjeson et al. (2006) name the three approaches *predictive*, *explorative* and *normative*, although they argue that forecasting should be included in the first category as forecasting scenarios are an attempt to *predict* what is going to happen in the future. Another approach to scenarios are backcasting studies, which are concerned with developing normative scenarios and therefore sit within the third category. Backcasting entails a more systematic approach of working backwards from the desirable future to the present by determining and describing the pathway needed to realise the normative visions of the future (Dreborg, 1996). It can therefore work as an approach to facilitate discussions on sustainable transport futures by identifying the required measures to achieve the desirable future and thereby translate words into actions.

Also in Denmark, several scenarios to address the challenges of the future transport system at a national level have been developed by key actors in the transport sector through time, of which a few should be mentioned here. The first comprehensive Danish scenario study was produced in 1977 and explored five different scenarios of the transport sector at a national level towards 2000 (Trafikforskningsgruppen ATV, 1977). The study was part of the *limits to growth* agenda and explored individual vs. public transport under high and low levels of growth respectively (ibid.). Three decades later, the Technical University of Denmark (DTU) undertook a likewise comprehensive study investigating six future scenarios towards 2030 (DTU, 2006). These scenarios focus on personal transport and take into account not just economic growth but also technological development, regionalisation, environmental issues, and were meant to work not as a scientific

examination or a concrete basis for decision-making but rather as inputs to the ongoing discussions on future transport and infrastructure (ibid.). More recently, through its report on mega trends, Metroselskabet presented three scenarios more specific to the public transport sector in the Greater Copenhagen Area (Metroselskabet and Hovedstadens Letbane, 2017). One scenario focuses on individual transport and driverless technologies, another focuses on blurring the demarcation line between individual and public transport through Mobility as a Service (MaaS) solutions and the third focuses on a strong and sustainable public transport sector (ibid.). Common to these studies is that they are all *explorative* scenarios focusing on what could happen.

In contrast to this, in 2012 Teknologirådet undertook a backcasting study with a more *normative* character (Teknologirådet, 2012). It was developed as part of a discussion on what the transport system of Denmark could look like in 2050 if it was to be supplied by 100% renewable energy in order to reach the national goals of CO_2 emissions reduction (ibid.). The purpose was to explore what consequences such a transition would have in terms of modal split, mobility patterns, energy costs and infrastructure investments (ibid.) The study explores a reference or business as usual scenario, a scenario focusing merely on technological development and a more normative fossil free scenario focusing not just on technologies but also on how to encourage modal shifts and changed mobility patterns (ibid.). The study concludes that technological development alone cannot solve the issues of sustainability, hence the only way to reach this goal is through the fossil free scenario, a transition which is both deemed possible and even economically feasible if combined with limited growth in the amount of traffic (ibid.). Part of this scenario was the identification of certain policy measures to be implemented in order to reach the goal. These policy measures have, however, not yet been implemented.

A backcasting study in Sweden came to a similar conclusion: that if we only rely on technology we cannot reach CO_2 emissions reduction targets towards 2050, but rather the authors argue that technological development should be supplemented by policy packages which can both reduce travel demand and foster modal shifts (Åkerman and Höjer, 2006). They argue that the main policy measures should concern increased use of IT and stronger urban planning measures and also that changes within both institutional and spatial structures are needed (ibid.).

Backcasting as an approach to allow for systemic transformation to achieve sustainability

As mentioned before, backcasting is concerned with normative futures and is therefore suitable for sustainability oriented systemic changes (Vergragt and Quist, 2011). It was initially introduced in the 1970s in the energy sector where it was applied in planning and structuring of energy systems and has since been applied to a wide range of societal issues regarding sustainability (Wangel, 2011a). Backcasting serves as an appropriate approach to address sustainability issues due to the main idea of working towards a desirable sustainable future (Miola, 2008) and by allowing for a more systemic societal transformation in order to achieve sustainability (Vergragt and Quist, 2011). A general definition of backcasting (visualised in Figure 8) is represented by Robinson (1990), who pioneered backcasting as an analytical framework in which it was possible not only to define a desirable future, but also to identify and describe a pathway to realise it:

> "The major distinguishing characteristic of backcasting analysis is a concern, not with what futures that are likely to happen, but with how desirable futures can be attained. It is thus explicitly normative, involving working backwards from a particular desirable future end-point to the present in order to determine the physical feasibility of that future and what policy measures would be required to reach that point."
>
> (Robinson, 1990)

Backcasting is thus not only about developing a vision, but also about how to develop strategies and pathways to achieve that vision (Vergragt and Quist, 2011). Therefore, backcasting is an approach that potentially can bridge the gap between visions and the present.

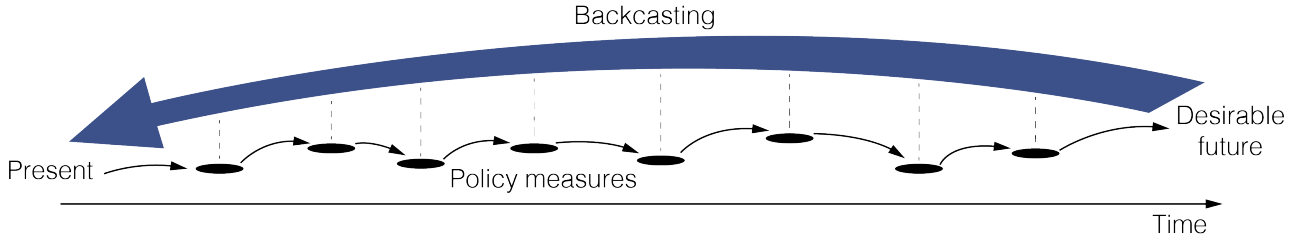


Figure 8. Backcasting: working backwards from a desirable future to the present to identify the required policy measures to reach the desirable future.

Backcasting is not necessarily the opposite of forecasting even though the wording might suggest so, but rather the two approaches are designed for solving different problems based on different views on scientific explanation in the social sciences (Dreborg, 1996). One crucial point on which the two approaches differ in terms of scientific explanation is on the attitude towards uncertainty. Where forecasting scenarios often apply sensitivity analyses to account for variations in external variables, the policies identified through backcasting rather describes the strengthening or weakening of trends as a choice for the authorities who formulate policies (ibid.). Höjer and Mattson (2000) even suggest that forecasting and backcasting are complementary in the sense that forecasting tools can be used to quantify the consequences of the different policy measures identified through backcasting.

When undertaking a backcasting study, it is essential to acknowledge the existence of different categories of backcasting; target-orientated, pathway-orientated, and action-orientated. These three categories are all part of a result-orientated backcasting approach. Target-orientated backcasting focuses on *what* should be changed in order to achieve a certain result, often described in a quantitative manner (Wangel, 2011a). The focus in pathway-orientated backcasting is less on quantitative goal-fulfilling but rather on *how* the changes could be ensured by exploring and bridging the gap between the present and the sustainable images of the future (ibid.). Action-orientated backcasting focuses on *who* could bring about change by developing some kind of strategy or action plan and also includes stakeholder identification (ibid.). Even though backcasting studies often take only one of the three categories as a point of departure, the categories are not necessarily mutually exclusive and backcasting studies often include more than one approach (Höjer et al., 2011; Wangel, 2011a).

The result-orientated approach can be distinguished from backcasting as a participation-orientated workshop technique, which should not be seen as a separate category but rather as an approach which can be applied to all three of the aforementioned categories (Wangel, 2011a). In the result-orientated approach one can thus very well make use of participatory backcasting, however the main difference between the two is that in participatory backcasting the overall aim is not the results as such but rather the outcomes of participation such as empowerment, increase in social capital or creation of other 'soft values' (ibid.). In relation to this thesis, participatory backcasting could potentially also contribute to increasing coordination among the involved actors – something which is not specifically addressed either by Wangel or other researchers of backcasting.

Backcasting in transport planning

In transport planning traditional forecasting – sometimes labelled as the predict and provide approach – is still dominant. However, several studies suggest that backcasting can prove very useful in terms of investigating how to achieve sustainable transport futures. The main justification for using backcasting in transport planning is that it can connect short-term and long-term targets, it can help to identify potential conflicts between the needed measures and it can display the actual consequences of achieving targets (Höjer

et al., 2011). In addition to this, the purpose of this thesis is to investigate whether backcasting can contribute to improving coordination among actors involved in transport planning and thereby act as an additional justification for applying backcasting.

Common to several studies is their suggestion that CO_2 reduction targets cannot be achieved merely by technological innovation, which instead need to be combined with policies fostering behavioural change in terms of reducing transport demand and encouraging modal shifts from individual to public transportation (Hickman and Banister, 2007; Åkerman and Höjer, 2006; Teknologirådet, 2012; Höjer et al., 2011). Such policies can include road pricing, supporting sustainable transport through urban form and urban planning, workplace and school travel plans, car sharing programmes and many others (Hickman and Banister, 2007). Even though many studies have identified useful policy measures to achieve sustainable transport systems, several authors including Banister and Hickman (2013) have identified an implementation gap between backcasting research and the way in which knowledge from backcasting studies is translated and actually implemented as policy measures. They therefore recognise a need for improved dialogue and knowledge transfer between researchers and practitioners within the field of transport planning (ibid.).

Lack of focus on actors in backcasting studies

This identified implementation gap stems partly from the general lack of focus on social structures and agency in backcasting studies, according to Wangel (2011a; 2011b). Through a literature review, Wangel (2011a) explains that the social objects of change, the actors, are rarely included in backcasting studies. According to her, there is a general lack of focus on *who* could bring about change and this obstructs the development of socio-technically consistent scenarios as most scenarios are based on existing social structures rather than questioning them, which, Wangel argues, is necessary to bring about change. Therefore, by not addressing actors in an explicit and explorative way, social structures and agency are maintained according to the status quo (ibid.). Focusing on the change agents can therefore be interpreted as another way to overcome the implementation gap as there is a need to understand the role of actors, because they are the ones who need to plan, implement and manage the suggested transition (ibid.). If actors are not included there is a risk that the suggested changes will never be implemented. This view is supported by Olsson et al. (2015) who argue that societal and political conditions are often not fully included in backcasting studies, which calls for a more socio-technical approach in backcasting. The inclusion of change agents in backcasting studies can therefore ease the translation of backcasting studies into actual implementation of policy measures by the key actors entrusted with promoting change (Wangel, 2011b).

In continuation of this, Wangel (2011b) suggests several ways of adding actors to backcasting studies. One way of adding actors to backcasting studies is through a *policy and change* method under which Actor-Network Analysis is mentioned as one possible approach (ibid.). The quality of policy and change approaches is that they not just highlight the importance of actors, but also point at how surrounding structures and actors can give rise to constraints and resistance to change (ibid.). She argues that when the purpose of a backcasting study is to contribute to some sort of action plan, it is of key importance to identify and describe which actors are required to get things done. Even though Wangel (2011b) addresses the need for including actors, she does not explicitly address the need for increasing coordination. We suggest that merely identifying and describing actors is often not enough since several actors are usually involved in implementing the changes suggested through backcasting – actors whose internal relations are critical when developing an action plan. Increasing coordination among actors therefore becomes a key aspect in promoting change. As this thesis is concerned not only with specific actors within the field of public transport planning but also the coordination between them, it becomes relevant to include actors and aspects of coordination in the backcasting scenario produced through this thesis.

Problem formulation

Seen from a sustainability perspective, there are many challenges around the existing transport system, both nationally and more specifically in the Greater Copenhagen Area. Likewise, there is great potential for strengthening public transport systems. One of the main challenges for such an improvement seems to be the many actors that constitute these systems and the lack of coordination between them. Rather than coordinating activities and visions, the public transport companies are caught in fights over passengers and ticket revenues. The current collaboration in DOT only addresses coordination of very limited elements of the public transport system concerning customer related activities. Additionally, the visions of the individual companies and of DOT are rather short-sighted and do not address the future role of public transport 20, 30 or 40 years ahead.

Backcasting is an approach to address desirable futures by applying a normative perspective, and to support a sustainable transition of our cities and their public transport systems. As such, the purpose of this thesis is to investigate the opportunities and challenges of backcasting to create a shared long-term vision for all public transport companies in the Greater Copenhagen Area. In this case, a long-term vision should be conceived as a vision at a strategic level concerned with holistic planning of public transport. As part of this investigation, the aim is to initiate discussions on the future role of public transport among key actors in the field by showing an example of a backcasting scenario through which these actors can collectively address sustainable transport futures. An additional aim of this thesis is to contribute to existing scientific knowledge on backcasting by investigating how backcasting can contribute to improving coordination between actors. The problem formulation which this thesis seeks to answer is as follows:

Problem formulation:
What are the opportunities and challenges regarding the use of backcasting to create a long-term vision across public transport companies in the Greater Copenhagen Area in order to contribute to improving coordination?

Since the public transport companies in the Greater Copenhagen Area currently collaborate through DOT, it seems relevant to focus on this collaboration. As part of the problem formulation, one sub-question therefore seeks to shed light on the current challenges of coordination:

Sub-question:
What are the current challenges of coordination among the public transport companies and to what degree does the current collaboration allow for creation of a long-term vision?

The answer to this sub-question, which will be described and elaborated in the first analysis, will form the basis of answering the problem formulation in the second analysis.

Methodological framework

The aim of this section is to describe the methodological framework of the thesis, including considerations on the applied methods and how they contribute to answering the stated problem formulation. This entails presenting how the methods affect the results of the analyses conducted in this thesis.

Such considerations are part of a research design ensuring that the collected data can answer the posed research question in an adequate and reliable manner, which is why a research design is needed before collecting data for the subsequent analyses (De Vaus, 2001). In the construction of a research design it is appropriate to reflect on whether the research questions, the collected data and the applied methods and theory are capable of answering the problem formulation in question (ibid.). The methods applied in this thesis to answer the stated problem formulation are visualised in Figure 9.

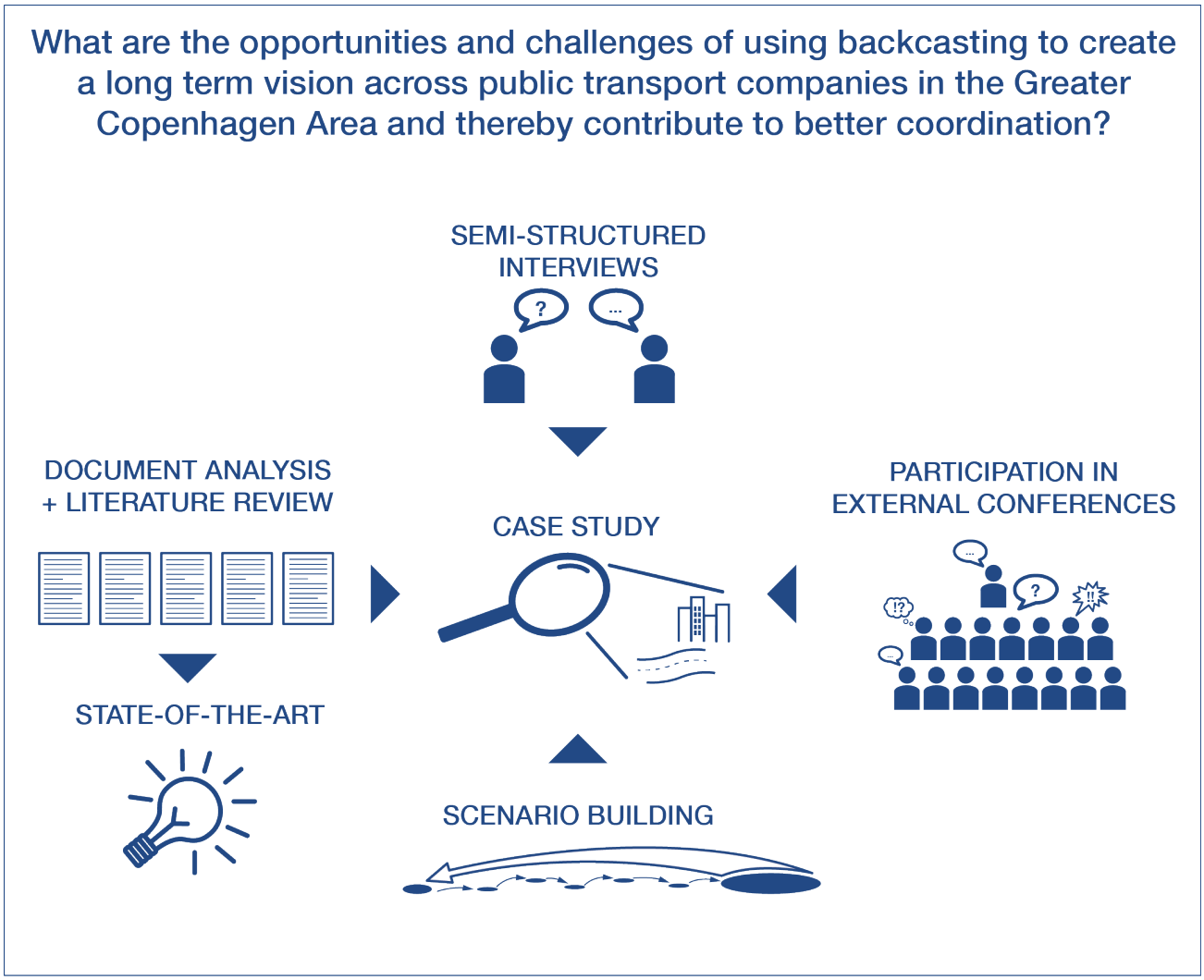


Figure 9. Visualisation of methods applied in this thesis to answer the stated problem formulation.

We perform a case study as the primary methodology, which is informed by data collected through three methods: document analysis and literature review; semi-structured interviews; and participation in external conferences. Furthermore, as this thesis is not only concerned with studying past or ongoing processes in a specific case but also to test the opportunities and challenges of using a specific approach – i.e. backcasting as a potential solution to solve the identified challenges – scenario building through the concepts of backcasting is another method applied to study the case in question. However, since it was not possible to conduct a full participatory backcasting study within the given time frame of this thesis, we have instead built an example of

a backcasting scenario in order to present and test backcasting as a method to the key actors of the specific case (see p. 27 on scenario building). Reflections and justification of all the applied methods will be more thoroughly accounted for in the following sections.

Case study

Since this thesis concerns the opportunities and challenges regarding the use of backcasting to create a long-term vision across the transport companies in the Greater Copenhagen Area, it is necessary to gain in-depth contextual understanding on how the transport companies currently address the challenges and opportunities of the future, both within each individual company and through the collaboration of DOT. This requires a methodological approach that can grasp the complexity of such a real-life situation, including the interests, relationships and areas of responsibility that define how the companies act both individually and in collaboration (Yin, 2014). We have chosen a case study as the primary method because this provides the opportunity to obtain contextual knowledge on the causal processes that take place within and around the public transport sector, and thus allows for understanding why and how certain events are taking place (De Vaus, 2001).

By allowing the researcher to reach a deeper level of detail, case studies can potentially bring forward new knowledge on the given topic which – despite the context dependency – may be transferrable to similar contexts (Richards, 2009; Flyvbjerg, 2006). However, this requires that the researcher is aware of the context-dependency of the study and avoids short-ended generalisations when transferring new knowledge to other contexts facing similar issues (Richards, 2009).

The question of generalisation and lack of credibility when transferring knowledge obtained from one context to another is among the most common criticisms of case studies (Flyvbjerg, 2006). Additionally, critics claim that there is an immediate risk of case studies being used as pure verification biased by the interpretations and subjective views of the researchers (ibid.). However, Flyvbjerg (2006) challenges this view by arguing that these criticisms are if not wrong, then at least oversimplified and misleading. One of his key points is that only through case studies can researchers get the in-depth context dependent knowledge which allows for the researcher to move from a 'rule-based beginner' to a 'virtuous expert' (ibid.). He further argues that when studying cases involving human affairs there appears to exist only context-dependent knowledge and that this knowledge is best obtained through case studies (ibid.). Case studies can thus provide a nuanced view of real life situations which goes beyond rule-based knowledge, and in relation to this Flyvbjerg (2006) stresses the importance of researchers being strategic when defining the case in order to increase its generalisability. He argues that formal generalisation is overestimated as the main source of scientific progress and that more weight should be given to the *force of the example* through case study research (ibid.).

As mentioned in the problem analysis (p. 12) the case of public transport in the Greater Copenhagen Area is different compared to other metropolitan regions in the sense that the public transport sector is constituted by many actors. Therefore, precautions should be taken when generalising the ability of backcasting to generate coordination between entities responsible for transport provision in a delimited area similar to the one studied in this case. However, similar configurations where private actors are involved in the public transport sector exist in other cities, and the case study in this thesis can serve as a generalisable example of such a situation. Also, the analysis can potentially contribute with new knowledge within the field of backcasting especially regarding the current lack of academic knowledge and experience regarding the inclusion of coordination among actors in backcasting studies. In relation to this, the backcasting scenario conducted in this thesis (see Analysis on backcasting on pp. 47-68) puts considerable emphasis on the inclusion of actors.

Document analysis and literature review

The purpose of the sub-question of the problem formulation is to investigate the current level of coordination in DOT, which not only includes various stakeholders but also contradictory perceptions of the quality of this collaboration. It has therefore been important to support data from the qualitative semi-structured interviews with the most objective data possible as these can help to provide an in-depth understanding of the current level of coordination. To accommodate this, we have undertaken a document analysis as a contribution to the qualitative case study of this thesis. Bowen (2009) argues that combining methodologies when studying the same phenomenon adds credibility to a study by highlighting coincidences and conflicting data and statements. In this thesis, the document analysis includes law material defining the tasks of DOT, various analyses on DOT and the possibilities of restructuring the collaboration, quantitative analyses on the expected development within the transport sector, reports from expert groups, and lastly strategies and traffic plans from both DOT and the individual transport companies. These documents have provided an understanding of the interests of the different stakeholders, including how they perceive the future and the need for further coordination, which has been essential when developing the backcasting scenario.

As this thesis investigates the opportunities and challenges regarding the use of backcasting to create a long-term vision across the transport companies, it has been necessary to get a thorough understanding of backcasting and the possibilities and limitations for its use within transport planning. Therefore, we have conducted a literature review as a methodological approach to ensure the inclusion of state-of-the-art knowledge on backcasting in this thesis (see Problem analysis pp. 14-17). This has also helped define which elements of backcasting to apply in this thesis. As a method, a literature review is an appropriate way to obtain a relatively high level of knowledge within a given academic field by learning from existing experiences on the topic in question (Flick, 2009). In-depth academic knowledge on backcasting has – as mentioned above – been of key importance when building the backcasting scenario of this thesis which contributes to answering the overall problem formulation. Furthermore, since this thesis investigates the possibility of backcasting contributing to improving coordination between the transport companies, the literature review focuses on academic backcasting studies in which similar approaches to the importance of actors have been applied.

Semi-structured interviews

This thesis concerns a complex situation in which the viewpoints, interests and responsibilities of various stakeholders are decisive to answering the problem formulation. It is therefore necessary to gain in-depth qualitative knowledge which can represent the perspectives of the transport companies and other relevant actors. We have chosen semi-structured interviews as the primary method for data collection as this approach ensures the creation of similar frameworks for all interviews while allowing individual interviewees to provide more specific information on aspects that he or she finds relevant (Kvale and Brinkman, 2015).

As this thesis is not only concerned with analysing the current situation but also with testing ideas of a potential solution for the identified problems, we have conducted a total of 10 interviews in two rounds as visualised in Figure 10. One round provided knowledge on the current challenges of coordination among the public transport companies in order to answer the sub-question of the problem formulation. The second round allowed for testing the backcasting scenario in order to answer the overall problem formulation. A table of all interviewees, their position, and their specific contribution is provided in Table 2. The interviews have all been recorded and a verbatim transcription (see appendix C) has been undertaken to enable in-depth data analysis (see p. 25).

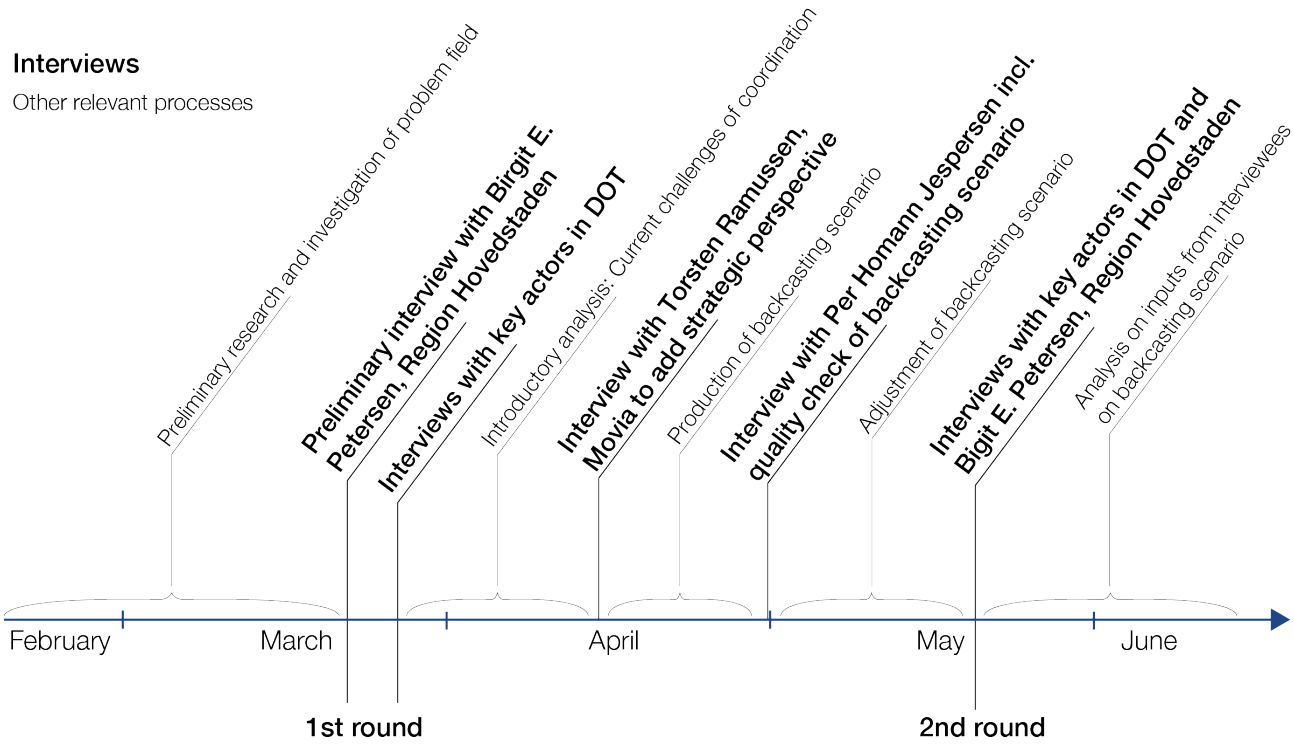


Figure 10. Interviews in chronological order including what elements of the thesis the interviews contributed to.

In the first round we conducted five semi-structured interviews with key actors. Besides providing knowledge on the current level of coordination these interviews also aimed at bringing insight into how the actors perceive future challenges of the transport sector at a more general level, including the future role of public transport. These insights served as useful inputs when conducting the backcasting scenario.

As part of the five interviews, we conducted a preliminary interview with Chief Consultant and Team Leader of Mobility in Region Hovedstaden, Birgit Elise Petersen, since the region has been articulating the need for better coordination within DOT through various analyses and lobby work. This interview thus served as an introduction to the scope of DOT. Additionally, the interviewee recommended the three board members of DOT as key informants in order to gain an in-depth understanding of the existing collaboration. Based on that recommendation, we have interviewed Director of Communications and Branding in DSB and chairman of DOT, Lars Kaspersen, Chief of Staff with responsibility of communication, press, branding and customers and board member of DOT, Camilla Struckmann. Unfortunately, it was not possible to set up an interview with the board member from Metroselskabet, Rebekka Auken Nymark, due to her busy schedule. Instead, we have conducted an interview with Head of Department for Customers and Neighbours in Metroselskabet, Hanne Tærsbøl Schmidt, who has also been deeply involved in the collaboration dynamics of DOT. This was followed by an interview with Chief Consultant in Hovedstadens Letbane, Jørgen Østergaard. However, through this interview it became apparent that Hovedstadens Letbane only plays a minor role in the current collaboration, since the light rail is only a construction project and all administrative tasks of Hovedstadens Letbane are currently undertaken by Metroselskabet. Because of that, this actor was not included in the second round of interviews.

The first round of interviews was based on similar looking interview guides to ensure the possibility of cross-checking answers across interviews (see appendix B1-B2). The interview guides consisted of open-ended questions, giving the interviewees the possibility to elaborate their response beyond the scope of the posed questions (Turner, 2010). In relation to this, we aimed at remaining neutral during the interview in order to avoid indicating a desired answer or showing other emotional expressions towards the interviewees (ibid.).

Because the interviewed actors within DOT are all hired within customer relations – and as this thesis aims at investigating the opportunity to create a long-term vision at a more strategic level – it seemed appropriate to conduct a supplementing interview that might provide considerations into the more strategic planning tasks of the companies. Therefore, the first round of interviews was supplemented by an interview with Divisional Manager at Centre for Transport and Planning in Movia, Torsten Rasmussen, who provided these insights. However, due to the limited time frame under which this thesis was conducted, it was not possible to either conduct or process data from interviews with similar actors within DSB and Metroselskabet. This is a potential shortcoming of this thesis.

Between the two main rounds of interviews, we conducted an additional interview with Associate Professor at Roskilde University and former member of the Congestion Commission Per Homann Jespersen. He is also the chairman of a group of experts who – on the basis of inquiry by Region Hovedstaden – produced a discussion paper on the potential reorganisation of DOT in order to provide better and more cost-effective public transport. The purpose of this interview was to add expert knowledge on the topic of coordination among the transport companies and to test knowledge gained from the first round of interviews in order to ensure reliability and validity of these data. Furthermore, this interview was conducted after a draft for the backcasting scenario had been produced, thus the interviewee could provide inputs and critical considerations on the scenario as a sort of quality check before presenting the scenario to the key actors in DOT.

In order to test the ability of backcasting to initiate discussions on a common long-term vision, the original idea was to organise a workshop. However, as all key actors are busy people it was not possible for them to allocate time on the same day. Instead we settled for a second round of individual interviews with the key actors. Unfortunately, the representative at Metroselskabet refused to meet due to her busy schedule. Furthermore, Lars Kaspersen from DSB postponed the interview twice and ultimately cancelled it, although for the second appointment Kaspersen had invited Rune Jon Jensen, Head of Secretariat in DOT, to participate. In effect, only Rune Jon Jensen in DOT and Camilla Struckmann in Movia took part in the second round of interviews, which constitutes another potential shortcoming of this thesis. The two interviews were supplemented by an interview with Birgit Elise Petersen in Region Hovedstaden, considering that the region acts as an important actor through its lobby work towards a potential restructuring of DOT. The interviewees received a short document on the backcasting scenario (see appendix A1) prior to their interviews. As the focus of these interviews was to gather inputs for the proposed scenario and the associated measures in order to optimise that scenario and analyse the potential of backcasting, we followed a less strict interview guide (see appendix B5), allowing interviewees to more freely elaborate on their responses.

Name and company/authority	Position and academic background	Particularly contributed to the thesis in relation to:
Birgit Elise Petersen Region Hovedstaden	Chief consultant and team leader of mobility Employed since municipal reform in 2007 Academic background: Architect and urban planner	• Overall regional planning for public transport and the role of Region H • Limitations and challenges of current collaboration of public transport companies and the potential for a 'Transport for Greater Copenhagen' • Inputs for final backcasting scenario • Opportunities and challenges of backcasting to initiate discussions on long-term vision
Lars Kaspersen DSB	Director of Communications and Branding Employed since 2012 Chairman of DOT in 2016/17	• Knowledge on current challenges of coordination as understood by DSB • Potentials and limitations of DOT
Camilla Struckmann Movia	Chief of staff with responsibility of communication, press, branding, business plan, and customers Employed since 2015 Board member in DOT Academic background: Master and Law and Master in IT	• Knowledge on current challenges of coordination as understood by Movia • Potentials and limitations of DOT • Inputs for final backcasting scenario • Opportunities and challenges of backcasting to initiate discussions on long-term vision
Torsten Rasmussen Movia	Divisional manager of consultancy in the Centre for Transport and Planning Employed since 1983 Academic background: Civil engineer	• Knowledge on strategic work and visions of Movia • Professional discussions on possible transport futures and scenarios
Hanne Tærsbøl Schmidt Metroselskabet	Head of Department for Customers and Neighbours Employed since 2010 Academic background: Political science	• Knowledge on current challenges of coordination as understood by Metroselskabet • Potentials and limitations of DOT
Jørgen Østergaard Hovedstadens Letbane / Metroselskabet	Chief Consultant Employed since 2011 Academic background: Political science	• Knowledge on current challenges of coordination as understood by Hovedstadens Letbane
Rune Jon Jensen DOT	Head of Secretariat Employed since 2015 Academic background: Economics and Business Administration	• Inputs for final backcasting scenario • Opportunities and challenges of backcasting to initiate discussions on long-term vision
Per Homann Jespersen RUC (Roskilde University)	Associate Professor Academic background: Civil engineer in chemistry	• Expert knowledge on the coordination between public transport companies • Quality check of the backcasting scenario

Table 2. List of all interviewees and their specific contribution to the thesis.

Reflections on interviews – reliability and limitations

During all interviews, we remained aware of potential biases of interviewees given that their willingness to be critical towards their own company might be limited.

The fact that the interviewees in the public transport companies were all hired within customer relations and not the departments undertaking strategic development is another limitation to this thesis. Even though this can cause some constraints on the interviewees' capability to understand and answer questions regarding strategic aspects, it seemed important for this thesis to take its starting point in the current collaboration, i.e. DOT. Therefore, the focus was on gaining thorough insights into the current work undertaken in DOT, including its limitations. In order to make up for this lack, we have also interviewed an employee involved in strategic development in Movia. If more time had been available, it would have been useful to include interviews with similar employees in the other two companies.

Another limitation of this thesis is the lack of interviews with the owners of the transport companies. At this level only Region Hovedstaden is represented. It might have been useful to conduct interviews with other actors at the owner level, i.e. state, municipalities and Region Sjælland, as several of the interviewees have mentioned these as key actors when defining overall strategies of the companies, which in turn would play into the current level of coordination. Again, this was not possible due to time and resource limitations.

Data analysis

In order to process and analyse the qualitative data from the conducted interviews, we have structured relevant quotes from each interviewee in two tables sorted by themes relevant to this thesis (see figure 11) – one for each round of interviews. The table from the first round of interviews gives an overview of differences and similarities between statements of the interviewees and thus highlights their individual role and interests, but also their relations including their different views on the current level of coordination. This way potential conflicts are revealed and the table allows for identification of key findings through comparison and analysis of selected quotes. We applied the same method for the data collected in the second round of interviews where quotes of the interviewees were structured around the different elements of the scenario. In this way it was possible to compare and identify synergies between quotes. Furthermore, this table allows for analysis of the opportunities and challenges of backcasting as an approach to create a long-term vision and thereby contribute to improving coordination since it represents the different views by the interviewees on the topic.

	Lars Kaspersen	Camilla Struckmann	Hanne T. Schmidt	Birgit E. Petersen	Jørgen Østergaard
DOT and its potentials/ limitations	The issues of DOT has mostly been related to the differences in geographic and the different task specifications given by the owners "Jeg tror egentlig det er den der ejerfrom ift. hvad er det du skal som virksomhed, og sådan geografiske områder, er de store udfordringer"	DSB and Movia moving more and more in the same direction, whereas the Region has opposing interests "Men der vil jeg tro, at DSB og Movia er ved at bevæge sig lidt mere i samme retning end regionen måske er." + "Der er jo ingen tvivl om, at Region Hovedstaden f.eks. har jo været ekstremt ude med riven i forhold til Din Offentlige Transport."	Metroselskabet very interested in DOT because half of their customers come from other modes: "Metroens kunder, vi ved jo fra kundeanalyser at halvdelen af vores kunder, kommer enten til/fra et bus eller tog, ikke. Og det i sig selv giver jo hele incitamentet for at samarbejde. " + "Vi vil det rigtig gerne! Og vi vil også gerne at DOT var mere end det er. Og det er jo kompromisets kunst."	DOT not given enough possibilities to secure coordination "man kan ikke sige DOT er svag, man kan sige at de muligheder som har fået, de ikke var tilstrækkelige for at sikre denne her koordinering." Lobbyism to start an evaluation of DOT: "så kører vi så lobbyarbejde i forhold til trafikselskaberne og især Transportministeriet til at få dem til at sætte en evaluering i gang."	-
Challenges of coordination	There is a perception of a need for more coordination, which is not always the best or most effective solution. Better to improve the existing cooperation: "[illegible] tit lavet den der [illegible]"	Main conflicts concern money! Which had lead to some cases brought all the way to court. There is a need to simplify the models to have less complex reltionships with each other, so fewer things can go wrong "Jamen [illegible]"	Need for cultural transformation: "Så jeg tror da også, det er kulturforandringer, som skal gennemføres og forbedre trafikinformationen." Always possibilities for improvement when it is [illegible]ommon	Taking passengers from each other, only thinking about getting more passengers within their own system: "det er dilemmaerne ved den måde man organiserer det på, at man tager kunder fra hinanden, ikke. Man tæller kun på sine egne systemer. Der er mange ting der slet ikke hænger sammen."	The general challenges and barriers of a further coordination is a lack of mandate and economy from the owners that allow the companies to coordinate and do strategical planning together: "Ja man kunne selvfølgelig sige at vi som ejere vil give jer trafikselskaber et større mandat til at sætte jer..."

Figure 11. Example of the data analysis of interviews from first round of interviews, where relevant quotes are structured in an extensive table summarising key findings within main themes.

Participation in external conferences

During the thesis we participated in two external conferences concerned with the future role of public transport in the Greater Copenhagen Area (see appendix D for participant observation notes):

- "Megatendenser og fremtidens transport" (Megatrends and Transport Futures) organised by Region Hovedstaden on the 6th of April 2017
- "Hvordan får vi mere og bedre kollektiv trafik for pengene?" (How do we get more and better public transport for our money?) organised by Region Hovedstaden on the 9th of May 2017

Participation in these conferences has given useful insights into current discussions on the future transport sector among key actors in the field, revealing relevant aspects on their relationships, viewpoints and interests. Likewise, both conferences have served as a medium through which we could make ourselves visible in the discussion.

The first conference was centred around a report on megatrends and the future role of public transport in Greater Copenhagen Area conducted by Metroselskabet and Hovedstadens Letbane and financially supported by Region Hovedstaden (Metroselskabet and Hovedstadens Letbane, 2017). At this conference, there was evidence of consensus around the uncertainty of the future transport sector among key actors in the field especially in terms of both technological innovation and structural development such as urbanisation. We further observed that the participants agree that discussions on how to address future challenges are needed. Furthermore, the presentations at the conference accounted for viewpoints on how these future challenges could be addressed, which served as inputs for narrowing down the problem field of this thesis. Lastly, the conference made it possible to establish two important contacts. One with Professor Glenn Lyons from the University of the West of England, Bristol who gave a presentation on the need for practitioners to adopt more normative planning approaches in order to address the aforementioned

uncertainties. He gave advice on how to apply more normative scenarios and what pitfalls to be aware of when building scenarios. At the conference we were given the chance to shortly discuss our thesis and the use of backcasting with him. Additionally, we gained contact to Per Homann Jespersen.

The second conference was organised as a discussion meeting with a more concentrated focus on the potential reorganisation of DOT as a way to achieve better and more cost-effective public transport. More specifically the meeting was based on two specific pieces of work by Region Hovedstaden: an analysis of organisation in other metropolitan regions conducted by the consulting firm COWI; and the aforementioned discussion paper on a potential reorganisation of DOT conducted by a group of experts led by Per Homann Jespersen. Participants were all key actors involved in the public transport sector, including the board members of DOT. A great share of the meeting was dedicated to discussing coordination among the public transport companies in which we participated actively. The discussion gave new inputs for the conducted analyses of this thesis as well as insights into the relationships between the actors. The meeting also served as an opportunity to present our example of a backcasting scenario to key actors within the field, including handing out a leaflet (see appendix A2) to all participants.

Scenario building

Since part of this thesis is concerned with testing potential solutions to the identified challenges of coordination through backcasting, it has been essential to create an example of a backcasting scenario. To create such an example, the initial idea was to conduct a workshop with the three board members of DOT in order to involve them as active participants in a participatory backcasting approach (Wangel, 2011a). Such a workshop would both serve as a real-life test of the opportunities and challenges of backcasting as an approach to create common visions, as well as allow for observation of the actors' willingness and ability to collaborate. However, as mentioned above, it was not possible to find a date where all actors could participate. Instead, we have built an example of a backcasting scenario with the purpose of presenting it to the involved actors in order to observe and analyse their responses. Data for this scenario came from a broad range of qualitative sources, including interviews, participant observation notes from conferences, external analyses and other similar scenario studies, as well as plans and strategies of the transport companies. Furthermore, the scenario building was based on knowledge acquired through academic literature on backcasting.

Due to limited time, resources and data, it has not been possible to conduct a full backcasting study but rather we conducted the scenario with enough level of detail for the actors to understand backcasting as an approach to create long-term visions and connect such visions to actual initiatives. Since a full backcasting study could not be conducted, our focus has been to create one normative vision which contains several themes that set a direction for its realisation. We then applied backcasting to one theme in order to act as an example of the methodology in terms of identifying which specific measures are required for the realisation of this theme. This is visualised in Figure 12. It should be stressed that it has not been a success criteria for this thesis to reach a situation where all interviewees agree with the proposed scenario, but rather the scenario should serve as a basis for discussing the potential for a common vision and how backcasting as an approach might serve to create such a vision. A similar approach has been adopted by Kok et al. (2011), where various backcasting scenarios including action agendas (similar to policy packages) were developed through a broad participation of actors with the purpose of initiating discussions.

To give a thorough description of how and why the scenario has been built – including methodological considerations – we will elaborate on each element of the scenario building in the following.

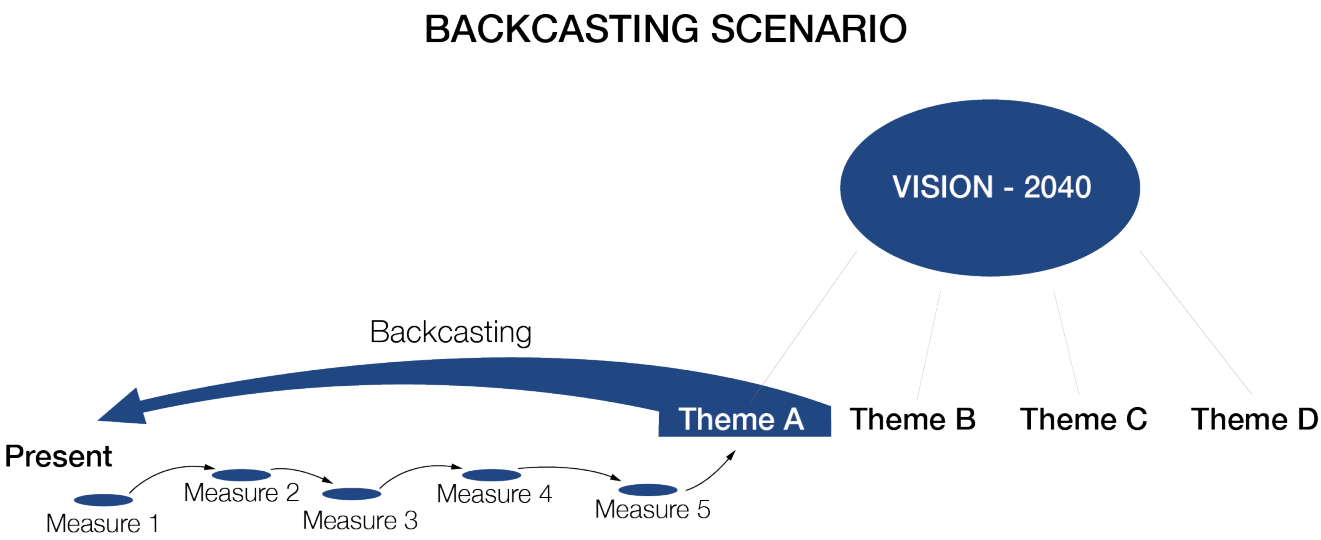


Figure 12. Backcasting scenario, where backcasting is applied to one theme of the overall vision in order to identify and describe the measures for its realisation.

Vision

As described in the literature review (see Problem analysis pp. 14-17), the key purpose of backcasting is to work backwards from a normative endpoint to identify and describe the measures required for its realisation. Backcasting studies, especially target-orientated backcasting, often involve setting a quantitative goal as an endpoint (Wangel, 2011a). However, in the vision produced in this thesis, the normative character derives from a qualitative description – a kind of narrative – of the future role of public transport in the Greater Copenhagen Area by 2040. The vision is presented in Figure 17 on p. 48. Year 2040 seemed as an appropriate timeframe since it is not too extensive for the transport companies to relate to, and yet long enough to allow for substantial transitions. It is evident that the realisation of a qualitative vision allows for a broader margin of interpretation compared to a quantitative goal, e.g. a specific CO_2 reduction target. However, it was not possible to set a quantitative goal due to lack of data on how the identified measures could contribute to achieving such a goal. We also found it likely that a quantitative goal could potentially work against the purpose of applying a backcasting approach, i.e. to initiate discussions on the future role of public transport. Furthermore, qualitative visions have been applied in path-orientated backcasting studies as a way to explore the path to realise the goal and thereby what measures to include (Järvi et. al., 2015; Höjer et. al., 2011). However, if a full backcasting study were to be conducted on the case in question, it would eventually be necessary to define a more overall quantitative goal.

The overall focus of the vision was inspired by the first round of interviews which included questions regarding challenges of the current coordination, the possibilities of creating a common long-term vision within DOT, as well as questions regarding the main challenges of the future transport sector. Through a synthesis of these data we have created a vision that highly favours public transport in order to support the interests of the public transport companies. With the lack of direct involvement of actors in the creation of the vision, awareness has been given to our potential subjectivity and biases. However, by deliberately focusing on making the vision as relevant as possible for the key actors, we have sought to eliminate subjectivity and biases. Furthermore, the legitimacy of the vision is ensured through testing it with the actors.

Themes

As the realisation of the proposed vision entails a broad range of measures, the implementation and realisation of which depend on various actors, including different regulatory means, the measures have been arranged according to a number of themes. The themes act as policy packages – a concept commonly applied in various backcasting studies (Hickman and Banister, 2007). Each theme provides realisation of parts of the

vision, meaning that the themes should both be seen as both separate but also interlinked, as it is necessary to carry out all themes in order to reach the desirable future described in the vision. The themes have emerged from our internal discussion on what it would require to realise the vision. Through this discussion it became apparent that some aspects of the vision related to measures of spatial planning, some to investments in infrastructure, some to technological innovation in terms of fossil free technologies, while others related to the coordination between traditional public transport modes and other modes of transport – in other words the concept of Mobility as a Service (MaaS). MaaS is a shift away from personally owned vehicles towards seeing mobility as a service by combining traditional modes of public transport with other transport modes such as shared cars, bicycles etc. into a unified system and holds great potential for future transport systems (McCluskey, 2016).

Due to time and resource limitations, we only applied backcasting to one of these themes in order to identify specific measures for its realisation. The theme chosen for more detailed analysis was the theme most closely related to the collected data, i.e. MaaS (see pp. 50-51 in Analysis on backcasting). Furthermore, as the purpose of this thesis is to test the opportunities and challenges of applying a backcasting approach rather than to conduct a full backcasting study, it did not seem necessary to provide further details on more than one theme.

Measures

Likewise, we identified the measures needed for realising the theme through our internal discussion based on the qualitative data collected through the thesis. Especially the conference on the future role of public transport and the interview with the strategic planner in Movia contributed with important inputs on the potential for MaaS, including the necessary steps for its development. Cases from other cities/regions where similar measures have been implemented were also included as important sources of inspiration and legitimisation of the proposed measures. Knowledge on the process of such cases and the timeframe of their implementation contributed to estimating the sequencing of implementation and to understand the relations between individual measures. Since all measures rely on uncertainties in terms of certain technologies or other development processes, we stressed that the proposed measures and timeframe for their implementation should serve only as a guideline when presenting the backcasting scenario to the actors.

One important element of each measure has been to identify and describe key controversies and the necessary actor configurations to address these. This has been done in order to not just describe what and why each measure should be implemented but also to give attention to who should implement the measures (Wangel, 2011a; Wangel 2011b). As described in the problem analysis on p. 17, the lack of inclusion of actors is a shortcoming in many backcasting studies, and since this thesis is concerned with the coordination between actors we found it appropriate to keep a strong focus on actors. This focus on actors will be elaborated more thoroughly in the theoretical framework on p. 30.

Theoretical framework

The purpose of this section is to account for the selection of Actor-Network Theory (ANT) as a viable theory to contribute to answering the posed problem formulation. This includes an introduction to the theory and its overall purpose. Secondly, the main concepts of the theory will be explained. This will be followed by an explanation of how the theory is applied to the case studied in this thesis.

Justification for using ANT

The aim of this thesis is to investigate how backcasting can be used to create a long-term vision and in order to contribute to improving coordination across the public transport companies in the Greater Copenhagen Area. As these actors have opposing and conflicting interests that complicate coordination, the selected theory must be one that allows for studying this complexity. Furthermore, since one of the purposes of this thesis is to suggest changes to current ways of planning for public transport and thereby improve coordination among public transport companies, the theoretical framework must allow for analysing *change in the making.*

ANT is a theory of socio-technical change and stability that considers science and technology as social processes and provides an analytical framework for studying the dynamics of science production. Thereby ANT can work as a lens for analysing change in the making. A main assumption of ANT is that change and stability is constituted by controversies among actors since agreement or disagreement on these controversies defines relations between actors. In relation to this, any technological system or artefact, scientific claim or social organisation is constituted by a network of both human and non-human actors. The stability and strength of such an entity is associated with the intensity of controversies, the interconnectedness between actors and thus also the level of coordination within the network. By studying controversies between actors, ANT can therefore serve as a useful theory in analysing coordination among actors as in the case of public transport companies in the Greater Copenhagen Area.

ANT was first proposed in the 1980s by Michel Callon, Bruno Latour, John Law, and many others and grew out of the field of Science and Technology Studies (STS). STS is a dynamic interdisciplinary field of studies that consider science and technology as part of society by identifying a strong relation between scientific development and societal change (Sismondo, 2010). As part of this relation, STS assumes that technology and science are social activities and therefore investigates how scientific knowledge and technological artefacts are constructed as human products (ibid.). Through this assumption STS subscribes to the theory of social constructivism in which technology not only shapes human action, but likewise human action shapes technology. STS emphasises the ways in which scientists and engineers attempt to construct stable networks and structures and consequently how knowledge and artefacts are constitutive of collectives and societies (ibid.).

Since its formation, ANT has been continuously developed by several researchers, leading to the ANT terminology constantly changing. However, in the following section the key elements of ANT applied in the analysis of this thesis will be accounted for.

Key elements of ANT

The primary methodology of ANT is to track and follow *actants* over a process of change. An actant can be any actor, human or non-human, endowed with the ability to act, i.e. “an actor is anything doing something” (Venturini, 2009, p. 266). ANT scholars claim that isolated actors do not exist as actors are always composed by and constitute networks (ibid.). According to Callon et al. (1986) the purpose of ANT is to analyse the relations between actors within interlinked *actor-networks* in which actors exert influence on each other in order to redefine the network to support a certain outcome. ANT is thus a framework that allows for revealing the relationships and the level of coordination between actors during a process of change. As part of the study of any process of change it is useful to explore the moments of controversy – the situations where actors disagree (Venturini, 2009). Exploring controversies is an effective approach in tracking and following actors,

since controversies function as "a space of conflict and negotiation" (ibid., p. 261), thus studying controversies can work as a lens through which relations between actors can be analysed. Furthermore, since controversies and relationships between actors are dynamic, time is an important factor when analysing processes of change, and therefore a temporal view must be considered.

The main concept of ANT is the process of forming actor-networks, which are seen as heterogeneous networks of aligned interests (Latour, 2005). These heterogeneous networks encompass technological, social, economic and political dimensions (Rydin, 2012). A stabilised actor-network is the outcome of a series of negotiations between actors who over time have successfully formed a network. Such a stabilisation is not permanent but can certainly be persistent (Callon et al., 1986). Actors within a network can have different interests and such a viewpoint of a particular element in the network represents another central concept of ANT, i.e. the *spokesperson*. The nature of the spokesperson is one with the capacity and wish to enrol or displace other actors and thus one who can facilitate and steer a process of change (Callon, 1986). Even though the spokesperson succeeds in establishing consensus and alliances it is still important to note that these can be contested at any moment (ibid.). Therefore, an actor-network is never a completely stable thing but rather a thing in the making.

The process of *translation* is another key concept of ANT according to Callon (1986). Translations are what happens when actors attempt to transform other actors to allow an actor-network in support of a certain aim to be established. In effect, translation is a strategic approach to change in which alliances and alignments between actors are established. Since all actors will hardly ever agree on a common outcome within any given network, the process of translation is thus a process "during which the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited" (Callon, 1986, p. 203). Translation thus refers to the way in which agency among actors is negotiated (Rydin, 2012). To translate someone is to make other actors work differently than before as an approach to bring about change. Therefore, to translate is also to displace (Callon, 1986). To translate another actor is to establish oneself as a spokesperson by expressing in one's own language what others say and want, how and why they act in certain ways – and if the process is successful, no actor will oppose the desired outcome of the spokesperson (ibid.). Thus, during a translation process actors attempt to reach agreement on an outcome that will benefit all actors in the network (Callon et al., 1986), however, it should be noted that translation is always a process and never a completed accomplishment (Callon, 1986). According to Callon (1986) the process of translation consists of four steps, even though not all four are required in all processes:

> *Problematisation* – A querying of the current standpoint of an actor and the introduction of a dilemma, which suggests that the actor can either agree with the spokesperson – and in doing so receive a mutual benefit from solving their outcomes – or be displaced and instead exist outside of the given actor-network. Through the problematisation, the spokesperson frames the problem, determines a set of actors and defines their identities, and consequently renders herself indispensable to other actors in the actor-network.
>
> *Interessement* – In the interessement, the spokesperson attempts to impose, strengthen and stabilise the identity of the other actors in the network who were defined through the process of problematisation. Different interessement devices, e.g. physical artefacts, regulatory measures etc. can be used for this stabilisation of identity of the actors.
>
> *Enrolment* – the definition and distribution of a certain role to the actor in the new actor-network. Enrolment is achieved if the interessement is successful. The distribution of roles is thus the result of negotiations during which the identity of the actors is determined and tested.

> *Mobilisation* – the successful enrolment of an actor. This enables the spokesperson to make use of the actor in the actor-network in support of the desired outcome – the actor has become mobilised.
>
> (Based on Callon et al., 1986; Callon, 1986)

Another concept of the process of translation relates to how the relationships between actors are defined by *intermediaries* passing between them, of which four main types exist: literary inscriptions, technical artefacts, regulation, and money (Callon, 1990). More specifically, in relation to the field of planning, Rydin (2012) points to the role of planning documents as intermediaries to bring actors into relationships with each other. Translation can be said to *go through intermediaries* (Latour, 1996) and intermediaries can therefore assemble actors and contribute to defining their internal relationships.

For the more practical use of ANT, the concept of *simplification* is an essential element. Each network can be said to consist of an unlimited number of actors, so without considering some networks as simplified and stable, analysis of actor-networks would be almost impossible. Such a *stabilisation* is often fostered by processes of standardisation, classification and calculation, which nevertheless are often hidden in *black boxes* (Rydin, 2012). From an ANT perspective, technological development is considered as processes of stabilisation or *closure* where controversies decrease in intensity or where the interpretation of an artefact becomes more and more stable. At some point, the artefact will be so resistant to change that it becomes almost impossible to change it – a black box has been established (Jæger, 2000). An example is the metro of Copenhagen which is a simplification of a wide variety of relations between both human actors – like politicians and planners in the Municipality of Copenhagen, the Municipality of Frederiksberg and the Ministry of Transport, Building and Housing; technical personnel, and private companies – and non-human actors like the technical components in terms of metro trains, rails etc. For daily users, however, the metro is only considered a mode of transport and all those relations are not questioned. It is these relations between actors that allow for simplifications and a black box is therefore seen as certain areas within networks where the relationships between actors are unchallenged and thereby taken for granted (Rydin, 2012).

Applying theory to the case

The majority of case studies based on ANT are retrospective analyses of successes or failures in innovation and technological development (Akrich, Callon, Latour and Monaghan, 2002). An example is Bruno Latour's attempt to explain the failure of implementing Aramis – an automated train system during the 1970s and 1980s in Paris – not due to any particular failure but as a set of failed coordination of actions among politicians, planners, technical personnel, private companies etc. (Latour, 1996).

However, in this thesis the methodology of ANT is applied to processes *in the making* in order to assess the current level of coordination among the transport companies. Furthermore, the purpose of applying ANT is to identify actor configurations and explore controversies in order to depict the necessary translations over a process of change towards a strengthened public transport sector, including improved coordination among key actors. By proactively applying theoretical frameworks of STS during a process of change, the analysis thus allows for inclusion of otherwise transparent elements implicit in the assumptions and paradigms of the involved actors (Elle et al., 2010). Additionally, when one explores controversies in change processes, issues are best studied when they are still unresolved as controversies rapidly lose all interest once agreement has been reached or the discussion has been closed (Venturini, 2009). Past issues can therefore only be investigated if one can move back to the moment in which the controversy played out (ibid.). Instead, more is revealed to the observer when systems and networks are not yet stabilised among the involved actors than is the case for an already stable system (Elle et al., 2010). Applying theories within STS to ongoing processes is therefore a natural and consistent continuation of the original idea upon which STS is built (ibid.).

Applying ANT to the case of this thesis can both shed light on controversies and relations between the involved actors – including how actors try to exert influence on each other – as well as the role of non-human

elements such as planning documents and regulatory measures. At present, since DOT is the main coordinating network of actors, the analysis will be based on studying agreements and disagreements within the DOT collaboration. However, DOT is still in the phase of establishment and some actors in the transport sector currently try to influence the collaboration in order to increase coordination. Looking into this ongoing process and the controversies of establishing coordination among the public transport companies can thus serve as an indicator for the opportunities and challenges regarding the use of backcasting to create a long-term vision in order to contribute to improving coordination.

Analysis on current challenges of coordination

The aim of this is analysis is to assess and understand the current challenges of coordination across the public transport companies in order to analyse to what degree the current collaboration allows for creation of a long-term vision. First of all, we will provide in-depth knowledge on how and why DOT was formed, since this can contribute to shedding light on key controversies and how different actors influenced the processes that led to the formation of DOT. Next, we turn our attention to the achievements of DOT in order to analyse how the involved actors perceive the current situation and what challenges they relate to the existing collaboration. In relation to this, DOT has been criticised from different sides since its establishment, a critique which on examination can contribute to highlighting the ongoing controversies related to the current lack of coordination. In continuation hereof, we identify and analyse four key challenges related to the current coordination among the public transport companies: focus on optimisation within each company rather than the public transport system as a whole; lack of incentives for long-term holistic planning across the companies; different ambitions for the collaboration in DOT; and limited coordination of long-term investments between the companies.

Through the perspectives of Actor Network Theory the analysis will shed light on the internal processes related to these challenges and thereby unravel the controversies between actors and how these affect the current level of coordination. The section closes with a discussion on the degree to which the current collaboration in DOT allows for creation of a long-term vision.

The formation of DOT

Different forms of rather informal collaborations between the public transport companies in the Greater Copenhagen Area have existed since the 1970s around tasks such as improvement of stations and establishment of a common ticketing system across transport modes (Trafik-, Bygge- og Boligstyrelsen, 2017). However, a 2005 law dictated a more formal collaboration. The main purpose of this *Law on transport companies* was to dictate how bus companies should be organised in relation to the municipal reform in 2007, but for the Greater Copenhagen Area the law also required that a collaboration must be established between Movia, Ørestadsselskabet (which later became Metroselskabet) and DSB, and that a yearly status report containing results and suggestions for improvements should be produced (Transport- og Bygningsministeriet, 2005). This collaboration was implemented through the "Direktørsamarbejde" (Collaboration of Directors) coordinated by Trafikstyrelsen. The new law gave rather free reins to the public transport companies in defining the tasks, but the collaboration was characterised by many internal conflicts and, according to Director of Communications and Branding in DSB, Lars Kaspersen, it never worked out as intended:

> "Earlier, we took part in a collaboration in the Greater Copenhagen Area where the Directors met and it did not work out. I think the transport companies made a mistake, that instead of making it work, it simply did not work out."
>
> (Kaspersen, 2017)

The Direktørsamarbejde was criticised by many actors who started questioning the organisation of public transport in the Greater Copenhagen Area, which is visualised in Figure 13.

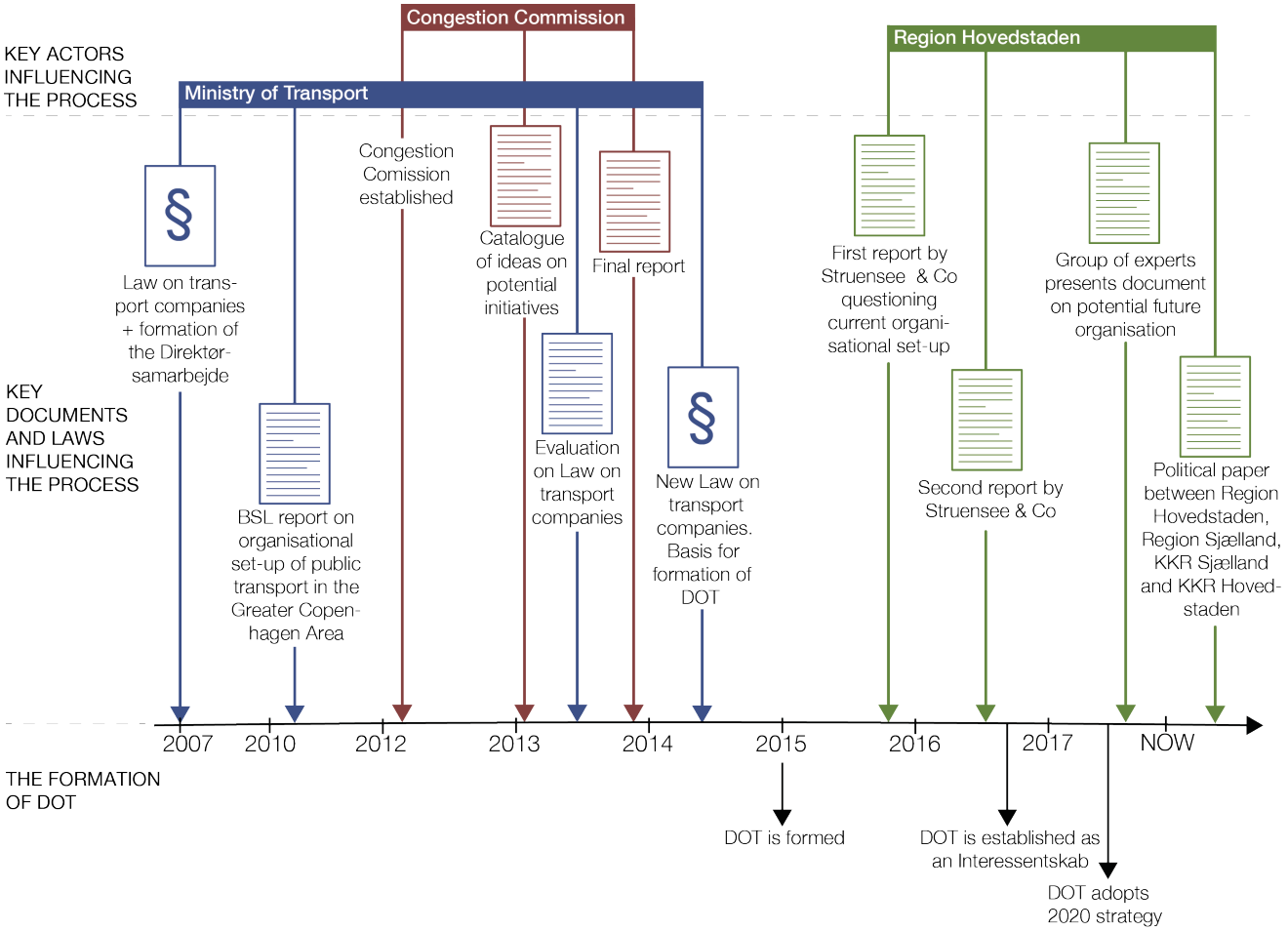


Figure 13. Timeline showing the important events, documents and laws in relation to the formation of DOT including how different key actors try to influence collaboration among the public transport companies.

The Ministry of Transport acted as the main spokesperson in this period of criticism, producing several documents which questioned the lack of coordination. The first of these, a 2010 report ordered by the Ministry from the German consulting firm, BSL, emphasised the dysfunctionality of the Direktørsamarbejde. The report pointed out that the collaboration had no real power to enforce decisions on its members and that this structure, which solely depended on the commitments of participants, did not solve any real coordination tasks such as integrated planning of public transport supply, common marketing, and real time information across transport modes (BSL, 2010). The report highlighted that, individually, all public transport companies acted professionally and innovative in attracting customers to their specific transport mode, but rather the challenges concerned the organisational set-up which only to a very limited degree allowed for coordination (ibid.). As a solution, BSL suggested the creation of *Transport for Greater Copenhage*n – an umbrella organisation at the coordination level which would be responsible for long-term transport planning, design of overall passenger information system, marketing and communication, unified customer care etc. This organisation would thus take over these tasks from the public transport companies who in turn would merely become operators (ibid.) – see Figure 14. Even though this report did not lead to any immediate consequences for the public transport companies, it was part of a process of problematisation in which the Ministry of Transport started to question the current collaboration by investigating alternative organisational set-ups, in which identity and agency of the public transport companies could be distributed differently.

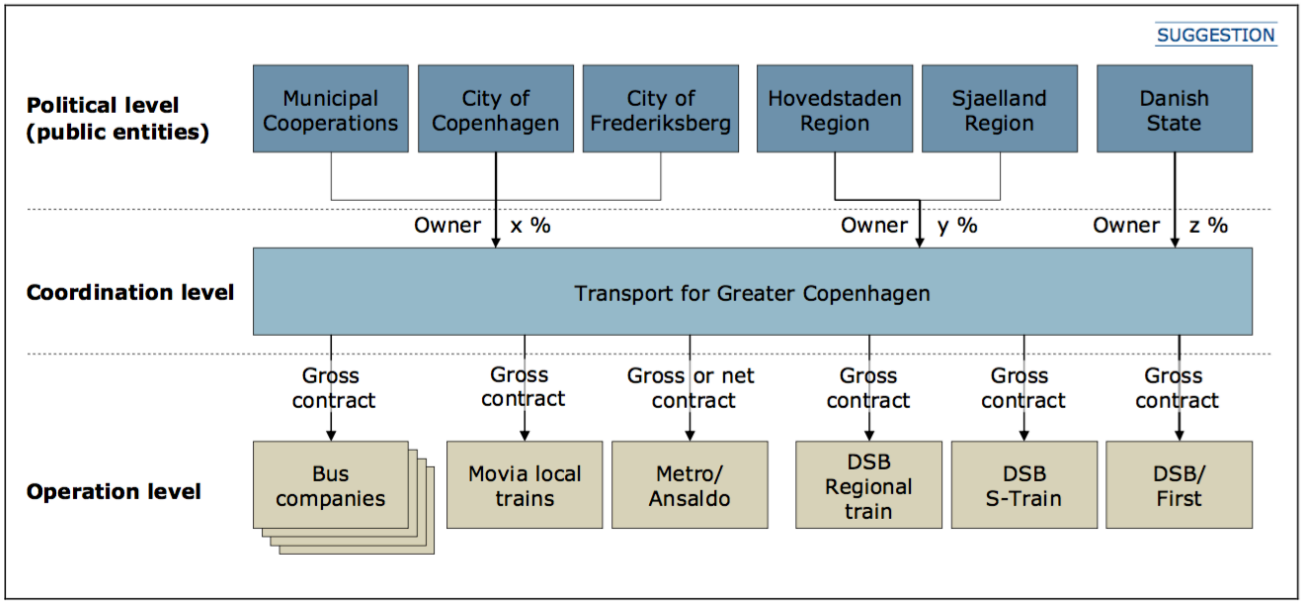


Figure 14. A Transport for Greater Copenhagen as suggested by BSL (BSL, 2010, p. 40)

The next attempt to question the Direktørsamarbejde came in 2012 when the Congestion Commission was set up by the government at the time to analyse current and future challenges of the transport system in the Greater Copenhagen Area, and to propose a strategy that would both reduce congestion and air pollution as well as modernise the infrastructure in the area. Among the many suggestions (49 in total) was the proposal of a new organisational structure of public transport in the Greater Copenhagen Area (Trængselskommissionen, 2013a). In concrete terms, four different models of organisational set-ups with different levels of integration were proposed, ranging from a consolidation of the companies into one – in line with the BSL report – to an umbrella organisation with a low level of integration, containing a limited number of tasks only concerned with customer related activities – i.e. an organisation like the current DOT (ibid.). The main focus of the proposal was to take point of departure in the mobility needs of customers by allowing for quick and effective contiguous trips across different public transport modes, but also to establish coordination of strategic long-term planning of public transport (ibid.).

Based on the suggestions of the commission, first presented in a catalogue of potential ideas in February 2013 (Trængselskommissionen, 2013b), an evaluation of the 2005 law on transport companies was undertaken by the Ministry of Transport simultaneously with the final reporting of the Congestion Commission. The Ministry was beginning to lose both patience with Direktørsamarbejdet and confidence in the ability of the transport companies to facilitate and improve coordination themselves (Kaspersen, 2017). The evaluation identified how a considerable share of the customers do not perceive public transport as one coherent system due to the lack of coordination between the actors within public transport in the Greater Copenhagen Area (Transportministeriet, 2013). The evaluation acted as a powerful document suggesting different models for re-organisation: an expanded version of the “Direktørsamarbejde”; an umbrella organisation; and a model with maximum integration (ibid.). Based on the evaluation, the Ministry recommended an umbrella organisation as the best possible solution to solve the identified coordination challenges concerning customer related activities. This model was comparable to the least ambitious model suggested by the Congestion Commission – one may suggest that the Ministry lobbied for this model because they wanted a solution that would cause the least conflict between the public transport companies and thus would be easier to implement. In relation to this, especially DSB's opposition to organisational restructuring seemed to weigh in heavily, considering that – as a national company – DSB exerts significant influence on the Ministry, as several interviewees point out (Jespersen, 2017; Petersen, 2017). Furthermore, the suggested

umbrella organisation model acted as a response to some very specifically defined challenges concerning customer relations while it failed to address challenges at a more strategic level.

Based on this, the Ministry requested that the public transport companies themselves suggested a common model for such an organisational change (DSB, Metroselskabet and Movia, 2013). This led to the approval of the 2014 Law on transport companies (Transport- og Bygningsministeriet, 2014) which forced through a more formalised umbrella organisation across the public transport companies around specific tasks concerning customer related activities. The law thus acted as an intermediary through which the Ministry of Transport forced the actors to collaborate and improve their relations. Based on the law, which gave rather free reins as to exactly how the umbrella organisation should be constituted, DOT was finally formed in January 2015 and was later established as an *Interessentskab* in November 2017. An interessentskab (I/S) is a Danish form of partnership of at least two owners, who are personally liable.

Even though the law removed some autonomy from the companies to facilitate the collaboration themselves, the public transport companies acknowledge that the numerous conflicts between them, along with the fact that the Direktørsamarbejde was achieving very few results, made it necessary to force through a more formalised collaboration (Kaspersen, 2017: Struckmann, 2017). By being forced to collaborate, there has been a growing realisation among the companies that they are mutually dependent on each other and can each benefit from collaborating – a cohesion that, according to Movia, will only grow as DOT achieves more and more results (Struckmann, 2017). We therefore suggest that the law and the negotiations between actors during the formation of DOT has distributed somewhat new identities to the three public transport companies, in which internal relations have been improved as the companies have slowly started realising their interdependency.

Main achievements of DOT

Since DOT was formed in 2015 it has been undergoing a process of stabilisation in which former controversies between the public transport companies have decreased in intensity. In relation to this, all the actors in DOT highlight how they have been struggling to reach agreement – first of all on how to formally constitute the company (Kaspersen, 2017; Struckmann, 2017; Schmidt, 2017). One key aspect of these disagreements is the fact that the companies have different ambitions regarding the collaboration in DOT (see pp. 44-45), although they still succeeded in reaching agreement on the 2020 strategy. The main focus of the strategy is value creation for customers as well as for the three companies through improving marketing and branding, travel information, correspondence between transport modes, etc. (DOT, 2017). The strategy includes five strategic goals concerning customer related activities and several key performance indicators (KPI) are defined for each goal. These indicators are measured through the customer satisfaction survey, as exemplified in Figure 15 (ibid.). The next step for DOT is to convert each strategic goal into a more concrete action plan.

Gode skiftemuligheder og korrespondancer	Skala	jan-15	maj-15	sep-15	jan-16	jun-16	nov-16	Målforslag 2020
Jeg oplever, at køreplanerne er afstemt mellem bus, tog og metro, så jeg undgår ventetid	10	4,5	4,5	4,3	4,5	5,0	4,7	6,0
Overensstemmelse mellem den information, jeg får igennem forskellige informationskanaler på rejse	10	5,9	5,8	5,7	5,9	5,9	5,6	8,0
Brugbar information når jeg skal skifte fra et offentligt transportmiddel til et andet	10	5,1	5,3	5,1	5,3	5,7	5,4	7,5
Brugbar trafikinformation når der ikke er forsinkelser	10	5,7	5,7	5,6	5,8	5,6	5,4	6,5
At skifte mellem/sammenhæng mellem transportformer	10	-	-	-	-	-	-	+ 25 pct.

Figure 15. Example of KPI's related to the customer satisfaction survey of the strategic goal *Correspondence between transport modes* (DOT, 2017, p. 5)

The main purpose of the strategy is to maintain current passenger numbers in a period where numerous changes to the system will occur due to the many new developments in infrastructure (Jensen, 2017; Struckmann, 2017). As such, Movia sees DOT as a collaboration addressing current customer needs, i.e. helping customers through the coming period and thereby achieving maximum return on the investments (Struckmann, 2017).

Seen from a more strategic sustainability perspective, under which improved coordination between public transport companies is deemed necessary in order to strengthen the future public transport system, it is not enough to address very specific challenges on the short term. Seen from this perspective, the current strategy of DOT is therefore unambitious as it does not address any strategic coordination challenges on the long term. This view is supported by some informants who are critics in the field, like Region Hovedstaden and Associate Professor at RUC Per Homann Jespersen (Petersen, 2017; Jespersen, 2017). The actors in DOT themselves, however, see the strategy as very ambitious:

> "It is an alignment of what one [the public transport companies] should work for – with some very clear and specific targets [KPI's] on what to achieve with this collaboration by 2020. And the targets are very ambitious!"
>
> (Struckmann, 2017)

The fact that they perceive the strategy as very ambitious, and that they see it is a great achievement to have reached agreement, indicate how malfunctioning the former Direktørsamarbejde was. Even though the strategy can be evaluated as unambitious, it still shows a clear improvement of the collaboration among the public transport companies. According to several interviewees, the current DOT can thus potentially act as a stepping stone for expanding the areas of responsibility in the near future (Struckmann, 2017; Petersen, 2017; Jensen, 2017).

Criticism since the formation of DOT

Despite the acknowledgement that collaboration between the public transport companies has improved since the establishment of DOT, it has been criticised by different actors of which Region Hovedstaden has offered some of the harshest critique. Examining the critique points put forward by Region Hovedstaden helps highlighting the current challenges of coordination seen from the perspective of an actor at owner level.

Region Hovedstaden sees a great need for improved coordination beyond activities concerning customers and – based on outcomes from the Congestion Commission among other things – they believe that DOT was the lowest common denominator (Petersen, 2017). Their interests mainly stem from their work on regional development through the regional growth and development strategy (ReVUS) (Region Hovedstaden, 2015), as well as their economic interests in Movia, considering that Region Hovedstaden invests approximately DKK 0.5 billion in operating busses per year – equivalent to 50% of all their available funds for regional development. In order to bring down spending, they have a substantial economic interest in making public transport more cost-effective, at least within Movia.

Region Hovedstaden seeks to establish itself as a spokesperson trying to facilitate a discussion on the current level of coordination and a process of change towards an expanded version of the current DOT. This discussion is especially informed by the issues of congestion and its negative environmental and socioeconomic effects. The main argument is that by adding responsibilities beyond customer related activities, and by increasing the decision-making power of DOT, the collaboration is better geared toward improving coordination across public transport modes and thereby also across the companies (Petersen, 2017). Nevertheless, Region Hovedstaden acknowledges the fact that DOT is a substantial improvement over the Direktørsamarbejde:

> "Now they have chosen this order of musketeers – that everything they do together is fantastic. And that is actually very good in comparison to the old Direktørsamarbejde, but it is simply not enough. We want them to go further."
>
> (Petersen, 2017)

The first attempts to address the issues of coordination were through two reports produced in 2015 and 2016 by the consulting firm Struensee & Co. The first report questioned the organisation of transport companies and suggested three concrete models for increased integration (Struensee & Co, 2015). However, this was heavily criticised by actors who did not believe Region Hovedstaden ought to interfere. During the interview conducted for this thesis, the interviewee from Region Hovedstaden did not explicitly reveal from where and whom this opposition came. As an example of this delicate matter, in the following the interviewee explains how municipalities were calling them to say that "they did not want this and that model" and how the involved actors felt their positions were threatened:

> "Because everybody starts to think: am I a Director in such a new organisation? Am I still Leader or Head of Department? Am I even employed? This is how people instantly start to think, right? That is a very natural thing to do."
>
> (Petersen, 2017)

Due to the threat of potential reorganisation – which to a certain degree existed since the Ministry of Transport first started to question the lack of coordination – the public transport companies promptly defended their own positions, a reaction we observed during the conference "Hvordan får vi mere og bedre kollektiv trafik for pengene" (see appendix D2).

Because of the negative response to the first report by Struensee & Co, the focus in their second report was changed slightly towards finding ways to improve DOT within the current legislative framework, rather than suggesting a complete reorganisation of the public transport sector. During the interviews with key actors in DOT, however, it became clear how powerful the first report was, as it still heavily remains in the minds of the actors:

> "There is no doubt that Region Hovedstaden have been very critical towards DOT. And they suggest that if you create a new political agency on top, then it will provide better. (...). Personally, I am not sure I share that opinion."
>
> (Struckmann, 2017)

Since then, it seems like Region Hovedstaden has acknowledged the failure of their initial approach and have instead turned the approach upside down:

> "So now we can maybe try to discuss visions, and what it is we believe a collaboration across the transport companies should do. Then we can start to talk about organisation at a later stage."
>
> (Petersen, 2017)

Whereas Region Hovedstaden initially simply questioned the current status quo, it now acts as an active spokesperson in a process of creating alliances and consensus around the need for improved coordination. One clear attempt of creating such an alliance is the work to develop a political paper prior to the municipal and regional elections in autumn 2017, stating the views of the involved actors on the potentials for DOT in the future. This work is facilitated by Region Hovedstaden in collaboration with Region Sjælland, who try to

mobilise KKR Sjælland and KKR Hovedstaden[1] to put pressure on the current collaboration in DOT. The purpose is "(...) to sit down and say, what can we agree on, how can we jointly verbalise this, and then move on" (Petersen, 2017). The political paper is supposed to exert influence at all levels, including the Ministry of Transport, in order to convince the Ministry to undertake an evaluation of DOT with the aim of expanding the tasks and increasing the decision-making power of DOT.

However, the focus on reorganisation is still present, given that Region Hovedstaden recently funded a project in which a group of experts – including Associate Professor at RUC Per Homann Jespersen – were to analyse both the current DOT as well as suggest potential future organisation modes of the public transport sector (Jespersen et al., 2017). The focus of this document by the group of experts is not the organisational set-up per se, but rather to identify which challenges different organisational set-ups may solve. This document thus acts as another critical voice against the current collaboration in DOT.

Challenges stem from fundamental differences between the public transport companies

Even though DOT has not existed long enough to fully evaluate what can be achieved through the collaboration, we have identified four key challenges for coordination among the public transport companies through interviews and document analysis: focus on optimisation within each company rather than the public transport system as a whole; lack of incentives for long-term holistic planning across the companies; different ambitions for the collaboration in DOT; and limited coordination of long-term investments across the companies. As all these challenges are related to the fact that the companies exist to undertake three different tasks across three different geographical delimitations, it is essential to understand the purpose, tasks and organisation of each company in depth, including to what degree each company currently works with long-term visions, as well as the autonomy of each company in its relation to its owners. There are a number of differences between the companies regarding their intrinsic characteristics that entails barriers for improved coordination and a common long-term vision in the current collaboration. This will be accounted for in the following paragraphs.

DSB is a national company with a long history reaching back to 1848, however, it was established in its current form as an Independent Public Company (Selvstændig Offentlig Virksomhed) in 1999 (DSB, n.d.). The main responsibility of DSB is to plan and operate national and regional trains, as well as S-trains in the Greater Copenhagen Area. The sole owner of DSB is the Minister of Transport, Building and Housing and the interviewee in Region Hovedstaden highlights that DSB exerts great influence on the Minister (Petersen, 2017). DSB is managed by a board of which six members are appointed by the Minister and three members are representatives of the staff of DSB. The vision of DSB is to be the backbone of public transport in Denmark, a vision that has been developed by the company itself, although it is regulated through the objects clause of DSB as well as through a 10-year contract between DSB and the Ministry of Transport (Kaspersen, 2017). The contract prescribes the level of service that DSB needs to provide on all its corridors in the following ten years. DSB is dependent on a political mandate from its owner for new investments and other initiatives, even though DSB as a company has some degree of autonomy as long as its work complies with the objects clause (ibid.). A national political agreement from 2015 states that from 2025 DSB can potentially cease train operation and instead be responsible for inviting tenders for all national rail traffic and thus become "Movia on rails" (Regeringen, 2015). As such, DSB is exposed to potential reorganisation in the near future.

Movia was formed in 2007 and is responsible for all buses and a few local trains in the area of Sjælland. The owners – 45 municipalities and the two regions – determine the level of service in specific corridors within the individual owner's geographical area and Movia ensures provision of this level of service. Movia is managed by a board which includes politicians from the owner level among its members. Like DSB, the

[1] KL (Kommunernes Landsforening) has a KKR (Kommunekontaktråd) in each region. Each KKR manages the municipalities' interests on a regional level in terms of tasks that are most effectively resolved in a collaboration between the municipalities in the region.

company naturally has some degree of autonomy and not all single actions need to be approved by the board, but the board sets the overall direction for Movia's work (Struckmann, 2017). The Trafikplan – which Movia is legally required to develop every four years – manifests their strategic work and visions (Rasmussen, 2017). It contains initiatives for the following four years, although some initiatives reach further, e.g. in the current Trafikplan 2016 one initiative is for all buses to become fossil free by 2030 (Movia, 2016). One part of the plan is a strategic network of buses which contribute to feeding passengers into the railroad network. The strategic network therefore needs to be adjusted when investments are made in railway corridors like the new metro in inner Copenhagen, in order to spread out the value of investments to a broader geographic area by using the busses as feeders to the metro system (see Figure 16). This way, the service of Movia in a sense ranks at the bottom in a hierarchy of public transport modes, since Movia is dependent on adapting its buses to the railroad network. In addition to the strategic network, Movia proposes a network of +Way corridors where buses run on segregated busways within the Greater Copenhagen Area, with a focus on ensuring integration with the new metro (2019) and light rail (2023) (Movia, 2016). The strategic network and the +Way network indicate that Movia actively works to ensure a certain level of strategic coordination between different modes of public transport. However, one may suggest that this coordination mainly stems from the fact that Movia is dependent on adapting to the railroad network.

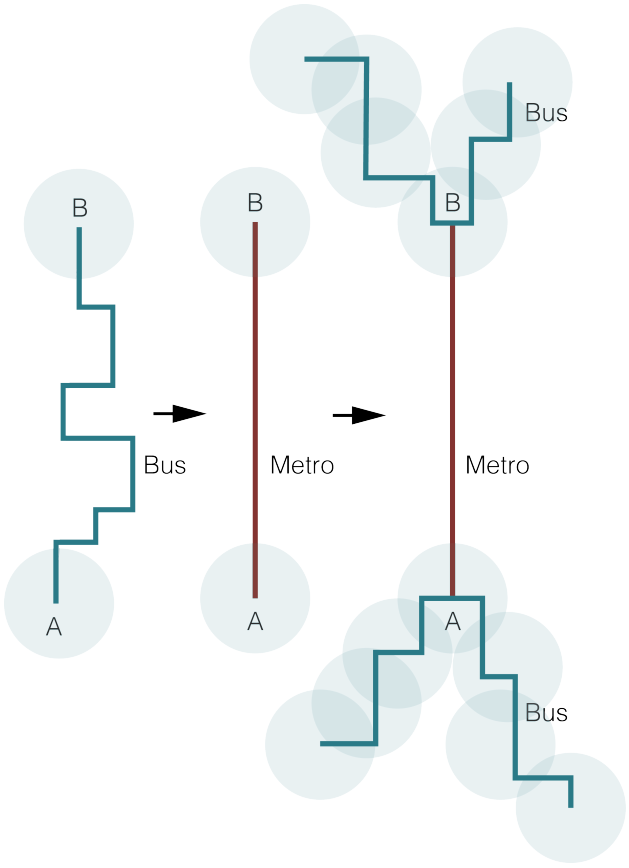


Figure 16. Buses can be used as feeders to the metro system in order to spread out value of investments in metro lines to a broader geographic area.

The process of developing the plan is a democratic process where all municipalities and the two regions are consulted and contribute to the plan, and the plan is approved by the board of Movia. Due to the large number of actors on the owner level, as well as the fact that the mobility needs of the municipalities vary significantly given their demographic differences this is naturally a complicated process (Struckmann, 2017). In the Greater Copenhagen Area focus is on central corridors, whereas transport services are located where feasible without compromising basic mobility needs of citizens in sparsely inhabited areas (ibid.). This is related to the fact that Movia sees public transport as basic welfare (ibid.). Furthermore, Movia is under constant pressure

from the owners to deliver cost-effective service (Movia, 2016), although in recent years the company has succeeded in cutting down expenses while simultaneously maintaining a high level of customer satisfaction (Struckmann, 2017).

Metroselskabet was established in 1993 as Ørestadsselskabet to develop the first metro in Copenhagen among other things. In 2007, the company evolved into its current form. The board of Metroselskabet represents its owners and consists of both politicians and non-politicians: three members are appointed by the state; three members are appointed by the Municipality of Copenhagen; one member is appointed by the Municipality of Frederiksberg; and two members are appointed by the staff in Metroselskabet. Generally, operating the metro is a lot easier than operating trains and buses as the metro runs in a closed system and cannot get stuck in traffic like a bus, nor is coordination with other railway operators needed (Schmidt, 2017). The metro is very dependent on the other modes of public transport given that about half of the passengers are either fed into the system by bus/train or change to bus/train (ibid.). The work of Metroselskabet is planned through a four-year business strategy, which is produced by the board (ibid.). Based on the business strategy, Metroselskabet develops a commercial strategy, which also needs approval from the board (ibid.). Because investments in metro are long-term investments lasting 50-100 years, Metroselskabet generally applies a more long-term perspective than the other two public transport companies, and as a result of that they have actively addressed the future of public transport in the Greater Copenhagen Area through its recent report on mega trends, as mentioned in the problem analysis (see p. 14).

As evidenced above, the companies have different premises for engaging in the collaboration of DOT due to differences in purposes, tasks, organisational set-ups, and demographic delimitations. This causes challenges in terms of coordination as accounted for in the following sections.

Optimisation within single systems

One of the main challenges concerning the current organisational set-up of the companies is that each company exists for one main purpose: to optimise the service offered by the individual company. This is explicitly acknowledged by several interviewees, including Birgit E. Petersen from Region Hovedstaden, Per Homann Jespersen from RUC, and Rune Jon Jensen from DOT, however, the interviewees from the three companies have only indirectly indicated so, as a few examples can help shed light on.

One example is the many controversies on revenue sharing in recent years. Revenue sharing is currently based on very complicated distribution keys based on passenger counting, as accounted for by one interviewee:

> "We have different ways of counting passengers. We [Movia] count, some weigh trains, others do something different. And [then there are] conversion factors that you'd almost need to have the Nobel prize in economy to be able to understand. It is heavy, it is burdening, and it is not based on trust."
>
> (Struckmann, 2017)

More simple models for revenue sharing that are based on trust could potentially solve some of these issues. In this regard, the complicated distribution keys and conversion factors seem to act as black boxes that are not questioned even though they govern both the internal relations of the companies, and how they act towards each other. The controversy became very explicit when DSB and Metroselskabet took legal action in an arbitration case against Movia in 2008. The arbitration case concerned a changed procedure in the passenger countings of Movia which led to changes in revenue sharing (Københavns Kommune, 2015). The case was followed by several other cases and was only settled in 2015 when the court of arbitration determined a due compensation of DKK 161.4 million to be paid by Movia to DSB and Metroselskabet (ibid.). However, despite the case, the disputes over passenger countings continue. Cases like these are rather damaging to the collaboration between the companies, as accounted for by one interviewee:

> "(...) they don't want to give each other anything (...). The transport companies need to collaborate, and then they take each other to court to get money out of ticket revenues."
>
> (Petersen, 2017)

The implementation of Rejsekortet is another example of how controversies between actors have led to a lengthy and very complicated process. According to one interviewee, simplification of models, systems and procedures could have remedied some of the controversies:

> (...) Simplification of the current system implies that Dorte, Henrik and Flemming [the CEO's of the three companies] approve of such a simplification. And it is hard to make such a thing happen without someone suffering. You can use Rejsekortet as an example where these types of collaborations cannot deliver simplifications at all. It was formulated as a project to let the price depend on the distance travelled and not on the zones (...). When Rejsekortet was implemented, you ended up making an almost 1:1 reproduction of the in many ways poor zoning system that we had at the time."
>
> (Jespersen, 2017)

It seems that even though there is an intention to simplify the complicated disagreements between the companies, the companies are too concerned with their own business to be able to see the bigger picture, and all good intentions get lost in these complex processes.

Lack of incentives for long-term holistic planning

All these controversies related to the economic profit of each company shows a lack of incentives for holistic planning across the companies. A dilemma can thus be identified in the current organisational set-up in the sense that the three companies are taking passengers from each other, rather than increasing total passenger numbers in the overall system, which is explicitly formulated in the document on potential reorganisation conducted by Per Homann Jespersen and three other experts in the field:

> "[It is] a tactical game, where the negotiations between the transport companies primarily concern how to get a slice as big as possible of the common cake, rather than working out how they, together, can make an even bigger cake, which more customers will buy and which can increase the revenue base."
>
> (Jespersen et al., 2017, p. 6)

This view is supported by the interviewee in Region Hovedstaden:

> "These are the dilemmas of the way in which it is organised. You take customers from each other, right. You only count within your own system. There are a lot of things that really don't make any sense."
>
> (Petersen, 2017)

Even though the companies deliver good results individually, the overall picture is often forgotten (Jespersen et al., 2017). The companies seem to be more concerned with controversies here and now, rather than securing their common interests on the longer term in order to improve the public transport system as a whole. No common strategy across public transport modes exists, and neither does anyone address the connection between private and public transport modes at a strategic level (ibid.).

A key concern, which is highlighted by several interviewees, is the lack of comprehensive understanding of mobility patterns, as data only exist within the single systems whereas none exists on the public transport system as a whole (Petersen, 2017; Jespersen, 2017). Common data is available through Rejsekortet but the companies are not willing to share data between each other (Petersen, 2017). One interviewee mentions that this resistance among the companies to share data derives from economic interests:

> "(...) the only countings that they [the three companies] make is to see how big a piece of the cake, the economic cake, that they should have in relation to the ticket revenues."
>
> (Petersen, 2017)

The main problem therefore seems to be the lack of willingness to share data across the companies, which might be because more exact data can potentially change the current models for revenue sharing. The interviewee further stresses that as long as the companies are not willing to share data it will be impossible to obtain an adequate understanding of the commuter patterns, which is necessary to ensure a fully integrated public transport system (ibid.).

In order for holistic planning across the companies to improve, there would need to be incentives for the companies to do so. However, the achievements of DOT are currently dependent on the priorities of the individual companies rather than on holistic considerations on the future role of public transport. Since DOT is dependent on the companies reaching consensus there is a risk that the collaboration will be limited to the lowest common denominator (ibid.). The companies do not have either the resources, competencies or the institutional capacity to facilitate coordination due the current organisational set-up, which hinders holistic planning. With the processes prior to the establishment of DOT in mind, it appears that the formation of DOT and the tasks it is meant to solve are based on top-down political pressure through the Law on transport companies, rather than on an institutional design providing real incentives for collaboration. For holistic planning to improve, there seems to be a need to provide incentives either through top-down political enforcement or by changing the institutional design of the companies. Such an improved institutional design would give greater incentives for coordination in terms of adding resources, competencies, and institutional capacity to collaborate across companies on aspects related to long-term holistic planning.

Different ambitions for DOT

Despite the observed satisfaction with the recently adopted 2020 strategy across the three companies, through the interviews, we have identified different ambitions on the collaboration in DOT. Generally, Movia and Metroselskabet are more positive towards DOT than DSB, as explicitly accounted for by the interviewee in Movia:

> "Our ambitions on what DOT should be have been higher than for example the ambitions of DSB. That is not a secret as such."
>
> (Struckmann, 2017)

However, Movia underlines how DSB is increasingly moving in the same direction as the other companies (ibid.). Yet there seems to be limited alignment on the level of ambition. The main controversy here seems to be related to the different geographical delimitations. As a national company, DSB needs to balance national and regional customer facilities which complicates the coordination tasks within DOT (Kaspersen, 2017). This leads to conflicts when customer related initiatives that differ or contravene with similar services offered by DSB at a national level are to be implemented within the geographical area of DOT (ibid.). This perspective is supported by the interviewee in Region Hovedstaden:

> "One can say that DSB sees itself as this big national company. And they find it a bit difficult to see why they should involve themselves in something more regional or local. Because they say that they are owned by the state, you know, it is the Minister [that DSB is owned by]. That is kind of their attitude: we are ourselves, we run our own thing."
>
> (Petersen, 2017)

Furthermore, with the political agreement from 2015 stating that the role of DSB can potentially change beyond 2025, the company is exposed to a general threat of reorganisation in which they are not interested, according to Lars Kaspersen. As one example of the downside of reorganisation, Lars Kaspersen mentions how the former separation of S-trains from DSB into HT led to many conflicts and was not a sensible solution (ibid.).

The geographical delimitation is not a challenge for Movia, since DOT covers the same geographical area as Movia. Movia wants to expand the collaboration of DOT "both in depth as in width" (Struckmann, 2017) and is very interested in improving coherence across the different modes of public transport. We suggest that this view stems from the fact that the service Movia provides needs adapting to the other modes of transport, and therefore Movia is to a large degree already dependent on the other companies. Generally, it is highlighted by the interviewee in Movia that there is a growing understanding of the interdependency across the companies and that establishing such a collaboration takes time (ibid.).

This view on DOT is supported by Metroselskabet who also has a great interest in improving the existing collaboration, as half of the passengers of the metro are fed into the metro by bus and train. Metroselskabet is therefore interested in a "stronger organisation, which can achieve more" (Schmidt, 2017), however, the interviewee highlights that DOT should only undertake operational tasks and not overall visioning and development which instead should be taken on by the planning authorities (ibid.).

Even though the companies have different ambitions for the collaboration in DOT, they have succeeded in reaching agreement on the strategy towards 2020 which, by all three, is seen as a big step in the right direction. However, the difference in ambitions is certainly a great challenge in order for DOT to adopt a more long-term vision in the future.

Limited coordination of long-term investments

Another identified challenge is the current lack of coordination of investments. Each company thus has its own vision which does not necessarily accord with that of the other companies, since they neither are forced nor motivated to collaborate on such tasks. However, some coordination can be identified in the sense that the individual visions take future public transport investments into account – examples of this are the strategic network, and the network of +Way corridors provided by Movia where future investments in railroad are taken into account.

An example of the lack of coordination of investments, is the common passenger information system created in the context of DOT, which lacks an overall roll-out plan and is only implemented gradually for each station and bus stop as funding becomes available (Jespersen, 2017). The fact that even such rather short-term investments happen ad hoc shows how difficult it is for the public transport companies to coordinate investments.

In terms of the lack of coordination of more long-term investments, the interviewee in Region Hovedstaden both points towards a general lack of overview of investments and especially highlights the lack of appointing central hubs within the system (Petersen, 2017). The region believes that doing so can contribute to creating a stronger public transport system and counteract congestion (ibid.). Region Hovedstaden is thus interested in expanding DOT to include such strategic considerations as accounted for in the second report produced by the consulting firm Struensee & Co:

> "In the long term, DOT can be a platform for development of a strategic plan for transport in Greater Copenhagen, which will make it easier to integrate housing and urban development plans with public transport."
>
> (Struensee & Co, 2016, p. 44)

Summary: The potential for a long-term vision across public transport companies

We have identified and analysed four key challenges of coordination in the above as part of the answer to the sub-question of the problem formulation concerning the current challenges of coordination: focus on optimisation within each company rather than the public transport system as a whole; lack of incentives for long-term holistic planning across the companies; different ambitions for the collaboration in DOT; and limited coordination of long-term investments between the companies. Besides identifying and analysing these challenges, the sub-question also includes investigating the degree to which the current collaboration allows for the creation of a long-term vision at a strategic level.

Due to fundamental differences in the institutional design of the companies regarding different purposes, geographical delimitations, tasks, owners, and organisational set-up, they both currently and historically only collaborate when forced to do so. Had the coordination of customer related activities currently undertaken in DOT not been forced through by law, we believe it is very unlikely that this coordination would have taken place due to the many controversies between the companies. There are simply no incentives for holistic planning, and since DOT is established to undertake a limited number of tasks which are not related to visioning at a more strategic level, the current collaboration does not contain either the agency nor the competencies to do so. Indeed, all three companies highlight that in order for DOT to become the platform for development of a long-term vision across the public transport system, the collaboration should be given more decision-making power. On the other hand, interviewees in the companies highlight that currently they are not interested in surrendering autonomy to DOT. This constitutes the key controversy in relation to the lack of coordination. Due to this, the current collaboration only allows for creation of a long-term vision across the public transport companies to a very limited degree, if at all. As a result, it will also be a central part of the following analysis on the potential of backcasting to contribute to the creation of a common long-term vision to suggest potential solutions to this controversy and thereby improve coordination among the transport companies.

Analysis on backcasting as an approach to create a long-term vision and improve coordination

The aim of this analysis is to investigate the opportunities and challenges regarding the use of backcasting to create a long-term vision across public transport companies in the Greater Copenhagen Area and thereby contribute to solving the coordination challenges identified in the first analysis. The analysis is built around an example of a backcasting scenario created with data from our interviews and document analysis. As accounted for in the methodological framework (see p. 27), the backcasting scenario has been presented to key actors in a second round of interviews (see appendix A1) with the purpose of assessing the applicability of backcasting.

First, the background of the backcasting scenario will be presented. This is followed by a presentation and discussion of the overall vision, including more specific themes as part of the vision. Potential measures within one theme will then be presented one by one, with a main focus on identifying and analysing the necessary actor configurations through the perspectives of Actor-Network Theory, in order to suggest by whom the measure can be implemented and how potential controversies can be remedied. Inputs from interviewees will be included along the way and form the basis for discussing specific elements of the scenario, including whether or not they might be put into practice. In this way, this example of a backcasting scenario will serve as a basis for a final summary on how backcasting as an approach can serve to create a long-term vision and improve coordination among the public transport companies in the Greater Copenhagen Area.

Background for backcasting scenario

To provide the best possible basis for discussing how backcasting can serve as an approach to create a long-term vision, it has been of key importance to make our backcasting scenario relevant to key actors involved in future development of the public transport sector. Therefore, the scenario takes point of departure in the current coordination challenges identified in the first analysis as well as more general future challenges for the transport sector, as indicated by the interviewees. The scenario has also been informed by other normative scenarios, and the recent study on the future role of public transport sector in the Greater Copenhagen Area by Metroselskabet and Hovedstadens Letbane (2017) was particularly inspiring to us.

In relation to this, all interviewees in the three companies mention driverless cars as one of the main future challenges (Schmidt, 2017; Kaspersen, 2017; Rasmussen, 2017). More specifically they are concerned with the effect of driverless cars on public transport demand, as well as the risk of severe congestion issues if driverless private car use is not regulated or heavily restricted (ibid.). Nevertheless, one interviewee sees the development of driverless technologies as a great potential for the public transport sector, under the condition that the technology would be integrated with existing modes of transport such as driverless busses or driverless shared cars (Rasmussen, 2017).

Furthermore, there seems to be a general consensus among the companies, that if public transport is to compete with private cars, it is essential to establish a public transport system which can ensure reliable, quick, and continuous door to door trips (Struckmann, 2017; Kaspersen, 2017). To achieve this, the interviewees present different viewpoints on the needed level of coordination between the transport companies, including the future areas of responsibility of DOT, as accounted for in the first analysis. In this regard, Region Hovedstaden highlights the need for increased coordination and collaboration between the companies within DOT by strengthening the organisational set-up and by expanding its areas of responsibility to include more strategic planning tasks (Petersen, 2017).

In the first analysis, we have identified a general lack of addressing the future of public transport on the long term. If the public transport sector is to respond to some of the identified future challenges, such proactive discussions across all three companies must be initiated collectively and addressed by concrete actions. The backcasting scenario we have developed therefore suggests a number of concrete measures for

addressing future challenges. The idea is that DOT, through a full backcasting study, could potentially develop a similar normative vision and actively work towards it through implementing the measures that will be identified through such a study.

Overall vision of the backcasting scenario

Our point of departure for the vision has been to describe a situation where public transport is as strong as possible. We perceive the vision as desirable both from a sustainability perspective as well as from the perspective of the three transport companies, as it is in their interest to maintain and potentially increase their market shares by providing a favourable alternative to private cars. In this regard, the key focus is to ensure that high levels of mobility are offered by means of great flexibility and strong integration between different modes of transport. Furthermore, the vision addresses the expected development of driverless technologies and attempts to turn it into an advantage. Lastly, it is seen as a precondition that both users and the three public transport companies perceive the public transport system as one system, in which the companies rely on each other to provide the best possible service. The vision representing this desirable future, which we have developed prior to the second round of interviews, is presented in Figure 17.

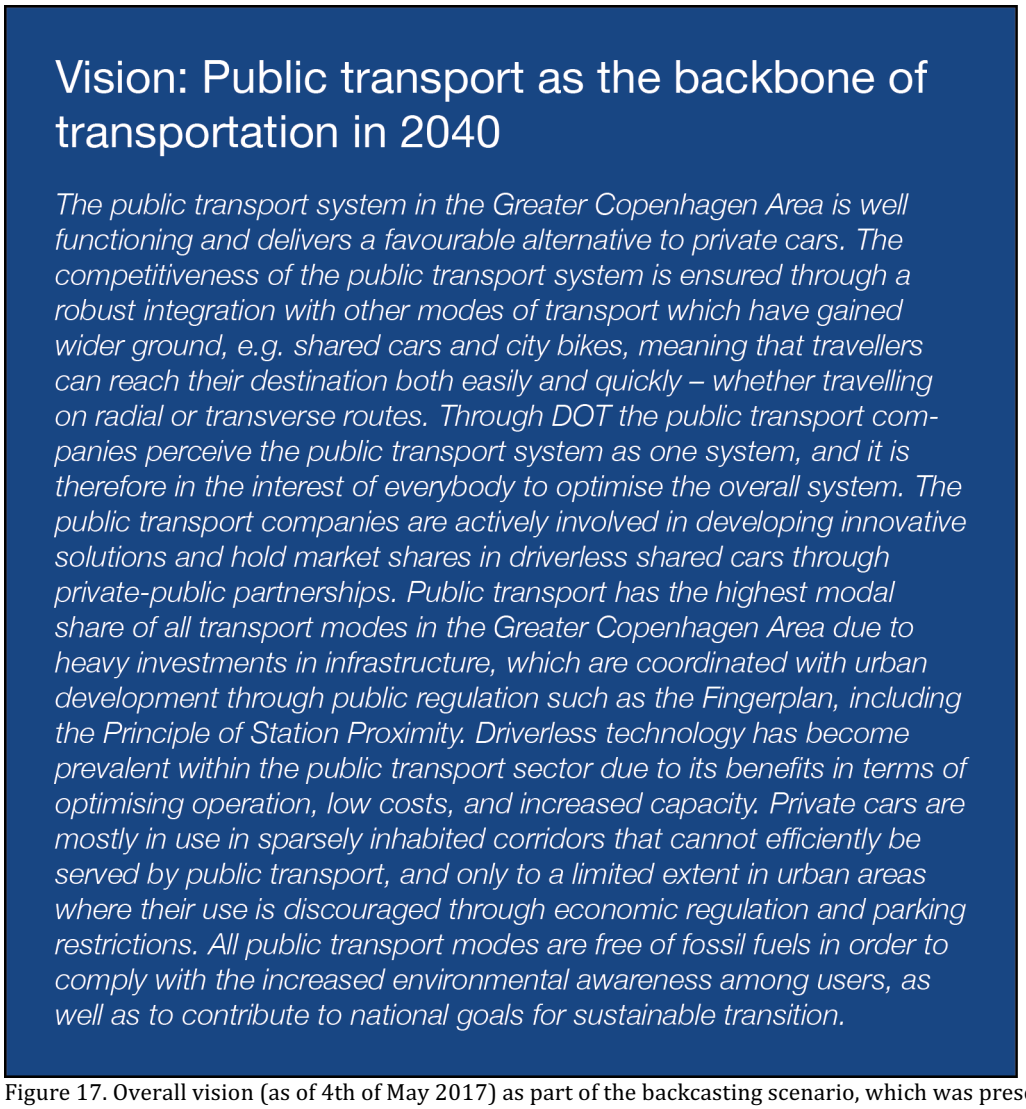


Figure 17. Overall vision (as of 4th of May 2017) as part of the backcasting scenario, which was presented for key actors in the second round of interviews.

When presented with the vision, all the interviewees were positive towards its overall objectives, which shows a certain level of agreement between actors. However, they all point to different challenges of the vision, as accounted for in the following.

First of all, all three interviewees took a critical stance on the question of who should adopt such a vision (Petersen, 2017; Jensen, 2017; Struckmann, 2017). They all believe the vision should be adopted at a national political level rather than in DOT, as it contains many elements that concern processes reaching beyond what DOT both currently and potentially in the future can control, e.g. national regulation such as the Fingerplan, as well as restrictive regulation of private cars. This is expressed by one interviewee:

> "In relation to the vision, the decision-making power is missing. Who should decide this thing? And until you define that, it is difficult [to realise the vision]. (...) In a vision like this I think that you should include (...) who has decided that it should be well-functioning and a favourable alternative to private cars. That could be addressed: that someone has decided it and therefore it has to be carried out."
>
> (Petersen, 2017)

In relation to this, in the second round of interviews, all interviewees suggest that such a vision should be determined at the national political level, i.e. by the Ministry of Transport, as it concerns national policies and regulation (Petersen, 2017, Struckmann, 2017, Jensen, 2017). This is critical, since there is currently a lack of national political interest in public transport, as highlighted in the problem analysis (see p. 8) and by several interviewees (Petersen, 2017; Struckmann, 2017), and it is therefore unlikely that such a vision would be adopted under the current political situation. The interviewees still agree that DOT could potentially adopt elements of the vision – but for this to happen, finance is needed for these new tasks, as accounted for by one interviewee:

> "Decision-making power and finance are interconnected. And the transport companies have to be good at managing buses, trains, and metro (...) and delivering the best possible service towards customers. Create the best possible service (...) for the available money. And this would be something new!"
>
> (Jensen, 2017)

To sum up, in order for DOT to adapt elements of the vision, it both needs increased decision-making power, which is in line with the results of the first analysis on p. 46, but it also needs increased finance. The discussion on who could adopt a vision like the one suggested by us will be further elaborated in the conclusion on p. 69.

One interviewee argues that many elements of the vision is what DOT is already striving for in terms of improving integration between public transport modes (Jensen, 2017). Such a viewpoint shows that DOT is somehow supportive of the vision, but it also shows a lack of acknowledgement among the companies of the need to actively address coordination challenges and the future role of the transport sector. The interviewee argues that DOT is already addressing these issues (ibid.) which however, is not the case according to the first analysis of this thesis, and based on this we suggest that the actors within DOT are generally too optimistic about the current collaboration and the role that DOT is playing in addressing the challenges of coordination.

As accounted for in the methodological framework (see p. 27) the backcasting scenario does not include an overall quantitative goal, however, one interviewee pointed to the need for more concrete goals:

> "You don't necessarily have to put it into numbers or percentage points. But maybe it could be more concrete in the sense that (...) public transport should remedy a greater part of the congestion (...) that it [public transport] should play a bigger role."
>
> (Petersen, 2017)

In contrast to this, we find it likely that setting a more overall quantitative goal can hinder the discussions on the future role of public transport and therefore, if a full backcasting study were developed at a later stage, we suggest that such general discussions take place before setting a quantitative goal. That one interviewee explicitly requests a more overall goal should, however, be taken into account in such a process.

Themes as part of the vision

As part of the overall vision we identify four themes which can contribute to setting a direction for putting the vision into effect:

A. Mobility as a Service: integrate public transport with other modes of transport like shared cars and city bikes through a well-developed MaaS system
B. Technological development: make all public transport modes free of fossil fuels
C. Spatial planning: integrate public transport investments with urban development
D. Infrastructure investments: expand the public transport system with new corridors

These themes were all identified and described prior to the second round of interviews. More themes could potentially be developed, but we perceive these four themes as the most essential in relation to the suggested vision. As a supplement to these, one interviewee suggested a theme on data and knowledge, as she sees a stronger knowledge base as a prerequisite for strategic planning across transport modes:

> "What we need is greater knowledge about the behaviour of customers. It is difficult to plan anything significant if we don't have knowledge and data on door to door transport."
>
> (Petersen, 2017)

The need for more data on mobility patterns is also highlighted in the first analysis in relation to the lack of incentives for holistic planning (see p. 43), and we see it as an appropriate theme that can support the realisation of the vision and thereby contribute to solving challenges of coordination.

All interviewees in the first round of first interviews have pointed towards the need for ensuring reliable, quick and continuous door-to-door trips, which is also the main objective of DOT according to the 2020 strategy (DOT, 2017). Furthermore, several interviewees have mentioned the potential for increasing integration of public transport modes and other modes of transport (Rasmussen, 2017; Kaspersen, 2017; Jespersen, 2017). One these grounds, we choose theme A, Mobility as a Service, as the one theme on which to perform backcasting, including describing the pathway for its realisation in more detail. This is undertaken through identification and thorough description of the main measures needed to realise the theme in the following sections. The remaining themes could likewise have been described in more detail, but we have not deemed it necessary since the purpose is merely to test backcasting as a method to encourage proactive discussions, develop visions and thereby improve coordination, and not to undertake a full backcasting study.

Measures to realise theme A. Mobility as a Service

In this section we identify nine measures (see Figure 18) needed to realise *theme A, Mobility as a Service*, which will be presented and analysed in the following. The measures were all identified and described prior to the second round of interviews. More measures could potentially be developed, but we perceive these nine

as the most essential in relation to the theme. Furthermore, each measure could possibly be described in more detail and separated into a number of individual measures.

The measures have primarily been identified based on the challenges of coordination described in the first analysis, as well as on key points highlighted by the interviewees during the first round of interviews. We have also made sure that all measures imply processes that DOT has a fair chance of influencing. First, the content and purpose of the measure will be described followed by an analysis – through the perspectives of ANT – of the necessary actor configurations for realisation of the measure, based on inputs from interviewees in the second round of interviews. Potential controversies are then highlighted and where possible we suggest how these can be remedied.

It should be noted that some measures are more directly concerned with establishing MaaS solutions, whereas others are general measures that will contribute to realising all themes of the vision. However, these are also included in order to realise theme A. As seen in Figure 18, some measures are interconnected and form the basis of the following measures, whereas other measures are more likely to become implemented in isolation. We have not provided detail on when exactly each measure is to be implemented, thus Figure 18 merely represents considerations on when each measure should be implemented in relation to other measures. Furthermore, since the implementation of individual measures is likely to stretch over several years, the measures will not necessarily be implemented one by one, but rather simultaneously.

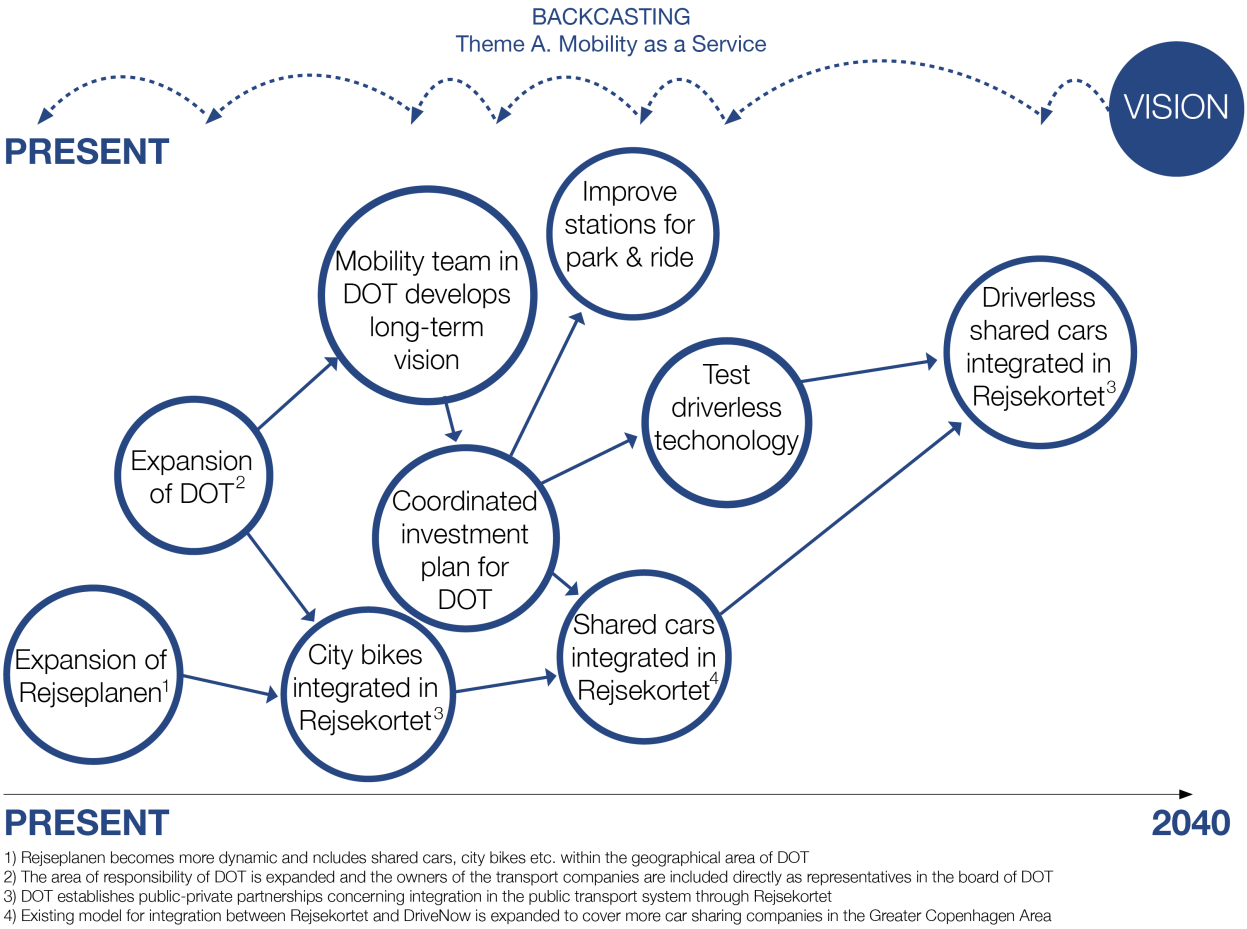


Figure 18. Overview (as of 4th of May 2017) of all nine measures that we suggest are required to realise theme A. Mobility as a Service.

Expansion of Rejseplanen

Content and purpose

The focus area of this measure is the webpage and app Rejseplanen – an online itinerary service where customers can acquire detailed information on their public transport trip options. The measure entails an expansion of the functionalities of Rejseplanen to include itineraries and booking possibilities of additional mobility services such as shared cars, city bikes, car-pooling services and taxis. Based on the suggestion by one interviewee, the measure also involves making Rejseplanen more dynamic by improving real time information including information on when unforeseen incidents such as system failures and accidents are expected to be solved (Jespersen, 2017).

Rejseplanen is an appropriate platform on which to offer these services as it is the most popular public internet service in Denmark with more than 30 million hits per month (Rejseplanen, n.d., a). Thereby, it acts as an important information channel between public transport companies and users of public transport. Additionally, one interviewee mentions that a great part of current coordination between the companies derives from the work on Rejseplanen (Rasmussen, 2017), and it is therefore natural to build upon this platform when integrating new modes of transport.

The purpose of the measure is to ensure an alternative to private cars when public transportation is insufficient by expanding Rejseplanen concurrently with the development of MaaS. An expansion of Rejseplanen should be seen as the first step towards integration of other modes of transport into the public transport system as part of MaaS, which will be further accounted for on pp. 61-65.

A similar solution has been initiated by Nordjyllands Trafikselskab (NT) – the equivalent to Movia in Region Nordjylland. NT has established a public-private partnership with three municipalities and the Danish carpooling service GoMore. As part of this collaboration, a pilot project named NT+GoMore was initiated in March 2017 where 13 carpooling stops, serving as pick-up points for GoMore customers, were designated close to key public transport nodes like stations and major bus stops based on strategic considerations (NT, n.d.). Currently, the booking system and itinerary services are facilitated through the GoMore app, but the plan is to integrate GoMore in Rejseplanen for Northern Jutland by the end of 2017 (ibid.). The latter suggests that a similar solution is possible within the geographical delimitation of DOT.

Controversies and configuration of actors

The first step in the process of expanding Rejseplanen, is to establish a collaboration between the three public transport companies and Rejseplanen as it is from this collaboration that the inclusion of actors providing additional mobility services should originate. The necessary actor configuration to expand the functionality of Rejseplanen is visualised in Figure 19. We suggest that DOT can act as a key spokesperson in facilitating this process, since an expansion of Rejseplanen is a customer related activity across the companies and thus within the current area of responsibility of DOT. Additionally, the three companies are among the owners of Rejseplanen (Rejseplanen, n.d., b), and therefore it seems rather simple for DOT and the companies to engage Rejseplanen in the process. On the other hand, the first analysis shows that ownership itself does not necessarily ease change processes and that such processes require a lot of work from the involved actors. Anyhow, in this case we suggest that the actors will all have a strong interest in such a collaboration. This is supported by one interviewee, who mentions that Rejseplanen and DOT already collaborate on developing new passenger information systems, which indicates that a relation between these two actors already exists (Jensen, 2017).

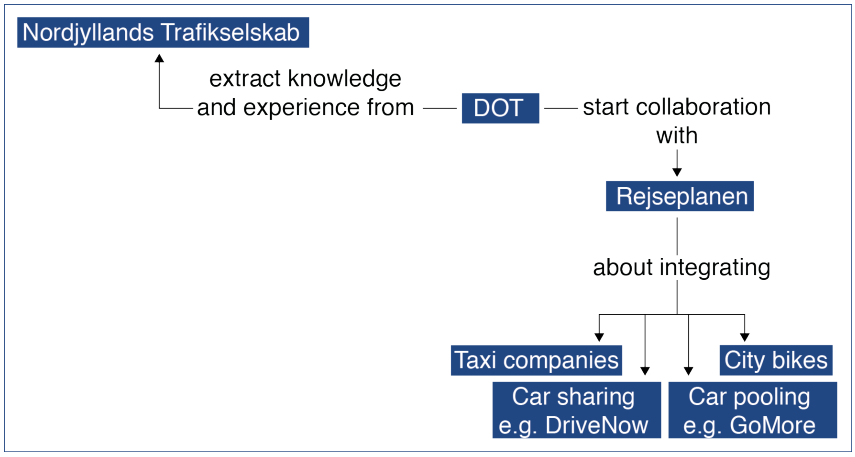


Figure 19. Potential actor configuration for the process of expanding Rejseplanen to cover other services than traditional public transport modes.

The private actors providing mobility services appear to be simple to engage in the actor configuration, as an inclusion of their services into Rejseplanen is likely to increase their market shares. Even though the actor configuration should be rather simple to establish, it involves many actors who might have opposing interests. Based on this, it might be a potential challenge to balance the self-interests of the involved actors in the work of the collaboration. Additionally, integration of additional modes of transport in Rejseplanen could give rise to technical challenges regarding integration between Rejseplanen and the existing booking systems of the various private companies. These technical challenges could include the possibilities to check availability and book the new transport modes through Rejseplanen. Including NT in the collaboration can potentially remedy some of these organisational and technical challenges as NT can provide knowledge and experience from their pilot project with GoMore.

Expansion of DOT

Content and purpose

This measure focuses on expanding the areas of responsibility of DOT to include tasks beyond customer related activities. This includes tasks at a strategic level which can allow for long-term holistic considerations in order to address the future challenges of the transport sector as well as the coordination challenges identified in the first analysis. More specifically, an expanded DOT can serve three main purposes: to facilitate collaboration on key initiatives and projects such as implementation of MaaS solutions; coordinate activities and visions across the public transport companies; and serve as a mouthpiece for the companies towards external stakeholders in order to communicate common interests. The expansion of DOT is seen as a prerequisite for realisation of most, if not all, of the subsequent measures.

In the first analysis of this thesis, it is apparent that strategic tasks cannot be solved within the current organisational framework of DOT – neither is it currently possible to develop a shared long-term vision. Additionally, the board members of DOT argue that decisions on how to address future challenges as well as the creation of a long-term vision should stem from the owner level i.e. the planning authorities (Schmidt, 2017; Struckmann, 2017). Therefore, we perceive it as necessary to directly include representatives from the owner level of the transport companies in the board of DOT. This contrasts with the current situation where the directors of customer relations have been appointed as board members. The purpose of this expansion of the board is to increase the decision-making power of DOT by providing political mandate as well as the competencies to strategically address the future challenges of the transport sector. The need for political mandate is supported by the interviewee in Region Hovedstaden, who argues that an expanded DOT including representatives from the owners is a prerequisite for the creation of a long-term vision (Petersen, 2017). She argues that DOT holds the potential to become an organisation in which decisions concerning all the transport

companies are taken including tasks such as strategic planning and a coordinated investment plan, especially if DOT is led by a strong board representing both political and economic interests (ibid.).

We suggest an expansion of the existing DOT rather than a more radical organisational change since two interviewees believe that merging the three companies into one would not only be undesirable, but also ineffective for the public transport system (Struckmann, 2017; Kaspersen, 2017). Regarding the actual setup of the board, members could eventually be those board members currently represented in the boards of the individual transport companies. According to one interviewee, the chairman should be an external actor with knowledge on public transport in order to ensure professional ambitions and avoid special interests from one of the owners/companies (Jespersen, 2017). In relation to this, the interviewee refers to former negative experiences of including public servants and politicians into boards, and further advocates that a professional board would be more likely to ensure an impartial operation of DOT (ibid.). In contrast to this, the interviewee in Region Hovedstaden argues that a combination of different actors such as politicians, private actors, researchers and public servants would be appropriate and mentions the board of Transport For London as a successful example (Petersen, 2017). She especially stresses the need for including politicians and other actors who have the power and agency to ensure funding (ibid.).

Controversies and actor configuration

Based on the conducted interviews, the document analysis and the first analysis of this thesis, we identify three potential actor configurations that can contribute to a realisation of expanding the tasks and board of DOT (see Figure 20):

A. As the current Law on transport companies does not contain restrictions on how the transport companies formally organise themselves within DOT (Transport- og Bygningsministeriet, 2014), it would be possible for the companies to alter the composition of the board. Such an actor configuration relies on creating consensus among the companies and their respective boards.
B. The first analysis suggests that collaboration between the companies did not deliver any significant results until the coordination was forced through by the 2014 Law on transport companies. It is therefore suggested that a new law expanding the tasks and organisational set-up of DOT would be necessary, with the law acting as an intermediary defining a new role of DOT.
C. Another similar option entails that the owners of the transport companies – the municipalities, the regions, and the state – put pressure on the transport companies to expand the board of DOT. This will require that the planning authorities realise the need for collectively addressing coordination challenges and the future role of public transport and that this can be achieved through an expansion of DOT.

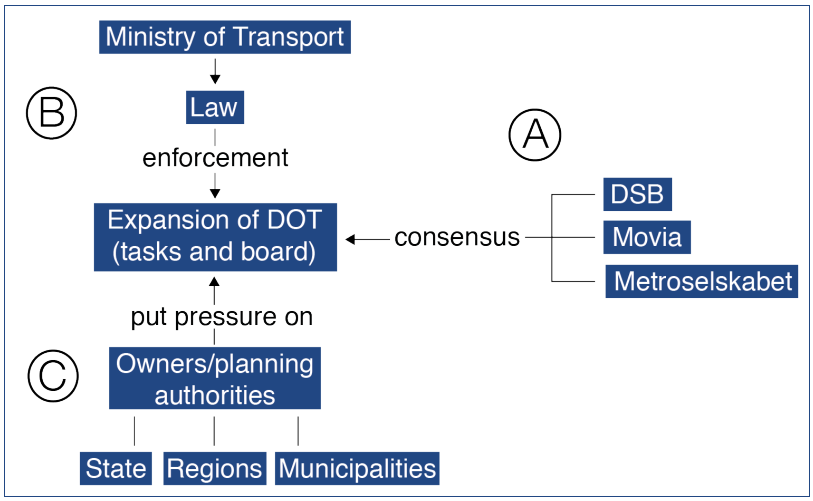


Figure 20. Potential actor configurations needed in order to realise an expansion of DOT.

Even though each of these actor configurations can lead to the desired expansion of DOT, various controversies related not only to the content of such an expansion but also to the processes of constituting these configurations can be identified as accounted for in the following.

First of all, interviewees within both Movia and DOT question the likelihood of realising such an expansion as well as the actual contribution of the expansion (Jensen, 2017: Struckmann, 2017). In relation to this, one interviewee stresses that coordination within the given framework already contains many challenges and opposing interests, and that the inclusion of more actors within the existing network not necessarily would result in improving coordination:

> "If it is difficult to finance between the three companies in DOT because ownership is both municipal and national, then I do not dare to think about how it would be if the state and the municipalities should be included in this big vision given that they have individual interests. If you want to do something like that, then you need a narrow framework. Besides that, you need to be sure that you have a concrete plan defining what this expansion of the collaboration entails. And we can see how we already encounter many challenges in the current set-up."
>
> (Jensen, 2017)

Based on this, both interviewees highlight the importance of ensuring that additional value is achieved before an expansion of DOT is put into effect (Jensen, 2017: Struckmann, 2017). Rather than developing an overall vision, they both suggest that it will be more likely and appropriate for DOT to become a strategic forum which can assemble visions and strategies from the individual transport companies, and based on this can suggest common recommendations on how to address future challenges (ibid.).

In any case, the interviewee in Movia acknowledges the need for a holistic approach addressing what the future public transport sector could look like, but she also argues that there is too much focus on the organisational setup of DOT:

> "When we [the public transport companies] become very preoccupied with the structure [of public transport] and very little with the vision, I think it is a pity, because it is the vision that is interesting and the fact that you [as a public transport company] can see yourself and your contribution in relation to the whole. And when you begin perceiving public transport as a coherent ecosystem, then something happens."
>
> (Struckmann, 2017)

In relation to this, she argues that focus should rather be pointed towards developing a common understanding among the transport companies, that they are inherently interconnected and that coordination of customer related activities creates value for both customers and companies (ibid.). This is complemented by the interviewee in DSB, who argues that long-term planning is about customer related activities and that previous experiences from the operational collaborations in HUR indicate that collaboration between the companies should only include customer related activities (Kaspersen, 2017).

Additionally, several interviewees argue that the current work of DOT exemplified through the 2020 strategy is the first step in the right direction of improving coordination in the public transport sector (Kaspersen, 2017; Jensen, 2017; Struckmann, 2017). One interviewee elaborates this further:

> "I actually believe that DOT is a good first step. Now we are collaborating on something which adds value and is directly measurable. Give it some years and see if it actually works. See that the companies can cooperate and create results, which benefit the customers."
>
> (Jensen, 2017)

Based on these considerations, it seems that the actors within the transport companies and DOT believe that an expansion of the tasks of DOT should happen incrementally from within the existing network of DOT. They also suggest that the relation between the transport companies should mainly be constituted around the benefits of collectively addressing customer related activities (Kaspersen, 2017: Jensen, 2017). As a result, it seems very unlikely for the transport companies to voluntarily expand the board and tasks of DOT since they do not acknowledge the benefits of such an expansion. Additionally, they seem to believe that the current challenges of coordination can be solved within the framework of customer related activities. We perceive this incremental change process of DOT as insufficient, if the suggested scenario including the overall vision and the specific measures are to be realised. Therefore, we suggest that in order to expand DOT, pressure should derive either from a national political level through enforcement of a new law or through pressure from the planning authorities.

As described in the first analysis, Region Hovedstaden is currently working to create consensus on the need for improved coordination and a stronger DOT among the same actors that figure in the suggested configurations in Figure 20. If Region Hovedstaden succeeds in this process of actively engaging municipalities and the Ministry of Transport, this can be an important step towards an expansion of DOT.

Lastly, several interviewees state that an expansion of DOT might require changes not only to the Law on transport companies but also to the laws regulating the objectives of Metroselskabet and DSB since these objectives would change should e.g. Metroselskabet be involved in initiatives that benefit DSB (Jespersen, 2017: Jensen, 2017). This suggests, that it would be necessary to engage the Ministry of Transport as an active spokesperson working towards an expansion of DOT.

Mobility team in DOT develops long-term vision

Content and purpose

This measure contains the appointment of a mobility team within the framework of an expanded DOT. This should be seen as the first step towards the creation of an overall long-term vision for the future role of the public transport in the Greater Copenhagen Area. The role of the mobility team should be to analyse and understand how mobility trends and technological as well as societal development will shape the future. The creation of a common mobility team should be seen in continuation of the work that both Movia and Metroselskabet have initiated on addressing how the future will shape their companies and their transport services. During the last two years, Movia has had six people employed dedicated to the area of mobility and future trends (Rasmussen, 2017). Metroselskabet is likewise addressing megatrends and the future role of public transport through the previously mentioned report (Metroselskabet and Hovedstadens Letbane, 2017; Schmidt, 2017).

The ideal outcome of the work of the mobility team is a shared long-term strategic vision that defines a desirable future for the public transport companies and appoints the needed initiatives and investments to put the vision into effect. A shared vision can create a framework in which the companies can work collectively towards common objectives and thereby potentially mitigate conflicting interests in relation to the challenges of sub-optimisation described in the first analysis. Such a vision can potentially be developed through a backcasting approach similar to the one applied in this thesis – something which will be further discussed in the conclusion on p. 69.

Jespersen et al. (2017) argue that DOT, in the present legal framework, holds the potential to create the overall framework for strategic planning of public transport in the Greater Copenhagen Area by producing a long-term strategic vision, whereas the actual implementation will take place in the individual companies. In contrast to this, we suggest that in order to fully improve coordination some strategic tasks should be undertaken specifically by DOT – something that will be elaborated further in the following measure on a coordinated investment plan.

Controversies and actor configurations

On the assumption that the previous measure Expansion of DOT has been put into effect, DOT can act as spokesperson in the process of appointing a mobility team. This entails defining the working conditions of the team, allocating finance and other resources including a mandate to develop a shared long-term vision. The actual effect of the vision as an overall framework will only be ensured to the extent that the vision is approved and embodied into the work of the individual transport companies as visualised in Figure 21. The content of the shared long-term vision should be reflected in the plans and strategies of each individual company, in order to ensure that short-term solutions, initiatives, and daily actions are in line with the overall vision of DOT. This alignment with existing visions and strategies holds a number of potential controversies as accounted for in the following paragraphs.

First of all, there is a potential pitfall of the overall vision being less ambitious when aligned with existing visions, strategies and interests of the companies, since the overall vision is expected to apply time horizons and mobility concepts that the companies have not taken into account in current visions. When the companies need to accept the overall vision, there is also a risk that the lowest denominator will be decisive for the level of ambition. To address this, inputs from a broad range of external actors such as universities, and business and industry organisations could be included in development of the vision in order to qualify and legitimise the vision.

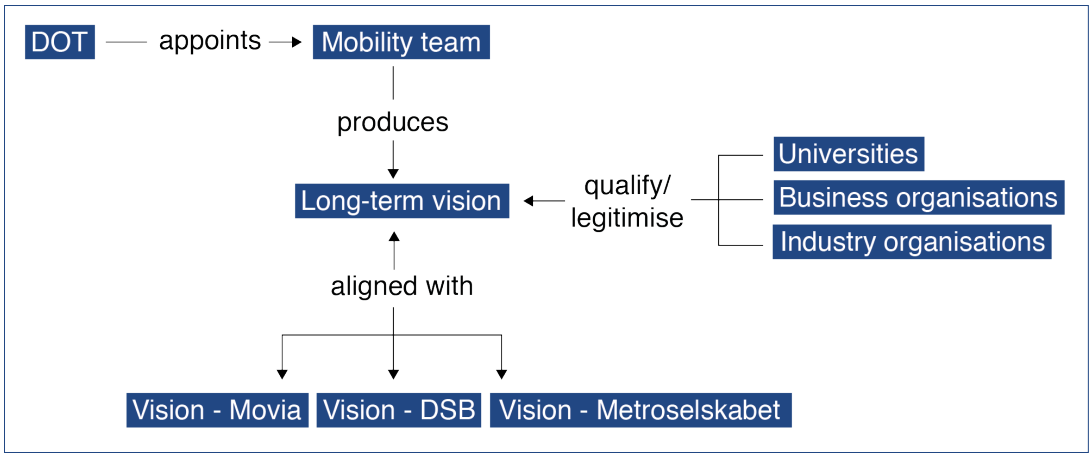


Figure 21. Actor configuration of appointing a mobility team that produces a long-term vision which should be aligned with the visions of the individual companies and vice versa.

Another key challenge of establishing a common long-term vision is that it might require changes to the legislative framework of DOT according to several interviewees (Jensen, 2017; Jespersen, 2017). These interviewees also highlight that changes to the laws regulating DSB and Metroselskabet might be necessary if the vision entails that these companies have to attend to tasks beyond their current objects clause (ibid.). However, we argue that if the expansion of DOT has been realised through a new Law on transport companies, it is being reasonable to suggest that such a legal framework would allow for DOT to develop a common long-term vision at a more strategic level. In contrast to this, it is suggested by one interviewee that changing the legal framework is a complicated process, and rather than producing a common vision, DOT could instead work as a strategic forum:

> "(...) I believe the art of the possible would be more realistic. That you put some people together in some forums where you say, 'This is our vision and this is our vision' (...) and then you can get someone to put it together. If this someone is DOT, then you could make some recommendations on how things should be in the future."
>
> (Jensen, 2017)

Additionally, the interviewee argues that each company has specialised in specific modes of transport, and that these competencies could eventually be lost if the responsibility of strategic planning was assembled in one organisation (Jensen, 2017). We do not perceive this as a risk, since the purpose of a shared vision produced by DOT is not to hinder, but rather to draw on these competencies.

Similarly, one the interviewee in Movia does not believe a common long-term vision for public transport as such across the companies is the right solution, but rather suggests that strategic considerations and identification of synergies between the companies could be a mandatory part of the plans and strategies of each company (Struckmann, 2017). In relation to this, she stresses that Movia already takes such considerations into account through the strategic network of buses through which integration with other modes of public transport is ensured (ibid.). Additionally, she argues that even if DOT manages to develop a shared long-term vision for public transport as such, it will not have any effect unless finance is earmarked specifically for the realisation of the vision (ibid.), which is why a coordinated investment plan is seen as a prerequisite for realising an overall vision of DOT as elaborated in the following section.

Coordinated investment plan for DOT

Content and purpose

As mentioned above, the implementation of a long-term vision is highly dependent on the allocation of finance. Therefore this measure entails the creation of a coordinated investment plan for DOT, which can serve as a clarification of the presented vision containing a chronological overview of the investments that need to be accomplished in order to put the vision into effect. The investment plan should thus be produced simultaneously with the vision.

The development of a long-term vision and a coordinated investment plan is suggested as a solution for the lack of coordination of long-term investments identified in the first analysis. Likewise the current lack of economic incentives for the companies to adopt a holistic planning approach could be remedied through agreement on a coordinated investment plan in which all the companies have committed themselves. Besides providing an overview of investments, the investment plan should determine which actors are to finance each investment. Some investments will be appropriate for DOT to carry out, whereas others will be more appropriate for the individual companies to carry out. Driverless S-trains would for example be within the domain of DSB whereas Movia would be responsible for development of Bus Rapid Transit (BRT) systems. Such investments should be coordinated through DOT and DOT should also carry out investments in collective projects that benefit all companies. In relation to MaaS, examples of collective projects are improvement of park and ride facilities at stations and establishment of public-private partnerships with car sharing companies. In such projects DOT can play a facilitating and coordinating role given that DOT has the strategic overview of what each project should contribute to in relation to improving the overall public transport system.

Controversies and actor configurations

The mobility team within DOT can act as a spokesperson in the development of the investment plan, since the mobility team is also responsible for creating the long-term vision, which creates the framework for the investment plan as illustrated in Figure 22. As mentioned above, the role of the investment plan is that the vision is put into effect. For this to happen, the investment plan need to serve as an intermediary defining the economic responsibility of the companies and DOT in relation to the initiatives described in the vision. In production of the investment plan, the companies need to reach agreement on how to finance collective projects – something which will entail that each individual company transfers funding to DOT. As these negotiations on finance are an inherent part of the establishment of the investment plan, it is central to identify and solve potential controversies that can block agreement between the companies. The coordinated investment plan can be seen as a simplification of a network, in which detailed negotiations on finance take

place as shown in Figure 22. When this network is studied in detail, key controversies between actors can be revealed.

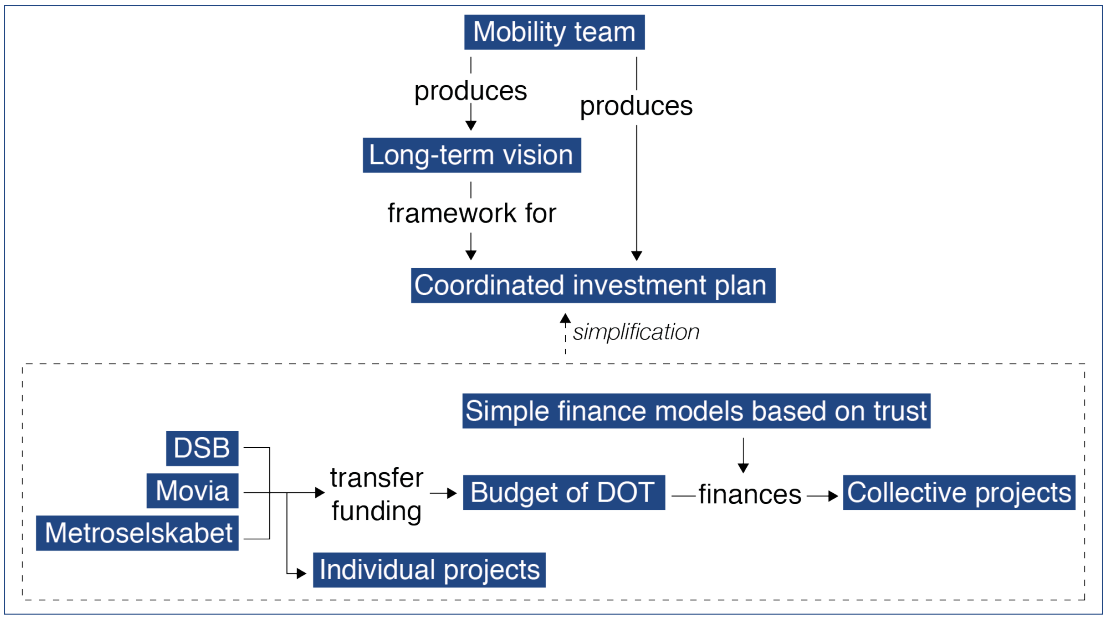


Figure 22. Actor configuration concerning production of a coordinated investment plan, including the underlying network behind the investment plan.

Currently, collective projects are financed through a certain financial basis of distribution that defines each company's allocation of funds for each single project (Jespersen, 2017). However, this is a heavy and complicated mechanism that causes many conflicts between the companies as described in the first analysis. Instead of applying a similar basis of distribution when determining the transfer of funding from each company to the budget of DOT, it is suggested by one interviewee that this budget could be perceived as a shared budget where some projects will benefit one company while other projects benefit other companies (ibid.). Such an allocation of funds to the budget of DOT would rely more on trust and a common understanding among the transport companies that collaboration benefits them all. The benefits of simplifying models of finance is also acknowledged by one interviewee (Struckmann, 2017). Furthermore, interviewees from all the three companies have argued that integration and interdependency between the companies is an inherent part of the current DOT collaboration (Schmidt, 2017: Kaspersen, 2017; Struckmann, 2017).

We see the actant 'simple finance models based on trust' as the missing link which through its properties can stabilise those relations that constitute the investment plan. When stabilised, the underlying network behind the investment plan can be interpreted as a *black box* wherein relations between actors are taken for granted. To reach such a situation of agreement each company need to omit suboptimisation, which will certainly be complicated as described in the first analysis. Based on the conducted interviews both Movia and Metroselskabet seem more willing to do so, as they to a larger degree than DSB acknowledge the interdependency between the three companies. As mentioned above, especially Movia recognises the need for improving the relations and coordination between actors by simplifying the finance models.

Additionally, some investments will most likely be of such a size that municipal, regional or national funding is needed e.g. driverless S-trains, upgrades of train stations or future investments in new public transport corridors like metro, rail or BRT. Some of the suggested projects of the investment plan will therefore depend on actors whose allocation of funding rely on political negotiations. For this reason, the investment plan and the vision should also be seen as documents serving to inform decision makers on the strategic direction and the need for investments in public transport. Based on this, we suggest that a

coordinated investment plan, which sets a shared strategic direction for the public transport companies could make it easier to attract heavy investments from the authorities.

If DOT is expanded and has developed a shared long-term vision as well as a coordinated investment plan, we suggest that DOT has the decision-making power, the knowledge and strategic competencies, and the needed funding to initiate implementation of MaaS solutions as visualised in Figure 18. Improving stations for park and ride; integrating new transport modes into the public transport system through Rejsekortet; and testing driverless technologies are all central to theme A. Mobility as a Service and will be elaborated in the following sections.

Improve stations for park and ride

Content and purpose

This measure entails expanding train stations with park and ride facilities along with other service facilities in order to accommodate the current lack of strategic coordination on appointing central hubs within the public transport system as described on p. 45 in the first analysis. This is supported by several interviewees, who acknowledge park and ride facilities as an important element in attracting private car commuters to replace part of their trip by public transport and thereby foster a modal shift and contribute in reducing congestion (Jespersen, 2017; Jensen, 2017; Rasmussen, 2017). Additionally, the purpose is to accommodate the integration of new transport modes in order to ensure MaaS by placing shared cars and city bikes at stations.

Jespersen et al. (2017) suggest that supplementing service facilities could include shopping, parcel delivery and pick-up, kindergartens, and car services. By including these service facilities at stations commuters can meet some of their basic needs in one spot instead of having to travel across the city to shop, pick up children etc. and in effect, total trip distance can potentially be reduced. Additionally, service facilities at stations can serve as an element in integrating urban development with transport planning, which is also part of the overall vision as described in Figure 17.

Controversies and actor configurations

We suggest that it is necessary to establish some sort of 'station collaboration' between key actors in order to strategically appoint central hubs and expand these with park and ride facilities as well as other services. We identify DOT, DSB, Movia, Banedanmark, municipalities and other private actors that provide service facilities as key actors (visualised in Figure 23). DSB and Movia are seen as relevant actors due to their strong interests in ensuring convenient exchanges between bus and train – exchanges in which Banedanmark is also an "active player" due to its responsibility of railway infrastructure, according to one interviewee (Kaspersen, 2017). Inclusion of municipalities in the collaboration would especially be relevant regarding integration between urban development and transport planning.

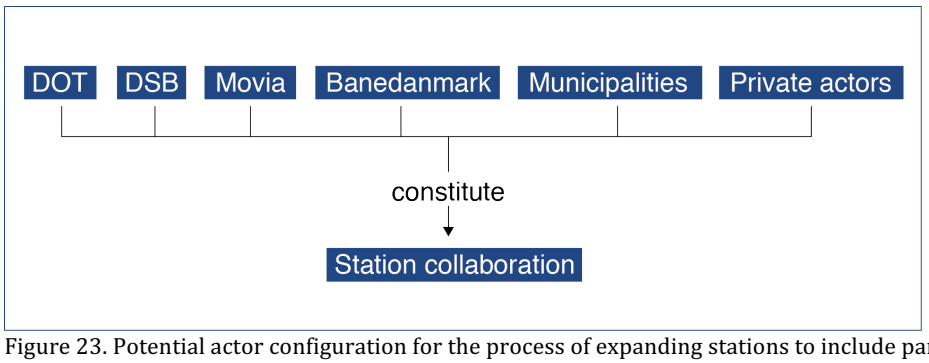


Figure 23. Potential actor configuration for the process of expanding stations to include park and ride facilities and other services through a station collaboration.

We suggest that DOT can act as a key spokesperson in facilitating the establishment of such a collaboration as an expanded DOT with a long-term vision would most likely have the greatest strategic overview of where to

locate station hubs. Jespersen et al. (2017) highlight that the existing organisation of transport companies is not geared to manage such a complicated task and instead suggest an independent station company – inspired by the Swedish company Jernhusen – as a potential solution. Jernhusen is a nationally owned company that owns a network of railroad-related properties across Sweden and is responsible for developing and managing these in order to ensure strong integration between transport modes (Jernhusen, n.d.).

Generally, the controversies of such a collaboration seem to lie in how to constitute it and which actors to include. These controversies could potentially be remedied if DOT is provided with the decision-making power, competencies and finance to coordinate such initiatives.

A key controversy is the economic considerations regarding the distribution of investments between actors as well as how potential revenues are to be distributed among actors. Negotiations like these are meant to be part of the investment plan, and therefore it is deemed likely that the involved actors have allocated funding for station expansions through the investment plan. Additionally, municipalities can provide funding if they become part of the collaboration due to their interest in urban development at and around stations.

Another controversy is the conflicting views represented through the second round of interviews. The interviewee in Region Hovedstaden highlights the need for a new strong collaboration (Petersen, 2017), whereas the interviewee in DOT believes that expansion of stations is to a large degree already taking place:

> "Well, it is something they do out there already, it is actually not that far into the future. You are doing it at Køge Nord, which to a certain degree is park and ride."
>
> (Jensen, 2017)

Køge Nord is a new station on the future railway between Ringsted and Køge, which will not only have 1,700 park and ride spaces but is also a central spot for urban development when fully built in 2018 (Køge Nord Station, n.d.). By presenting this example, the interviewee in DOT argues that providing park and ride facilities is something that will happen "by itself" as incremental changes to the current public transport system and that it does not necessarily require a common vision and coordinated investment plan of DOT (Jensen, 2017). On the contrary, the interviewee in Region Hovedstaden argues that there certainly is a need for an overall strategic plan which can appoint central hubs (Petersen, 2017). We suggest that such a strategic plan could be adopted by DOT in collaboration with the aforementioned actors in order to ensure a holistic approach across the three companies and thereby avoid ad hoc solutions. However, we deem it likely to be difficult to reach agreement among the involved actors of the suggested collaboration based on the different viewpoints of interviewees on how quickly and with what scale of effort park and ride is to be implemented.

Integration of new transport modes into the public transport system through Rejsekortet as part of MaaS

Content and purpose

Since the measures related to integrating transport modes linked to MaaS (city bikes, shared cars, and driverless shared cars) into the public transport system through Rejsekortet are interrelated and imply similar processes and actor configurations, they were presented together for the participants in the second round of interviews. These measures will therefore also be described and analysed as one in the following section.

First of all, we suggest that MaaS should not be perceived as a new service to be implemented by new external actors, but should rather build on existing platforms such as Rejsekortet and Rejseplanen – something which is supported by one interviewee:

> "There doesn't necessarily need to be any certain institutional structure around it. We have a great part of MaaS already, one could say, via Rejsekortet. That thing about expanding Rejsekortet, well, maybe that is our MaaS in the future. So that very institutional idea that MaaS is something someone else creates for us and then we subscribe to it and so on – I don't necessarily believe in that."
>
> (Jespersen, 2017)

The purpose of integrating city bikes, shared cars and in the future driverless shared cars, is to provide a supplement to more traditional modes of public transport and thereby improve mobility options in order to ensure quick, reliable and continuous trips across the Greater Copenhagen Area. An additional aim is to encourage current non-users of public transport to change mobility practices and thereby foster a modal shift from private to public transportation to address congestion issues, among others. The new transport modes can feed additional passengers into the public transport system and can also close the gap between traditional public transportation services and the users' destinations. Additionally, the integration of shared cars might also hold the potential to lower car ownership which can be a crucial element in changing people's mobility practices (Rasmussen, 2017). If MaaS is competitive with private cars – in terms of price and flexibility – it can postpone, if not remove, the need to buy a car according to one interviewee (ibid.). MaaS is thus key in increasing public transportation use in accordance with the overall vision in Figure 17.

Regarding city bikes, a city bike system run by the commercial foundation By- og Pendlercykel Fonden is at present implemented in the municipalities of Copenhagen and Frederiksberg – a system which would be appropriate to build further upon and one which over time could spread to all municipalities in the Greater Copenhagen Area. Additionally, a natural link between the city bikes and the public transport system already exists as it is currently possible to access city bikes through Rejsekortet – although payment through Rejsekortet is not yet possible (Bycyklen, n.d., a). Full integration into Rejsekortet will thus require that payment becomes possible. The purpose of the current system in Copenhagen and Frederiksberg is to provide a coherent network within dense urban areas. In contrast to this, we suggest that city bikes as part of MaaS primarily should focus on locating bikes at key public transport nodes in order for the bikes to serve as a contribution to the existing public transport system. It is suggested by one interviewee that a feasibility study can ensure that bikes are only located where feasible in terms of mobility demand (Jespersen, 2017).

City bikes are likely to be used for shorter distances or in urban environments, whereas integration of shared cars can address the mobility needs of those commuters whose current mobility demand can only be met by private cars e.g. people living outside the range of fast and reliable public transport modes, people whose destination is located far from public transport nodes, or people who has to reach several destinations during one day. By locating shared cars at key public transport nodes these can contribute in substituting private car use. Also here, a feasibility study can shed light on the locations in which shared cars should be offered (ibid.).

At a later stage and when technological development has advanced, driverless shared cars can substitute conventional shared cars. Driverless technology can increase flexibility and if actively addressed by the public transport companies be a way of turning the technological innovation into an advantage and thereby avoid the risk that driverless technology will only increase the share of private transportation (see also pp. 65-67). However, if this should be avoided it is acknowledged that both parking restrictions and strict regulation is needed as accounted for in the overall vision and supported by several interviewees (Struckmann, 2017; Jespersen, 2017; Petersen, 2017).

Several shared car solutions already exist. As an example the company DriveNow owns 400 cars that are already integrated with Rejsekortet (DriveNow, n.d.). However, we suggest that a more strategic approach to the integration between public transport modes and other transport modes is needed, since no one currently addresses this as described on p. 43 in the first analysis. Such a strategic approach is different from

the current approaches of car sharing companies like DriveNow, whose main purpose is not to serve as feeders for public transportation but rather to provide full door to door trips.
During our document analysis and interviews we have identified an existing interest among the public transport companies to integrate these type of solutions as exemplified by one interviewee:

> "What role do we play in all this? Should we be part of some sort of collaboration which facilitates the whole trip? (...) because, if you need to go by car to the bus which takes you to the station – then all that needs to work as a flow."
>
> (Kaspersen, 2017)

One specific example of this interest is a partnership established in 2011 between DSB and the former electric car company Better Place. They launched a one year pilot project on implementation of shared cars at two train stations from where employees at selected companies could rent shared electric cars through their train ticket (DSB, 2011). The ambition of this public-private partnership was to implement car sharing solutions at a number of key commuter stations around Denmark and later expand the service to regular commuters (ibid.), however, the pilot project seemed to fail as it never spread (Jespersen, 2017).

Another example of the interest in integrating private and public transportation is the project "Den samlede rejse" (the continuous journey) initiated by Movia and the other regional transport companies (FlexDanmark, 2017). The purpose of the project is to integrate the existing flextrafik service into the public transport system through Rejseplanen in order for users to consider the system as a whole instead of consisting of separate systems. Thereby it will become possible for users to plan and book the whole trip through Rejseplanen and to buy only one ticket which can cover the whole trip (ibid.). Flextrafik is a taxi service offered by the transport companies to disabled citizens, citizens who have special needs or citizens who live in areas with poor coverage of public transport (Movia, 2009).

Controversies and actor configurations
We suggest that DOT can play a key role in ensuring MaaS, as an expanded DOT would have the strategic overview to facilitate and coordinate initiatives – something which is supported by one interviewee:

> "We see DOT as the one to be responsible for MaaS. (...) If we don't link together MaaS solutions and private [transportation] incredibly close with public [transportation], then we don't really believe the needed collaboration will occur."
>
> (Petersen, 2017)

Several interviewees argue that DOT or the individual public transport companies would never have either the political, organisational or economic power to own fleets and rather suggest that economic responsibility and development should be undertaken through public-private partnerships (Jespersen, 2017; Rasmussen, 2017). Furthermore, the private actors that currently provide car sharing services also have more technical and commercial knowledge and experience of managing shared cars (Rasmussen, 2017). Based on the this, we do not deem it likely that DOT will own a fleet of shared cars or city bikes, but rather suggest that DOT can be a key spokesperson by facilitating and engaging in private-public partnerships with Rejsekortet and relevant private actors like DriveNow and By- og Pendlercykel Fonden as visualised in Figure 24.

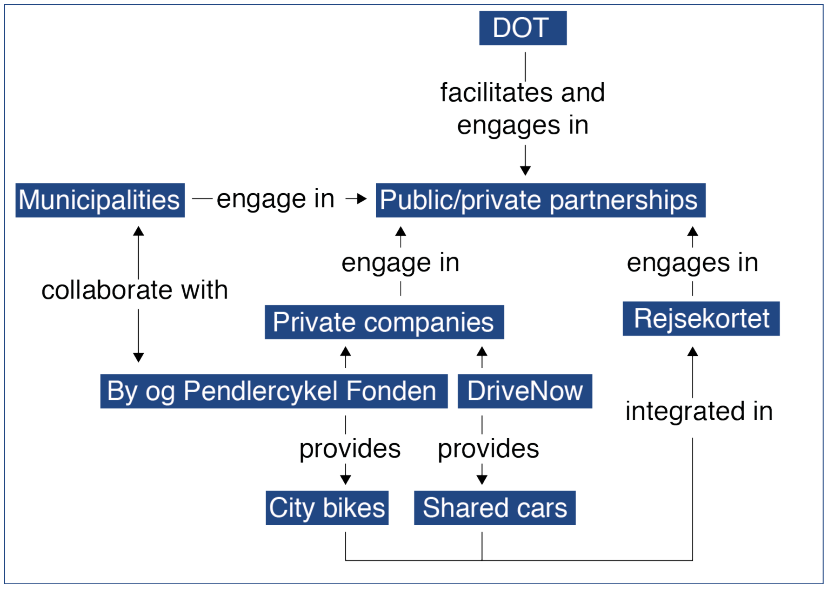


Figure 24. Actor configuration of the integration of MaaS solutions in Rejsekortet through public/private partnerships.

The engagement of actors like By-og Pendlercykel Fonden seems to be rather simple, since they already perceive themselves as the "fourth leg" of public transport (Bycklen, n.d., b) and are already partly integrated in Rejsekortet. Car sharing companies are also likely to be interested to engage in a private-public partnership, as an integration into the public transport system gives access to new markets. Additionally, such a partnership can benefit the car sharing companies beyond the boundaries of the collaboration, if the integration of shared cars results in decreasing car ownership, since low car ownership generally can be assumed to make more people use car sharing services.

A specific element that DOT can provide in relation to MaaS is the suggested feasibility studies because an expanded DOT with an appointed mobility team would have the competencies and the holistic overview to undertake such a task as supported by one interviewee (Jespersen, 2017). A feasibility study could also dictate which municipalities to engage in the collaboration of expanding city bike services, since the current city bike system in Copenhagen and Frederiksberg is municipally funded. In relation to this, By- og Pendlercykel Fonden argues that since the public procurement is already settled upon, it is rather uncomplicated for new municipalities to enter the foundation (Bycyklen, n.d., b). That the organisational framework already exists, eases engagement of municipalities in a private-public partnership on city bikes as part of MaaS.

It should be noted, that some public transport companies are likely to be more interested in some transport services than others. As an example, Movia already provides a sort of car sharing solution through flextrafik and may therefore have greater interests in MaaS than the other companies. As Movia's flextrafik service already has a GPS driven control system, there is a potential in building upon this system when driverless shared cars are to be implemented at a later stage, according to one interviewee:

> "So in that way we have a control system, that the others [DSB and Metroselskabet] don't have. In that way we have the lead in comparison to the others."
>
> (Rasmussen, 2017)

In relation to this, two interviewees believe that MaaS to some extent already exists through the services that the public transport companies provide (Jensen, 2017; Rasmussen, 2017). This is supported by one of the interviewees in Movia, who further argues that MaaS is already on its way within the existing organisational set-up:

> "It will come all by itself, because there are more and more people, and not more money and therefore you have to be smarter at planning this as a Municipality or a Region in order to provide services to the citizens. So it will come all by itself in the structure we have."
>
> (Struckmann, 2017)

This is supported by another interviewee, who argues that DOT not necessarily needs to integrate MaaS, since it will be addressed anyways by the individual companies:

> "Integration of city bikes into Rejseplanen and such things (...) make sense in themselves. And when we can see that the things make sense (...) – then it will be addressed anyways."
>
> (Jensen, 2017)

The discussion on which tasks DOT should undertake, and which tasks should be undertaken by the individual companies is one of the key controversies highlighted in relation to the expansion of DOT on pp. 53-56. In relation to this, several interviewees argue that if efforts of developing MaaS are not coordinated across public transport companies there is a risk that it will not be built on a holistic approach but rather prone to internal conflicts between the companies and thereby positive effects of potential synergies will be lost (Petersen, 2017; Jespersen, 2017). As DOT holds the potential to be the main coordinating actor of public transport in the Greater Copenhagen Area, we suggest that it is it appropriate for DOT to be responsible for coordinating MaaS solutions.

Other challenges arise in terms of integrating new transport modes into Rejsekortet. The process of developing Rejsekortet has been rather lengthy and characterised by technical challenges as well as many internal conflicts between the involved actors (Rasmussen, 2017). These internal conflicts mainly seem to derive from the disagreements on revenue sharing, as accounted for by one interviewee who believes that DOT can become the main actor in solving these issues:

> "It is 15 years ago, that I firstly heard about Rejsekortet. (...) There are many things that they are now working to repair. (...) The reason for this, is that they have been sitting and arguing, and been afraid of [losing] their own ticket revenues. Put it into DOT."
>
> (Jespersen, 2017)

As Rejsekortet will be one of the main platforms for integration between transport modes, the conflicts on ticket revenues in relation to Rejsekortet can potentially complicate the process of integrating new transport modes into the public transport system. It is therefore important for the key actors who are to propose changes to Rejsekortet to be aware of these potential controversies.

Test of driverless technologies

Content and purpose

This measure is intended to provide the knowledge and experience on driverless technologies necessary to implement driverless busses as well as driverless shared cars as part of MaaS. The integration of driverless technologies can both lower costs and increase capacity of the existing system. By being involved in testing and developing driverless technologies, the public transport companies can actively work against the risk that driverless technologies will merely lead to increases in private car use. Thereby it is possible to turn the threat of technological innovation into an advantage according to one interviewee (Petersen, 2017).

In relation to this, one interviewee argues that driverless busses on dedicated busways can be implemented long before driverless cars – perhaps even before 2030 (Jespersen, 2017). A starting point can be the project "Den kvikke vej" in Copenhagen, which is a short BRT segment where buses run on segregated busways providing fast and easy access for buses (Movia, 2016). According to one interviewee, it will be

reasonable and presumably rather simple to convert this infrastructure into lanes dedicated for driverless busses (Jespersen, 2017).

The purpose of testing driverless cars is to reduce costs and increase flexibility and capacity by substituting conventional shared cars as part of MaaS. Therefore, it is important that the available driverless technology is reliable and technologically mature when such a substitution is to take place. As an example, the Municipality of Vesthimmerland has already initiated a process of implementing driverless vehicles on the road in order to transport municipal social and health care workers. The municipality has entered in a collaboration with the foundation Autonomous who provides operational and technical knowledge (Pedersen, 2016). The municipality sees a great potential for cost reductions since driverless technology will release time for administrative work during transportation (ibid.). However, the project has been delayed by the existing legal framework, which currently does not allow testing driverless vehicles within mixed traffic (ibid.).

Controversies and actor configurations

The first step in the process of testing driverless technology is to establish a private-public partnership with the aim of carrying out tests. As driverless technologies can play an important part in providing MaaS solutions, and as DOT can play a key facilitating role in the provision of MaaS, we suggest that DOT can act as a spokesperson in bringing together actors that are involved in development of driverless technologies. This can be done by engaging in a private-public partnership as visualised in Figure 25.

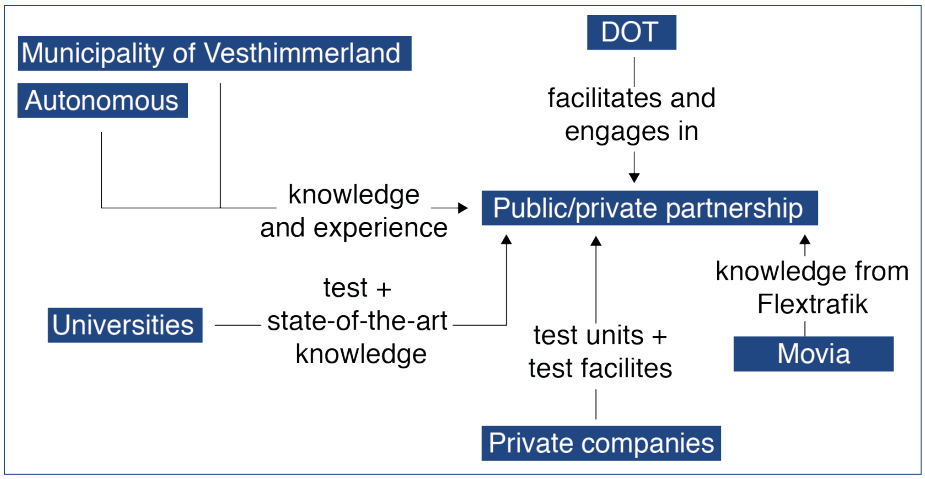


Figure 25. Actor configuration concerning test of driverless technologies

Such a partnership could include private companies developing driverless technologies, with the responsibility of providing driverless units for tests including test facilities. Universities capable of facilitating tests and providing state-of-the-art technical knowledge could also be included. The Technical University of Denmark (DTU) is currently involved in a test project of driverless vehicles in protected space, but over time these tests can take place in real road environments (Rasmussen, 2017). The employees responsible for flextrafik services within Movia are currently in dialogue with the responsible researchers of this test project (ibid.). Based on this, it would be appropriate to actively engage Movia in the partnership. Additionally, the implementation of driverless busses would be within the area of responsibility of Movia.

The Municipality of Vesthimmerland could also be included in the partnership by providing knowledge and experiences from their ongoing project on driverless vehicles. In relation to this, a key barrier for conducting real life tests is the current legal framework. However, the Minister of Transport, Building and Housing recently introduced a bill allowing experimental schemes on driverless busses which has met wide support in the parliament (Kristensen, 2017).

Another key controversy is the degree to which DOT should engage in developing driverless technologies. One interviewee suggests that the public transport companies should rather wait for the technology to be fully developed before integrating it into the system:

> "When the [driverless] technology is there, then we integrate it into the solution we have. We might not be first movers, but we wait and see in which direction it develops, and then we (...) assess how it [driverless technology] can be integrated."
>
> (Jensen, 2017)

In contrast to this, we suggest that DOT and the public transport companies can play an active role in addressing the potentials of driverless technologies in order to integrate these technologies as part of MaaS – something which is supported by one interviewee:

> "Everybody shouts about it (...). That driverless [private] cars solve everything. But they don't! At least not in the Greater Copenhagen Area. A driverless car takes up almost as much space as a non-driverless car. It does not address congestion. (...) It has to be connected to this [MaaS]."
>
> (Petersen, 2017)

By being actively involved in developing these innovative solutions rather than waiting for other actors to develop driverless technologies, DOT and the public transport companies can be at the forefront of delivering a favourable alternative to private cars in order to ensure a strong public transport sector in the future.

Summary

As it is apparent from the above analysis focusing on actor configurations and controversies has given rise to many discussions with the interviewed actors. There were few disagreements between the actors on the content of the vision and the single measures, even though the necessity and likelihood of implementation of some measures have been questioned. Controversies derived regarding the responsibilities of DOT and the need for mandate as well as the quality of the current coordination within the collaboration. These controversies were especially visible when discussing the need for expanding DOT. The actors within DOT question the need and value of increasing the decision-making power, whereas Region Hovedstaden sees it as a prerequisite for improving coordination between the companies. This should be seen in the light of the ongoing discussion lead by Region Hovedstaden on the quality of coordination within DOT. We suggest that part of the resistance to organisational restructuring among the actors in DOT is a way for the actors to legitimise their own work and undermine external criticism of DOT. Based on viewpoints expressed by the interviewees, a more nuanced account of the challenges and opportunities regarding the use of backcasting to create a long-term vision across the companies will be presented in the following.

One interviewee considers backcasting as a *"relieving"* alternative, which stands in contrast to more traditional transport planning practices, since it motivates the involved actors to actively address the initiatives and activities needed to achieve the overall vision (Petersen, 2017). In relation to this, she mentions that backcasting could be a useful approach when conducting the regional growth- and development strategy as well as other transport related development projects of Region Hovedstaden (ibid.). At the same time, she acknowledges that conflicting interests in a political organisation like Region Hovedstaden can potentially stand in the way of an ambitious vision and she highlights the potential conflict between the rigidness of long-term approaches and the need for flexible planning processes in such an organisation (ibid.). In contrast to this, we suggest that the purpose of applying backcasting is exactly to go beyond four-year election periods and other short-term decision-making processes in order to allow for long-term planning approaches that can facilitate a sustainable transition of the transport sector.

Regarding a potential long-term vision of DOT, the interviewee from Region Hovedstaden sees backcasting as useful, but highlights the risk that the outcome would be rather unambitious:

> "I also believe that DOT could use it [backcasting]. However, I think that you rather quickly would encounter issues regarding the vision – it has to be rather narrow. Because they [the actors in DOT] keep saying: 'We do not have mandate for that'"
>
> (Petersen, 2017)

Based on this, one can question the applicability of backcasting to create a long-term vision of DOT if such a vision is based on the lowest common denominator rather than normative reflections on a desirable future. According to one interviewee, another challenge of using backcasting is related to the uncertainties of future development within transport, which complicates making decisions that reach far into the future:

> "A lot happens in this sector – it is actually incredibly difficult to agree on something that reaches really far into the future. We have a game changer concerning driverless technology. Will it happen in 5 years? Will it happen in 10 years?"
>
> (Struckmann, 2017)

By highlighting uncertainties, the interviewee seems to justify the timeframe of Movia's strategic planning which does not address the future role of public transport 20, 30 or 40 years ahead. Additionally, the quote clarifies that uncertainties are a key challenge when making predictions, but this is yet another argument for applying backcasting as the purpose of the approach is to address desirable rather than probable futures by focusing on what *should* happen rather than what *could* happen.

To remedy the challenges of reaching agreement on a long-term vision, one interviewee suggests that backcasting could serve as a non-committal brainstorm process defining the desirable future including the needed initiatives to reach that point (Jensen, 2017). In this way, he believes that backcasting should only be applied in the initial phase upon which the *'real'* work of negotiations can start on how and by who the identified initiatives are to be realised (ibid.). In contrast to this, we suggest the opposite – that real negotiations between actors can indeed take place through a participatory backcasting process. This corresponds with the arguments put forward by one interviewee stating how backcasting can motivate the involved actors to actively address responsibility of specific initiatives (Petersen, 2017). Additionally, we advocate that if aspects concerning *how* and *who* are left out, there is a risk that the suggested initiatives will never be implemented (Wangel, 2011a; Wangel, 2011b).

Generally, the actors within DOT see a potential in applying backcasting, but they question the need for a long-term strategic vision and therefore seem to be critical towards using backcasting to create a long-term vision of DOT. We suggest that these critical viewpoints partly stem from the existing institutional settings and procedures of both the companies and DOT, making it hard for them to adapt to the timeframes and normativity of backcasting. Furthermore, the interviewed actors' competencies and the fact that coordination is currently limited to tasks regarding customer related activities seem to shape their understandings on how future challenges of public transport are to be addressed and to what degree these challenges are to be addressed collectively.

To sum up, the inputs from the interviewees indicate that there are both opportunities and challenges regarding the use of backcasting to create a long-term vision across public transport companies in the Greater Copenhagen Area in order to contribute to improving coordination. Based on the identified controversies and the discussions with interviewees on the proposed scenario, we suggest that backcasting can at least contribute as an approach to initiate discussions on the future role of public transport. Additionally, the focus on actor configurations made it possible not only to discuss the content of the scenario, but also to address how and by who changes should derive including how to improve coordination among actors.

Conclusion

Through a case study, this thesis examined the opportunities and challenges regarding the use of backcasting to create a long-term vision across public transport companies in the Greater Copenhagen Area in order to contribute to improving coordination. As part of this, the aim was to initiate discussions on the future role of public transport among key actors in the field by showing an example of a backcasting scenario through which these actors could collectively address sustainable transport futures.

The first analysis reveals that four main challenges currently hinder coordination between the three public transport companies: focus on optimisation within each company rather than the public transport system as a whole; lack of incentives for long-term holistic planning across the companies; different ambitions for the collaboration in DOT; and limited coordination of long-term investments between the companies. These challenges seem to stem from fundamental differences in the institutional design regarding purposes, geographical delimitations, tasks, owners, and organisational set-ups of the public transport companies. These differences limit the degree to which the current collaboration allows for the creation of a long-term vision at a strategic level. Additionally, the configuration of public transport in the Greater Copenhagen Area is currently not geared to develop a shared long-term vision due to the lack of agency, competencies, and limited budget of DOT. At the same time, the public transport companies are not willing to surrender autonomy to DOT in order to increase its decision-making power. The companies seem to be stuck within the existing framework in which they are not able to see the need for collectively addressing the future role of public transport 20, 30, or 40 years ahead.

We have addressed these controversies through our example of a backcasting scenario. A central part of the scenario is to change the existing configuration of DOT. Merely changing the existing organisational set-up is insufficient to improve coordination and interventions should therefore include expanding the tasks, adding new knowledge and competencies, and increasing the decision-making power and the budget of DOT. If a full participatory backcasting process were to be undertaken, we suggest it is of key importance to address these changes as part of developing a long-term vision. Since the public transport companies constitute DOT, addressing the configuration of DOT includes addressing the configuration of the three companies. It is therefore not only the identity and role of DOT that may change through such a participatory backcasting process, but also the identity and role of the three public transport companies. Seen from the perspectives of ANT, backcasting can thus work as an *interessement device* through which new identities of actors are imposed and stabilised. In relation to this, the main focus of our backcasting scenario is the actor configurations that impose new identities on existing actors by depicting *who* should do *what* with *whom* in relation to the suggested measures. In all measures we suggest that DOT can act as a key spokesperson serving three main purposes: to facilitate a process of change by engaging in collaborations on key initiatives and projects, such as implementation of MaaS solutions; to establish consensus and alliances by coordinating activities and visions across the public transport companies; and to serve as a political mouthpiece for the alliance between the companies towards external stakeholders, in order to communicate common interests.

An important part of this thesis was to present our example of a backcasting scenario to key actors through interviews. During these interviews many discussions arose on the identity and role of actors, their relations, and the level of coordination needed between them in order to address the future role of public transport. As a result, we suggest that to some extent backcasting already seems to work as an interessement device. Furthermore, we propose that identifying and describing actor configurations as part of applying backcasting is a useful method through which a full participatory backcasting study can contribute to improved coordination among the actors entrusted with promoting change. Analysing actor configurations can thereby contribute to bridging the gap between backcasting research and the way in which knowledge from backcasting is translated and actually implemented as policy measures.

One of the main controversies in our discussions with some key actors was centred around the question of *who* could develop a vision similar to the one we have developed, since this vision contains many elements beyond the limits of both the existing and a potential future DOT with greater decision-making power. The development of a long-term vision within DOT requires that the public transport companies reach agreement

without compromising a high level of ambition. This thesis clearly indicates a risk of the companies arriving at a vision of the lowest common denominator. One may question whether such a vision would even be normative and effectively outside the scope of backcasting studies. Additionally, key actors argue that a long-term vision of DOT would have to be rather narrow and cover merely elements on which DOT can potentially impact. However, if the vision solely includes activities of DOT, then backcasting may not be applicable because backcasting studies generally address rather broad societal issues.

At the same time, key actors argue that strategic decisions should be taken by the planning authorities (state, regions and municipalities) rather than the public transport companies, which calls for an inclusion of the planning authorities in the development of a strategic vision. In accordance with this, the vision developed through this thesis includes national regulation like the Fingerplan and restrictions on private car use, making it more likely to be adopted at a national political level as an overall strategy for public transport in the Greater Copenhagen Area. Furthermore, public transport infrastructure requires heavy investments from municipalities, regions, and the state. Developing a strong public transport system as part of a sustainable transition of the transport sector therefore requires the overall framework for future development to be determined by the authorities, since even an expanded DOT can only impact parts of such a system.

These considerations are important in relation to how a full participatory backcasting study would be designed if it were to contribute to improving coordination. The fact that the interviewed actors within public transport in the Greater Copenhagen Area did not express any opposition to the content of the vision developed through this thesis, suggests that they seem to agree on the importance of developing a strong future public transport sector. Rather, controversies arise when it comes to questions like: *who* should do *what*; what is the future role of DOT, the public transport companies, and the planning authorities, i.e. the owners of the transport companies; to what degree should DOT facilitate coordination beyond customer related activities? To answer such questions it is not enough to rely only on the actors currently represented in the board of DOT, i.e. the directors of customer relations. We therefore recommend that actors beyond the current collaboration in DOT be involved in such a participatory backcasting study. This includes actors at the owner level, i.e. the planning authorities, as well as representatives from the public transport companies who have knowledge on strategic planning.

In relation to this, the analysis of this thesis highlights that there are contrasting views upon what aspects of the public transport system DOT should be responsible of coordinating, as well as different understandings of what long-term strategic planning entails. We suggest that alignment of such understandings can be negotiated and ensured through a participatory backcasting process, and the purpose of backcasting is thus also to create alignment among actors on these central aspects.
Other challenges include the willingness among actors to be normative, as well as their ability to look beyond the current framework in terms of the distribution of agency and power between actors. Based on this, we suggest that a backcasting approach can ensure the normativity of the vision by addressing desirable, and not only probable, futures.

As a concluding remark, we suggest that backcasting can be used to create a long-term vision across public transport companies in the Greater Copenhagen Area as well as contribute to improving coordination on two main preconditions: first, actors at the owner level, i.e. the planning authorities, as well as representatives from the public transport companies who have knowledge on strategic transport planning should be included in a participatory backcasting study; and second, all actors should be open towards structural changes that may allow for transition.

The Greater Copenhagen Area only serves as one example of an urban context where there is a lack of key actors collectively addressing sustainable transport futures. Many cities worldwide face similar challenges regarding the lack of coordination between key actors on the future role of transport systems. We suggest that including key actors as active participants in a participatory backcasting study can contribute to improving coordination across actors within transport planning in cities. Additionally, we suggest that identifying and describing actor configurations for each policy measure is a useful approach to specifically address aspects of coordination when undertaking a backcasting study.

Reflections

> "Those who have knowledge, don't predict. Those who predict, don't have knowledge."
>
> Lao Tzu (604 B.C. - 531 B.C.)

Our inspiration for undertaking this Master's Thesis derived from an observed need for applying normative approaches in the transport sector. Prior to this Master's Thesis we undertook a study on the role of traffic models in large infrastructure projects in Denmark and found that current transport planning practices are heavily dominated by forecasting approaches, which are sometimes labelled as *predict and provide*. Current predict and provide models are based on a neoliberal growth imperative supporting the view that increasing transport volumes generate economic growth. In these models, the many negative environmental and social consequences of increasing private car use seem to be undermined by the suggested positive monetary value of time savings. Additionally, the predicted traffic growth that form the basis of these calculations is prone to many uncertainties even though it is well acknowledged, that we cannot predict the future. The neoliberal system also builds upon an idea of freedom – in the transport sector symbolised through private cars. But this idea certainly does not go hand in hand with sustainability concerns. If we are to develop a sustainable transport system it requires questioning the ideas of eternal growth and absolute freedom.

Therefore, we see an urgent need to challenge current traffic models and transport planning practices to favour public transport over private cars. In relation to this, it is necessary to base decisions on desirable futures rather than on predictions of plausible or probable futures in order to address issues of sustainability by bringing normativity into transport planning practices. Backcasting is one approach that can ensure this normativity.

From the introduction and the problem analysis it is clear, that transition of the transport sector is yet to occur at both a global, national and local level. To a large extent professionals within the field know what such a sustainable transition requires, but recommendations – like the ones suggested by the Congestion Commission in 2013 – seem to get lost in endless political fights over short-sighted issues. Even though an ambitious goal to become free of fossil fuels by 2050 has been set at a national level in Denmark, decision-makers appear to worry more about their own career than making the *right* decisions. Also, election imperatives thus stand in the way of the long-term planning approaches needed to ensure sustainable transport futures.

Additionally, the plans, strategies and visions of the public transport companies in the Greater Copenhagen Area have shown to be rather short sighted seen from a sustainability perspective. Even though many discussions on the future role of (public) transport take place, we observe a lack of actively addressing this in visions as well as in actual actions by actors within the field. Our key concerns are the absence of normativity and the lack of addressing issues collectively, since we see coordination among actors as a prerequisite for applying a holistic planning approach. Such a holistic approach is needed in order to develop a sustainable transport system.

Due to our worry about the future of cities and the observed need for normativity, our aim is not merely to analyse current challenges, but to actually suggest and test a solution for the identified challenges. Therefore, we have deliberately chosen to be normative by building a normative scenario which actively addresses the future. The scenario not only describes a desirable future, but also outlines how to reach that point in order to connect the future with present day actions. This is one of the main strengths of backcasting. We are well aware that the scenario is built not only on our analysis, but also upon our own normativity.

During the interviews, we had the chance to discuss this with Associate Professor at RUC Per Homann Jespersen. Here it came forward that even though the scenario is normative, the aim is to describe a future which is desirable for the public transport companies in order for us to contribute with new perspectives on both their individual as well as their collective work. He also highlighted that even though many actors will sympathise with the scenario, it is controversial because it breaks with current trends. This trend breaking

character of the scenario is conscious, since our aim has been to influence discussions and thereby impact on key actors and their relations. As Sustainable City engineers, we are educated to think innovatively about the future of cities and address socio-technical issues from a trend breaking sustainability perspective.
Through this Master's Thesis we have participated in discussions on transport futures by expressing our concerns about the future of cities and by leaving room for questioning current visions, practices and the level of coordination among public transport companies in the Greater Copenhagen Area. We believe, that if transition towards a sustainable transport sector is to take place, decision-makers, practitioners and other key actors need to start not just discussing, but also actively addressing the future.

"Innovation starts with a story about the future."
(Nesta – UK innovation foundation, 2013)

References

Akrich, M., Callon, M., Latour, B., & Monaghan, A. (2002). The key to success in innovation part I: the art of interessement. *International Journal of Innovation Management*, 6(02), pp. 187-206

Auken (2002). Answers in the wind: how Denmark became a world pioneer in wind power *The Fletcher Forum of World Affairs,* 26(1), pp.149-157

Banister, D. (2008). The sustainable mobility paradigm. *Transport Policy*, 15 (2008), pp. 73–80

Banister, D. and Hickman, R. (2013). Transport futures: Thinking the unthinkable. *Transport Policy,* 29, pp. 283-293

BEST (2016). *BEST – Benchmarking European Service of public Transport,* [online]. Available at: http://nordicpublictransport.com/wp-content/uploads/Session-5-Hall-A-Norway-BEST-Helsinki_16062016.pdf (Accessed 8th of June 2017)

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9 (2), pp. 27–40

BSL (2010). *Analysis of the Organisational Set-up of Public Transportation in the Greater Copenhagen Area,* [online]. Available at: https://www.trm.dk/~/media/files/publication/2010/redegoerelse-om-kollektiv-trafik/017400620trm20organisational20setup20final20report2020100308.pdf (Accessed 8th of June 2017)

Börjeson, L., Höjer, M., Dreborg, K.H., Ekvall, T. and Finnveden, G. (2006). Scenario types and techniques: Towards a user's guide. *Futures,* 38(7), pp.723-739

Bredsdorff, M. (2017). Det går den forkerte vej: CO2-udslippet fra de danske biler stiger igen. *Ingeniøren,* [online]. Available at: https://ing.dk/artikel/gaar-forkerte-vej-co2-udslippet-de-danske-biler-stiger-igen-199126 (Accessed 8th of June 2017)

Bycyklen (n.d.), a. *Log ind med dit rejsekort,* [online]. Available at: https://bycyklen.dk/da/saadan-goer-du/log-ind-med-dit-rejsekort/ (Accessed 8th of June 2017)

Bycyklen (n.d.), b. *Organisation,* [online]. Available at: https://bycyklen.dk/da/organisation/ (Accessed 8th of June 2017)

Callon, M. (1986). Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. In: *J. Law. Power, action and belief: a new sociology of knowledge?* London, Routledge, 1986, pp.196-223.

Callon, M. (1990). Techno-economic networks and irreversibility. *The sociological review*, 38 (S1), pp. 132-161

Callon, M., Law, J. and Rip, A., ed. (1986). *Mapping The Dynamics of Science and Technology*. 1st ed. Houndsmills: The Macmillan Press LTD

De Vaus, D. A. (2001). *Research Design in Social Research*. Thousand Oaks: Sage Publications

DOT (2017). Strategi for DOT – Din Offentlige Transport – 2017-2020, [online]. Available at: https://www.moviatrafik.dk/media/5728/strategi-for-dot_2017.pdf (Accessed 8th of June 2017)

Dreborg, K. H. (1996). Essence of backcasting. *Futures*, 28 (9), pp. 813-828

Driscoll, P. A. (2014). Breaking Carbon Lock-In: Path Dependencies in Large-Scale Transportation Infrastructure Projects, *Planning Practice & Research*, 29 (3), pp. 317-330

DriveNow (n.d.). *Hvordan virker bybiler med DriveNow?*, [online]. Available at: https://www.drive-now.com/dk/da/how-it-works/ (Accessed 8th of June 2017)

DSB (2011). *Med elbil fra tog til dør,* [online]. Available at: https://www.dsb.dk/om-dsb/presse/pressemeddelelser/med-elbil-fra-tog-til-dor/ (Accessed 8th of June 2017)

DSB (n.d.). *Forretningsbetingelser,* [online]. Available at: https://www.dsb.dk/om-dsb/virksomheden/forretningsbetingelser/ (Accessed 8th of June 2017)

DSB, 2014. *Strategi 2030,* [online]. Available at: https://www.dsb.dk/globalassets/om-dsb-test/job/psi_strategibog_a4-2008-v3.pdf (Accessed 8th of June 2017)

DSB, Metroselskabet and Movia (2013). *Det skal være NEMT at være kunde i den kollektive transport – oplæg til paraplyorganisation,* [online]. Available at: http://www.ft.dk/samling/20121/almdel/tru/bilag/357/1280627.pdf (Accessed 8th of June 2017)

DTU (2006). *Fremtidsscenarier for transport i Danmark.* DTU, Lyngby

Elle, M., Dammann, S., Lentsch, J. and Hansen, K. (2010). Learning from the social construction of environmental indicators: From the retrospective to the pro-active use of SCOT in technology development. *Building and Environment*, 45 (2010), pp. 135-142

Energistyrelsen (2017). *Basisfremskrivning 2017.* Energistyrelsen, København

European Commission (2017). *A European Strategy for low-emission mobility.* [online] Available at: https://ec.europa.eu/clima/policies/transport_en (Accessed 8th of June 2017)

FlexDanmark (2017). *Den samlede rejse,* [online]. Available at: https://www.flexdanmark.dk/web/flextrafik/den-samlede-rejse (Accessed 8th of June 2017)

Flick, U. (2009). Using Documents As Data. In: Flick. U. (2009). *An Introduction to Qualitative Research.* 4th. ed. London: Sage Publications, pp. 254-262

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry,* 12(2), pp. *219*-245

Hickman, R. and Banister, D. (2007). Looking over the horizon: transport and reduced CO2 emissions in the UK by 2030. *Transport Policy,* 14, pp. 377–387

Hovedstadens Udviklingsråd (2000). *Trafikplan 2003.* Hovedstadens Udviklingsråd, Valby

Hovedstadens Udviklingsråd (2004). *Høringssvar vedrørende forslag til lov om trafikselskaber.* Hovedstadens Udviklingsråd, Valby. [online]. Available at: http://www.ft.dk/samling/20042/lovforslag/l83/bilag/2/146384.pdf (Accessed 8th of June 2017)

Hovedstadsrådet (1989). *Kollektiv trafikplan 1989.* Hovedstadsrådet, Valby

Höjer, M., Gullberg, A. and Pettersson, R. (2011). Backcasting images of the future city – Time and space for sustainable development in Stockholm. *Technological Forecasting & Social Change*, 78, pp. 819-834

Höjer, M. and Mattson, L. (2000). Determinism and backcasting in future studies. *Futures,* 32(2000), pp. 613-634

Ingeniøren (2015). *Leder: Efter rejsekortet – giv os Transport for Greater Copenhagen.* Ingeniøren, 20.03.2015, [online]. Available at: https://ing.dk/artikel/leder-efter-rejsekortet-giv-os-transport-copenhagen-174859 (Accessed 8th of June 2017)

Jernhusen (n.d.). *Strategi,* [online]. Available at: https://www.jernhusen.se/om-jernhusen/strategi/ (Accessed 8th of June 2017)

Jespersen, P. H., Sørensen, C. H., Nielsen, O. A. and Als, P. (2017). *Hvordan får vi mere og bedre kollektiv transport for pengene? Bud på fremtidens organisering af kollektiv trafik i Greater Copenhagen,* [online]. Available at: https://www.regionh.dk/til-fagfolk/trafik/Analyser-og-rapporter-om-trafik/transport-for-greater-copenhagen/Documents/Rapport%20-%20bedre%20kollektiv%20trafik.pdf (Accessed 8th of June 2017)

Jæger , B. (2000). *SCOT in action.* Research Papers / Department of Social Sciences, nr. 1. Roskilde, Roskilde Universitet

Järvi, T., Tuominen, A., Tapio, P. and Varho, V. (2015). A transport policy tool for reduction of CO2 emissions in Finland – Visions, scenarios and pathways using pluralistic backcasting method. *Transportation Research Procedia*, 11 (2015), pp. 185-198

Klima- og Energiministeriet (2011). *Energistrategi 2050 – Fra kul, olie og gas til grøn energi.* Klima- og Energiministeriet, København

Kok, K., Vliet, M., Bärlund, I., Dubel, A. and Sendzimir, J. (2011). Combining participative backcasting and exploratory scenario development: Experiences from the SCENES projects. *Technological Forecasting & Social Change, 78, pp. 835-851*

Kristensen, M.R., (2017). Folketinget giver grønt lys til førerløse busser. *Berlingske,* [online]. Available at: https://www.b.dk/nationalt/folketinget-giver-groent-lys-til-foererloese-busser (Accessed 8th of June 2017)

Kvale, S. and Brinkmann, S. (2015). *Interview, det kvalitative forskningsinterview som håndværk*. København: Hans Reitzels Forlag

Københavns Kommune (2015). *Orientering om voldgiftssag mellem Movia, DSB og Metroselskabet,* [online]. Available at: https://www.kk.dk/sites/default/files/edoc/92d9ce96-12cb-4a77-aa74-12df066403fb/bddeab65-b18d-486e-a909-96f67b2604e7/Attachments/12417288-13371517-1.PDF (Accessed 8th of June 2017)

Køge Nord Station (n.d.). *About Køge Nord Station,* [online]. Available at: http://koegenordstation.dk/english/about-koege-north-station/ (Accessed 8th of June 2017)

Ladd, B. (2012) "You can't build your way out of congestion." – Or can you?, *disP - The Planning Review*, 48 (3), pp. 16-23

Latour, B. (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory*. New York, Oxford University Press

Latour, B. (1996). *Aramis, or, The love of technology* (Vol. 1996). Cambridge, MA: Harvard University Press

Lorentzen, K. P. (2016). *V: Vejene fører til vækst og velfærd.* Altinget, 18.05.2016, [online] Available at: http://www.altinget.dk/transport/artikel/v-vejene-foerer-til-vaekst-og-velfaerd (Accessed 8th of June 2017)

Lorentzen, K. P. (2017). *Lad os investere klogt, helhedsorienteret og langsigtet i fremtidens transport.* Jyllandsposten, 21.04.2017, [online]. Available at: http://jyllands-posten.dk/debat/breve/ECE9521027/lad-os-investere-klogt-helhedsorienteret-og-langsigtet-i-fremtidens-transport/(Accessed 8th of June 2017)

Marcussen, H. (1996). *Hovedstadsrådet 1. april 1974 - 31. december 1989. Erindringer 6 år efter.* Byplanhistoriske Noter nr. 32. Dansk Byplanlaboratorium, København

May, A.D., Kelly, C. and Shepherd S (2006). The principles of urban integration in urban transport strategies. *Transport Policy,* 13, pp. 319-32

McCluskey, B. (2016). A smoother ride. *Engineering & Technology*, 11(9), pp. 36-41

Metroselskabet, 2014. *Metroselskabets forretningsstrategi 2014-2018,* [online]. Available at: https://www.kk.dk/sites/default/files/edoc/3c012778-46ff-4ba6-bf38-1bb5bf00b5ef/42b827e0-036e-4463-b30a-d0d42ae090e8/Attachments/16255818-20144451-1.PDF (Accessed 8th of June 2017)

Metroselskabet and Hovedstadens Letbane (2017). *Megatendenser – Fremtidens kollektive transport i Hovedstadsområdet.*

Miola, A. (2008). *Backcasting approach for sustainable mobility.* European Commission, Joint Research Centre, Institute for Environment and Sustainability, Scientific and technical research series

Movia (2016). *Trafikplan 2016*. Movia, København

Movia (2009) *Flextrafik. Konceptbeskrivelse Version 1.0,* [online]. Available at: https://www.moviatrafik.dk/media/1887/flextrafik_konceptbeskrivelse_120110_final_web.pdf (Accessed 8th of June 2017)

Nesta (2013). *Don't stop thinking about tomorrow: A modest defence of futurology* [online]. Available at: https://www.nesta.org.uk/sites/default/files/dont_stop_thinking_about_tomorrow.pdf (Accessed 8th of June 2017)

Newman, P. and Kenworthy, J. (2006). Urban Design to Reduce Automobile Dependence. *Opolis: An International Journal of Suburban and Metropolitan Studies*, 2 (1), pp. 35-52

Newman, P. and Kenworthy, J. (1999). *Sustainability and Cities: Overcoming Automobile Dependence.* Island Press, Washington, D.C., USA

NT (n.d.) *Samkørsel via NT+GoMore,* [online]. Available at: https://www.nordjyllandstrafikselskab.dk/Bus---togtrafik/Samkoersel-(NT-GoMore) (Accessed 8th of June 2017)

Olsson, L., Hjalmarsson, L., Wikström, M. and Larsson, M. (2015). Bridging the implementation gap: Combining backcasting and policy analysis to study renewable energy in urban road transport. *Transport Policy*, 37 (2015), pp. 72-82

Regeringen (2015). *Passagertogtrafik i Danmark 2015-2024.*

Region Hovedstaden (2016). *Massiv trængsel udfordrer regionen,* [online] Available at: https://www.regionh.dk/presse-og-nyt/pressemeddelelser-og-nyheder/Sider/Massiv-traengsel-udfordrer-regionen.aspx (Accessed 8th of June 2017)

Region Hovedstaden (2015). *Copenhagen – hele Danmarks hovedstad. Regional vækst- og udviklingsstrategi,* [online]. Available at: https://www.regionh.dk/til-fagfolk/erhverv/regional%20vaekst%20og%20udvikling/Sider/Regional-vaekst-og-udviklingsstrategi.aspx (Accessed 8th of June 2017)

Rejseplanen (n.d), a. *Mere om Rejseplanen,* [online]. Available at: https://help.rejseplanen.dk/hc/da/articles/115000127329-Mere-om-Rejseplanen (Accessed 8th of June 2017)

Rejseplanen (n.d), b. *Rejseplanens parter,* [online]. Available at: https://help.rejseplanen.dk/hc/da/articles/214318225-Rejseplanens-parter (Accessed 8th of June 2017)

Richards, K. (2009). Geography and the Physical Sciences Tradition. In: Clifford, N., Holloway, S., Rice,S.P. and Valentine, G. (ed.). *Key Concepts in Geography.* London: Sage

Robinson, J.B. (1990), Futures under glass. A recipe for people who hate to predict. *Futures* (October 1990), pp. 820-842.

Rydin, Y. (2012). Using Actor-Network Theory to understand planning practice: Exploring relationships between actants in regulating low-carbon commercial development. *Planning Theory*, 12(1), pp. 23-45

Sager, T. and Ravlum, I. A. (2004). Inter-agency transport planning: co-ordination and governance structures. *Planning Theory & Practice*, 5 (2), pp. 171-195

Sismondo, S. (2010). *An Introduction to Science and Technology Studies.* 2nd ed. Wiley-Blackwell

Sjöblom, G. (2011). Introduction: The return of transport coordination. *Transfers,* 1(2), pp. 50–60

Struensee & Co (2015). Transport for Greater Copenhagen

Struensee & Co (2016). Større sammenhæng i den kollektive trafik i Greater Copenhagen

Teknologirådet (2012). *Dansk transport uden kul og olie – hvordan? Et oplæg til debat om hvordan dansk transport bliver uafhængig af fossile brændsler inden 2050.* Teknologirådet, København

Tetraplan (2013). *Transportministeriet - Trængselskommissionen. Basistrafikfremskrivninger 2018, 2025 og 2040*

Transport for London (n.d.). *About TfL,* [online]. Available at: https://tfl.gov.uk/corporate/about-tfl/ (Accessed 8th of June 2017)

Trafik-, Bygge- og Boligstyrelsen (2017). Samarbejde på Sjælland, [online]. Available at: https://www.trafikstyrelsen.dk/DA/Kollektiv-Trafik/Samarbejde-paa-Sjaelland.aspx (Accessed 8th of June 2017)

Trafikforskningsgruppen ATV (1977). *Trafik2000, et forskningsprojekt om trafikkens udvikling under forskellige samfundsmæssige forudsætninger*. Akademisk Forlag.

Transport- og Bygningsministeriet (2005). *Lov om trafikselskaber.* LOV nr 582 af 24/06/2005 Historisk, [online]. Available at: https://www.retsinformation.dk/forms/R0710.aspx?id=22454 (Accessed 8th of June 2017)

Transport- og Bygningsministeriet (2014). *Lov om ændring af lov om trafikselskaber og lov om vægtafgift af motorkøretøjer m.v.* LOV nr 745 af 25/06/2014, [online] Available at: https://www.retsinformation.dk/Forms/R0710.aspx?id=163825 (Accessed 8th of June 2017)

Transport- og Bygningsministeriet (2015). *Bekendtgørelse af lov om trafikselskaber.* LBK nr 323 af 20/03/2015, [online]. Available at: https://www.retsinformation.dk/Forms/R0710.aspx?id=168627 (Accessed 8th of June 2017)

Transportministeriet (2013). *Evaluering af lov om trafikselskaber.* København, Transportministeriet

Trængselskommissionen (2013a). *Mobilitet og fremkommelighed i hovedstaden: Betænkning 1539. Hovedrapport.*

Trængselskommissionen (2013b). *Reduktion af trængsel og forurening samt modernisering af infrastrukturen i hovedstadsområdet. Idékatalog*

Turner, D. W. (2010). Qualitative Interview Design: A Practical Guide for Novice Investigators. *The Qualitative Report*, 15(3), pp. 754-760

UITP (2015). *Corridor maximum capacity of urban transport modes, in persons/hour/direction,* [online]. Available at: https://twitter.com/UITPnews/status/777790983178190848 (Accessed 8th of June 2017)

United Nations (2014). *World Urbanization Prospects*. United Nations

Urry, J. and Dennis, K. (2009). *After the Car.* Polity Press

Venturini, T. (2009) Diving in magma: How to explore controversies with Actor-Network Theory. *Public Understanding of Science,* 19(3), pp. 258–273

Vergragt, P. J and Quist, J. (2011). Backcasting for sustainability: Introduction to the special issue. *Technological Forecasting & Social Change*, 78 (2011), pp. 747-755

Vilhof, P. (1994). Planlægning for kollektiv trafik. In: Lahrmann, H. and Leleur, S. (1994). *Vejtrafik – Trafikteknik og trafikplanlægning*. Polyteknisk Forlag, Lyngby

Wangel, J. (2011a). Exploring social structures and agency in backcasting studies for sustainable development. *Technological Forecasting & Social Change*, 78 (2011), pp. 872–882

Wangel, J. (2011b). Change by whom? Four ways of adding actors and governance in backcasting studies. *Futures,* 43 (2011), pp. 880–889

Yin, R. K. (2014). *Case Study Research: Design and Methods*. 5th ed. Thousand Oaks: Sage Publications

Åkerman, J. and Höjer, M. (2006). How much transport can the climate stand? – Sweden on a sustainable path in 2050. *Energy Policy,* 34 (2006), pp. 1944–1957

Interviews

Jensen, Rune Jon (2017). Conducted the 16th of May 2017 at DSB. See appendix for transcription.

Jespersen, Per Homann (2017). Conducted the 28th of April 2017. See appendix for transcription.

Kaspersen, Lars (2017). Conducted the 23rd of March 2017 at DSB. See appendix for transcription.

Petersen, Birgit E. (2017). Conducted the 20th of March and 15th of May 2017 at Region Hovedstaden. See appendix for transcription.

Rasmussen, Torsten (2017). Conducted the 22nd of April 2017 at Movia. See appendix for transcription.

Struckmann, Camilla (2017). Conducted the 27th of March and the 28th of April 2017 at Movia. See appendix for transcription.

Schmidt, Hanne Tærsbøl (2017). Conducted the 29th of March 2017 at Metroselskabet. See appendix for transcription.

Østergaard, Jørgen (2017). Conducted the 22nd of March 2017 at Hovedstadens Letbane. See appendix for transcription.