KTH ROYAL INSTITUTE
OF TECHNOLOGY

Licentiate Thesis in Planning and Decision Analysis

Public transport meets smart mobility

Roles and relationships shaping driverless shuttles and MaaS

KELSEY OLDBURY

Stockholm, Sweden 2021

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Abstract

This licentiate thesis investigates the development of two aspects of smart mobility, driverless shuttles and Mobility as a Service (MaaS) in relation to public transport. Smart mobility has emerged as a term to describe and label a group of changes unfolding in the transport sector, such as the role out of automated vehicles, electrification, the spread of platforms and new types of shared services, as well as new concepts to integrate multiple forms of mobility, often referred to as Mobility as a Service (or MaaS). The aim of this thesis is to provide insights into the governance of smart mobility, and more specifically the ways in which public transport governance and planning is shaped or reshaped by these processes.

I explore how pilot projects for MaaS and driverless shuttles are being implemented in a specific case in Barkarbystaden, in Järfälla municipality in the greater Stockholm region. Barkarbystaden is a site of large scale infrastructural and urban development. This broader development has influenced the emergence of a collaboration between the local municipality of Järfälla, Stockholm's regional public transport authority (RPTA), and the private bus operator Nobina Sweden. The collaboration is based on developing public transport in tandem with new technologies and services. As part of this collaboration two pilot projects were launched, one for driverless shuttles as part of public transport, and one for MaaS. In this thesis I draw on the concept of the *governance assemblage* to explore the formation of the collaboration, and *translation* to discuss the framing and introduction of both driverless shuttles and MaaS. I specifically ask which roles, responsibilities, and links between the organisations involved and smart mobility shape and characterise the collaboration, as well as how relations take shape around MaaS and driverless shuttles.

This case shows how the backdrop of urban and infrastructure development in Barkarbystaden plays a key role in shaping these developments and highlights the influence of existing roles and relationships within public transport planning. In this study the introduction of smart mobility is characterised by the relationship between the operator and RPTA. The way in which smart mobility takes shape with a clear link to the existing role and responsibilities of the bus operator suggests for the role of the private operator takes on a new meaning within public transport in relation to smart mobility. The aspects of smart mobility piloted in this case also have different implications and connections to public transport governance and planning. The pilot for driverless shuttles creates connections to established formal documents, roles and existing processes for public transport provision while MaaS re-orders roles between the RPTA and the

operator in this case. This re-ordering of roles is part of the framing of the MaaS concept, and this case illustrates how this emerges in a specific context and the ways in which different actors relate to the concept, influencing how MaaS materializes in this setting. Altogether, this case highlights how different forms of smart mobility have different implications for public transport planning and governance and illustrates how the role of the operator gains new significance at the intersection of smart mobility and public transport.

Sammanfattning

Denna licentiatavhandling undersöker utvecklingen av två aspekter av smart mobilitet: små autonoma bussar och Mobility as a Service (MaaS) och hur dessa utvecklas och implementeras i ett kollektivtrafiksammanhang. Smart mobilitet är ett begrepp som kommit att användas för att beskriva förändringar som pågår inom transportsektorn, såsom utveckling av autonoma fordon, elektrifiering, en ökad användning av digitala plattformar, nya typer av delade tjänster, samt nya sätt att kombinera och integrera mobilitetstjänster t ex genom koncept som MaaS. Syftet med avhandlingen är att bidra med kunskap om styrningen av smart mobilitet, och mer specifikt hur styrning och planering av kollektivtrafik formas och omformas av dessa processer.

Jag utforskar pilotprojekt för MaaS och små autonoma bussar i ett specifikt fall i Barkarbystaden, i Järfälla kommun i Stockholmsregionen. Barkarbystaden är ett område där storskalig infrastruktur- och stadsutveckling pågår, och i samband med denna bredare utveckling har ett samverkansprojekt vuxit fram mellan Järfälla kommun, Stockholms regionala kollektivtrafikmyndighet och bussoperatören Nobina som tillhandahåller busstrafik i området på uppdrag av regionen. Samarbetet mellan dessa aktörer tar avstamp i planeringen och utformningen av kollektivtrafik i detta område, och genomsyras av ambitioner att implementera nya typer av teknik och tjänster som kan knyta an till den vidare stadsutvecklingen. Som en del av samarbetet lanserades två pilotprojekt, ett för förarlösa bussar och ett för MaaS. I avhandlingen använder jag begreppet *governance assemblage* för att undersöka hur samarbetet formades. Jag använder också begreppet *translation* för att analysera hur autonoma bussar och MaaS har ramats in och utvecklats över tid. Jag undersöker specifikt vilka roller, ansvarsområden och länkar mellan organisationerna och smart mobilitet som formar och karakteriserar samarbetet, liksom hur relationer tar form kring MaaS och små autonoma bussar.

Avhandlingen visar hur infrastruktur- och stadsutvecklingen i Barkarbystaden spelar en nyckelroll för hur samarbetet mellan aktörerna tog form och belyser hur befintliga roller och relationer inom kollektivtrafikplanering påverkar utvecklingen av smart mobilitet. Av studien framgår hur introduktionen av smart mobilitet påverkas av förhållandet mellan operatören och kollektivtrafikmyndigheten. Smart mobilitet tar form med en tydlig koppling till bussoperatörens befintliga roll och ansvarsområde vilket tyder på en ny betydelse för den privata operatörerens roll inom kollektivtrafik i förhållande till smart mobilitet. Implementeringen av MaaS och små autonoma bussar vissa hur dessa aspekter av smart mobilitet har åtskilliga konsekvenser och kopplingar till

styrning och planering av kollektivtrafik. Medan piloten för små autonoma bussar knöt an till formella dokument, roller och processer för kollektivtrafikförsörjning, ledde MaaS-piloten till förändrade relationer mellan operatören och kollektrafikmyndigheten. Att omorganisera befintliga roller och strukturer är en del av MaaS-konceptet. Denna studie illustrerar hur ett försök att realisera konceptet faller ut i praktiken, och att vad MaaS blir påverkas av hur olika aktörer förhåller sig till konceptet. Sammantaget belyser denna studie hur olika former av smart mobilitet har olika konsekvenser för planering och styrning av kollektivtrafik, samt att operatörens roll får en ny betydelse i mötet mellan smart mobilitet och kollektivtrafik.

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Stockholm, 11th January 2021
Kelsey

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1 Introduction

On the 26th November 2018, I attended a kick-off event for a recently established collaboration in Barkarbystaden, a new urban core being developed in Järfälla municipality in the north-west of the Stockholm region. The event was held in the newly built school in the area, and by one o'clock most people had assembled in the large, blue staff room on the second floor. Participants mostly came from the three main organisations involved in the collaboration: the local municipality of Järfälla, Stockholm's regional public transport authority (RPTA) and the bus operator Nobina, the transport company responsible for providing bus services in the area. Others present also included researchers connected to the project. The kick-off began with opening speeches from political representatives from the region and the municipality. The political representative for Region Stockholm, Kristoffer Tamsons, addressed those present as the new parents of the project, emphasising that the collaboration had been set up to develop public transport and new technologies in tandem with the urban and infrastructural development planned for the area in the coming decades. He finished off his speech by asking us all to stand together for a photograph, to confirm that we were all part of the project.

This collaboration, known as 'Modern Mobility in Barkarbystaden', was formally established in June 2018, with the aim of developing public transport in tandem with urban development, and simultaneously developing new technological ideas and services with implications for the future of public transport. These services included the development of a Bus Rapid Transit line (BRT), autonomous buses in the form of small, driverless shuttle buses, larger buses, and a digital platform service known as Mobility as a Service, which is often abbreviated to MaaS.

'Modern Mobility in Barkarbystaden' has been formally running for two years, and concluded in December 2020.[1] Work on the different services involved in the collaboration has developed in various ways between its start date and the time of writing, November 2020. The small, driverless shuttles were launched in late October 2018, a few weeks prior to the kick-off. These have subsequently undergone a series of developments, involving a slight extension to the initial route, and the addition of three more buses in February 2019, with ongoing plans to develop the service further in the area. In October 2019, the digital platform for travel planning, officially known as Travis, was launched as both a pilot specific to Barkarbystaden, and a platform accessible to the whole of the

[1] There are however plans underway to continue the collaboration

Stockholm region. The BRT line was also launched in August 2020, but is not analysed as part of this study. This licentiate thesis is based on research which primarily took place during the first year of the collaboration, and focuses on the establishment of the collaboration, the initial stage in developing the driverless shuttles in late 2018, and the lead-up to the launch of the MaaS platform in October 2019.

The developments in Barkarbystaden are a recent example of the types of project currently taking place around "smart mobility" in various locations throughout the world. Smart mobility is used here as an umbrella term, and has been applied in previous research (Docherty et al., 2018; Marsden & Reardon, 2018a) to label a number of changes currently unfolding in the transport sector. The areas usually included in smart mobility involve the roll-out of automated vehicles, the electrification of vehicle fleets, the proliferation of platform applications used to facilitate access to various shared mobility services, and a new concept for integrating multiple mobility services, often referred to as Mobility as a Service, or MaaS (Marsden & Reardon, 2018a; Finger & Audouin, 2019). Overall, smart mobility can be described as a "collection of technical innovations that have the potential to change the forms and ways in which people move around" (Reardon, 2020, p. 140). The developments in Barkarbystaden are one recent example of the type of projects currently taking place around "smart mobility" in various locations throughout the world. Certain studies have focused specifically on automation (Hopkins & Schwanen, 2018; 2019), including the type of driverless shuttles studied here (Ainsalu, 2018; Antonialli, 2019; Smolnicki, 2017). Others have focused specifically on MaaS (Isaksson et al., 2019; Hirschhorn et al., 2019; Mukhtar-Landgren & Smith, 2019; Smith, 2020). In this study I explore how driverless shuttles and MaaS are being piloted in the same context.

In research literature on urban transport and mobility, there has been a growing interest in "smart mobility", which has received considerable attention in terms of the 'disruptive' changes already brought about by some of these developments (Meyer & Shaheen, 2017; cf. Frenken & Schor, 2017). The technologies and concepts included under the smart mobility umbrella have also garnered recognition because of the potential they hold for more efficient and sustainable urban transport systems (Docherty, 2020; Smith, 2020).

Smart mobility is not a single change, but an array of technologies and ideas which will affect particular parts of the mobility system in different ways (Marsden & Reardon, 2018a). Within the public transport sector, this has led to discussions about how smart mobility will reshape urban transportation. The boundary between public and private transport is becoming increasingly blurred (European Commission, 2017), and in response to this, the International

Association of Public Transport has noted that public transport is undergoing a 'redefinition' (UITP, 2019).

Overall, the governance and planning of smart mobility has emerged as a clear theme in the research literature, which seeks to problematise the hype around smart mobility and critically debate its potential future(s) (Marsden & Reardon, 2018a; Finger & Audouin, 2019; Pangbourne et al., 2020; Paulsson & Hedegaard Sørensen, 2020). Researchers have emphasised that a broader, predominantly technical focus often belies the socio-technical nature of these developments (Mladenović, 2019). It has also been emphasised that, despite its potential, the implications of smart mobility for sustainability are still to be proven (Lyons, 2018; Marsden & Reardon, 2018a; Pangbourne et al., 2020). At the same time, public actors find themselves in a challenging position involving the negotiation of their role in these developments, as well as the planning and policy measures needed to steer the changes so that their roles are not bypassed (Docherty et al., 2018; Stone et al., 2018; Moscholidou, 2020). Researchers have also drawn attention to the types of setting where smart mobility is currently evolving, highlighting that developments often take place in the form of test beds, pilots and demonstration projects (Berglund Snodgrass et al., 2019; Mukhtar-Landgren & Paulsson, 2020). The governance of smart mobility is therefore no longer simply a discursive question. It is in these types of 'on the ground' projects that entities such as automation and new platforms for mobility like MaaS are defined in practice, and new alliances are made between actors (Tironi & Valderrama, 2019; cf. Evans & Karvonen, 2014).

It is interesting to explore the development of smart mobility in Barkarbystaden in relation to this broader literature on smart mobility. Barkarbystaden is a case where different aspects of smart mobility (automated driverless shuttles and MaaS), are being developed within the same project framework. They are also part of a collaboration which clearly situates the driverless shuttles and MaaS within the ongoing development of public transport, driven by an ambition to integrate these services with 'ordinary' public transport. It is also an arrangement where public actors are centrally involved as two of the main organisations in the collaboration. How smart mobility develops within this collaboration is therefore of interest from a governance and planning perspective. The publicly announcement of the collaboration (Järfälla municipality, 2018) communicates the joint commitment established between the actors around the complex issues of urban development, public transport and smart mobility, also making the project visible in the public eye (Fred, 2019). Previous research into collaboration and public transport governance has however highlighted that collaborations also involve ambiguities, risks and challenges influencing

accountability and transparency in decision making processes (Paulsson et al., 2018; cf. Torfing et al., 2009; Olesen, 2012; Allmendinger & Haughton, 2010).

In this licentiate thesis I aim to contribute to an emerging body of literature on the governance and planning of smart mobility from a social-science perspective (Marsden & Reardon, 2018a; Finger & Audouin, 2019; Paulsson & Hedegaard Sørensen, 2020). I examine the governance and planning of smart mobility with a particular focus on one example of the types of arrangement in which public actors are involved as smart mobility emerges. Governance can be broadly defined as the "process of steering collective action" (Briassoulis, 2019, p. 420). It is a multifaceted concept, and this thesis takes a relationalist, non-reductionist approach as its point of departure. In line with literature which has problematised the focus on sovereign political institutions and top-down, hierarchical structures, I understand governance as processes which are not confined to formal political institutions. Governance is used in a way which acknowledges that processes for steering collective action occur as interdependent activities shared between state, market and civil society (or public and private actors), and that these processes take place simultaneously as co-existing modes of governance (Lange et al., 2013). I also regard planning as one component of governance, and use Abram and Weszkalnys's (2013, p. 3) definition of planning as "a broad range of tactics, technologies and institutions to try and control the passage into the future, … spread across private and public organisations". I therefore understand that many processes are involved in steering collective action, and the collaboration in Barkarbystaden represents one context through which to study how processes of governance and planning for smart mobility are taking place. Building on these definitions of planning and governance, I approach the collaboration in Barkarbystaden as a *governance assemblage*, a term which is used to conceptualise the collaboration as a provisional and situated composition of actors, gathered around the governance of a particular issue (Briassoulis, 2019; Parks, 2019).

This thesis is interested in how smart mobility is being developed and implemented in a specific context, and more precisely how configurations of actors already involved in the provision of public transport are working with smart mobility. I understand Barkarbystaden as a key site where the so-called 'redefinition' of public transport is taking place, and where ideas that are believed to be an influential aspect of the future of transport are being tested in relation to existing organisations and processes. This ultimately also has implications for how automation and MaaS themselves are formed, and the influence they have on public transport. The collaboration in Barkarbystaden is fronted by the municipality of Järfälla, Stockholm's regional public transport authority and the bus operator Nobina. However, it also involves the innovation companies

Barkarby Science and Nobina Technology, connected to the municipality and the bus operator respectively (see Figure 1).

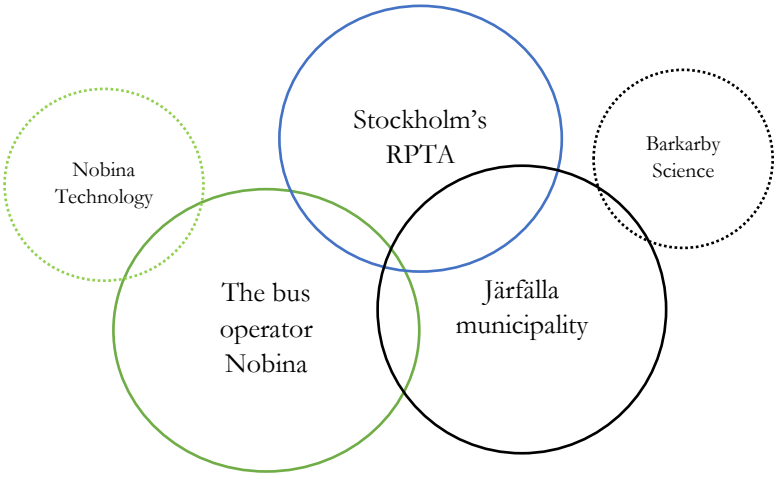

Figure 1. Diagram giving an overview of the main organisations involved in the collaboration: Stockholm's Regional Transport Authority, Järfälla municipality and Barkarby Science, the innovation company affiliated with the municipality. It also includes the bus operator Nobina and its innovation company, Nobina Technology.

1.1 Aim and research questions

The aim of this thesis is to provide insights into the governance of smart mobility, and more specifically the ways in which public transport governance and planning are shaped or reshaped by these processes. To do this, I explore how driverless shuttles and MaaS are being introduced through a collaboration around public transport in Barkarbystaden. The governance arrangement investigated in this study is a collaboration consisting predominantly of actors who are already established in the provision of public transport; the local municipality, the regional public transport authority and the bus operator currently contracted to provide public transport in the area. I therefore understand it as illustrative of how these actors have come together to work with smart mobility.

Drawing on assemblage thinking (Bueger, 2014; Savage, 2020), I understand this collaboration as a governance assemblage (Briassoulis, 2019). I use this to structure the analysis and discussion of the process through which a set of relations are established, and how the governance and planning of driverless shuttles and MaaS take place in relation to this. I use my first research question to guide an analysis of this process, and ask specifically: *Which roles, responsibilities and links between the organisations and smart mobility shape and characterise the collaboration*?

To explore the relationship between driverless shuttles and MaaS, and the organisations involved, I complement the concept of the governance assemblage with the Actor Network concept of translation. Translation (Callon, 2007 [1986]) has been used to discuss processes through which actors negotiate their roles and their margins of manoeuvre, and the ways in which they determine boundaries of action. I apply my second research question to both driverless shuttles and MaaS, and ask: *Based on the translation concept, how do relations between actors take shape around driverless shuttles and MaaS? How are relationships moved around, changed, or linked in new ways?*

1.2 Thesis outline

Following this introductory chapter, Chapter 2 presents the broader context of infrastructural and urban development influencing the introduction of smart mobility in Barkarbystaden. It also explores the main general responsibilities of the regional public transport authority and local municipal authority, and introduces the key actors in more detail. Chapter 3 introduces public transport governance in a broad sense and presents smart mobility as the field of research I aim to contribute to, before exploring driverless shuttles and MaaS specifically. Chapter 4 presents the analytical framework used in this licentiate thesis. Chapter 5 describes the methods used, and Chapters 6, 7 and 8 form the three empirical chapters. In Chapter 6, I explore the process through which the collaboration was established, using the governance assemblage as a conceptual tool. In Chapters 7 and 8, I explore how relations took shape around driverless shuttles and MaaS respectively. In Chapter 9, I discuss the more general findings from the research presented in the empirical chapters.

2 Background

In this chapter I present the regional and local planning contexts, and institutions of significance for the development of smart mobility in Barkarbystaden. I give an overview of the 2013 Stockholm Negotiation, as well as formal responsibilities for land-use and public transport planning in terms of the local authorities (municipalities) and the regional public transport authority respectively. I then introduce Barkarbystaden as a place, and give a brief overview of the key actors involved in the collaboration 'Modern Mobility in Barkarbystaden'.

2.1 The 2013 Stockholm Negotiation

The development of smart mobility in Barkarbystaden is taking place against the backdrop of large-scale infrastructure and housing developments. These developments are a product of the 2013 Stockholm Negotiation, which is an influential package for developing housing and public transport infrastructure. The 2013 Stockholm Negotiation is a contract between the Swedish state, the Stockholm region (previously Stockholm County) and four of the 26 municipalities which make up the Stockholm region. These four municipalities are Stockholm City, Nacka municipality, Solna City and Järfälla municipality. The regional Stockholm metro system will be developed further as part of this agreement, either through the extension of existing lines or the addition of new ones. In association with this expansion of the metro network, the municipalities, or local authorities, have agreed to reciprocate by constructing new housing in the areas adjoining the new metro stations (Swedish Government, 2013).

Overall, a total of 78,000 dwellings will be built through the 2013 Stockholm Negotiation. Of these, there are plans to build 14,000 in Järfälla, in the new area of urban development called Barkarbystaden. Järfälla municipality is situated in the north-west of Stockholm, and its involvement in the 2013 Stockholm Negotiation is based on the extension of a branch of the blue line of the Stockholm metro. Stockholm's metro system currently consists of three main lines, commonly referred to as the blue, green and red lines. The blue line currently runs from a station in the city centre (Kungsträdgården) to the north-west of the city, splitting into two lines, and one branch currently terminates in Akalla in Stockholm City, on the border with Järfälla municipality. This line will be extended in Järfälla.

In 2019, work started on excavating the tunnel to extend the metro line from Akalla into Järfälla municipality. This new line will have two new stops, one in the new, dense urban area of Barkarbystaden, and the second and final station,

Barkarby Station. The latter is also an existing overground commuter station, and will be a new public transport hub in future. These developments have also been included in the most recent Regional Development Plan for the Stockholm region, RUFS 2050 (Stockholm County Council, 2018a), in which the Barkarby-Jakobsberg area is one of eight regional cores (see Figure 2).

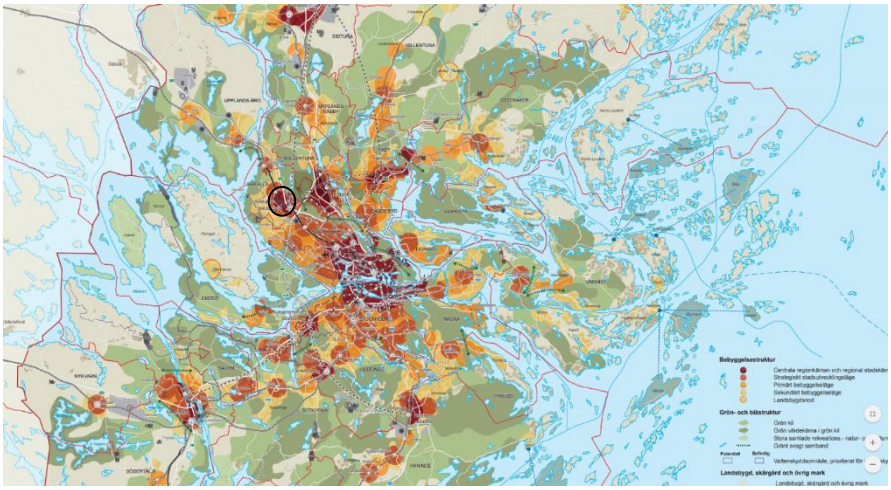

Figure 2. Section of map from the Regional Development Plan for the Stockholm region. The dark red areas show the central regional core (central Stockholm) as well as the planned regional cores, with Barkarby-Jakobsberg circled to the upper left of central Stockholm (Stockholm County Council, 2018b). Reproduced with the permission of Region Stockholm.

2.2 Formal responsibilities and frameworks for land-use and public transport planning

In addition to the Stockholm Negotiation, governance and planning of the built environment at regional and local levels in the Stockholm region form part of the broader context in this case. I shall elaborate on the main general responsibilities of the regional public transport authority and local municipal authority, as well the key planning documents used by these actors.

2.2.1 Regional public transport planning

Public transport planning in Sweden is formally a task for regional public transport authorities (RPTAs), a role which emerged after national legislative reform in 2010. The Public Transportation Act (SFS, 2010: 1065) challenged the previous governance structure which had been in place across Sweden, where the majority of local and regional public transport in the country was governed and planned by limited liability companies, county councils and local authorities

(Jansson & Wallin, 1991; van de Velde & Wallis, 2013). The new legislative reform came into force in January 2012, and since then the new legal organisations, the RPTAs, have been responsible for public transport in Sweden's 21 regions (Rye & Wrestland, 2014; Paulsson & Isaksson, 2019). Although the RPTAs share some of the responsibility for regional public transport with municipalities, in practice the RPTA has almost exclusive responsibility for carrying out strategic public transport planning and managing public transport provision (Government Report 2015/16: RFR, 14), predominantly in terms of contracting public transport services through procurement processes (Johansson et al., 2017).

The regulatory change introduced by the Public Transport Act placed a new emphasis on the strategic level (Johansson et al., 2017). One of the key changes reflecting this emphasis in the Act is the fact that the RPTA is responsible for developing a Regional Transport Supply Programme (Trafikförsörjningsprogram in Swedish), or RTSP for short. Engström (2018, p. 25) describes the programme as obligatory in terms of planning and procurement of public transport in a region. The document aims both to guide and describe long-term goals and requirements for public transport in the region, and its content is also based on political visions and goals at both regional and national levels (ibid; Paulsson & Isaksson, 2019). An RTSP is developed through consultation with a broad range of relevant actors and stakeholders, including the municipalities in the region, private operators, neighbouring regions and the general public (Paulsson & Isaksson, 2019). Within this document, the RPTAs also outline their public service obligation to citizens (The Swedish Public Transport Association, 2020). In Sweden, a well-functioning public transport system is considered an important aspect of welfare, contributing to a "fair and publicly accessible transport system" (Stjernborg & Mattisson, 2016, p. 1).

2.2.2 Municipal land-use planning

In Sweden, local land-use planning is the responsibility of municipalities. This role is regulated by The Swedish Planning and Building Act (SFS 2010: 900), which states that planning the use of land and water is the role of the municipality. Sweden is made up of 290 municipalities, and this law means that, in practice, "municipalities formally control and govern urban and transport planning within their municipal boundaries" (Johansson et al., 2017). This has often been described as a local planning monopoly (see Blücher, 2006), which gives municipalities the "exclusive right to formulate and adopt land use plans" (Hrelja, 2019, p. 3). In terms of public transport, this means that municipalities have the main responsibility for designing and positioning urban development, and its relationship to public transport (Hrejla, 2015).

The municipality is responsible for a variety of different planning documents. Two key documents are detailed development plans (*detaljplaner*) and comprehensive plans (*översiktsplaner*). Detailed development plans are a fundamental municipal responsibility in terms of the built environment. This is where the municipality decides the boundaries between public space (*allmän plats*), development districts (*kvartersmark*) and water areas, and consequently determines the use and design of these areas (Engström, 2018). Detailed development plans are legally binding once they have been settled. The comprehensive plan is the municipality's strategic development document, providing guidance for decisions about how the built environment should be used, developed and maintained (Boverket, 2020). Though they are not legally binding, comprehensive plans are intended to be an obligatory supporting document for all decisions involving land use (Engström, 2018). Other specific planning documents related to mobility which fall under the municipal umbrella of responsibilities include traffic strategies, parking standards, cycling plans, mobility management and sustainable travel strategies (ibid.).

2.3 Barkarbystaden, and the key actors in 'Modern Mobility in Barkarbystaden'

The local and regional authorities involved in the project 'Modern Mobility in Barkarbystaden' are Järfälla municipality and Stockholm's RPTA, as well as the bus operator Nobina who, for a number of years, have been contracted by the RPTA for 'ordinary' public transport provision in the area. In this section, I will elaborate on Barkarbystaden as a key site in terms of urban development in Järfälla municipality, and introduce the key actors involved. In addition to the municipality, the RPTA and Nobina, I will also introduce Barkarby Science, an innovation company established by the municipality, as well as the operator Nobina Sweden AB and its innovation company Nobina Technology, since these are two organisations are also involved in the collaboration 'Modern Mobility in Barkarbystaden'.

2.3.1 Barkarbystaden, Järfälla municipality and Barkarby Science

While urban development in Järfälla has gathered pace and taken place on a larger scale within the 2013 Stockholm Negotiation, plans to develop a new urban area called Barkarbystaden existed on a small scale prior to the Negotiation. Ideas for development have focused on land previously occupied by a national military air base. The area of land where most of the housing development will be based is situated on the old state airfield, which was closed down for peacetime use in 1974, and retired as a wartime air base in 1994. Plans to use this area for housing have existed since the 1980s, when a project proposal for "Barkarby-staden" was

first put forward (Järfälla municipality, 2006, p. 9). The municipality gradually purchased the air-base land from the state from the 1980s onwards, and some areas have already been developed, such as the Barkarby Retail Park, built in the 1990s (Järfälla municipality, 2006).

In 2006, a new plan for developing the area was accepted by the local authority, which covered new areas of housing development and a plan for a new tram connection between Barkarbystaden and Akalla-Kista (Järfälla municipality, 2012). These smaller-scale plans for urban development have been expanded as part of the Stockholm Negotiation, and the plan for the tram line was withdrawn in favour of the new metro line (Järfälla municipality, 2016). An initial phase of housing construction based on pre-Stockholm Negotiation plans means that some housing has already been constructed, and around 8000 people currently live there. Urban development will expand outwards from this existing area, and around 30,000 new residents are expected to live in Barkarbystaden by 2032 (Barkarbystaden, 2020). The main goal of Järfälla's most recent comprehensive plan is to "grow with quality" (Järfälla municipality, 2014), while taking into account the municipality's broader role in the region (see Järfälla municipality, 2016). The comprehensive plan notes that Barkarbystaden is the municipality's "largest and most important area of development" (Järfälla municipality 2014, p. 97).

The organisational structure of the municipality is divided into different sections, governed by elected politicians in a municipal assembly (*kommunfullmäktige*) and the municipal executive assembly (*kommunstyrelse*). These are served by various committees (*nämnder*), which are responsible for different aspects of the local authority's legal remit. In Järfälla, the municipal administration occupies two different offices involving the municipal executive committee (*Kommunstyrelsens förvaltning*) and the municipal technical services committee (*kommunens tekniska förvaltning*). A new administrative organ was established within the municipal executive committee to be specifically responsible for 'Project Barkarbystaden'.

In association with the planned developments for Barkarbystaden, Järfälla municipality co-founded an innovation company, Barkarby Science, in 2018. Barkarby Science is a company co-owned by seven different actors: Järfälla municipality, Atrium Ljungberg, E.ON Värme A, Järfällahus, NCC, Scania and Skanska. It also involves The Royal Institute of Technology and Södertörns University. Barkarby Science aims to act as a platform for collaboration on urban development, and hopes to contribute to Barkarbystaden becoming an innovative and sustainable city, with a focus "on new innovative systems, the environment, or new innovative technological solutions which create a better everyday life for people in the city" (Barkarby Science, 2020), with an emphasis that innovation

projects should benefit the citizens living in the area. The work of Barkarby Science is based on the UN's Agenda 2030 Sustainability Goals, and has four specific themes: the attractive city, the circular city, the climate-smart city and future mobility (ibid). The project with Nobina, Stockholm's RPTA and Järfälla is the first project in which Barkarby Science has been involved as part of its work on future mobility.

2.3.2 Public transport in Region Stockholm

In 2019, Stockholm County Council became Region Stockholm, and within Region Stockholm the RPTA (in Swedish *Trafikförvaltningen*) is responsible for providing public transport across Stockholm's 26 municipalities. The RPTA in Stockholm, which operates under the trademark SL, consists of three main departments: Strategic Development (*Strategisk utveckling*), Project and Procurement (*Projekt & Upphandling*) and the Traffic Department (*Trafikavdelningen*) (Bergendahl, 2016). In line with the RPTA's overarching responsibility to provide public transport in the Stockholm region, the Strategic Development department is responsible for ensuring that the development of public transport takes place through both strategic and long-term work. The more operative Traffic Department is responsible for overseeing and maintaining contracts with public transport operators, municipalities and infrastructure maintenance, as well as managing some infrastructure (ibid).

The RPTA produced its first Regional Transport Supply Programme (RTSP) in 2012, and in 2017 an updated version was developed (Stockholm County Council, 2017a). The 2017 RTSP outlines a vision of public transport which is both attractive and sustainable, and contributes to the regional goal for Stockholm to become Europe's most attractive city-region (Stockholm County Council, 2017a, p. 5). The programme notes that public transport will need to cater for an increasing population in the Stockholm region which, based on population figures from 2017, is expected to lead to a 43% increase in public transport use by 2030 (2017a, p. 10).[2]

The RTSP includes an overarching aim for more people to be willing and able to choose public transport over cars (2017a, p. 16). This is broken down into three main goals: 1) "increase travel with public transport", 2) "a smart public transport system" and 3) "an attractive region" (p. 13). In this context, a smart public transport system is defined as a system which "benefits passengers and the region in a cost-effective way for society" (p. 17). This includes both the cost of running public transport, but also the cost of incidents, emissions and environment and health impacts. The program also outlines a strategic approach

[2] These figures are however based on pre-Covid-19 estimates.

made up of four areas: collaboration (*samverkan*), people in focus (*människan i fokus*), efficient resource use (*effektiv resursanvänding*) and adaptability (*anpassningsförmåga*).

The RTSP also briefly touches on future mobility trends which could impact public transport. Examples given in the programme include technical developments which could make it possible to share information in new ways and allow for the automation of cars and buses, as well as digital solutions which promote a sharing economy and different ways of sharing resources. The programme also refers to a possible future with currently unknown ways of travelling collectively (2017a, p. 10). The programme does not discuss any of these in detail, but notes that it is hard to predict what the future of public transport will look like. The strategic development plan does not specifically describe how the RPTA plans to work with these aspects, and simply suggests that, while "innovative solutions" are to be encouraged, a technical lock-in should be avoided (see p. 24).

Although it is hard to locate its specific approach to smart mobility in this document, in practice the RPTA has been involved in a number of projects related to the development of smart mobility across the Stockholm region through its Strategic Development department, which is responsible for pursuing activities related to the future trends listed above. In 2017 the RPTA also produced its own strategic document for MaaS/Combined Mobility (Stockholm County Council, 2017b), to which I return in the analysis in Chapter 8.

2.3.3 Nobina and Nobina Technology

In the Stockholm region, the RPTA provides public transport across a number of modes. As mentioned above, the RPTA's role in commissioning public transport means that it procures public transport from private-market operators. Within this arrangement, the operators are responsible for planning and operating the specific services and lines while the RPTA is still responsible for overall strategic planning (Region Stockholm, 2020a). In 2019, the RPTA had procurement contracts with four different operators across the region: Nobina Sweden AB, Keolis, Transdev and Arriva. Nobina Sweden AB currently holds the contract for bus transport in the area, which covers two municipalities in the Stockholm region, Järfälla and Upplands-Bro.

Nobina Sweden AB is part of the larger Nobina corporation which operates across the Nordic countries in Sweden, Denmark, Norway and Finland. Nobina provides contracted public transport solutions in all four of these countries, but its market position is strongest in Sweden (Nobina 2020a). Nobina's history as a public transport provider began in Sweden in 1911, and the company has grown

to become one of the Nordic region's largest transport providers. The Nobina Group registered on the Swedish Stock Exchange in 2015 (Nobina, 2020b). Nobina's vision is "Everyone wants to travel with us", with the objective of increasing the use of public transport by simplifying everyday travel (Nobina, 2020c).

In early 2016, Nobina also established Nobina Technology, the Nobina Group's innovation and development company. Nobina Technology is part of the Nobina Group, but is also described as a separate entity, created to answer the group's need for a "laboratory for the development of shared mobility solutions" (Nobina, 2020a). On Nobina's website, Nobina Technology is described as having the "freedom to conduct experiments, collaborate with experienced industry players … and develop new ways to address opportunities related to shared mobility" (ibid). Nobina Technology has worked on automated buses in different forums since 2016, first as part of a showcase where self-driving minibuses were first tested in Sweden, and then as part of Drive Sweden, a national initiative for the development of smart mobility. Between January and June 2018, Nobina Technology ran a pilot with driverless shuttle buses in the northern Stockholm suburb of Kista, together with a number of other actors (see Hafmar, 2018). This pilot was followed by the launch of the same driverless shuttle buses in Barkarbystaden in October 2018, as part of 'Modern Mobility in Barkarbystaden'. Nobina Technology has also worked to develop a new type of platform application, Travis, described above as Mobility as a Service. I explore both areas in more depth in the empirical chapters.

3 Literature review

In this section I give an overview of the literature this licentiate thesis draws on and aims to contribute to. I begin with a broad introduction to public transport, followed by a discussion of the concept of smart mobility more generally. I then explore literature on the governance and planning of automation and MaaS, paying specific attention to the implications of these areas of smart mobility for public transport.

3.1 Public transport

Public transport is considered an important aspect of a city's transport network and the urban economy. Research highlights that public transport shapes the circulation of capital, and influences local property development, as well as access to jobs, schools and services (Farmer, 2011). Public transport infrastructures are also instruments of power and social control in terms of how they reflect and reproduce structural inequalities and shape accessibility (Graham & Marvin, 2001; Winner, 1980). The governance, planning and delivery of public transport is often characterised by complex institutional settings, collaboration and partnerships between a number of organisations (Hrelja et al., 2018; Paulsson et al., 2019). Due to its complexity, public transport is generally considered hard to define, and resists easy categorisation. In broad terms, it can be described as the production of the service known as 'transport' for large bodies of people, not just individuals (Hall et al., 2017). Public transport provision is commonly understood as a matter of public interest (Glover, 2011).

It usually takes a number of different forms, often including buses, ferries, light rail, subways or metros, commuter rail, and regional and inter-urban rail[3] (Glover 2011). In terms of legal regulations and policy definitions, the exact definition of public transport is often dependent on specific national policy contexts and government regulation. Public transport is also generally market based, at least to some extent. This can range from a state controlled closed market, to open markets, or a regulated market with limited competition (Glover, 2011). Public transport is therefore characterised by a mixture of public and private organisations, and the planning and governance of public transport is spread across government, or state entities, as well as private enterprises. The relationship between public and private organisations is often referred to as public-private partnerships. These can be defined in different ways, but generally

[3] This definition does not take into account more informal, or para-transit type services. See Cervero & Golub (2011).

describe the involvement of private parties in the design, construction, maintenance and operation of public infrastructure, or a public service, often through a long-term contract (de Jong et al., 2010). This also means that the line delineating public and private roles and responsibilities is a complex one to draw within public transport. There is, however, an ongoing understanding of public transport as a service for which public institutions are ultimately responsible (Glover, 2011).

In recent years, changes related to smart mobility have begun to tease at the established contours of public transport. These changes involve automated vehicles, driverless or automated vehicles, ICT and platform applications, as well as services which no longer run to fixed timetables (Hall et al., 2017). Researchers, as well as practitioners involved in the public transport industry, are highly aware of the new context in which public transport currently finds itself, and the potential changes this will bring to public transport provision and its place in the transport system more generally (Hensher, 2017). In terms of research, a growing body of literature has begun to discuss the implications and significance of these emerging technologies.

3.2 Smart mobility

The concept of smart mobility is used here to group a number of changes currently taking place within the transport and mobility sector. Researchers use the term not only to group a set of developments, but also to analyse and discuss the changes (Marsden & Reardon, 2018a; Finger & Audouin, 2019). Based on Marsden and Reardon's (2018b, p. 2-3) categorisation, the areas included under this label are: the role out of intelligent infrastructures, the electrification of vehicle fleets, a shift to 'usership' rather than 'ownership' inspired by the growth of the sharing economy, the introduction of connected and autonomous vehicles, the proliferation of platform applications available on smartphone devices, and the concept of integrating applications into a single bundled service offering known as Mobility as a Service (MaaS). Smart mobility is therefore an umbrella term used to group a number of different developments in the mobility sector, in order to distinguish between these services and existing modes. It does not imply that one of these areas is necessarily 'smarter' than the other. As Marsden and Reardon (2018b) point out, the 'smartness' of transport systems has changed over time, and they give the example of the how traffic signals were introduced in 1868 outside the Houses of Parliament in England ushering in new sets of rules and regulations. Another example are the smartcards introduced on the London Underground in the 1990s, which are ubiquitous today (Badstuber, 2018), showing how 'smart' referred to a slightly different set of technologies in the

1990s. 'Smart mobility' as an umbrella term can therefore be understood as a temporal concept to make sense of a set of developments which are currently taking place.

As with several other sectors, the digital age and the development of new technologies have influenced thinking about the future of transport and mobility (Lyons, 2018). The concept of smart mobility, and the innovations included as part of the concept, are often closely connected to discussions on how these innovations could lead to a transition away from the current automobility paradigm (Marsden & Reardon, 2018a). Drawing on Jenkins et al. (2019, p. 6), I understand innovation from a socio-technical perspective, as something which is a technical and social process which involves and produces complex relationships between a range of actors, and which is contextualised by changes in broader systems and processes. Innovation is rooted in the idea that a shift, transition or transformation will come about (Ryghaug & Skjølsvold, 2020). In line with this, the potential to combine technologies and mobilities in new ways is often seen as an opportunity to shift to a more sustainable transport system and new types of travel behaviour, as well as reduce the negative impacts of mass car use, such as congestion, crashes and poor air quality (Docherty et al., 2018). However, whether any combination of smart mobility innovations will be sufficient to lead a transition away from the automobile and combustion engine is still unclear (Pangbourne et al., 2020). As smart mobility includes a variety of services, Reardon and Marsden (2018, p. 156) have been quick to point out that it will entail "transitions, plural", where each aspect within the concept will involve its own complex networks. Docherty et al. (2018) also emphasise that the changes brought by smart mobility will occur in different places, to different degrees, at different times, and will probably not be accessible to all members of society at the same time. This is also a result of the ways in which many of these technologies and concepts are rolled out in their early stages of development.

The current methods predominantly used to roll out innovations in practice often take the form of pilot projects, tests beds, trials and demonstration projects, and these terms are often used synonymously (Mukhtar-Landgren & Paulsson, 2020; cf. Ryghaug & Skjølsvold, 2020). Pilot projects are often used as modes of innovation, and can be defined as "relatively small projects, as well as larger, targeted sets of projects and policies that set out to explicitly create new socio-technical realities within a demarcated site" (Ryghaug & Skjølsvold, 2020, p. 4; cf. Berglund-Snodgrass & Mukhtar-Landgren, 2020; Fred, 2019). These types of project have also been discussed using terms such as urban experimentation and laboratories (Evans & Karvonen, 2014; Karvonen & van Heur, 2014; Marres, 2018). Pilot projects have been identified as specific sites for both the "testing and enactment of realities", and therefore as the specific "settings and

instruments" through which new entities are shaped, knowledge is produced and governance alliances are forged (Tironi & Valderrama, 2019, p. 167). Pilot projects are sites where potential futures are formulated and materialised (Ryghaug & Skjølsvold, 2020).

Based on this understanding of smart mobility as context dependent innovations which are currently developing in different forms, often through pilot projects. I specifically analyse two areas which fall under the label of smart mobility: autonomous vehicles and MaaS, and illustrate how they are being implemented in a collaboration rooted in public transport. In the following sections, I summarise current literature on driverless shuttles, as a specific form of automation in relation to public transport, and the concept of MaaS.

3.3 Automation and public transport

Many new and existing actors have been working to develop self-driving systems for vehicles in complex environments (Cohen & Jones, 2020), from Ford and Daimler in the existing automotive industry, to Google and Baidu in the ICT sector, and Uber in the ride-hailing sector (Marletto, 2019). Automated public transport, such as trains running on fixed-guideway systems, has been around for a number of decades (Stocker & Shaheen, 2017; Marletto, 2019). However, the automation of the driving task on buses is a new type of more technically demanding automation in public transport. Driverless shuttles designed specifically for use in public transport are a specialised area of development, often promoted as a shared last mile solution. This is the specific area of interest of this thesis. I therefore situate this research in relation to wider definitions of automation, and look specifically at governance and planning literature on automation from the smart mobility literature.

Automation was previously tested and developed at various points in the 20th century. Hopkins and Schwanen (2019, p. 78) remind us that, "[w]hile framed as particularly novel and contemporary technologies, CAVs [connected and automated vehicles] have undergone multiple waves of hype and experimentation". High expectations, public trials and government funding contributed to phases of development in the 1920s and the 1960s-70s, but these ultimately fizzled out as the technology failed to live up to expectations (ibid; cf. Hopkins & Schwanen, 2018). In the most recent period of technological development, machine learning and new forms of sensor technologies and connectivity have helped realise the current wave of tests in terms of rolling out automation.

A definition of automation can be approached from various angles. The term 'automation' is generally used to define a process through which vehicles are

engineered to sense and interpret their surroundings and take over driving tasks traditionally performed by humans (Correia et al., 2016; Cohen & Jones, 2020). Scholarly efforts have focused on the technical aspects of vehicle automation, or what has been described as a techno-rational approach (Legacy et al., 2019). This has looked at how vehicles perceive the road environment, the consequences of automation for the driver and traffic-flow analysis (Milakis et al., 2017), as well as scenario and modelling techniques (Legacy et al., 2019). The predominantly technical focus is reflected in the way automation is categorised on different levels, such as the commonly used 0-5 levels of automation defined by the Society of Automotive Engineers. Level 0 is used to denote no automation, and level 5 full automation. The main distinction between levels 0-2 and 3-5 is "whether the human operator or automated system is primarily responsible for monitoring the driving environment" (Stocker & Shaheen, 2017, p. 6). Level 5 therefore means that the automated system is fully responsible. This taxonomy does not, however, include insights into the range of services through which automation is being developed.

Various versions of self-driving vehicles are emerging, from passenger vehicles to freight trucks (Mladenović, 2019), and driverless shuttles represent one type of automation currently under development. In order to take different forms of automation into account, Smolnicki and Soltys (2016, p. 2185) distinguish between autonomous private vehicles, self-driving car sharing, self-driving car-pooling and ride sharing, and driverless shuttles. Driverless shuttles are described as a bus-like form of automated vehicle used for group transit, often designed to be an aspect of public transport. A 2018 study aimed at gathering an overview of worldwide experiments involving these types of shuttle found a total of 92 projects in the form of trials (69.23%), showcases (20.88%) and regular services (9.89%) (Antonialli, 2019). The role of driverless shuttles is commonly framed as a solution to the first and last mile dilemma which, in public transport, is used to describe the beginning and end of an individual's public transport journey. Driverless shuttles usually have the capacity to carry around 10-12 passengers, and can follow a fixed route, or a flexible on-demand route (Smolnicki, 2017). Two French start-ups dominate the market for driverless shuttles: Navya and EasyMile (Antonialli, 2019). The driverless shuttles used in Barkarbystaden are EasyMile's EZ10 shuttle (EasyMile, 2020).

While this taxonomy helps situate the type of automation under investigation in this thesis, this study understands driverless shuttles as a socio-technological phenomenon (Mladenović, 2019). This way of framing automation focuses on the configurations of actors or organisations involved in its development, rather than just the technology. Trials for developing automation are both a global and local phenomenon, with regions and countries competing in an international race

to develop technologies for this market (Hopkins & Schwanen, 2018). Many initiatives to test driverless shuttles are taking place globally, and the public sphere frequently plays a fundamental role in facilitating these developments (Antonialli, 2019; Ainsalu, 2018).

The literature on smart mobility approaches the role of public actors in the planning and governance of automation at different levels. Docherty et al. (2018) discuss the governance of automation in general, as part of a range of smart mobility services subject to overarching state responsibility. Others have explored the implications of automation for how cities, towns and infrastructures are managed, and how prepared public actors are to meet the changes introduced by private automated cars (Stone et al., 2018; Guerra, 2016; Legacy et al., 2019). However, there are fewer studies exploring the implementation of automation from a governance perspective, or the specific institutional contexts of these developments. Automation has been explored through state level activities driven by techno-optimism (Hopkins & Schwanen, 2018), as well as through the lens of experiments in automation (Hopkins & Schwanen, 2019) and as an example of test bed planning (Berglund-Snodgrass & Mukhtar-Landgren, 2020). Hopkins & Schwanen (2019) note that urban experiments are often made known through quantitative metrics, but can also be understood through configurations of the actors involved. Inspired by this understanding of automation involving configurations of actors, this thesis contributes to research on the governance and planning of automation by looking at how automation, and specifically driverless shuttles, are introduced as part of the configuration of actors in Barkarbystaden.

3.4 Mobility as a service and public transport

The concept of Mobility as a Service (or MaaS) has become a heavily discussed term within the transport sector in recent years. MaaS can be defined as a "type of service that through a joint digital channel enables users to plan, book and pay for multiple types of mobility services" (Smith & Hensher, 2020, p. 56). The central premise of the concept rests on combining, or integrating, different transport services, usually via a single platform application typically used on a smartphone (Pangbourne et al., 2018; 2020; Li, 2019). The MaaS concept is therefore also sometimes referred to as integrated mobility, or combined mobility (*kombinerad mobilitet* in Swedish[4]). The mobility services normally incorporated into the platform are public transport, carpools or car-sharing services, electric

[4] In Swedish, *kombinerad mobilitet,* or combined mobility, has been defined as "Services which facilitate movement from one place to another with different modes of transport" (*Tjänster som underlättar att med olika transportsätt ta sig från en plats till en annan*) (Samtrafiken, 2017, p. 18).

scooter services (e-scooters), bike share and taxi services. Public transport becomes one of many services on offer within the MaaS concept.

The promise of MaaS, and one reason why it has attracted considerable attention within the transport sector, is based on the suggestion that this type of service has the potential to "make it easier and more attractive for users to combine complementary mobility services, and thus enable more people to satisfy their travel needs without owning or using private cars" (Smith, 2020, p. 2). The MaaS concept has therefore gained traction as a potentially transformative re-interpretation of mobility, described by some as a 'new paradigm', while others have emphasised that MaaS should be understood as the medium, and not the sum of the services (Smith, 2020). Based on the latter perspective, the MaaS concept has been described as a "service model that can entail or embrace new travel behaviour such as decreased car ownership, servitisation and increased multi-modality" (Smith & Hensher 2020, p. 56).

The formation of MaaS has been facilitated by a number of developments which have taken place during the last two decades, including the increasingly widespread use of smartphones, the spread of GPS, e-ticketing and e-payment, and integrated technology infrastructures (Jittrapirom et al., 2017). It is also dependent on the rise of services which make up the so-called 'sharing economy', predominantly based on the proliferation of digital platforms which have opened up new opportunities for organising and offering services in new ways (Martin, 2015; cf. Oldbury & Muhktar-Landgren, 2020). Platforms have become the digital infrastructure mediating transactions between providers and passengers (Stehlin, Hodson & McMeekin, 2020). As an example of a mobility platform, MaaS reveals specific entanglements between the digital and the material, as well as business and market logics (ibid).

Platforms have considerable implications for the public bodies responsible for conventional infrastructure provision, planning and funding (Cohen & Jones, 2020) as they create what Stehlin, Hodson and McMeekin (2020, p. 1254) describe as an "interstitial platform infrastructure dependent on existing (often publicly funded) infrastructures like road networks, sidewalks and other public spaces, [and] existing transport systems". The 'As-a-Service' moniker is also part of a global trend of servitisation. "As-a-Service" originates in cloud computing and the ICT sector (Merket, Bushell & Beck, 2020). It was developed through work on consumption-based services, and the idea of a standardised platform which could also offer new insights into consumer behaviour based on data generated by the platform (ibid). MaaS can therefore also be seen as part of a consumer-centric trend, where users are primarily viewed as consumers rather than citizens (Papa & Lauwers, 2015). The influence of new types of service platforms can also be seen more generally in popular attempts to describe MaaS as the Spotify, or

Netflix, of mobility (see Reid, 2019). The main difference is that mobility cannot be fully digitalised, and mobility networks cannot be managed in the same way because of this (see Pangbourne et al., 2018). The reliance of the MaaS concept on multi-modality as an alternative to the private automobile rests on the idea that private mobility service providers (such as car share, bike share and e-scooters) should be able to grow their businesses through the concept (Smith, 2020). This consequently means that public and private transport services which have, in some respects, been in competition with each other to move people around, are now combined as part of MaaS (Merket, Bushell & Beck, 2020).

Due to uncertainty about how to realise the arrangement of actors on which the MaaS concept is based, much of the research into the concept has focused on the different roles public and private actors should take on in order to establish MaaS services. This might include the types of actor who should ultimately be responsible for providing MaaS (Smith, Socher & Karlsson, 2019), and how public actors have started to define their role in relation to MaaS (Isaksson et al., 2019; Hirschhorn et al., 2019). Karlsson et al. (2020, p. 286) note that, while national legislation defines what public transport is, "MaaS calls into question the whole idea of public transport, what it is and what it could be; at the same time, public transport is an essential part of any MaaS ecosystem". The question of how public actors and public transport authorities orientate and position themselves in relation to the MaaS concept has consequently been viewed as a key aspect in realising the concept, especially in terms of the practicalities of being able to sell public transport tickets as part of a MaaS service (Smith, Sochor & Sarasini, 2018). However, even though public transport is seen as a key part of MaaS, and development of MaaS led by the public sector has been described as a way of balancing social aims and business goals, public-sector led development has also been viewed as a development path which could result in a service that is attractive neither to private actors nor to end users (Smith, Sochor & Karlsson, 2018).

There has been much discussion about roles which should be taken by which actor, and how to put the concept into practice. However, the question of how public sector actors can and should develop MaaS is still open, and public sector roles in MaaS are not considered to be well understood (Smith, 2020). Smith (2020) also suggests that more knowledge is needed on public sector activities in terms of developing MaaS. Mukhtar-Landgren and Smith (2019) highlight the processual and social contexts through which the policy agenda for MaaS is established and negotiated. On this basis, MaaS can be understood not as a single entity, but as a concept which can take on a range of different forms depending on the context (Smith & Hensher, 2020). Building on an understanding of MaaS which sees it as developing within a specific context, this thesis adds to this area

of the literature with a specific case in order to contribute insights into public sector activities to develop MaaS in a pilot project in Stockholm.

3.5 Summary

In this section, I began by highlighting the complex landscape of public transport governance. With the onset of smart mobility services, this landscape has had to grapple with the implications of new platform technologies involving concepts for integrating mobility such as MaaS and the development of automated vehicles. Driverless shuttles are discussed here as a specific form of automation with the potential to introduce a new type of service to public transport. These types of bus are currently being trialled intensively on a global scale. However, less is known about the specific configurations of actors involved in implementing this technology. MaaS as a concept has garnered considerable attention, and is about more than just one technology. It is more specifically about a previously unseen re-ordering of actors. Despite the hype, the concept has proved difficult to realise, and there is still space for more research into how MaaS is being developed in specific contexts. Based on this literature overview, I would suggest that driverless shuttles and MaaS have different implications for public transport, and this case study also provides an opportunity to compare both of these as part of the same collaboration and explore how the context in Barkarbystaden informs their development in relation to public transport. In the next chapter, I introduce the theoretical framework used to analyse the governance setting in which automation and MaaS are being introduced.

4 Analytical framework

To analyse the situated implementation of driverless shuttles and MaaS in a specific organisational setting, I draw on two analytical tools which have been used to explore emergent, constructive processes. The first is the *governance assemblage*, from assemblage thinking. The second is the concept of *translation* from Actor Network Theory (ANT) and Science and Technology studies (STS). Assemblage thinking and ANT are conceptual siblings, both sharing a relational approach, and an emphasis on emergence and the socio-material (Müller & Schurr, 2016; Müller, 2016).[5] While translation and assemblage have been employed more broadly in urbanism studies and mobility research, they have not so far been used to explore smart mobility (cf. Marsden & Reardon, 2018a; Finger & Audouin, 2019; Paulsson & Hedegaard Sørensen, 2020). My contribution to smart mobility literature therefore involves making use of these analytical tools to explore the governance of smart mobility and the ways in which public transport governance and planning are shaped and reshaped in the processes to implement driverless shuttles and MaaS.

4.1 Thinking through assemblages

Assemblage thinking is a component in poststructuralist relational thinking, and has become an analytical tool, or apparatus, for studying the practices of relating (Bueger, 2014). Assemblage thinking has been described as an "ontology of becoming", which "denotes the coming or fitting together of diverse, heterogeneous, material and human components into dynamic, provisional, decomposable, but irreducible wholes to serve a purpose, and creating agency" (Briassoulis, 2019, p. 425, drawing on DeLanda, 2006). It is an approach which emphasises the relations between the actors involved in an assemblage, where actors include humans, animals, technologies, machines, imaginaries or places, depending on the assemblage. Because the focus is on that which connects different actors, a relationalist understanding of reality forms the foundation for assemblage thinking (Bueger, 2014). This perspective does not view relations as fixed or static, but as "emergent and enacted in practices" (Bueger, 2014, p. 62), or what has been described as an ongoing process of ordering (Müller, 2015). Smart mobility, and how it is enacted in configurations such as the collaboration in Barkarbystaden, is an example of how driverless shuttles and MaaS emerge in practice.

[5] For a full discussion of where ANT and assemblage overlap, but also depart from each other, see Müller & Schurr (2016) and Müller (2016).

An assemblage is understood here as a "constructive process that lays out a specific kind of arrangement" (Nail, 2017, p. 24). As their foundation in relational thinking implies, assemblages are contingent and not static. Assemblage thinking is open to multiplicity, as different assemblages can exist simultaneously. Being part of one assemblage does not exclude the elements included there from being part of other sets of relations. Assemblages are differentiated by the specific sets of relations through which they are constituted. These sets of relations are sites where the different elements become meaningfully related. Assemblage thinking has therefore been described as a "sort of anti-structural concept that permits the research to speak of emergence … in nonetheless ordered social life" (Marcus & Sakka, 2006, p. 101, cited in Bueger, 2014, p. 60). The term 'anti-structuralist' does not suggest that assemblage thinking rejects the idea of ordered social life. Instead, it is an approach which offers an alternative understanding to theories based on levels, layers, territories, spheres, categories, structures and systems. This therefore paves the way for studying the development of smart mobility through the connections it generates, seeing it as more of a puzzle than a micro-meso-macro framing of the scales and actors involved.

Another way of expressing the assemblage approach to structure is as a relationship between parts and wholes. Savage (2020) describes how parts and wholes are conceived as a key departure point for the ontology of assemblage thinking, which has implications for the understanding of social processes and phenomena to which this approach is applied. It has been argued that social scientists have often conceptualised social formations as processes akin to biological organisms, with their own internal logic and order (Savage, 2020). Drawing on DeLanda, Savage describes how this way of framing produces a specific type of conception of the relationship between parts and wholes, namely that wholes are framed as aggregates of parts, and parts are viewed as products of the whole (ibid). Assemblage thinking offsets the idea of a direct link between parts and wholes. "The notion of assemblage erodes an understanding of the world as singular, but also rejects an atomised understanding of the world. … Different realities overlap and interfere with each other" (Bueger, 2014, p. 61). I understand this case of smart mobility as an exploration of how driverless shuttles and MaaS become part of specific sets of relations, and can therefore "partially but not fully be understood as artefacts of national political and policy contexts" (Savage, 2020, p. 323).

As assemblage thinking focuses on the processual *assembling* of specific sets of relations, it is a useful overarching approach through which to understand smart mobility and the governance activities associated with these technologies and concepts. This approach is a way of analysing governance processes as they are enacted (Savage, 2020). As discussed in Chapter 3, smart mobility is understood

as a range of phenomena which are not likely to generate a single, uniform transition. In line with assemblage thinking, the sets of relations which have emerged in connection to the governance of smart mobility in Barkarbystaden are viewed as contingent and contextual (Briassoulis, 2019), and as a site where governance processes are currently being enacted.

4.2 The governance assemblage

As mentioned in the introduction, and drawing on Rhodes (2007), I understand governance as the process of steering collective action, consisting of interdependencies between organisations which include both public and private actors. Governance is used to acknowledge that processes for steering collective action are a responsibility shared between the state, markets and civil society, and that these processes take place simultaneously as a variety of co-existing modes of governance (Lange el al., 2013). I build on Rhodes' (2007) suggestion that research into governance involves analysing the changing boundaries between the situated actors who are steering collective action, as well as the ways in which practices of governance are remade in response to specific dilemmas. In this study, I focus on smart mobility as an area through which these changing boundaries can be studied, and where practices of governance are currently being made, and potentially remade.

In line with this, I refer to planning as a component of governance. Planning has long been established as more than a linear process which follows an intentional path from implementation to execution (Coperius, van de Grift & Lagendyck, 2015). Instead, it is networked across a range of actors (Healey, 2003; 2007; Fredriksson, 2011; Marsden & Reardon, 2017). Planning is defined here as something which "entails a broad range of tactics, technologies and institutions to try and control the passage into the future, including practices and ideas that have spread across private and public organisations" (Abram & Weszkalnys, 2013, p. 2). This definition echoes the relational approach outlined above, and encompasses the many interactions between different organisations, technologies and ideas about the future which are involved in the planning and governance of smart mobility.

I build on these definitions of governance and planning through term *governance assemblage*, which is used in order to understand the particularities of governance (Albrecht, 2015; Briassoulis, 2019). In her discussion of the governance assemblage concept Briassoulis (2019) argues that assemblage thinking contributes to the situated study of governance, and is a relationalist, non-reductionist ontological approach to governance. It paves the way for discussion on how governance is developed through specific empirical examples, and how

assemblages produce governance. It also helps to highlight what is being governed (Briassoulis, 2019; Albrecht, 2015). The concept of the *governance assemblage* has helped highlight governance as a specific area to which assemblage thinking can be applied. The terms governance arrangement (Albrecht, 2015; Haarstad, 2016; Hodson et al., 2017), and policy assemblage (Ureta, 2015; Savage, 2020) have also been used as analytical tools with a similar approach.

The term governance assemblage denotes the "provisional, situated, unique compositions" (Briassoulis, 2019, p. 440, cf. Parks, 2019) which gather around a specific purpose, or for governing a particular issue or issues. This approach has been used to analyse the formation of specific governance assemblages, and how certain components come together: "their composition, [the] processes of assembly, practices and mechanisms" (Briassoulis, 2019, p. 437), as well as the spaces of governance created by these specific sets of relations (cf. Allmendinger & Haughton, 2010). In this study, I use these dimensions of the governance assemblage to understand the collaboration in Barkarbystaden as a provisional, situated site of governance for smart mobility. This framing does not aim to exclude formal governance procedures, means or instruments, but analyses these as components of the assemblage (Briassoulis, 2019; cf. Savage, 2020).

In terms of how certain components come together, the governance assemblage concept is both a way of understanding the *process* through which a specific configuration of actors emerges, and a way of describing a specific composition of actors, facilitating ongoing recognition of the potential effect of the new configuration of actors. In this thesis, I am particularly interested in the processual formation of the governance assemblage, and how this emerges through a certain constructive process (Nail, 2017) or "act of assembling" (Ureta, 2015, p. 12). The process of assembling is consequently a potential way of changing, or establishing, particular sets of relations between new and existing entities (Ureta, 2015). A governance assemblage can therefore be a basis for, and a process though which, new relationships between organisations and new technologies, or concepts, are created (Parks, 2019). It is also a process through which these relationships are shaped and (potentially) reshaped in relation to smart mobility.

To more precisely describe the process through which a specific configuration of actors emerges, I draw on research which has sought to identify the different ways in which assemblages come together (Li, 2007). Based on her research into the governance of community forest management in Indonesia, Li identifies a

number of practices through which characterise assemblages.[6] She uses these to highlight the effects of specific arrangements, discuss which roles are retained or which actors are given more influence, and how new elements are grafted onto the assemblage and established roles are re-worked (Li, 2007). To analyse more clearly the processes through which the governance assemblage is formed, I specifically draw on one practice identified by Li: *forging alignments*. Li describes this as "the work of linking together the objectives of the various parties to an assemblage" (2007, p. 265). I extend this beyond just objectives, to include the different types of linkages, or junctions, created across conventional organisational boundaries and interdependencies (Jensen et al., 2015).

Understanding governance assemblages as specific spaces, or sites of governance, also means recognising how they create new kinds of potentialities, or effects. As a result of this, assemblages can be described as productive (Müller, 2015). Although he uses assemblage thinking to discuss policy making, Ureta also describes the process of an assemblage coming together as having the potential to "make a new mode of ordering" (Law, 1994 cited in Ureta, 2015, p. 12). A governance assemblage is therefore not without effect, or its own agency, in the sense that new sets of relations facilitate change. This creates new (or alternative) potentialities, as contextual arrangements of actors introduce opportunities for governance to emerge in certain ways[7] (Savage, 2020). Using the term governance assemblage also helps highlight the actors involved, and their relationship with the material or technical devices which are governed (Kortelainen & Albrecht, 2014).

In this thesis, the governance assemblage concept is used to engage with the changing nature of governance and planning for smart mobility. Governance assemblages are not understood as isolated from existing processes or disconnected from established infrastructures and services. I therefore interpret the collaboration as an assemblage which is offset, but not disconnected, from existing governance roles and responsibilities for planning public transport. In other words, I understand the collaboration in Barkarbystaden as a site where a new configuration of actors has been established, and a process through which new potentialities connected to smart mobility are created.

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[6] Li identifies six different practices which she discusses in relation to the assemblage of community forest management: 1) forging alignments, 2) rendering technical, 3) authorising knowledge, 4) managing failures and contradictions, 5) anti-politics, and 6) reassembling (Li, 2007, p. 265).

[7] The other aspect of this also involves a recognition that governance assemblages could be assembled differently and have alternative effects.

4.3 Translation

While I use the term governance assemblage to establish an understanding of the set of relations which make up the collaboration, I apply the concept of translation to analyse specifically how driverless shuttles and MaaS become part of, and are shaped by, the governance assemblage in Barkarbystaden.

Translation has been used as a concept from ANT to understand the processes through which relations are made and unmade. Müller (2015, p. 30) describes ANT as an "empirical sister-in-arms of the more philosophical assemblage thinking" and that, like assemblage thinking, ANT is interested in the processual and provisional "ordering of entities beyond one universal principle". However, ANT has been described as having a "richer conceptual vocabulary" (Müller & Schurr, 2016). Translation is one of these concepts, and has been described as a term which "marks a space of possibility", where "meanings are interpreted and reinterpreted to make them fit their new context" (Clarke et al., 2015). The concept of translation has been widely used since it first came to prominence in studies by ANT scholar Michel Callon, who used it to study the introduction of the electric vehicle in France in the 1970s (Callon, 1986), and most influentially in a study on scallop farming (Callon, 1984).

Callon drew on the work of the philosopher Michel Serres who, inspired by changes in science and culture during the 19th century in Europe, initially developed the concept of translation in relation to the themes of order and disorder. He was specifically interested in where order and disorder, or different kinds of order, met (Law, 2009). Translation developed as a way of theorising this interface, and the processes of mediation and transformation taking place at these meeting points (Brown, 2002). Callon (2007 [1986], p. 59) defines translation as a general process through which "the identity of actors, the possibility of interaction, and the margins of manoeuvre are negotiated and delimited". It has also been summarised as "an act of invention brought about through combining and mixing varied elements" Brown (2002, p. 6). Therefore, like assemblage thinking, translation is a productive process. However, to make sense of the different stages of negotiation and interaction between actors, Callon also outlines specific moments which can be used as tools to structure an analysis of this process.

As part of the study into scallop production, which involved researchers from a scientific community, fishermen and the scallops themselves, Callon (2007, [1986]) identifies four moments of translation: *problematisation*, *intressement*, *enrolment* and *mobilisation*. These can overlap in different ways, and do not necessarily occur in a linear process (Callon, 2007 [1986]). The four stages are not presented here as a blueprint for translation. Although Callon's study of scallops was used to develop these four phases of translation, certain actors ultimately

rejected the roles imposed on them by other actors (Callon, 2007 [1986]; Law, 2009; Murdoch, 2005). These moments are used instead as entry points to structure an analysis of processes through which specific areas of smart mobility are introduced.

The first of these, problematisation, is described as a process where the actors make themselves relevant or even "indispensable" to the network (Callon, 2007 [1986], p. 60). It is therefore a process where a series of actors become involved in a network and also establish their identities and the links between them (ibid). Problematisation is often framed as a process "to incorporate interests, and to interest those who are still only potential partners" (Callon, 1980, p. 210). This moment also includes the creation of obligatory passage points. These are certain points around which actors converge, and which not only mediate the relationships between actors but also define the action. They are necessary for the continuation and development of the translation process (Callon, 1986b). Obligatory passage points highlight not just the identification of the actors who should be involved, but also the interests which can bring these actors together and anchor them.

The second moment is known as intressement, which I interpret as similar to the English word engagement, or what could be described as a process of creating interest. After the process of problematisation, "intressement is the group of actions by which an entity … attempts to impose and stabilize the other actors it defines through its problematization" (Callon, 2007 [1986], p. 62). Here, Callon acknowledges that some actors in the network have greater influence in terms of defining the goals and identities of others, and can influence the balance of power (ibid). This is not a clear-cut process, and is open to adjustment as a component of the practices being developed within the network or arrangement. Callon also explains that this may involve different kinds of devices, intressement devices, or engagement devices, which make material the ideas formed in earlier moments of problematisation and engagement (cf. Pelizza, 2020). Murdoch (2005, p. 66) highlights that this is a process of stabilisation which is "often delegated to non-human entities such as technologies". It has also been noted that this phase of translation can weaken links actors may have to other areas, highlighting that translation is also a process of displacement (Callon, 2007 [1986]; Wallsten, 2017) where relations are shifted, moved around, changed or linked in new ways (Law, 2009).

Intressement or engagement is closely connected to the third moment, known as enrolment. Enrolment represents the culmination of the engagement or intressement process. "Enrolment does not imply, nor does it exclude, preestablished roles" (Callon, 2007 [1986], p. 65), but represents the moment where roles have been defined and distributed after a phase of determination and

testing (ibid). Enrolment can occur in different ways. It can be consensual or coercive, or somewhere between the two (Murdoch 2005). The fourth moment is mobilisation. "To mobilise, as the word indicates, is to render entities mobile which were not so beforehand" (2017 [1986], p. 71). In his study of scallop fishing Callon explains this in terms of how, after scallop fishing became an object of scientific research, the fishermen, scallops and research specialists become connected in new ways. Through a process of translation, the scallops are reinterpreted as scientific diagrams and graphs and made into a new entity and object of academic research. Mobilisation is therefore also closely connected to questions of representation. "Who speaks in the name of whom? Who represents whom?" (ibid, 68). Understanding who is represented, and how, is closely tied to the moments of problematisation and engagement, and has crucial implications for which actors ultimately represent, or become the spokesperson for, the other actors involved.

I use translation to understand ongoing processes for implementing smart mobility, and specifically driverless shuttles and MaaS. Pilot projects for introducing smart mobility can be seen as part of a general process through which actors negotiate their roles in relation to new technologies and concepts. I also understand them as meeting points where these technologies are made material in specific contexts, and sites where driverless shuttles and MaaS are interpreted and reinterpreted to make them fit their new context (c.f Tironi & Valderrama, 2018).This thesis uses Callon's moments of translation to structure an analysis of the ways in which MaaS and driverless shuttles are 'translated' in relation to the governance assemblage in Barkarbystaden. I specifically focus on problematisation and intressement.

Callon emphasises that these moments of translation are not necessarily a neat, linear process, suggesting that "[t]ranslation is a process before it is a result" (Callon, 2007 [1986], p. 75), and an endeavour before it is achieved (Callon, 1986b). Translation is closely linked to the specific context in which it unfolds: "strategies of translation often depend on the circumstances in which they develop" (Callon, 1986b, p. 26). I analyse the pilot projects for MaaS and driverless shuttles as specific contexts which are shaping smart mobility, and I use translation as a concept for exploring how smart mobility meets public transport.

Smart mobility is often embedded in a rhetoric which presents a range of changes that have the potential to bring about a transition and reorganise mobility systems in new ways. Translation has been used to analyse the relationship between different 'orders', and Serres originally used the term to discuss the relationship between order and disorder, or different kinds of orders (Law, 2009). Of specific interest is the point where different orders "rub up against each other"

(Law, 2009, p. 144). I do not use the term 'order' to create the impression that social order is monolithic. Instead, it is a useful metaphor for understanding the changes which are taking place in the mobility sector. As outlined in Chapter 3, smart mobility can be understood not as a single transition, but as a series of transitions taking place across a number of different contexts. Building on this approach to smart mobility, I make use of translation to help understand processes where different kinds of orders come into contact with each other and apply this to the introduction of smart mobility in Barkarbystaden. This case is therefore understood as a site where the development of driverless shuttles and MaaS is negotiated in relation to public transport, where actors' roles are shaped, and where links are formed between smart mobility and the different organisations.

4.4 Applying the governance assemblage and translation as analytical tools

This analytical framework has informed the overarching aim of this thesis, which is to provide insights into the governance of smart mobility, and the ways in which public transport governance and planning are shaped and reshaped by these processes. In the empirical analysis which follows, I use the concept of the governance assemblage to explore my first research question. This focuses on the roles, responsibilities, and links between organisations which characterise the collaboration between Stockholm's RPTA, Järfälla municipality and the bus company Nobina. In Chapter 6, I pay specific attention to the process of assembling, and how the collaboration takes shape. In Chapters 7 and 8 respectively, I use the concept of translation to analyse two pilot projects involving driverless shuttles and MaaS. Drawing on the literature on translation, I ask how the relations between actors take shape around driverless shuttles and MaaS, and how they are potentially changed, moved around, and linked in new ways in the pilot projects to develop these areas of smart mobility.

5 Methodology

In this section I give an overview of the methods used, and the empirical material gathered in this thesis. I understand methods as constructive of the worlds they describe and consider the research to be part of the social process being studied and narrated (Atkinson, Coffey & Delamony, 2003; cf. Hammersley & Atkinson, 1995). Drawing on Law (2004), I understand methodology as a way of participating in how reality is enacted. Methods are understood not as a tool for revealing or disclosing an ultimate truth, but as tools which help construct partial understandings of a research problem, and which therefore help to understand the nature of a problem. (Alvesson & Sköldberg, 2009).

The process of collecting material initially took place within two projects: 'Reinventing Public Transport in a future of smart mobility: roles, strategies and collaboration', funded by K2, Sweden's national centre for research and education on public transport, and 'Energy-efficient smart mobility needs governance tools supporting shared mobility', funded by the Swedish Energy Agency. The finalisation of this work is part of another K2 project, 'New mobilities in the making – an exploration of collaborative arrangements that shape future urban public transport'. As smart mobility is a relatively new phenomenon, the methods were chosen in order to explore the question of where and how smart mobility is currently governed and planned from an exploratory, abductive point of departure (Alvesson & Sköldberg, 2009). This empirical base was then analysed using the analytical framework outlined in the previous chapter. In this chapter, I aim to give an overview of the methods, as well as the type of empirical material gathered, and the analytical process involved. I first describe how I approached this field, and the choice of case, followed by an outline of the methods used to follow the development of smart mobility related to a collaboration between public and private actors.

5.1 The empirical case

As mentioned in the previous chapter, smart mobility is understood as a heterogeneous phenomenon which takes different forms. This research has evolved out of an interest in how smart mobility develops through the activities which take place to test concepts and ideas such as MaaS and automation, and the actors engaged in these activities. A general ambition guiding the choice of study was to connect the research closely with activities to implement smart mobility, and specifically a case in which public actors were involved in the developments. The choice of this case was therefore informed by developments

in Sweden, and specifically Stockholm, related to smart mobility at the time of planning.

In spring 2018, around the time I became involved in the two first projects mentioned above, I heard that pilots for driverless shuttles and MaaS were potentially going to take place in Barkarbystaden[8]. I contacted the RPTA to learn more about these developments, and they explained that it was likely that these pilot projects would become part of a larger collaboration led by Nobina in collaboration with Järfälla municipality. This collaboration was publicly announced in June 2018 (Järfälla municipality, 2018). In August 2018, I and one of my supervisors contacted representatives for the new project to discuss the possibility of following the development of smart mobility as part of this broader collaborative context. During the process of gaining access to this configuration of actors, the structure and intent of the collaboration became clearer, and formed my initial understanding of the case. I had partially started this work in June 2018, attending an open house for one of the detailed development plans for Barkarbystaden. The open house, held at the local school in Barkarbystaden, gave me an opportunity to travel to Barkarbystaden for the first time, and potentially meet representatives from the municipality involved in the collaboration. At the event, one of the traffic planners from the municipality suggested I contact Barkarby Science to learn more about the collaboration, and mentioned that discussions about MaaS and driverless shuttles had started to take shape. At the same time, my supervisor and I had also been in contact with the RPTA, who recommended that we contact Nobina, as they were responsible for a funding application to Vinnova which would ultimately finance the parts of the project related to the driverless shuttles and MaaS. At our initial meeting with Nobina to discuss the possibility of doing research into smart mobility, the background and contours of the project involving MaaS and driverless shuttles became much clearer. The representative from Nobina also had a specific interest in the role of collaboration in public transport, and this overlapped with the aims of this research in terms of following the development of smart mobility in a specific governance context. The representative from Nobina also explained the organisational structure of the project, referred to as 'Modern Mobility in Barkarbystaden', and how it would be divided into different levels (see Figure 3 below). This was an influential meeting, as I based my suggestion for a

[8] Recently, as I was in the final stages of writing up this research, I went to check something on what used to be a website for Barkarbystaden, where information about developments, plans and news in the area could be found, and noticed that it had been re-branded by the municipality as Barkarby (see https://barkarby.se/) to cover both the area of Barkarbystaden and Veddesta. I have chosen to continue to use Barkarbystaden throughout the analysis so as to represent how the different actors referred to the specific area during the period of time this research took place.

methodological approach on the plan for the structure of the collaboration, and asked whether would be possible for me to follow meetings in the project group, as well as specific groups for MaaS and driverless shuttle buses.

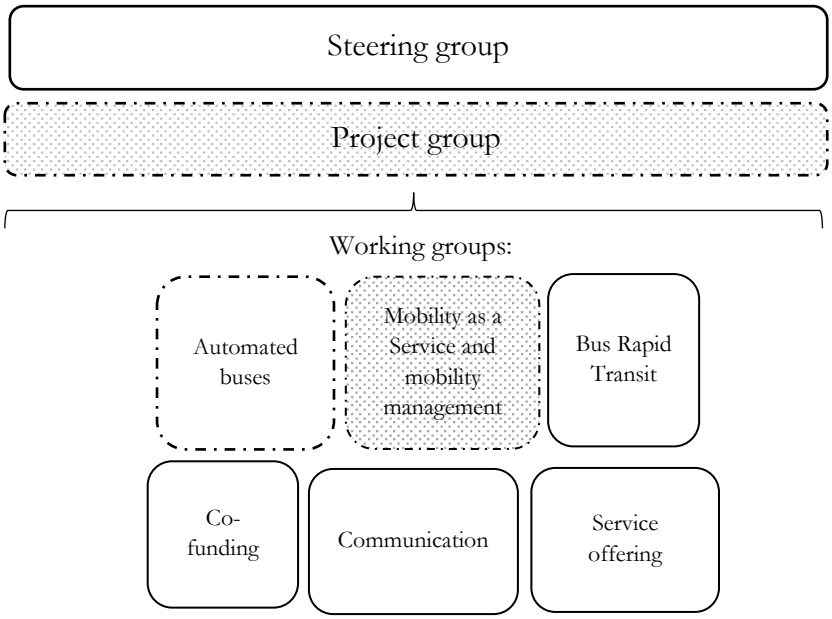

Figure 3. Diagram showing the organisational structure of the collaboration with the three organisations represented in each group. The specific groups interviewed as part of this research are outlined with a dashed line, and the groups where participant observation in meetings took place are shaded in with a dotted background.

With my supervisor, I formulated a letter to send out to the different organisations involved. In this letter, we briefly presented the research context, and smart mobility. We outlined the general aim of understanding more about collaboration and governance and driverless shuttles and MaaS as specific examples of smart mobility. We also included a suggestion for how the research would be carried out, and potential outputs. The representative from Nobina shared this document with the other organisations involved in the project, and we also arranged specific meetings with representatives from Järfälla municipality, Barkarby Science and Stockholm's RPTA to present the research and ask in person whether I could take part in the project meetings. The process through which I negotiated access to the project also coincided with the phase in which the collaboration itself started in earnest, and I began attending project meetings in September 2018. Although this marked the start of my access to, and

involvement in the process, I also had to introduce myself and the research on an ongoing basis, through participant observation in group meetings and one-on-one interviews (cf. Brorström, 2015). I mention this in the sections below, along with more detailed accounts of the methods used.

5.2 Methods involved in gathering material on the collaboration and smart mobility

I followed the early stages of the collaboration and the first year of the project, from September 2018 to late 2019, through participant observation in meetings and specific events, making use of two different phases of interviews to focus more specifically on the development of driverless shuttles and MaaS. This combination of methods was used with the aim of gathering a more complete understanding of the processes underway. In this section, I outline the different methods used.

5.2.1 Participant observation

This study took its inspiration from organisation anthropology and ethnographic research within complex organisations (Garsten & Nyqvist, 2013). Participant observation is a method used in qualitative research to gain access to spaces of governance and policy making, and it was chosen as a method suited to the organisational structure of the collaboration. As mentioned above, Nobina explained that the structure of the project would involve different sub-groups: an overarching steering group, a project group responsible for running the project and a number of different working groups, including one specific group for automated buses and another for MaaS (see Figure 3 above). Organisational anthropology has described meetings as useful 'vantage points' (Brown et al., 2017), and a 'methodological tool' (Sandler & Thedvall, 2017) through which to gain a contextual overview of the process in question.

Meetings have been described as ubiquitous in many contemporary contexts, and as sites where organisation and relationships are produced. They are therefore important (and under theorised) sites for research (Sandler & Thedvall, 2017), and project meetings were used as one methodological point of departure. They were studied in order to understand the governance and planning of automation and MaaS, and were seen as a mechanism through which activities were synchronised (ibid). The challenges of long-term participant observation in a specific organisational setting have been acknowledged by Baker and McGuire (2017), who note that it is hard to simply 'hang around'. This is also a challenge if the issue in question lies at the intersection of a number of organisations. Participation in meetings was therefore used as an approach for studying

moments where the different actors involved came together, and to orientate myself and the research within the developments.

I began by following the meetings in the project group in September 2018. These were initially held in person, in the form of two-hour meetings every two weeks. The in-person meetings offered a valuable opportunity to meet the different representatives involved from each organisation. I attended the first three of these types of meetings. Initially I took written notes, but at the second two I recorded the meetings. After three of these in-person meetings, the format was changed to weekly digital coordination meetings, sent out as a standing email calendar invite. I followed these meetings on a weekly basis from October 2018 to the end of 2019. At these meetings I made notes by hand, and later directly onto my computer. The meetings were hosted and led by Nobina, and followed a standard agenda based on the status of each working group. They were specifically useful for understanding progress in different areas of the collaboration. I gained an overview of what was happening in the project in general, as well as weekly updates on the small driverless shuttles and MaaS.

I participated in these via my laptop from my own office and, after an initial chat with participants in the digital meeting room before the meeting began, I was mostly involved as a 'participant listener'. Those involved in this meeting included one representative from Nobina, two representatives from the municipality, one representative from Barkarby Science, and two representatives from the RPTA, however not all representatives were present at every meeting. Participants usually announced themselves when they joined the call, and the chairperson then usually named all participants upon commencing the meeting. I assume that my presence affected what was said in some way, and potentially gave everyone the feeling they were being observed. However, as the format of the collaboration and this type of meeting was new for everyone, having a researcher take part in the meetings did not necessarily change an existing dynamic. Sandler and Thedvall (2017, p.12) describe individuals in meetings as representing their organisations, and consequently also representing "a community of practice". This is a useful way of approaching the roles of different actors in general, but reflecting on my role as a 'researcher-representative', I could also be seen to represent research as a parallel community of practice. Every fourth week, these meetings were replaced by a more administrative meeting related to the part of the collaboration funded by Vinnova. This also included researchers responsible for work funded through the project at the Integrated Transport Research Lab (ITRL) at the Royal Institute of Technology, KTH. I also took part in these meetings.

Although my initial ambition was to participate in meetings in the working group for driverless shuttles and MaaS, I was only able to participate in meetings

within the MaaS working group. I asked the project leader responsible for the working group for the driverless shuttles from Nobina Technology about the possibility of my taking part in the working group for the driverless shuttles. After this, I was invited to one meeting involving other researchers from ITRL, who were involved in research on the project. My impression is therefore that this working group was more loosely structured, and that communication took place on more of an ad-hoc basis, as questions about the launch of the driverless shuttles arose. My involvement in the MaaS working group developed after I interviewed one of the representatives from Nobina Technology, and asked about plans to start up the specific working group for MaaS, after which she invited me to take part in these meetings. I therefore also took part in five working group meetings for MaaS, which were held on a monthly basis between January 2019 and June 2019.

Table 1. List of meetings attended

Meeting type	**Time-span**	**Meeting length**	**Meetings attended**	**Document-ation**	**Organisations**
Initial project group meetings (in person)	Bi-weekly, Sept - Nov 2018	120 minutes	3	Agenda, field notes	Nobina, Järfälla municipality, Stockholm's RPTA, Barkarby Science
Digital project group meetings	Weekly, Oct 2018 – Dec 2019	Approx. 20 - 30 minutes	35 approx.	Agenda, field notes	Nobina, Järfälla municipality, Stockholm's RPTA, Barkarby Science
Digital funding group meetings	Monthly*	30 minutes	6	Agenda, field notes, minutes	Nobina, Stockholm's RPTA, Järfälla municipality, ITRL
MaaS working group (3 in person and 2 digital (2))	Monthly meetings, Jan 2019 – June 2019	60 minutes	5	Agenda, field notes	Nobina Tech, Nobina, Stockholm's RPTA, Järfälla municipality, Järfälla business, Barkarby Science

*These replaced the digital project group meetings every 4th week

Apart from participant observation in meetings, I also took part in different types of event related to the project, both internal and public. Some of these took place in the initial stages of the collaboration, such as the public inauguration of

the shuttle buses, and an event where Nobina/Nobina Technology presented the small driverless shuttle buses at the RPTA offices. At the internal kick-off event held by the collaboration, I also presented more general research on MaaS throughout the Nordic countries, based on research from one of the projects I had worked on (see Isaksson et al., 2019; Hedegaard Sørensen et al., 2020), and at the one-year follow up workshop I presented ongoing work on the driverless shuttles (see Oldbury & Isaksson, forthcoming). I was also invited by the municipality to present ongoing work when they hosted a conference for the Swedish Public Works Association (Föreningen Sveriges Stadsbyggare) in April 2019. These gave me insights into the collaboration, but I myself also potentially contributed to the way in which participants understood smart mobility through this type of involvement. At a more general level, I attended different types of networking event held by organisations responsible for coordinating and facilitating the development of smart mobility in Sweden, such as Drive Sweden events on automated vehicles, and KOMPIS meet-ups for MaaS developments. Although these were not included in the analysis, they informed my understanding of the wider context of developments in automation and MaaS in Sweden.

In addition to attending meetings, I also visited Barkarbystaden on numerous occasions. An initial meeting with Barkarby Science about the possibility of following the collaboration with Barkarbystaden was combined with a walk around the urban area which had just been built. After interviews with the municipality in Jakobsberg, I often took the opportunity to stop at Barkarbystaden to travel on the shuttle bus and talk to the onboard drivers responsible for operating the buses. Järfälla municipality also hosts a variety of events in Barkarbystaden, such as autumn and Christmas markets, as well as a specific day – 'Barkarbystaden Day'. On Barkarbystaden Day the municipality and region presented a large model of developments and, along with Barkarby Science, met inhabitants and talked about progress related to the construction of both housing and the extension of the metro. I also attended site-specific events to see the different services in place in Barkarbystaden itself, such as the launch of the driverless shuttles and mobility services in place in Barkarbystaden as part of the Travis, MaaS platform. These visits informed my understanding of Barkarbystaden as a place, as well as the role of the mobility services in this location. I used the field notes and observations made during these visits to contextualise and inform the empirical analysis.

5.2.2 Interviews

Participant observation in meetings and other events was combined with semi-structured interviews (Kvale, 2011). The individuals interviewed were selected on

the basis of how representatives had been allocated to the collaboration from each of the organisations. As part of the structure of the collaboration, each group or working group was made up of representatives from the three main organisations, and this became my point of departure. Interviews were used here to gather more specific information on the perspectives of the different actors and their points of departure, perspectives which did not arise in the more operative meetings. In line with Roulston, de Marrais and Lewis (2003, p. 645), I understand interviews "as a site in which interviewers and interviewees co-construct data for research projects". This research generates material which constructs a narrative based on the actions and talk of actors from organisations with established positions in the social structure. However, as the development of smart mobility is currently dominated by actors in these spheres of activity, interviews with these actors are still useful in terms of understanding how these organisations talk about automation and MaaS.

The interviewees were chosen not as individuals, but as representatives of their organisations within the project groups and working groups. The interviewees were asked to participate in an interview because of their close involvement in the operative running of the project (representatives from the project group), as well as because they were involved in the implementation of the specific areas of smart mobility in question in the study (representatives from the working groups for MaaS and driverless shuttles). Interviews were used to gain insights into the process behind the development of the collaboration, which were not evident from the more operational discussions in meetings. They also provided specific information about the roles of the different actors involved. As the methods focused on the project group and working group, this thesis mainly represents how the governance and planning of smart mobility is shaped through these levels of the collaboration (cf. Brorström, 2017). This approach could have been developed further by including interviews with the steering group, and even political representatives from the region and local municipality.

In the majority of cases, I had already met interviewees through my participation in meetings, and I met others for the first time at the interview itself. The interviews were semi-structured, based on questions prepared beforehand which were used as a guide during interviews (see Appendix 1 for an example of an interview guide). An approach was used which allowed follow-up of specific avenues of questioning that arose spontaneously during the interview itself. Some specific questions were included based on insights from meetings and interview guides were adjusted for the specific organisation involved in each interview and whether the focus was on driverless shuttles, MaaS or in some cases both. Questions covered the lead-up to the establishment of the collaboration, the interviewee's role in the project, how the development of driverless shuttles

and/or MaaS connected more generally to the organisation in question, and wider issues regarding driverless shuttles and/or MaaS in relation to public transport and urban development. Some interviews helped me to identify areas for further analysis (specifically the procurement contract for public transport, which includes Järfälla municipality, as well as municipal planning documents of relevance). I conducted 17 interviews in total, some with the same actors twice as part of a second round of interviews on MaaS. All the interviews were recorded with the consent of the interviewee. They were carried out in Swedish and transcribed in full. Around half were transcribed by a professional transcriber, and I transcribed the other interviews myself. One interview was conducted by email, and one via Skype, due to difficulties arranging time for a face-to-face interview. In the case of the interview conducted by email, I sent a set of questions for the interviewee to answer in their own time. I have translated the quotes included here into English myself.

Language is an important part of the interview process and the collection of material, and it is worth noting that Swedish is not my first language. This is likely to have affected the dynamic of interviews, as I was not able to be as confident as I would have been in English, and was not always able to pick up humour or colloquialisms. However, as I had already met many of the interviewees at meetings, I was able to begin the interviews with some understanding of the collaboration. Reading through the transcriptions provided an important second layer of understanding the interviews in this case.

Most interviews took place at the interviewees' offices, to which I travelled. The majority of interviews took place in the autumn of 2018 in the initial phases of the collaboration and launch of the driverless shuttles. Additional interviews on the MaaS pilot project were carried out in September and November 2019 with representatives from Nobina Technology, Barkarby Science, Järfälla municipality and the RPTA, as the MaaS service took longer to launch. These interviews aimed to discuss the development process for the MaaS pilot project with the actors involved. However, equivalent additional interviews were not undertaken for driverless shuttles. The material gathered on MaaS is therefore more developed than the material on the driverless shuttles, and this is reflected in the detail and length of Chapters 7 and 8, which focus on driverless shuttles and MaaS respectively.

Table 2. List of interviews. DS is used as an abbreviation for driverless shuttle.

Interviewee	Organisation	Role in collaboration	Date
RPTA 1	RPTA	Representative of project group and MaaS working group	Oct 2018, Nov 2018, Sept 2019
RPTA 2	RPTA	Representative of project group and DS working group	Oct 2018
RPTA 3	RPTA	Representative from the RPTA working with MaaS	Aug 2018 *(two-person interview)*
Nobina 1	Nobina	Project leader for the project group	Oct 2018
Nobina Tech 1	Nobina Technology	Project leader for DS working group	Oct 2018
Nobina Tech 2	Nobina Technology	MaaS working group	Dec 2018
Nobina Tech 3	Nobina Technology	MaaS	Sept 2018 (*via Skype*), Nov 2019
Barkarby Science 1	Barkarby Science	Representative of project group, MaaS working group	Oct 2018, Sept 2019
Järfälla municipality 1	Järfälla municipality	Representative of the project group	Dec 2018
Järfälla municipality 2	Järfälla municipality	Representative of the project group	Dec 2018
Järfälla municipality 3	Järfälla municipality	Representative of the municipality in the DS working group	March 2019 (*email*)
Järfälla municipality 4	Järfälla municipality	MaaS working group	Dec 2018
Järfälla municipality 5	Järfälla municipality	MaaS working group	Sept 2019

5.2.3 Document analysis

The documents analysed for this research were used as complementary sources of information to participant observation and interviews, to gain deeper insights into specific aspects of the collaboration and smart mobility. Documents can be

understood as ways in which organisations represent themselves and their actions (Atkinson, Coffey & Delamont, 2003), and can therefore help understand the roots of specific issues, as well as providing background and context (Bowen, 2009). The documents analysed here were not coded thematically in the same way as the interviews, but were used to corroborate how they were referred to in interviews, and from there to offer a deeper understanding of the responsibilities and roles of different actors (ibid).

Certain documents, such as the tender documents for the contract, were referred to in interviews with the RPTA because of their role in terms of driverless shuttles, and these became key documents for further understanding how the relationship between the RPTA and the bus operator was structured. I have focused on the pre-study documents for the contract (Stockholm County Council, 2014a), as well as the general tender documents for the contract procurement (Stockholm County Council, 2014b). I analysed these as formal documents in relation to how they were mentioned in interviews. They have helped me to understand specific connections between actors which have shaped the collaboration and smart mobility. In the tender documents related to the contract, I looked at how reference was made to urban development in Barkarbystaden. I also focused on the specific aspects of the contract which had been mentioned in interviews related to the flexibility to include pilot projects.

Other documents used in the analysis included strategy documents produced by the RPTA on MaaS or combined mobility (Stockholm County Council, 2017b; 2018c), as well as the letter of intent (Järfälla municipality, Stockholm County Council, Nobina Sweden AB, 2018). Background information relevant to understanding the different actors and their roles and responsibilities was also gathered from the RPTA's Regional Transport Supply Programme (*Trafikförsörjningsprogra*m) (Stockholm County Council, 2017a) and formal documents produced by the municipality. These included its comprehensive plan and specific detailed development plans for Barkarbystaden, as well as its strategy for parking standards (Järfälla municipality, 2017). These were important in understanding the formal roles and responsibilities of the public actors within the collaboration, as well as the presence and absence of smart mobility in more formal planning documents, as mentioned in Chapter 2. I translated the quotes used from these documents into English.

5.3 Analysis

The process of analysis is an ongoing activity, which partially starts in the different stages of the research process. It ranges from the choices of who and what to involve in the study, to focusing and refocusing the research questions, and

attempts by the researcher to make sense of the research process (Crang & Cook, 2011). As mentioned in the introduction to this chapter, this research began within two research projects, which therefore formed the backdrop to the ongoing discussion in my licentiate project. This research context shaped my understanding of smart mobility at a general level. As part of these research projects, I have been involved in preliminary moments of analysis of the work presented in greater depth in this text. These involved project presentations and reports of a more comparative nature, which did not focus solely on this case (see Hedegaard Sørensen et al., 2020; Isaksson et al., 2019). Within the project framework, an initial phase of analysis took place as part of the work on an article (Oldbury & Isaksson, forthcoming) which focuses on the collaboration and the driverless shuttles. This therefore contributed to, and influenced the focus and direction of the research as it unfolded. As part of this phase of research the interviews and field notes from meetings were analysed with a focus on the actors involved in the collaboration, their existing and emerging relationships and ways of working, and their roles. The material was then worked into a narrative timeline (Kvale, 2011; cf. Brorström, 2017), and developed into a detailed and structured account of the processes. This timeline therefore acted as a basis for Chapter 6, which focuses on the collaboration. Building on this initial phase of research, I re-worked the timeline, recontextualising the initial approach through the lens of a new analytical framework, focusing on the roles, responsibilities and links between organisations in the relation to the governance assemblage analytical framework.

The collaboration therefore acted as a foil and building block for an analysis of driverless shuttles and MaaS, as pilot projects taking place in relation to this organisational context. I have focused on automation and MaaS as two separate units of analysis, but used the same analytical framework. For this, I gathered the material on MaaS and driverless shuttles in interviews and field notes, and sorted and categorised it according to the four moments of translation. I initially worked with these in the form of a timeline, and then developed them as patterns emerged around the specific moments. For example, the contract as an obligatory passage point and the MaaS platform as an intressement device, developed in this dialogue between the material and the analytical framework.

I mentioned language as one limitation, noted above, and I will now briefly reflect on other limitations. Though this research is rooted in ethnography, I did not immerse myself in the organisational settings of the participants in the study on a daily basis (cf. Ekenem, 2007). In planning this study, time limits prevented in-depth participation in each organisation, along with more pragmatic questions about how much of the daily work in these organisations focused on smart mobility. Within this study I was not able to follow all meetings which took place

at the various levels in the project. Participation in steering group meetings, or interviews with representatives from this group, would have added a new layer of understanding of the different levels of the organisations involved in planning smart mobility. In this study, I also focus specifically on one case, and this could have been developed by 'following' the objects of study further, beyond the case itself, for example by conducting interviews with Easy Mile, the company responsible for the driverless shuttles, or the other mobility companies involved in the MaaS pilot project, such as the carpool, taxi and e-scooter companies. Further comparison between of similar projects taking place internationally studies could also have been another avenue for methodological development.

The methods used in this research originate in a descriptive, interpretivist and exploratory qualitive tradition. The field of smart mobility was quite new to me, as were the different organisational contexts under investigation in the study. This research has therefore involved a learning process (Palaganas et al., 2017). The aim was not to create an omniscient account of the processes it describes. Instead, it is the result of a process of research and analysis which speaks to a certain group at a specific time (Crang & Cook, 2011). From the outset, this research was not guided by an intention to extrapolate general rules from the case in question, or 'best practice' recommendations for moving policy towards smart mobility. Drawing on Alvesson and Sköldberg (2009), I understand qualitative research as a situated activity which locates the observer in the world, and the phenomena observed are interpreted through a theory. It is an interpretation, rather than a representation of reality. Therefore, in terms of whether it is possible to generalise from this case, I consider generalisation as the possibility to say something about the patterns and tendencies which can be observed from this empirical material. The theoretically informed analysis of this empirical material can therefore be used to generate ideas and draw attention to neglected or less discussed dimensions of a phenomenon (cf. Alvesson & Sköldberg, 2009, p. 319, note 6). In the concluding discussion, I explore how this case contributes to the ongoing dialogue, and I consider how the findings from this study contribute to more general implications for the processes analysed here in terms of how smart mobility will move forward.

The processes described in Chapters 6, 7 and 8 do not follow a chronological order, but instead overlap in different ways. I have therefore included a timeline as a reference for the reader, to help locate the order of the events described in the following chapters (see Figure 4).

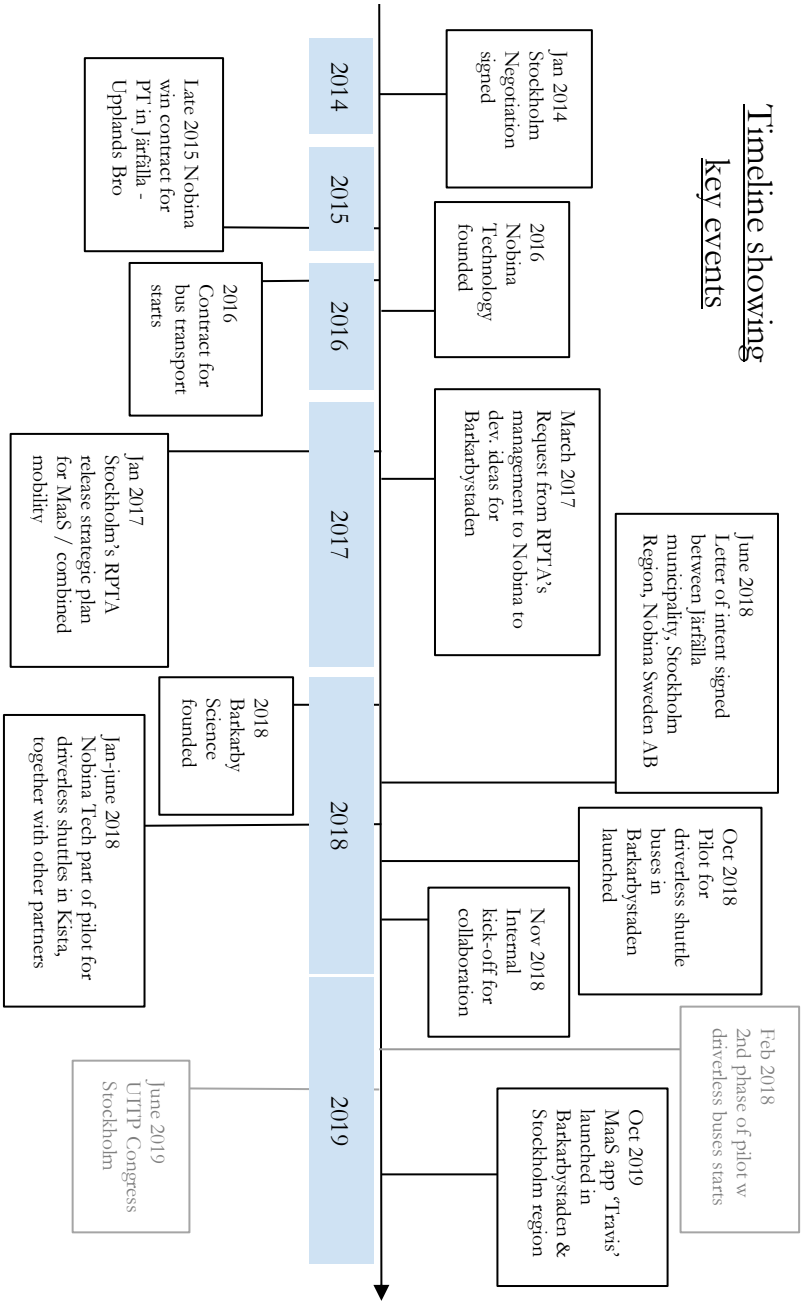

Figure 4. Timeline overview of key events discussed in this case. For context, the grey boxes show other important events not encompassed in this study.

6 A governance assemblage linking smart mobility to public transport

In this chapter, I use the concept of the governance assemblage as a theoretical tool to explore the process by which a configuration of actors emerges, and specifically how this creates links between the existing organisations and the smart mobility services analysed in this study. As discussed in Chapter 4, the governance assemblage concept can be used to focus on the process of assembly. To identify particular moments in this process where the actors connect to each other and to smart mobility, I use the term forging alignments (Li, 2007). Through the use of the governance assemblage concept, I aim to discuss the roles, responsibilities and links between organisations and smart mobility which emerge through this process, and to explore what characterises this collaboration as a site for the governance and planning of smart mobility. I also reflect on how this opens up for changes in public transport, and how the formation of the governance assemblage influences the ways in which governance emerges. Many of the actors involved in the governance of smart mobility in this case already had established positions and roles. This chapter therefore begins by describing the established relationship between the RPTA and Nobina, which provides the basis for the collaboration and one of the key ways of ordering relations in public transport.

6.1 The RPTA-operator relationship

As outlined in the background section, Stockholm's RPTA is the contracting authority for public transport provision, which has an established dynamic and way of organising relations between the RPTA and the private corporations which supply public transport in Stockholm. This is usually done through procurement processes which establish a business relationship between the RPTA and its operators (RPTA 2, 2018). The backdrop to the development in Barkarbystaden has its roots in this relationship, and specifically in the procurement contract for public transport provision in the area.

In Stockholm, public transport contracts for bus provision are commonly divided into geographical contract areas, which can cover one or more of the municipalities that make up the Stockholm region. Barkarbystaden falls within the contract area for Järfälla and Upplands-Bro, two municipalities in the north-west of the region. Public transport procurement contracts are usually in place for around 10 years at a time, and are renewed each decade after a new procurement process. In Stockholm, the procurement process involves a number

of stages, beginning with an analysis, or pre-study, of the contract area to gather knowledge and plan for the next contract period. This material is then reviewed and approved by the regional traffic committee, and the tender documents for the procurement are drawn up. Following this, operators who are qualified to make a bid are identified, and the procurement documents are made public and sent out to the qualified bidders. The bids received are then evaluated, and a winner is chosen (Region Stockholm, 2020b).

In 2013 the process started to procure an operator for the new ten-year contract period for Järfälla-Upplands-Bro. Both the pre-study report and the tender documents for the new contract for the area of Järfälla-Upplands Bro refer to the developments taking place in Järfälla as a result of the 2013 Stockholm Negotiation. They cover development of the new urban area, Barkarbystaden and the extension of the blue line of the metro, as well as the impact this will have on the new contract period:

> "Järfälla is specifically considered to be an area characterised by large changes during the contract period, which will require adjustments in bus traffic." (Stockholm County Council, 2014a, p. 11)

While these changes are acknowledged, the pre-study states that it is hard to estimate the exact point in time when this will become an issue for the contract. The considerable number of people expected to move to Barkarbystaden is flagged as an opportunity to influence travel behaviour from an early stage in urban development (Stockholm County Council, 2014a, p. 15). The main goals of the contract are outlined in the tender documents and in an interview with the RPTA. They involve increasing the modal share of public transport for motorised journeys, and achieving high customer satisfaction (RPTA 2, 2018). In the same interview, the representative from the RPTA also explained that, as part of the contractual assignment, the operator is responsible for presenting ideas and suggestions for fulfilling these goals (RPTA 2, 2018).

The pre-study emphasised that providing public transport to an area under development is complex, involving risks and challenges for the operator, and it recommended that the operator be given more contractual responsibility for the business of providing public transport overall. This was expressed specifically in terms of establishing a contract which would be sufficiently flexible "to manage the area's predicted changes" (Stockholm County Council, 2014a, p. 30). In effect, the urban development process was used as a form of motivation for giving the operator more responsibility and making the contract more flexible by including specific sections in the tender documents on changes and new projects or services (Stockholm County Council, 2014b, p. 26-27) for example. The RPTA explained that, through this contract, the bus operator was given overall

responsibility (*helhetsansvar*) for working with development issues within the contract period (RPTA 2, 2018).

In 2015, the bus operator Nobina Sweden AB was announced as the winner of the procurement process. The contract began officially in 2016 and is projected to last until 2026. At this point, there were no references to smart mobility, such as automation or MaaS, in the call for bids or the contract documents. The contractual relationship highlights a conventional interdependence between the RPTA and the bus operator, based on the contract as a formal instrument of governance and component of the assemblage, through which the relationship between the RPTA and the bus operator is forged. The contract is also a moment in which an important alignment is forged between urban development and public transport in the area. This lays a foundation which influences the governance assemblage, as the contract was created to be flexible enough to anticipate the changes occurring in the area, and outlines the operator's responsibility for working with the development of public transport. Specific sections were included to make it possible to introduce projects and new services, and the bus operator was given overall responsibility for development during the contract period.

6.2 Aligning roles for innovation in public transport

Around a year after the contract had been renewed for bus transport for the Järfälla-Upplands Bro area, the RPTA approached Nobina to ask the company to develop ideas for new services specifically for Barkarbystaden. An interviewee from Nobina recalled how, around March 2017, they were asked by managers at the RPTA to start a process to develop ideas which went beyond those specified in the contract:

> "So then it was [the RPTA] who asked us [Nobina] at management level if we could look at Barkarbystaden, and if we could do something more than just develop it at the level stipulated in the contract. Instead, they asked [for] something much more innovative, something that can really help and give Barkarbystaden more than just an ordinary … bus." (Nobina 1, 2018)

The expectation that innovative ideas should come from the operators supplying public transport to public authorities is an established dynamic in the relationship between the RPTA and its suppliers. It creates an interdependency between the RPTA and its operators with regard to innovation in public transport. In an interview with a representative from the RPTA, it was explained that, in general, the RPTA expects its operators to be active in generating ideas which fulfil the RPTA's overarching goals:

> "… we do not often want to get involved with the details, but instead it is better […] that we say what we want to achieve, and they come with how ... But as I said, I think that we must be rather careful not to steer the details too much in our procurement processes. We have to leave space for innovation." (RPTA 2, 2018)

Implicit in this is the suggestion that operators need to work on innovation within their own companies. This creates an alignment which can be seen to authorise the bus operator's responsibility for innovation, and confirms that the operator be the one to develop knowledge about innovation.

In order to develop and test new ideas, in 2016 Nobina established its own innovation company called Nobina Technology. On Nobina's website, Nobina Technology is described as "a laboratory for the development of shared mobility solutions" (Nobina 2020a). In an interview with Nobina Technology, establishing the innovation company as a separate entity to the main Nobina concern was described as a reaction to discussions in the transport sector at the time (Nobina Tech 3, 2018). Although Nobina Technology is connected to the main Nobina concern, it is able to act as a slightly separate entity and "conduct experiments, collaborate with established industry players … and develop opportunities related to shared mobility" (Nobina, 2020a). Through this new innovation company, Nobina started to forge an alignment between its more conventional supply of bus services within public transport and some of the developments included under the umbrella term of smart mobility.

The way in which Nobina views future developments within the transport sector became clear in another interview with a representative from the company. In answer to my question about how new technologies could influence cities, the representative explained how public transport could change, and specifically how it is influenced by the development of new types of mobility services:

> "On the one hand I think that the public transport industry is going to change quite a lot …. Previously it has been either publicly funded public transport, or your private car, and taxis exist in the middle as a functioning market. The band around taxis is going to become so much bigger because so many more alternatives are being created, which means that the public, public transport (*offentliga kollektivtrafiken*) is going to lose a lot of its role. They are going to have to take a step back a little bit, because they can't decide everything any more. … And that means that the border is going to become blurred - which system is which? And I think the public, public transport is going to have a slight identity crisis. What is its role? Look at Västtrafik, which is testing MaaS and wants to include everything under its umbrella. But I don't think it will work. I think that the public, public

> transport is going to become an actor within this system and be valued as a really high-capacity system." (Nobina 1, 2018)

The above quote highlights how the bus operator considers itself to be a as a different actor from public transport authorities in relation to the future of public transport. It is clear that the operator has started to think of public transport as a shared system in future, where the dominance of conventional public transport as we know it today has shifted. This produces a complex layering of roles, where the established dynamic of innovation resides with operators, making the RPTA heavily dependent on them in terms of how innovation emerges within public transport.

In this case, the request from Stockholm's RPTA to Nobina highlights how the operator is authorised as the actor responsible for innovation. This is the moment where Nobina's existing role as an operator starts to align with the work taking place in its innovation company, Nobina Technology. The work being undertaken by Nobina Technology influences the types of idea Nobina is able to put forward in response to the RPTA's request to develop services for Barkarbystaden, something which I explore further in the next section.

6.3 A new role for the bus operator in smart mobility?

Following the RPTA's discussions with the bus operator about developing new services in Barkarbystaden, Nobina initiated a process of analysis to develop ideas. In an interview with the bus operator, the interviewee explained that they used their internal analysis department, Nobina Analytics, to identify a number of solutions to present as ideas for development. In the same interview, the bus operator explained that Nobina Analytics formulated these ideas with a theoretical future inhabitant of Barkarbystaden in mind. They drew on plans for housing and construction which were available at that time, and took into account the municipality's aim for lower levels of private car ownership in Barkarbystaden (see Järfälla municipality, 2017), as well as ideas for how new services could replace private cars (Nobina 1, 2018).

This led to a shortlist of six suggestions, of which three became the main ideas for development: a BRT line, a Mobility as a Service application and the development of small automated shuttle buses, which I refer to as driverless shuttles, as well as larger city buses. In the press material released on the services (see Järfälla municipality, 2018), the BRT was described as a service which would approximate the connection the new metro extension would provide in the future. The driverless shuttles are described as a way of providing more attractive public transport which is accessible and available closer to housing, due to the size of the vehicles, and they are seen as more flexible in terms of replanning and

changing the service as the urban area grows and develops. MaaS is introduced as a digital service for piloting the sale of digital public transport tickets, journey planning and connecting public transport to other services such as cars and bike hire.

The request from the RPTA therefore created a more specific link between Nobina's existing role in public transport provision, and work which had begun in its innovation company. Through Nobina Technology, Nobina started to develop its role in relation to new types of technology and concepts, such as driverless shuttles and MaaS, and I expand on this in the next section. However, the suggestion of including automated buses and MaaS is linked to other general developments in these areas, related to Nobina Technology's own early pilots involving automated shuttle buses in another part of Stockholm (Kista), as well as other MaaS developments in Sweden and in the Stockholm region. As a result of these developments, there were already discussions between the RPTA and Nobina/Nobina Technology regarding the driverless shuttles and MaaS, and it is likely that these also influenced the types of solutions suggested by Nobina as part of the collaboration.

The ideas developed above were discussed and developed by Nobina in dialogue with the RPTA and the municipality. The bus operator's responsibility for coordinating and consulting with the organisations involved or affected by the contract is within the framework of its contractual role. In an interview with the RPTA, the bus operator's role in facilitating the discussion about developing new services was described as something the RPTA considered to be part of the operator's existing role in this case:

> "I would say that, even if we place quite a lot of responsibility on our operators to collaborate with municipalities, in this case Nobina has a greater responsibility than usual. But it is also within their remit to do that." (RPTA 2, 2018)

While the bus operator's role coordinating with the municipality is not a new one, it is a new type of role in terms of smart mobility within this new collaboration. The overlap between the existing role of the bus operator in terms of coordinating with municipalities, and its developing role as a supplier of automated services, was highlighted in an interview with the bus operator as part of a discussion on the process through which the collaboration took shape. A representative of the bus operator mentioned that, after the company had initiated its dialogue with Järfälla municipality in the spring of 2017, it realised that a number of other actors had also been in contact with the municipality regarding opportunities to develop new types of mobility solution in connection with urban development, such as automation. The bus operator explained that,

at this point, it became clear that none of the other actors had been in touch with the RPTA (Nobina 1, 2018). The operator suggested that these actors did not have the same awareness of the influence of the RPTA, and had gone directly to the municipality instead, thinking the mayor was the person to contact (Nobina 1, 2018).

In terms of the process through which a governance assemblage takes shape, in this case the operator's existing role proved crucial for establishing a link between the municipality, the RPTA and new suggestions for public transport development. The fact that the bus operator was testing different types of new services through its own company, Nobina Technology, influenced the types of solutions it put forward. It was therefore its established role as coordinator between the RPTA and the municipality which linked the actors involved and the smart mobility services. The governance practices involved in creating the assemblage were therefore made along existing lines, and the opportunity for the bus operator to develop this role was still dependent on the RPTA and the municipality. A representative from the municipality reflected on this in an interview:

> "I would suggest that Nobina is strongest as, what should I say, the idea generator. And then [the bus operator] wouldn't get anywhere if the RPTA were not involved, or if we were not involved. But I think Nobina is the motor." (Järfälla municipality 1, 2018)

Nobina is thus thought of as the main organisation responsible for the technology and concepts to be tested, and also leads coordination with the two main public actors involved. The opportunity for them to assume this role is dependent on the involvement of the RPTA and the municipality, but this is a moment where a new role is forged for Nobina within this constellation of actors in relation to smart mobility. The existing literature on smart mobility often discusses new private actors and public actors as two separate areas, creating the impression that these are two distinct spheres (Finger & Audouin, 2019; Marsden & Reardon, 2018a). However, this case shows that the relationship between public and private actors is not necessarily so clear cut, but reflects existing roles and relationships in public transport. The bus operator is an example of an established private organisation working on smart mobility services within public transport, and incorporating smart mobility into public transport is facilitated by the operator's existing connections to public actors. The governance of smart mobility has therefore developed along existing lines as the collaboration has unfolded.

So far in this chapter, I have focused on the bus operator and the RPTA, and how the contract and existing ideas about innovation have influenced the way alignments between these actors are forged. I now look more closely at the

municipal perspective on urban development, how this has generated links to smart mobility, and how it has influenced the specific ways in which the governance of smart mobility has emerged.

6.4 Connecting urban development and smart mobility

The process through which the governance assemblage was established links the municipality's existing responsibilities for planning and management in Barkarbystaden, and public transport provision, with its interest in using urban development as an opportunity to test new innovations and attract new actors to Barkarbystaden. This interest was reflected in the establishment of its own innovation company, Barkarby Science, in 2018.

The process of planning and constructing Barkarbystaden is expected to continue intensively for at least two decades. In an interview with a representative from the specific municipal department responsible for Barkarbystaden (Project Barkarbystaden), it was explained that the municipality had never before built on this scale, or at the pace required to fulfil the terms of the 2013 Stockholm Negotiation, which requires building approximately 1000 homes per year. The overarching thinking behind Barkarbystaden is to establish a "dense, classic town" close to public transport. The development was informed by lessons from previous phases of urban development, which had been heavily influenced by cars, and which had "created small car-dependant satellites which didn't link together" (Järfälla municipality 2, 2018). In contrast, Barkarbystaden aims to be an urban area where inhabitants are able to walk, cycle and use public transport, without needing to use cars. The construction process has been divided into different phases, where the land under development will be filled gradually, and the next phase of construction will only start when the previous one nears completion. By the time the new metro opens for use, thousands of people will already be living in Barkarbystaden.

The construction of the new urban area is characterised by a long-term perspective which considers how the structures built now and in the near future can still work in 80 years' time. In interviews, representatives from the municipality could not put into words exactly what this meant in practice, other than that plans for the urban development have been designed to take into account that people are likely to be living, working and moving in a totally different way in the future. Therefore, spaces have been designed so that they can be converted for different use (Järfälla municipality 2, 2018). This was also described as a long-term approach to urban planning based on creating "elasticity" for the future (Järfälla municipality 1, 2018). The interviewee said that it was hard to relate to the concrete physical implications of this, other than the

fact that "it means not building out certain possibilities" (Järfälla municipality 1, 2018). To try and explain this, the interviewee showed me a plan for a stretch of road in Barkarbystaden with a designated section for public transport in the middle, and car-lanes, bikes and pavements on either side. The representative explained that the space in the middle could potentially be converted into a green area, similar to Östermalm, an area in the inner city of Stockholm where tramlines have been made into alleyways of trees. "The houses stand where they stand" (Järfälla municipality 1, 2018), while road space can potentially be converted into something else. From this, I understand that the plans for the new urban area were not specifically informed by any particular type of new technology or mobility service, other than a perspective that the built environment should be flexible enough to accommodate future changes, and that current municipal planning is based on the fact that cars, public transport, bikes and walking are the dominant forms of mobility.

On top of this approach to physical planning for the future town, in 2018 the municipality also established its own innovation company, Barkarby Science, along with seven other actors (see Chapter 2), to facilitate innovation and urban development with Barkarbystaden as a test bed (Barkarby Science, 2018). Barkarby Science is also expected to focus on projects which are beneficial to people living in, or moving to Barkarbystaden, and innovation projects taking place in association with Barkarby Science aim to be of value for those who live or work in the area. In an interview with the municipality, establishing Barkarbystaden was described as a way of showing other actors that the municipality was willing to test new ideas in tandem with urban development: "We [Järfälla municipality] founded Barkarby Science as a signal to the industry to say that we are open for development" (Järfälla municipality 2, 2018). This signal did, in fact, attract a number of different companies interested in testing MaaS and self-driving vehicles (Järfälla municipality 2, 2018). These discussions also happened to coincide with Nobina approaching the municipality to discuss its suggestions for the development of services in public transport. The interviewee noted that the "package" of solutions suggested by the bus operator was interesting to the municipality, as it placed a number of services in context, rather than the municipality having to talk to separate actors about separate services (Järfälla municipality 2, 2018). Although the municipality described this package of services as a way of incorporating the respective interests of the RPTA, Nobina and the municipality, and building on the way the municipality had framed Barkarbystaden as a potential test bed, the collaboration with Nobina was also described as more than just a test bed:

> "On the one hand, we had started Barkarby Science as a signal to show others that we were open to development, which possibly made it

> interesting for Nobina to look at developing new services at the same time as we were developing a new, large-scale town … At the same time, we saw that it was necessary to kill two birds with one stone and remain at the cutting edge, but also solve some practical issues. It is very important for us that [our] inhabitants benefit from what we are doing from day one, and not just have an experimental laboratory which generates nice headlines, … But the important thing is that those who live in Barkarby and Järfälla feel that they benefit, and Nobina also gets to test things in real life ….” (Järfälla municipality 2, 2018)

In terms of how new and existing roles involving smart mobility have formed as part of the governance assemblage, establishing Barkarby Science as an innovation company to work with new types of solutions in urban development has created an opening for the municipality to connect with smart mobility services. It has been noted that planning through this type of collaborative setting, where experiments and testing can take place, is a recent trend (Berglund-Snodgrass & Mukhtar-Landgren, 2020; cf. Olesen, 2012; Allmendinger & Haughton, 2010). In this case, it also builds on the original contract, which made space for smart mobility developments and aligned them with the operator’s existing role.

6.5 Marking the formation of a governance assemblage

The new set of relations linking public transport and smart mobility was announced publicly in June 2018, and documented in the form of an agreement between the municipality, the region and the bus operator Nobina (Järfälla municipality, Stockholm County Council & Nobina Sweden AB, 2018). This public announcement and formal letter of agreement describes the purpose of the collaboration and its aim. This is a common characteristic of governance assemblages to mark what the assemblage gathers around (Briassoulis, 2019). Interviewees also noted how establishing this set of relations represents a new way of forging alignments between the different actors involved.

While the governance assemblage connects these organisations in a new way, it does not separate them from their existing responsibilities and interests outside of the collaboration. Instead, these have becoming meaningfully related to smart mobility in a new way. Nevertheless, the new commonalities brought together in the governance assemblage operate alongside the organisations’ other roles, and a representative from the municipality noted that this was something to be aware of:

> “Nobina is a commercial actor in the market and wants to make money. The RPTA has a mandate from Stockholm County Council which says

> it should guarantee good quality public transport in the Stockholm region. And we in Järfälla want the best for the citizens of Järfälla, and in this project specifically, urban development in Barkarbystaden." (Järfälla municipality 1, 2018)

Announcing the collaboration indicates that the governance assemblage has been publicly established, and marks the process through which a set of relations has been formed between the established actors. In the letter of intent signed by the management, or the most senior political representatives in each organisation, infrastructural and urban development at Barkarbystaden is again described as offering a unique opportunity to develop public transport in tandem with urban development from an early stage. Developing bus transport before the launch of the new metro line is described as a way of mitigating the likelihood of people moving to the area purchasing a car. Smart mobility is described in terms of the substantial technical developments taking place within the transport sector, such as electrification, autonomous vehicles and digitalisation. This is presented as a path for development which creates new opportunities for a public transport system able to fulfil the overarching goals set by each organisation (Järfälla municipality, Stockholm County Council & Nobina Sweden AB, 2018). The aim of the agreement is described as follows:¨

> "Through collaboration and coordinated activities and measures, the letter of intent aims to increase the share of sustainable travel in Järfälla municipality and implement modern public transport solutions to support urban development in Barkarbystaden. The measures ultimately aim to contribute to the fulfilment of the vision set out in Järfälla municipality's comprehensive plan, the Regional Transport Supply Programme, and Nobina's service contract for Järfälla." (Järfälla municipality, Stockholm County Council & Nobina Sweden AB, 2018)

The development of automated buses and Mobility as a Service as part of this collaboration agreement is therefore situated within a group of activities, and in relation to the overarching goals of each organisation, with the development of public transport in tandem with urban development at its core. In terms of how links are established between new and existing actors, the description of the role of technological developments in public transport highlights general expectations within the governance assemblage regarding how new technologies can potentially reshape public transport but still fulfil established goals. In interviews with the representatives from the municipality and Barkarby Science, it was explained that before the letter of intent was formalised, communication between these actors usually took place at a number of regular planning meetings each year, where developments affecting public transport provision were discussed

(Järfälla municipality 1, 2018). In this case, however, the collaboration did not develop through this established channel of contact, but through discussions higher up in the respective organisations (RPTA 2, 2018). This formal document marks the culmination of work to establish a specific collaboration around a variety of new services in public transport, and is an official symbol of the various alignments forged so far. As the previous sections of this chapter have aimed to show, the collaboration did not begin with this formal announcement, but the announcement was part of an ongoing process of assembly. The ways in which alignments had been forged until this point had implications for how ongoing work within the collaboration was structured. I begin to explore this in the next section.

6.6 Structuring and cultivating the governance assemblage

Shortly after the formal announcement of the collaboration and the signing of the letter of intent, the collaboration received funding from Vinnova,[9] Sweden's innovation agency, in September 2018, which supported work on the automated shuttle buses and MaaS. It was also around this time that I began attending meetings within the project group. At the first meeting I attended, held by the project group in early September 2018, discussions revolved around finalising the overall goals for the collaboration before they were presented for approval by the steering committee. Plans for the different working groups were also discussed, and the project leader from Nobina led the meeting. After a discussion on how to phrase the overarching goals for the project, the next point on the agenda involved how to man the different working groups within the collaboration. The PowerPoint shown at the meeting, which gave an overview of the six main groups, showed representatives from the RPTA and Nobina or Nobina Technology, who had already been nominated for groups. However, Nobina said that it was still waiting for representatives from the municipality for each working group, and the municipality said it was working on this. I tried to make a quick note of the relevant names for potential interview contacts. A representative from the RPTA asked which organisation should be responsible for the practical aspects of holding meetings in each working group, how to divide responsibilities, and whether it should be the RPTA or Nobina who should initiate the first contact in the different groups. Nobina consequently agreed to be responsible for the first contact, but suggested that the groups could decide for themselves how they organised their work. This discussion highlights how meetings were not just a methodological entry point, but as Sandler and Thedvall (2017) suggest,

[9] See https://www.vinnova.se/p/modern-mobilitet-i-barkarbystaden/

meetings also acted as infrastructure to generate, as well as maintain the collaboration.

In the groups in which I was able to participate, the precedents set in the project group with Nobina or Nobina Technology, who were leading the meetings, were replicated in the different working groups. In the project group, a routine was established where Nobina led the meeting, and reported on progress and the status of different parts of the project based on a set agenda covering the different working groups. In the MaaS working group, meetings were initiated jointly by Barkarby Science and Nobina Technology, and were often held in Järfälla, but Nobina Technology was responsible for presenting and leading the plan for development. It is not necessarily remarkable that Nobina or Nobina Technology assumed this role, as they were ultimately responsible for providing the services in question in the collaboration. This also shows how the contractual relationship between the RPTA and Nobina, and the operator's coordinating role within the contract, were transferred to the way in which roles were organised within the governance assemblage. In later chapters, I illustrate further how this, in turn, influenced the development of automation and MaaS.

Beyond the regular meetings to generate and maintain the collaboration, other aspects of internal work to produce the governance assemblage included an internal 'kick-off' for the representatives from all levels of each organisation (and researchers) involved in the project. At the meeting noted above in September, a representative from the municipality suggested that the project should meet as a whole, as a way of developing a shared understanding of the collaboration, and the municipality could give a presentation on the urban development. This suggestion was then taken forward by Nobina with support from Barkarby Science, and in the weekly coordination meetings it was referred to as the 'kick-off'.

The kick-off took place on the 26th of November 2018, and was held at a newly built local school in Barkarbystaden. Nobina organised an electric bus from the commuter train station in Jakobsberg to Barkarbystaden, for those attending the event. I also attended, along with one of my supervisors, and when we arrived at the school, we were all required to put on blue plastic overshoes at the doorway, before heading up to the second floor to a large blue kitchen and conference space. The political representative for public transport for Region Stockholm from the Moderate Party, Kristoffer Tamsons, had been invited to attend, along with the mayor of the municipality, Emma Feldman, also from the Moderate Party, to talk about what was important for the municipality in the context of the region. The two politicians opened the kick-off. Emma Feldman began with a brief speech highlighting innovation, the environment and technology. Kristoffer Tamsons gave a longer speech where, as I mentioned in the introduction, he

described everyone sitting in the room as parents of a new project, stressing that this work was contributing to building a town around people's needs from the very start. He also mentioned the importance of solving problems together, and how unique the collaboration was, suggesting that it formed a unique model for collaboration.

The rest of the meeting was structured around presentations, starting with representatives from the steering committee, followed by a presentation on the urban development from the project leader for Barkarbystaden. This was followed by presentations by the project group and the different working groups for the BRT, the small driverless buses and MaaS. There was also a section for research associated with the collaboration[10]. Breaks in the schedule were given over to questions for discussion, such as "What would it take for you to sell your car?" (*Vad krävs för att ni skulle sälja bilen*). In the group in which I participated, with representatives from Nobina's communication department and the group for the BRT and Barkarby Science, I mentioned that I did not have a car, but others described the car as a symbol of freedom and accessibility. They noted how a car made people feel secure, and enabled them to pick up or drop off children. However, certain aspects of car ownership were questioned, such as sitting in a traffic jam. I understood these types of questions as ways of generating discussion related to the general theme of the project, though in this case the question also highlighted the assumption that the majority of people owned attending the meeting would own a car. In the project group meeting the week after, we discussed the kick-off, and how it had been good to obtain an overview of the structure and put faces to names. Nobina noted that it was significant that the politicians had attended and were prepared to speak, and others agreed.

The kick-off was an important way of involving people in the collaboration, and mapping out the contours of the collaboration more clearly for those involved. The involvement of the politicians also highlighted the significance and potential of the collaboration, and the intention that the involvement of politicians should inspire those involved. The political involvement in the kick-off also served to highlight the ambitious nature of the project, and to emphasise its 'flagship' character to those involved. Although this is not analysed in depth

[10] As part of the section on research, I briefly presented the research I would be doing with the aim of understanding how Mobility as a Service and driverless shuttles develop as part of a specific organisational and urban setting. I also presented research being undertaken on MaaS in the K2 project 'Reinventing public transport', and gave a brief overview of development in Oslo, Helsinki, Copenhagen/Denmark, Stockholm and Gothenburg. Other researchers from ITRL at KTH also presented their ongoing research in connection to the project.

here, there have been efforts to market the project as a specific model for collaboration.[11]

6.7 Discussion

In this section, I have discussed the roles, responsibilities and links between organisations and smart mobility which shape and characterise the collaboration in Barkarbystaden. I have identified particular moments of importance in the process through which the governance assemblage developed, and through which alignments between actors were forged. An important formal instrument which shaped the governance assemblage was the design of the contract for public transport provision for the geographical area that includes Barkarbystaden. Through the contract, initial connections were forged between the RPTA and Nobina, as well as between the contract and Barkarbystaden as a key site of urban development. This influenced how the contract was written, so that it incorporated more flexibility and more responsibility for the operator, and I develop the implications of this in more detail in the coming chapters. I also discussed how, even under normal circumstances, Stockholm's RPTA generally assumes a less central role than the one it expects from its operators when it comes to innovation in public transport. This means that, in practice, operators represent the RPTA in terms of innovation in their service provision. In this capacity, Nobina had already begun to negotiate a role in relation to smart mobility and the future of public transport by founding its own innovation company, Nobina Technology. This more autonomous organ of the company was used to begin testing and developing solutions. It enabled Nobina to begin forging aligning between its organisation and general developments for smart mobility and developing its role in this area.

The chapter has shown how these initially loosely connected alignments started to assemble more closely after the RPTA asked Nobina to develop services for Barkarbystaden. Nobina's contractual role, and the idea that operators were best suited to leading developments in this particular case, were ultimately critical in forging an alignment with the municipality's ambition of using Barkarbystaden as a test bed in urban development. This builds on what was identified within the contract, where the more general clauses anticipating changes in the area influenced an emerging collaboration specifically around smart mobility. Within the collaboration, Nobina's existing role as operator, with an overarching responsibility for public transport, took on even greater significance when it became part of the governance assemblage. This is because

[11] A short film was made by Nobina in Swedish in December 2019 about the collaboration: https://www.youtube.com/watch?v=7VuHSsVIhmY

the work the company had previously been carrying out within Nobina Technology was now linked in a more concrete way to its established operator role.

The way in which the collaboration is structured and cultivated creates a clear separate project structure for the organisations to meet around and in terms of the different services the organisations are developing. Part of this structure is based on Nobina's contractual responsibility for coordinating activities related to the contract, a role of project leader which has been transferred to the collaboration. In this sense, actor-specific work is brought into the collaboration (cf. Borgström, 2019), as in this case the operator is also providing the new services, even if they are still under development. What is new within this constellation of actors are the services which are being developed. The collaboration forges new responsibilities around MaaS and driverless shuttles between all the actors involved. However, as the collaboration takes its point of departure from the established public transport relationship between the RPTA and Nobina, the role of the operator is dominant, characterising and representing the development of smart mobility within this collaboration. In the process through which the governance assemblage is formed, governance emerges along existing lines, but the role of the operator takes on a new significance in relation to smart mobility. I now develop this discussion in the coming chapters by exploring the driverless shuttles and MaaS as two different pilot projects for smart mobility.

7 Translating the driverless shuttle bus

Using the concept of translation (Callon, 1986), in this section I will analyse how relations between the RPTA, the bus operator and the municipality take shape around the driverless shuttles, and how and whether this moves relationships around, or links them in new or different ways. As outlined in the methods section, this chapter focuses on how the pilot project for driverless shuttles emerges within public transport. I use the term pilot project to describe a type of project which tests a smaller part of something bigger (Ryghaug & Skjølsvold, 2020; Fred, 2019), as well as a way of delimiting a specific organisational space distinct from more ordinary processes (cf. Berglund-Snodgrass & Mukhtar-Landgren, 2020). As mentioned in Chapter 3, I understand this pilot project as a setting in which to understand the development of driverless shuttles as a form of automation and smart mobility in relation to public transport.

The analytical framework guiding the analysis in this chapter is predominantly structured around two of the phases of translation referred to by Callon: problematisation and intressement. Problematisation is the phase of translation where actors become involved in a network, establish their roles and define action in certain ways. It also involves obligatory passage points. These are certain points around which different actors converge, and which mediate relations between actors. I use obligatory passage points to explore the role of the contract and the pilot project. Intressement, and specifically the aspect of this moment of translation known as the intressement device, are used to discuss how the relations which developed in the earlier phase of problematisation crystallise around the driverless shuttle as a specific device, or artefact. I begin with a short vignette of the launch of the driverless shuttles, which is emblematic of how the buses are mobilised as a new entity being piloted in public transport.

7.1 Launching the driverless shuttle bus – the unveiling of line 549

On October 24th 2018, the driverless buses were unveiled in Barkarbystaden's main square, 'Stora Torget'. At around 1pm, a small number of journalists, bystanders and representatives from the RPTA, Nobina and Järfälla municipality, had gathered in the square. One bus had been positioned on the pavement, and a few metres away from this, next to a bus stop for the service, Nobina had set up a portable blue stand with a bowl of sweets on it, and a banner stand positioned next to it, both carrying the words "self-driving buses in Barkarby" written in Swedish. Järfälla's portable municipal green and yellow banner had

been placed next to this. Soon, another driverless bus rounded the corner. Journalists filmed the bus and took pictures, but kept their distance. Three politicians disembarked from the bus to stand in front of the newly erected bus stop: Kristoffer Tamsons from Region Stockholm, Emma Feldman, the Mayor of Järfälla, and Tomas Eriksson who was, at the time, environment and public transport representative for the Swedish Green Party at the regional level.

Kristoffer Tamsons was the first to say something about the buses, describing them as "tomorrow's public transport" and part of what would make Stockholm "the world's most modern region". He declared this to be the first time self-driving buses had operated in normal traffic, presented a vision of the development of the buses and their initial route, and praised the collaboration between the municipality, Nobina and the RPTA in terms of the launch. He also added that it represented more than just self-driving buses, and was a service which had started in Barkarbystaden but could soon be scaled up to the whole of Stockholm. After Kristoffer Tamsons' speech, Emma Feldman and Tomas Erikson also made comments, saying that this project put Barkarbystaden at the forefront of innovation, and the project in general had the potential to contribute to an everyday life without cars. Emma Feldman and Kristoffer Tamsons officially marked the inauguration by displaying the timetable for the buses at the bus stop in the square, slotting it into the holder on the metal pole. The politicians then embarked on a first trip along the route, each in their own bus, along with members of the press and various representatives of Nobina, Nobina Technology and the municipality.

The public unveiling of the driverless shuttles can be seen as the public mobilisation of the service, and the shuttles represent a new entity within public transport, with the politicians as the external 'faces' of the collaboration and the pilot project in Barkarbystaden. The launch of the shuttle buses in October 2018 took place soon after the collaboration was formally announced and established in June 2018. The governance assemblage was therefore an overarching entity used to mobilise the testing and introduction of driverless shuttles within public transport.

7.2 The contract as an obligatory passage point

In order to understand how relations take shape around the driverless shuttles, I return to the role of the procurement contract that was previously mentioned in chapter 6. I make use of Callon's concept of the 'obligatory passage point' as part of the phase of problematisation in translation. This creates, or marks, a point where (certain) actors converge, and is a moment where the action is defined. It is also necessary for the continuation and development of the translation process.

I understand the contract as one such 'passage point' through which the driverless shuttle buses pass, and which mediates the terms under which the roles of the bus operator and the RPTA are defined.

The contract is one formal planning convention in public transport. It provides the basis for the governance assemblage and a framework for the relationship between the RPTA and its operators. As outlined in the previous section, the contract which covers the supply of bus transport for Barkarbystaden preceded the establishment of the collaboration itself, but contributed to the structure of the governance assemblage. The contract specification documents were written to include a certain flexibility, to take into account the changes related to infrastructure and urban development which could take place during the contract period. One specific section of the contract was particularly influential.

In interviews, a specific section of the contract specification, 'Projects and New Services' (Stockholm County Council, 2014b, p.27), was considered to provide the "entry point" for piloting automation within public transport (RPTA 2, 2018). This offered an opportunity to go beyond the existing terms of the contract, and its role was echoed in an interview with the bus operator as follows:

> "The possibility within the contract for pilot projects, new services, and that [the contract] was prepared to do more than we had initially written from the beginning, … those things were decisive in this coming to fruition." (Nobina 1, 2018)

In this case, the RPTA and the bus operator already had an established connection through the contract, and the 'project and new services' section in the contract was used to establish a new link to automation within this relationship. Viewed as an obligatory passage point, the contract was used to negotiate and mediate the possibility of testing driverless shuttles in public transport (cf. Brown, 2002).

In the original tender documents, the section on 'Projects & New Services' outlines the conditions for the development of a project or new service carried out in relation to the contract (Stockholm County Council, 2014b). It stipulates that the operator has an obligation, through its existing contractual role, to take part in projects which the buyer (the RPTA) assigns or implements, and which influence the contract or contract area. A project to test a new kind of onboard computer (bus PC) is given as an example of a possible project in the specification (Stockholm County Council, 2014b). New services are described as services which connect to the contract, but are not already covered within the scope of the existing contract specification. The development of the driverless shuttles was considered a new service outside the existing contract specification (RPTA 2, 2018).

In another interview with the RPTA, it was explained that the way the contract specification was written offered an opportunity to connect a number of aspects, but at the same time this was not the only factor influencing the developments:

> "And in this contract [the E28 contract] there is a section called 'development projects' [sic], something which meant that it was possible to include activities that we did not know about when the contract was written, both in terms of the opportunity to test them and also to finance them. So the conjunction is there, yes. It is connected, but at the same time it isn't. But Nobina has come furthest in operating self-driving vehicles, and the contract in Barkarby allowed it, and the place in itself was interesting." (RPTA 1, Nov 2018)

The above quote highlights that the series of developments which led to the pilot project for driverless shuttles were not planned as part of the contract. Instead, the way in which the contract had been written was influential in making a pilot project with the driverless vehicles possible. Until this point, work by Nobina, or more specifically Nobina Technology, on developing driverless shuttles had been taking place outside their contractual work. It is also important to note that in an interview with a representative from the RPTA it was explained that, even before the pilot project Nobina Technology was involved in Kista in 2018, Barkarbystaden had been identified early on in discussions between the RPTA and Nobina/Nobina Technology as the next step (RPTA 1, Nov 2018). Therefore, the idea of developing the technology had been discussed by the RPTA and Nobina/Nobina Technology before the collaboration.

In this case, the contract is a document which already defines the scope of actions between the RPTA and the operator, and is used as a passage point which opens up new possibilities for action. The projects and new services section of the contract does not stipulate exactly how or what should be developed. Driverless shuttles were not stipulated or referred to as a potential avenue of development in the contract. However, the contract allows it, which the RPTA said would not necessarily have been possible in other contracts (RPTA 1, Oct 2018).

While this section of the original tender documents was used to enable automation in public transport to be tested, the pilot project for the driverless shuttles was nevertheless formalised through a supplementary contract. This supplementary contract refers to the original section of the contract mentioned above, reiterating that the operator has an obligation to take part in projects initiated by the buyer (the RPTA). This supplementary contract also draws on the newly established collaboration between the actors, saying that "the operator's commitment to the project has its origins in the joint dialogue between the RPTA, the operator and Järfälla municipality regarding the development of different

public transport solutions for Barkarbystaden, with the aim of providing attractive public transport" (Stockholm County Council, 2018d). The supplementary contract highlights that the RPTA is therefore still formally responsible for initiating the pilot project for the driverless shuttles, even though the initiative and service itself came from the operator.

It is through the original formal contract that the overlap between the location and Nobina Technology's work on developing automation is defined as part of public transport. This automatically brings these existing roles into the pilot project, and in this case the pilot project could be described as falling within the normal sphere of work. In terms of how relations between actors take shape around the driverless shuttles, and how and whether this moves relationships around, this pilot project does not necessarily reposition relationships. Driverless shuttles are instead linked to existing processes in terms of public transport provision.

Callon suggests that obligatory passage points are created in specific moments in translation where action is defined, and as certain points around which actors converge, where the relationships between actors are mediated (Callon, 1986b). In this situation, the role of the contract highlights that these types of points of passage do not necessarily need to be new, but can also re-use existing tools to define relationships. However, the contract is a point of convergence first and foremost for the RPTA and the operator, which means that roles within the collaboration are also defined according to the contractual relationship. The contract is therefore not a passage point around which all actors in the collaboration converge uniformly. Building on this exploration of how the pilot project is defined by roles which already characterise public transport provision, in the next section of this chapter I consider in more detail how each of the actors approaches the pilot project.

7.3 Piloting the driverless shuttle

The previous section demonstrated how the driverless shuttles were framed as a pilot project through the contract. This section will continue to discuss the pilot project through the analytical lens of problematisation, and will explore the process through which interests are incorporated, and actors are made relevant through their involvement. Based on research at the time of the initial phase of implementation, I discuss how the organisations involved orientate themselves in relation to the pilot project as a point of passage. To do this, I divide this section into three parts where each of the organisations are discussed in turn, in order to explore how the pilot project both connects the organisations involved, and highlight differences in their ambitions and understandings regarding the

driverless shuttles. In this section, I group together the sister organisations Nobina and Nobina Technology, and Järfälla municipality and Barkarby Science.

7.3.1 The RPTA negotiates a pilot within public transport

On a general level, the RPTA considers the development of the driverless shuttles to offer potential ways in which the role of the bus could change and take on new forms in the coming years. This is linked to ideas about how public transport could be provided in the future if this type of service proves successful. It could, for example, operate as a night service, as well as a service for more sparsely populated areas:

> "… the considerable social effects are when we start to take this service out into more sparsely populated areas (*glesbygd*), when the technology is capable. There are sparsely populated areas in the Stockholm region too, where we can't really provide buses, or where a bus runs once a day maybe … but that isn't something that suits many people living there. We could be able to offer public transport to those who live in those types of area." (RPTA 1, Nov 2018)

These more general ideas show how the potential role of this type of vehicle is envisioned for the future, and the pilot project in Barkarbystaden possibly marks the start of these developments. Barkarbystaden also offered the opportunity to test a smaller type of bus as part of urban development, on smaller streets. In addition, it enabled the actors to work towards the possibility of developing these buses into an on-demand service in the longer-term, which can be booked or ordered via a smartphone (RPTA 1, Nov 2018). This can be found in press-release documents on the vision for how the buses could develop in Barkarbystaden (Järfälla municipality, 2018). The RPTA also expressed reservations about whether the driverless buses would be able to compete with cars, or whether people who generally walked would now take the bus (RPTA 1, Nov 2018).

As the RPTA is ultimately responsible for the contract, it is also responsible for defining the terms of the pilot project within this framework. In an interview, the RPTA described a pilot as a project which takes place during a limited period of time, in this case 8 months, with a clear beginning and end, and is evaluated during this same time period (RPTA 2, 2018).

These stipulations are also outlined in the supplementary contract, which describes the more technical and operational specifications for the pilot project. These stipulate that the project is an experiment (*försöksverksamhet*) which will be carried out between specific dates (24th October 2018 – 23rd June 2019), that Nobina/Nobina Technology is responsible for collecting information, and that three buses will run along a specific route with an onboard operator. It adds that

existing contractual obligations regarding ticketing, insurance and licensing are applicable during the pilot. Therefore, although it is a pilot project, it is still subject to the bus operator's contractual responsibilities in terms of its usual remit for public transport provision. The pilot project is therefore a site where the aim of testing a new form of technology overlaps with existing stipulations for public transport.

In one interview, this overlap was described by the RPTA in terms of the internal and external function of the pilot project. The interviewee explained that, internally, between the RPTA and Nobina, the first stage of introducing the driverless shuttle buses was framed as a pilot project, while outwardly, in terms of customers, the intention was that the shuttle buses appear to be another public transport service (RPTA 2, 2018). In terms of translation, this highlights the different functions of the pilot as a point of passage. While it establishes a space for testing, and for the RPTA and Nobina to negotiate their roles, there was also an intention that the public will interact with the buses from the start in terms of a paid service, as with public transport in general. Another aspect which highlights this tension involves ongoing questions about whether people who use the buses should be asked to pay for them, or whether for certain local events, such as Barkarbystaden Day, free journeys could be offered so that people could try the service out. However, in these discussions between the municipality, the operator and the region, paying for tickets on public transport was described as a political decision. Again, a desire to maintain the service as a 'real' component of public transport from the very start was an argument used by the RPTA and Nobina in favour of the driverless shuttles being a paid service (see field notes, 5/10/2018). This suggests more about the power dynamics between those who run public transport and the public who use it, as the proposal for, and implementation of this service came predominantly from influential actors within the public transport industry.

Translation is also a way of exercising power, and is a process which "mediates between what is and what will become" (Clarke et al., 2015, p. 36). The ambition of making the buses a paid service from the start highlights the way in which the above mediation and decision making influence how the technology should be introduced to customers. The service is also intended to encourage users to adopt certain behaviour patterns and roles in relation to the driverless buses (Pelizza, 2020). However, it is also possible to question the extent to which people using the buses perceive it as 'public transport' when the buses operate on a limited route at a limited speed. This generally indicates to the public that the driverless shuttles are still in a test phase.

One aspect of Nobina Technology's responsibilities for the driverless shuttles in Barkarbystaden involved the bus looking like it was of public transport and the

SL brand. The buses are red, have a specific type of striping, have the same type of system as a normal public bus service, have been approved by the Swedish Transport Agency, and follow a specific timetable and route (Nobina Tech 1, 2018). Nobina/ Nobina Technology also presented the shuttle buses internally at the offices of the public transport authority in early October 2018, prior to the start of the pilot. This generated comments and questions about how this type of service fit with existing guidelines for accessibility and design (field notes, 5/10/2018). In an interview, the RPTA (RPTA 2, 2018) suggested that, if the service did become a more permanent fixture in terms of public transport, the guidelines would need to be adjusted and updated in response to this type of bus. Therefore, although the buses are still subject to some aspects of the contract, they are not subject to other types of guidelines. Altogether, looking at the pilot as a point of passage for the RPTA, the pilot project lies somewhere between a test and ordinary public transport, as the service is presented as public transport, even while the technology is being developed.

7.3.2 Nobina and Nobina Technology

In interviews with Nobina Technology, the pilot project in Barkarbystaden was discussed in terms of how it differed from the company's previous pilot in Kista (see Hafmar, 2018), and how the opportunity to test the driverless shuttles in Barkarbystaden departed from its first test in Kista. The interviewee from Nobina Technology suggested that the collaboration with the municipality and the RPTA provided an opportunity to situate the driverless shuttles within a public transport context, going beyond a simple experiment, and described this as follows:

> "I can say that the big difference is that they make their way into public transport in general. It is not just an experiment, it is an opportunity to introduce customer value, so that they become part of the larger apparatus and become a natural part of public transport." (Nobina Tech 1, 2018)

In interviews with both Nobina and Nobina Technology, those involved in the project emphasised that they were still in an early stage of testing technology in terms of automated vehicles, but that this pilot was an opportunity to take these tests further. Nobina Technology explained that the test in Kista had helped the company to ascertain that the technology worked, but that they were still working with the technology on the understanding that it was not fully developed:

> "I'm not saying that we are testing the technology, because the technology we are using has already been tested … but I also know that it is not fully developed. So looking at customer travel patterns and how satisfied they are with the service, and what they want out of it, those are the parameters which we can work with to make the journey even better. Should it go faster, or should you be able to order [a bus] all the way to your front door? These

> are the types of question we want to ask our customers." (Nobina Tech 1, 2018)

Barkarbystaden therefore offers an opportunity to collect more information about how people use the buses.

The driverless shuttles were also described by Nobina Technology as a complementary service to the BRT, and are expected to provide a last-mile solution in terms of the municipality's aims to develop an urban area with low car use:

> "Barkarbystaden is intended to have a low vehicle per capita index. That has been said from the start, and so it is necessary to create a very attractive public transport service, and as part of this we have set up a list of improvement points so that we see Barkarbystaden as a whole, in terms of how it will grow in conjunction with the BRT line, and then the metro in 2025. And the self-driving buses are a complementary part of this" (Nobina Tech 1, 2018).

The smaller driverless shuttles are intended to be a service flexible enough to grow alongside an urban area under development. While this is specifically used to motivate the introduction buses in Barkarbystaden, these developments are also an aspect of more general work towards developing the role of the bus. For example, a representative from Nobina, explained in an interview that the company was trying to negotiate and work strategically to develop the role of the bus (Nobina 1, 2018). The interviewee also explained that as soon as the company had sufficient experience in using this technology, the buses would be moved from Nobina Technology to the main organisation. The technology was described as an enabler or facilitator (*möjliggörare*) in the work towards developing the system through this solution, and learning was considered a key aspect of the work with the small driverless shuttles (Nobina 1, 2018).

The same representative from Nobina also said that the pilot was no longer about testing the technology, but that the driverless shuttles in Barkarbystaden involved testing the concept of driverless shuttles as a bus service, and exploring the benefits they could bring to the public transport system (Nobina 1, 2018). The pilot project was also linked to Nobina's more general ambition to develop a bus system which could work in a city:

> "[…] we want to build a system that works in a city. We are also thinking about how our processes work. We have about 3500 buses today that are out and driving. What happens if we have 3500 self-driving buses? What kind of requirements does that impose on our activities and our organisation and our competencies?" (Nobina 1, 2018)

This system approach by the bus operator highlights that the company considers the pilot in Barkarbystaden to be about understanding how this kind of service can fit into the products it offers more generally. Consequently, the pilot project in Barkarbystaden is also a point of passage for the shuttle buses into Nobina's service offering. This project will potentially inform the future service Nobina can offer, the role of smart mobility within its services, and what it may be in a position to offer in future contract bids in different areas. In addition, the pilot project is a site of mediation between the current form of the technology and future avenues of development (Brown, 2002).

7.3.3 Järfälla municipality and Barkarby Science

While the bus operator connects the pilot to the potential future role of smaller shuttle buses within its services in general, the municipality and Barkarby Science, the innovation company affiliated with the municipality, frame the pilot in relation to innovation within urban development.

In an email interview, a representative of the municipality explained that discussions related to the pilot project for the driverless shuttle buses first reached their department (Parks and Streets) in June 2018. The initial work involved finding a location for the thermo-tent which would act as a garage for parking and charging the buses in Barkarbystaden, initiating the process for a building permit for this, and securing an electricity supply. The municipality also acted as a sounding board for Nobina Technology in discussions regarding the route and local traffic regulations (Järfälla municipality 3, 2019). Interviews with people working at the municipality revealed that they understood the pilot project primarily as an experiment aimed at understanding more about how applicable the shuttles could be in the area. They also saw it as a new type of technology which could make public transport more attractive, a shared form of travel which could potentially lead to a decrease in private car use (Järfälla municipality 3, 2019). The municipality had a pragmatic view of the first stage of the pilot, suggesting that it had a weak impact had in terms of its interest in improving public transport, as only an average of around 2.5 passengers were taking the bus per journey, meaning that buses were not fulfilling a clear demand (Järfälla municipality 1, 2018). Another representative suggested that the technology would become more attractive as it became more advanced (Järfälla municipality 3, 2019).

Alongside the more practical aspects of implementing the pilot project, the municipality and Barkarby Science suggested that the buses had a communicative role. The role of the buses was emphasised in terms of urban development, and specifically the influence of this type of project in putting the large-scale development in Barkarbystaden 'on the map' in a positive context (Järfälla

municipality 1, 2018). The municipality's interest in the buses focused on the communicative potential of being one of the first locations to test this type of bus. The communicative role of piloting automated technology in an urban area under development also overlaps with the role of Barkarby Science. This role involves working with Barkarbystaden as a test bed and attracting new actors to Barkarbystaden, in order to facilitate the testing of new and innovative solutions, and collaboration across sectors (Barkarby Science 1, 2018).

The fact that the municipality is interested in using urban development as a test bed and site of innovation means that the pilot project can be seen as an obligatory passage point. Karvonen and Enqvist (2019) note that in recent years it has become more popular to use test beds in an urban development context, and they define test beds as spaces which enable testing. Järfälla municipality's decision to establish Barkarby Science and frame Barkarbystaden as a test bed shows how the formal processes for traditional urban development in the municipality are overlaid by urban development as a location for this type of test. Hopkins and Schwanen (2018, p. 10) note that many urban trials are "configured in specific parts of the city – with low(er) traffic flows, less complex road configurations, and often on sites of new residential and/or commercial developments". The pilot project in Barkarbystaden is in line with this pattern of testing. However, on a more general level it is possible to ask where ownership of the Barkarbystaden test bed lies within this space, in terms of the different actors collaborating with the municipality. As discussed in Chapter 6, this specific collaboration was shaped by Nobina/Nobina Technology's ideas for the development of public transport, and the municipality was clearly interested in being part of these developments. A regional dynamic also comes into play in this case, involving the overlapping responsibilities for public transport between the municipality and the region, where the region has the overall responsibility for strategic public transport planning, while the municipality has the responsibility for the local built environment and land use planning. This means that the pilot project in Barkarbystaden takes on a regional significance, and could also be viewed as a regional test bed for smart mobility services as well as a site where developments related to smart mobility intersect with local planning processes.

7.3.4 Piloting what for whom?

In this section, I have explored the pilot project as a point of passage from different perspectives. Looking at how the various organisations frame the role of the pilot project highlights how piloting new, innovative forms of mobility in an urban development context can have communicative power for the municipality. This can be compared to the more direct role Nobina and Nobina Technology ascribe to the pilot in terms of helping them negotiate a place for this

type of offering within the framework of their broader role as a bus operator. This illustrates the different stages these actors are at in terms of defining their roles in relation to automated technologies, and the role they could take in shaping these developments. In line with this, the RPTA is also between roles. Although it established and defined the framework for the pilot, it was also ultimately responsible for deciding how far the shuttles were allowed to develop as a service. The various aspects of the pilot analysed here highlight the position of driverless shuttles between different states, in a hinterland between a test and a service intended as an integral part of public transport, and therefore subject to some of the normal regulations (ticketing), but not others (guidelines and legal requirements for accessibility). This suggests that the pilot project is a more flexible point of passage than the contract, as it allows the organisations to introduce their different interests and make different kinds of link between the shuttles and their own organisational agendas.

'Attractive public transport' has also been a recurring theme throughout this chapter, and highlights how all actors shared an understanding of automation as something which could make public transport more attractive. This involves ways in which this vehicle technology develops the image of public transport, but also involves how these actors see a more flexible and personalised type of public transport in future. This potentially means that public transport can expand into areas where it does not currently operate, and can develop new timetables.

7.4 The driverless shuttle as an intressement device

In the previous section, I highlighted how the roles of the different actors could be framed though an understanding of the pilot project for the driverless shuttles as a point of passage, and how this linked to their existing roles and ambitions in different ways. In this section, I draw on the concept of the intressement device, or a specific type of technological device through which roles are stabilised. I also show how the intressement device brings to fruition the ideas conceived at earlier stages.

In October 2018, I arranged to meet a representative from Nobina Technology to discuss the driverless shuttles. We first met in the café of the large shopping centre ICA Maxi Barkarbystaden, but in order to discuss the bus technology in more detail, we walked over to the large thermo-tent which had been constructed to house and charge the buses.

Figure 5. Photograph of one of the driverless shuttles charging in the charging tent in Barkarbystaden. Oct 2018. Photo: Author.

The representative from Nobina Technology began by explaining the technology the buses use to navigate, indicating that the hump on top of the bus is the navigation Lidar which, in simple terms, is a laser radar. Lidar stands for light detection and ranging, and bounces lasers off surrounding objects. The data collected can then be used to create a 3-dimensional digital model of the vehicle's surroundings (cf. Guerra and Morris, 2018). These are positioned around the top of the bus, facing forwards, backwards and sideways, and on each wheel cover, to perform a 360-degree scan around the bus. The vehicle also has a localisation and mapping system which, along with the Lidar, enables the vehicle to pick up fixed objects as points of reference for navigation while it is moving, as well as moving objects such as pedestrians, cyclists and cars.

The process of introducing this technology in a new setting involves teaching the bus how to drive in a new area. In the weeks prior to the launch of the driverless shuttle buses, the buses could be seen 'practising' the route they would follow in the first stage of the pilot (see Figure 5). This phase in introducing the buses involved an employee from Nobina Technology driving along the route manually, using the navigation gear stick on the bus. This created a "digital rail" for the bus to follow. After the route had been recorded, it could be fine-tuned. The bus could be programmed to drive at specific speeds along certain sections of the route, and specific stops could be added. Each time the bus drives the

route, it compares its journey with the programmed route and the fixed map points it recognises.

Figure 6. PowerPowerpoint slide showing the first stage of the route for the driverless shuttles Oct 2018-June 2019, with the planned urban development in Barkarbystaden in beige, and the existing area in light green. Photo: Nobina Technology (2018), reproduced here with permission from Nobina Technology.

The bus communicates with different systems. The self-driving software continuously communicates with the servers owned by EasyMile. At meetings of the project group, it was mentioned that this pilot was also a process through which Nobina had begun to build a new relationship with a new company, Easy Mile, who were also new to providing a service to public transport. Unlike other established actors who supply vehicles to Nobina, EasyMile was described in meetings as still developing its processes in terms of providing a service to public transport operators (field notes, 15/03/2019). The pilot in Barkarbystaden was therefore a way to work on this new link with an organisation new to supplying a service to public transport, and incorporate it into Nobina's existing systems and processes. In this sense, the bus is an entity which brings with it a new set of technologies and processes, such as the Lidar technology, and the software systems used to incorporate this into existing public transport processes.

Although automation is a form of technology which ultimately aims to remove the human-driver role (Correia et al., 2016; Cohen & Jones, 2020), in this case there is still a legal requirement for an onboard operator on each of the buses.[12]

[12] This was required legally as part of the permit to test the buses (Swedish Transport Agency, 2018).

The driver onboard the bus communicates with the traffic management responsible for the normal buses. In addition, information specifically relevant to Nobina is collected through this onboard driver, who is also responsible for verifying the passengers' tickets. The bus itself is supposed to generate information relevant to Nobina about the most frequently used bus stops, and how many people use the service. The onboard operator is still responsible for taking over when the bus is not able to follow the programmed route. For example, if a car is parked in the way, a signal will sound from the bus, but if this does not work, the operator is able to switch the bus from automatic to manual mode, drive around the obstacle or problem, and then connect the bus back to the automatic setting. The role of the onboard operator illustrates an intersection (potentially temporary) between the role of the bus driver who is still required on the bus, and the self-driving technology, as the driver is still required to intercept and take over manually in some situations. In meetings, Nobina mentioned that the operator on the driverless shuttles represented a new type of role for its bus staff, as they now had more time to talk to the people on the bus, and help people with children board the bus (the initial route of the bus passes two schools). Ultimately, however, they are working towards a service where the operator is located outside the bus, and able to manage and oversee the buses from a distance. Looking at the buses as an intressement device therefore also highlights how the role of the driver is currently shifting to a new form in relation to the technology being tested in the pilot project, and how drivers may also be displaced as the service develops.

At meetings, it was Nobina's responsibility to manage and report back on the buses themselves. At project group meetings, Nobina initially reported that it was having issues with data collection and the numbers coming in. In November 2018, it was estimated that there was an average of three people per trip (field notes, 23/11/2018), and these issues continued into early 2019. In January 2019, the numbers suggested there were between 50 and 150 people using the buses per day (field notes, 25/01/2019). In February 2019, when Nobina chose to calculate the number of journeys manually, they reported that around 100 trips per day, but it transpired that many people using the buses were often there just to see the bus, a phenomenon referred to as 'bus tourism' after a similar trend was noticed in the first trial in Kista (Hafmar, 2018). This often entailed people taking the bus for the whole route, and not just between specific stops, which produced a "strange statistic" (field notes, 15/02/2019) in the data Nobina was analysing in order to try and understand patterns of usage. Therefore, the bus can be understood as a device through which the operator role is actualised, and is the entity which stabilises the roles established during the earlier stage of problematisation (Callon, 2007 [1986]). However, the issues with understanding

the numbers of people travelling with the bus, and the patterns of usage, highlight that it is also a device which generates new types of uses.

I suggest that analysing the bus as an intressement device illustrates how the development of the driverless shuttle in public transport not only involves developing a new entity. It also introduces a new set of technologies and service providers, such as EasyMile, into public transport governance. This means that the buses as a technological device are at the forefront of how the driverless shuttle is stabilised within the pilot project. The bus operator was mainly responsible for updating other members of the group on progress, including the company's work on incorporating new processes and smoothing out problems, such as its work with the company supplying the buses. The driverless shuttle is therefore not a device which shifts relations within public transport provision to any large extent, but is instead a device linked to the operator's already established role as public transport provider.

Intressement is a part of the process of translation where certain relationships can be destabilised or moved around, and this process is highlighted by the relationship between the technology and the onboard operator. At this early stage, the onboard operator still plays an important supporting role for the driverless shuttle, but this role may ultimately be displaced as the technology develops.

In general, the focus on technology in the development and implementation of driverless shuttles also provides insights into how this is shaped by the ongoing relationships between actors. Nobina Technology/Nobina are closest to the technology, as the driverless shuttles are intended to develop as part of its service offering. The company therefore has a responsibility for the translation of the buses within public transport, mediating between the technology and other actors, communicating how the buses are developing and managing expectations, something which reinforces how this responsibility links back to the operator's established role within public transport provision.

7.5 Discussion

In this chapter, I have explored the initial stage of implementing driverless shuttles in public transport in order to discuss how relations between actors take shape around the driverless shuttles, and specifically how relationships are moved around, changed or linked in new ways. The contract is a key aspect of how relations between actors are shaped around the driverless shuttles, and situate the driverless buses within an existing framework of public transport provision.

In terms of governance, this means that the driverless shuttles are situated clearly as an object of governance within this existing framework. It provides an

opportunity for automation to be developed as a public service from an early stage, within a structure where public actors have the opportunity to shape these developments. The contract is used to create a space to develop the viability of these types of bus, where they are simultaneously under development and a paid service. However, it is also possible to ask whether a relatively undeveloped technology should be given space to develop within public transport, even if this can be used to motivate the development of the driverless shuttles in a 'real life' setting. Including the driverless shuttles from such an early stage also potentially creates an impression that a decision has already been made to follow this path of development, and if this is the case, when, how, and by whom was it decided? It may also be hard to extract the driverless shuttles from public transport now that they have been launched.

Though the driverless shuttles have been framed as a pilot project within the collaboration, it is clear that the different actors involved understand the pilot project through different lenses. In line with its formal responsibility for the contract, the RPTA relates to the pilot project through the formal contractual framework set up to stipulate where the pilot begins and ends, and the types of requirements the driverless shuttles should be subjected to as part of this. This reveals a tension between requirements which are motivated based on the driverless shuttles as an aspect of public transport (e.g. ticketing), and exceptions made because the pilot project is in the testing stages (e.g. fully subjecting the vehicles to existing guidelines and legal requirements for accessibility). The RPTA approaches its relationship and role in the development of the driverless shuttles along existing lines, in terms of its role as a contracting authority, a role it is only currently able to assume within this specific pilot setting.

Nobina Technology/Nobina has the overarching responsibility for the content of the pilot project and for operating the buses. In interviews, Nobina and Nobina Technology clearly articulated not only how the buses could be positioned to grow and develop as a service in tandem with Barkarbystaden, but also how this phase of piloting was a stepping stone towards a system where the role of the bus is potentially more multifaceted, and capable of fulfilling a number of different roles in an urban system. Here, the driverless shuttles have been defined as a complement to the BRT line, a combination which could potentially increase public transport use (Alessandrini et al., 2015). My analysis of the driverless shuttles as an intressement device suggests that they are a technical artefact predominantly mediated through Nobina Technology and Nobina, both in terms of how the company programmes the bus routes, and how it reports back on the development of the bus. Therefore, in terms of how actors shape the buses, Nobina Technology/Nobina has the most direct responsibility for establishing the technology as a service within public transport, learning about

the technology and developing the processes necessary to run this type of service. This also gives the company an influential role in setting a precedent in this pilot as developments move forward.

The municipality's relationship with the buses is shaped by the role the buses play against the backdrop of urban development. Beyond this, the municipality also plays a key role in providing the space for the buses to develop. The question of who is allowed access to public space in these types of pilot project is also closely connected to who is given the opportunity to test mobility solutions.

While public actors have been noted to play a key role in enabling these developments, existing organisations have also been portrayed as potential barriers to development, and public transport companies have been described as lacking the internal skills needed to operate and maintain automated systems (Alessandrini et al., 2015). This case study contributes a more detailed understanding of the dynamics between public transport authorities and the role of operators in the development of automation as a form of smart mobility in public transport. While this case shows how the public transport authority used the contract to open up a space to pilot driverless shuttles in public transport, and how innovation is viewed as something which emerges through the operator, the emphasis is on the role of the operator to develop skills and knowledge in terms of the operation and maintenance of automated systems. Moving forward, public transport authorities could also develop other types of skills, such as how to incorporate requirements for automation into their existing guidelines, how to balance different types of automation provided by different operators, and how to include automated services in future contracts. There is also a need to for the actors involved to continuously mediate between the potential promise of the driverless shuttles as an attractive contribution to public transport in the future, with the current form of the buses as a service and technology under development.

8 Translating the MaaS concept

In this section, I use the concept of translation to analyse how relations between actors take shape around a pilot to implement the MaaS concept in Barkarbystaden, in order to understand how relationships are moved around and new links are established. As mentioned in Chapter 3, MaaS can broadly be defined as a service model which is considered to have the potential to lead to new travel behaviour, such as decreased car ownership and increased multi-modality (Smith & Hensher, 2020). In practice, this is often described in terms of integrating a number of mobility services into one platform or channel, so that users can book, plan and pay for various forms of mobility (Pangbourne et al., 2018; Li, 2019). MaaS is, however, more than just a platform. It also involves the organisational and technical arrangements and re-arrangements which need to take place to realise the concept (Pangbourne et al., 2018; Smith, Sochor & Karlsson, 2019b).

In this chapter, I explore work towards the realisation of this type of service in connection to the collaboration in Barkarbystaden, as an example of how these concepts have started to move from the discursive realm to acquire a clear socio-material character (Tironi & Valderrama, 2019). I begin by using the theme of problematisation to discuss how the RPTA and Nobina Technology have established their roles in relation to the MaaS concept, and how the MaaS concept itself is framed in relation to the private car and the vision of a future shared mobility system. Through the concept of intressement, I then discuss how the pilot developed as part of the collaboration, and I specifically look at the MaaS application as an intressement device, to explore how the roles of public actors are enrolled and made material through the device.

8.1 The RPTA decides on its position in relation to MaaS

The development of the MaaS pilot in Barkarbystaden was influenced by more general activities in Sweden and Stockholm related to MaaS.[13] As a result of this,

[13] In the Swedish context, work on developing the MaaS concept was pioneered in Gothenburg, where an early pilot by the company UbiGo was launched at the end of 2013. Västtrafik (the public transport authority for the Västra Götland region) and Region Västra Götland then initiated a number of activities to develop the concept. More general national activities began to gain traction in 2017, with the launch of the Swedish Mobility Programme, followed by the publication of the MaaS strategy for Stockholm's public transport authority, as well as the launch of the national network for combined mobility, or MaaS, in Sweden (KOMPIS) and the KOMPIS road map. (See timeline in Smith, Sochor & Sarasini, 2018, p. 38).

some relations between the actors involved in the pilot project for MaaS in Barkarbystaden had already begun to take shape before the establishment of the collaboration.

In early 2017, the RPTA published its strategic decision on its future position in the development of MaaS. The RPTA's role in the pilot project is rooted in this formal decision. In this document, Stockholm's RPTA discusses combined mobility, or MaaS, in terms of its own future role. MaaS is described in this document as the packaging of different mobility services, and a solution where mobility is purchased as a coherent service which includes a number of different forms of mobility, such as public transport, carpools, bike share, car hire and taxis (Stockholm County Council, 2017b, p. 5). Based on this understanding of MaaS, the RPTA explained that it had decided to assume the role of "producer" (*producent* in Swedish) (ibid).

In essence, this decision reiterates the RPTA's existing role as a producer of public transport. This role would continue as part of a MaaS service, but the RPTA would also make ticketing accessible for re-sale by others through an open interface, with clear terms for re-sale and packaging (Stockholm County Council, 2017b, p. 19). Other possible roles, such as the RPTA offering the MaaS service itself, were not considered possible, or were at the very least legally questionable because of existing legal regulations limiting the role of public authorities in market competition (ibid). The RPTA decided instead to take an active role in market development as 'producer', and the initial stage in this development involved establishing an interface to create a link to its own ticket-sales channel. The strategy also involved a plan to use pilot projects to explore and evaluate business, trademark, technical aspects and timescales through the sale of digital tickets on specific terms and conditions (ibid, p. 21). These pilots were intended to cover different types of MaaS service, as well as different geographical areas and user groups in Stockholm:

> "In January 2017 the [Stockholm County Council's] Traffic Committee decided that Stockholm's Regional Public Transport Authority should, together with chosen partners, initiate or contribute to pilots for private and business customers with the aim of increasing knowledge about customer needs, benefits, target groups, packaging [of services], business models, etc. A handful of pilots will be launched in different [market] segments to enable an assessment of whether combined mobility can increase public transport's market share." (Stockholm County Council, 2018c, p. 12)

In this document, the RPTA links its interest in MaaS to its overarching organisational goals, one of which involves increasing the market share for public transport, and MaaS is described as contributing to an ability to offer more attractive public transport. This does not mean that public transport in itself

becomes more attractive, but is instead based on an assumption that public transport is likely to become more attractive when placed within the context of multiple shared services as part of MaaS (RPTA 3, 2018). The RPTA described MaaS as an opportunity to gain customers who do not usually use public transport, something which they felt the other services within a MaaS package would offer. In an interview this was described as the RPTA's main aim:

> "Interviewer: And if you could go back to what you started with, what was the aim of the service? Can you remember what you discussed then?
> RPTA 1: ... the aim was really to have a service which appealed to passengers. To offer something to those who do not travel solely on public transport. To access a broader offering with bikes, cars, etc. That was really the aim." (RPTA 1, Oct 2018)

Connecting public transport more closely to different types of mobility services emerging on the market was also part of the broader context informing how the RPTA positioned itself in relation to MaaS. In its initial strategic document, the RPTA notes that the boundary between public transport, or what is termed "classic public transport", and mobility services is changing (Stockholm County Council, 2017b p. 17) due to processes linked to digitalisation, general trends in the personalisation of services and shared mobility, meaning that public transport is situated in a complex and changing market (ibid). This therefore influenced the RPTA's ideas about who should be responsible for developing MaaS, so that, although it would participate, it would not take a lead role, and the role of developing the MaaS service would be taken on by other organisations. In an interview, a representative from the RPTA noted that, if the RPTA were responsible for developing a MaaS service, it would be likely to attract the same customers as it has today:

> "We could have procured (*köpa in*) the services, … cars and bikes, and those kinds of things. But it is quite likely that we would have marketed ourselves and developed the service the same way as we have always done. And then we would have just attracted the same passengers we have always done, those who are already public transport passengers. We are already quite good at that ... So, based on that I think it is a good decision to give others … the responsibility for recruiting and attracting customers and marketing themselves, and building these apps, to see if it can be different and they can attract customer groups that we haven't managed to attract." (RPTA 1, Oct 2018)

From this, I understand that the RPTA frames other organisations as more capable of attracting new customers to public transport. At that point in time, it was also quite unclear how MaaS would develop, so the decision to take part in,

instead of lead developments, could also reflect a more tentative approach (cf. Hirschhorn et al., 2019).[14] If these developments are considered in terms of problematisation, the RPTA defined its role along existing lines. However, at the same time it also introduced the possibility of piloting MaaS, creating an opening for other actors. The RPTA therefore also influenced the development of MaaS in the Stockholm region by defining pilot projects as the region's approach to developing MaaS, and starting the ball rolling by selecting partners for pilots in which the RPTA itself wished to participate.

The pilot for MaaS in Barkarbystaden also has its roots in this decision. In an interview with a representative from the RPTA (RPTA 1, Oct 2018) a description was given of the process which decided on the pilots. The interviewee explained that the RPTA began by releasing a digital announcement to say it was going to pilot MaaS, and that it would be willing to help with integrating tickets (RPTA 1, Nov 2018). Following this, the RPTA was contacted by around 20 companies, but around half of these fell by the wayside immediately, as these applications did not have a clear connection to the MaaS concept and seemed more interested in using the pilot to re-sell public transport tickets. Instead, the RPTA looked for suggestions which captured the ideas behind MaaS, such as combining different mobility services and guiding people towards shared services. They also noted that there were not a huge number of concrete options to choose from. Following this process, the RPTA announced it would be running four initial pilots: 1) a pilot for those travelling for work in the Stockholm region, run with Samtrafiken, 2) a pilot with the Finnish company MaaS Global and its MaaS service Whim, 3) a pilot with the Swedish MaaS company UbiGo, and 4) a pilot with the bus operator Nobina's innovation company, Nobina Technology.[15] Through this phase of problematisation, the RPTA started to establish its role, as well as links between itself and the concept. It also established Nobina Technology as a pilot partner for MaaS.

Through the lens of problematisation, the RPTA was setting in motion the possibility of interaction between itself and other actors, and beginning to delimit a framework for this (cf. Callon, 2007 [1986]). While the RPTA was defining its

[14] The Stockholm RPTA is also part of a Nordic group of public transport authorities which meet to discuss different approaches to MaaS. Each authority has taken quite different approaches to MaaS, based on particularities of the different contexts in each country (see Isaksson et al. (2019) for a comparison between Denmark, Oslo and Stockholm, and Mukhtar-Landgren & Smith (2019) for a comparison between Sweden and Finland).

[15] Some of these actors have specifically emerged with, and contributed to the development of the MaaS concept, such as UbiGo and Whim, while other actors like Nobina Technology and Samtrafiken were already involved in Swedish public transport provision. The UbiGo pilot is currently running in the City of Stockholm, and the Whim pilot has yet to be launched. See Alfredsson et al. (2020) for an analysis of the pilot conducted with Samtrafiken, focused on MaaS for businesses.

role as a producer, it was also starting to gather actors around the concept, and establish collaborations with other actors via the MaaS pilots. My interpretation of this is that MaaS was framed by the RPTA as a way of attracting new customers to public transport, but the responsibility for developing the specific MaaS platform, and negotiating with the other mobility services involved, was placed outside the RPTA's existing role. This broader context also highlights how the pilot with Nobina Technology in Barkarbystaden had its roots in a more general effort by the RPTA to learn from different types of MaaS pilots. As this study focuses on Nobina and Nobina Technology's role within the development of MaaS, I now look more specifically at how Nobina Technology defines its role.

8.2 Public transport within Nobina Technology's application

Around the same time as the RPTA released its strategy, Nobina Technology had also started to negotiate its role in relation to MaaS. As noted in Chapter 2, Nobina Technology was created by the main Nobina concern to create a more autonomous part of the organisation to work with new types of mobility solutions which could potentially be relevant for Nobina in the future. Alongside its work with the small driverless shuttles, Nobina Technology had started to work with the MaaS concept as an area of development shortly after the company was established in 2016.

In one of the first rounds of interviews I conducted on MaaS, a product developer at Nobina Technology explained that the company had begun their work on MaaS by gathering knowledge on the concept by conducting its own research, and that this involved research into public transport in the future, existing travel behaviour in relation to MaaS and the general public's understanding of MaaS.[16] The company was also specifically interested in understanding the position it should take in relation to what was described as "full-scale MaaS" (Nobina Tech 2, 2018).

Nobina Technology equated "full-scale" MaaS with the subscription format of the concept. In the research literature, MaaS has been categorised according to different levels, ranging from the integration of information, booking and payment, to subscription to a service (see Sochor et al., 2018; Lyons, Hammond & Mackay, 2019). In a subscription format, MaaS is conceived as something which individuals or households can subscribe to on (for example) a monthly basis, and a subscription gives them access to a selection of mobility services,

[16]At this point, MaaS was still in the early stages of development, and generally unknown to the public, which to some extent is still the case today.

ranging from public transport and carpools, to bike share, taxis and e-scooters.[17] Based on its interview research, market research and participation in MaaS-related events, Nobina Technology decided that its initial approach would not involve a subscription form of MaaS, as it felt the MaaS concept was not mature enough to be launched in this form (Nobina 1, 2018; Nobina Tech 2, 2018).

Instead, representatives from both Nobina and Nobina Technology described their chosen starting point in interviews as a 'pay-as-you-go' approach (Nobina 1, 2018). This role was defined more specifically as a "mobility broker" role, which the company felt more accurately captured its take on the MaaS concept (see Nobina, 2020d). Interviewees clarified that, in practice, this was a service similar to a multi-modal journey planner, where public transport is presented within a platform application alongside a number of other mobility services, allowing the user to compare services. The sale of public transport tickets would be incorporated into the version to be tested in the pilot. Academics have also defined the broker role as a "conduit for connecting" potential users of a transport service and suppliers of various transport services by facilitating the delivery of physical transportation (Hensher et al., 2020, p. 3).

Nobina Technology's name for this platform is 'Travis', and it is based on an earlier prototype platform with the same name created in 2017. In an interview with Nobina Technology in December 2018, when asked how different journey options would be presented to someone using Travis, an interviewee explained that the application would not present combination journeys across the different mobility services in the application. This meant that the application itself would not suggest a journey involving a combination of shared carpool and public transport, or a taxi and a bike-share service. The digital infrastructure required in a platform to make the types of calculation necessary for different combinations was described as too challenging for the app:

> "… the likelihood of all possible journeys is enormous, and the process of making all of those different calculations becomes massive, so massive that it would not generate a quick answer. It might not even be the right answer." (Nobina Technology 2, 2018)

Therefore, how users or customers travel, or combine these services, remains their choice. Framed in this way, public transport also becomes a service within another service, and the RPTA is only one actor among the other services included in Nobina Technology's platform (RPTA 1, 2019). The comparative

[17] Examples of this include The MaaS Global service, WHIM, and the Swedish service, UbiGo. UbiGo is credited as one of the first 'real-life' MaaS pilots took place in 2013-2014 in Gothenburg. Targeted at urban households, UbiGo offered a subscription to public transport, taxi, car and bike sharing, and access to rental cars (see Sochor, Karlsson & Strömberg, 2016).

function which Nobina Technology has used as its starting point was also described by the RPTA as something which could benefit public transport. When it was presented alongside different alternatives, the RPTA explained that it would hopefully be clear that public transport was cheaper than the other alternatives (RPTA 1, Nov 2018). It is interesting to compare this to a point mentioned in the previous section, which noted that public transport becomes more attractive if it is included in a platform with other services. Here, the potential contrast in price between public transport and other services is supposed to make it more attractive.

People working to develop MaaS at Nobina Technology explained that the general aim of the pilot was "for more people to be able to travel in the city without using privately owned cars", and for them to use shared modes and public transport instead (Nobina Tech 3, 2019). This was echoed by another representative from Nobina Technology, who explained that the "main goal is to get people away from private cars, or in any case, to get people to go from owning two cars to one car" (Nobina Tech 2, 2018). This person also added that realising this aim involves collaboration, as public transport alone cannot replace the door-to-door capacity of the car (Nobina Tech 2, 2018). These aims therefore link the development of a MaaS service with a general aim to reduce the use of private vehicles, and increase the use of shared modes and public transport.

Public transport has often been described as the "backbone" of MaaS (UITP, 2016), and this sentiment was reiterated by representatives of Nobina Technology, who emphasised that public transport plays an influential role in MaaS because of the large number of passengers public transport can involve as an established high-capacity service:

> "… generally, I think that when a MaaS service is launched, public transport has to take priority (*går först*). If you don't have public transport as the foundation, the whole MaaS service dies, because somewhere between 70 and 90 percent of journeys take place on public transport. And a large volume [of passengers] uses this form of transport. So you will need the other forms of transport occasionally, but not in the same way as public transport – so without public transport, you don't have a product in my opinion." (Nobina Tech 3, 2019)[18]

Perhaps this stance is not surprising, given that Nobina Technology forms part of a company whose business is public transport. It nevertheless shows how Nobina Technology's understanding of MaaS is heavily dependent on public transport being part of the product if the promise of the concept is to be realised. The role of public transport, as a high-capacity service within a MaaS service

[18] The interview is referring to pre-Covid-19 patterns of public transport usage.

offering, delineates it from many of the other types of new or emerging shared services which are also grouped within MaaS. In services such as e-scooters and bikes, the capacity of the vehicle is at the individual level, and sharing instead refers to shared access to a shared fleet of vehicles (Currie, 2018; Oldbury & Mukhtar-Landgren, 2020). Currie (2018) points out that public transport is often framed negatively by proponents of new forms of shared mobility, which are often associated with a positive and progressive image. The emphasis Nobina Technology places on public transport within a MaaS service suggests that the 'success' of the increased use of many shared services as an alternative to the private car is also reliant on public transport.

In this phase of translation, existing roles and responsibilities are shifted around as the RPTA and Nobina Technology negotiate their roles in relation to MaaS. Public transport becomes one of a number of services provided within the platform which the bus operator's innovation company is responsible for developing. The RPTA's decision to take part in MaaS pilots as one of many service providers, and Nobina Technology's position as one of the actors chosen to test the MaaS concept, mean that the relationship between the public transport authority and the operator is restructured, or re-ordered, in the pilot. This positioning made it possible for the bus operator to test and develop a new role as a potential MaaS operator (i.e. an organisation responsible for developing the platform itself, and coordinating and packaging the other mobility services within the platform). Through this, the company also have an opportunity to broaden its existing role, responsibilities and influence in the public transport industry.

In interviews with the RPTA, MaaS was discussed as a service which could steer people towards an increased use of shared services (RPTA 1, Oct 2019). When asked about the effect of placing public transport alongside these other services, with the associated risk that public transport could potentially lose customers to private actors, Nobina Technology reflected on this dynamic in terms of a more general move towards shared mobility:

> "That risk is always there. [The new services] can mobilise by themselves, but I think that, as I said, it is not as if shared mobility is going to decrease. The more customers we can get [to move] from a privately owned car to public transport, or to shared mobility, the more customers there are in the system as a whole. It might be that the percentage of those travelling with public transport is lower, but in the system as a whole there are more people using shared services." (Nobina Tech 3, 2019)

While both the RPTA and Nobina Technology frame MaaS as a way of increasing the number of people using public transport, the above quote also highlights a potential tension in framing public transport as part of a more general move to promote the development of shared mobility, and the relationship between public

transport and other shared forms of mobility as part of these changes. However, this potentially contradicts the RPTA's interest in MaaS as something which could increase its modal share. In general, the way in which Nobina and Nobina Technology established their role in relation to MaaS highlights how they both incorporated their interests as established actors within public transport, but also started to orientate this towards greater prevalence and use of other shared modes. Besides this more general backdrop, as the pilot project developed, MaaS was also problematised in relation to Barkarbystaden as a location, and I now explore this in the next section.

8.3 Barkarbystaden as a relevant site for a MaaS pilot

So far, I have focused on the RPTA and Nobina, how they started to negotiate and establish their roles in relation to MaaS, and consequently the framework for the type of pilot project in which they would collaborate. I now explore how the pilot for MaaS came to be connected to the specific site, Barkarbystaden. Even before the collaboration had been established, Barkarbystaden had been identified as an interesting area for testing MaaS as early as late 2017 and early 2018. As noted earlier in this chapter, the RPTA decided on four initial pilots for MaaS, spread out over different areas and customer bases in the Stockholm region. In early discussions between the RPTA and Nobina Technology, Barkarbystaden emerged as a suggestion for the location of the Nobina Technology pilot. This process was described in an interview with the RPTA:

> "When we started discussing [which pilots we would run] a year ago, or a year and a half ago, it must have been spring 2017, … we had just sent out information that we wanted to conduct tests [for MaaS] … And Nobina Technology was one of the companies who wanted to test MaaS in their way. And we thought that the difference between their proposal and the other proposals which came in was interesting, and we said we would like to do this with you. And then we started to discuss where [the pilot would take place]. And they really wanted to run the pilot in central Stockholm, where we already had a discussion about a pilot, and we said no, we would like to test a different combination. And then the difference between an established area, where people are already accustomed to public transport, and a newly built area. And then we came back to Barkarbystaden, and said that it was a good idea to test it there." (RPTA 1, Nov 2018)

This quote highlights the RPTA's influence in directing the pilots to certain geographical areas of interest around the region. Barkarbystaden was framed as an interesting site for learning more about the relationship between MaaS and an urban area under development, and about the influence a MaaS service could

have on the travel behaviour of those moving into the new urban area. In a progress report written by the RPTA on the development of MaaS, the pilot with Nobina Technology in Barkarbystaden is described as an opportunity to influence travel behaviour in Stockholm's largest urban development project before people start using cars (Stockholm County Council, 2018c, p. 4). This aspect, along with the opportunity to align the concept with Järfälla municipality's aim of building housing with lower quota for parking spaces in Barkarbystaden in their formal parking standards (*parkeringsnormer*), was developed in an interview with the RPTA:

> "… so there are two factors there: a new area means that people are moving there. And when people move, they are generally more susceptible to changes in their lives in general. … in moving, you are more likely to think – but what should I do now? […] And the second thing when it comes to Barkarbystaden is the number of parking spaces being built. It is very low. And in that sense, if you don't have a car there, there is the possibility that you will actually use all the other services that MaaS and public transport entail." (RPTA 1, 2018)

This quote highlights the early expectations behind the pilot for MaaS in Barkarbystaden. It was seen as a way of observing whether introducing a MaaS service could influence private car ownership in a new urban area, and connect to the local parking norms which had already been introduced (independently of the pilot project) by the municipality for Barkarbystaden. As part of their primary responsibilities for land-use planning, municipalities are responsible for setting parking standards, or parking norms, across the municipality. These include the new urban development, Barkarbystaden, where flexible parking standards have been introduced. This means that the required number of parking spaces is lowered if, for example, specific sustainable mobility services are implemented by the developer (Eriksen, 2019). In its regulations for parking, the municipality notes that housing developers have the option of a reduced parking allowance if they introduce measures to encourage sustainable travel. Recommendations in the guidelines include providing an annual public transport pass, incorporating a carpool or bike-sharing facility into the property, improved facilities for bike use, and introducing a specific mobility plan (*mobilitetsplan*) for the property (Järfälla municipality, 2019). However, no mention of a MaaS service is made within these guidelines.

An example of a MaaS pilot which specifically offered a MaaS service in housing without access to parking was launched in a newly built apartment complex in Gothenburg in 2019. Instead of parking, inhabitants were offered access to the EC2B app provided by the consultancy firm Trivector, through which they could buy public transport tickets, as well as book and use electric

cars, electric cargo-bikes, and electric mopeds parked in or near the housing association (Smith, Sochor & Karlsson, 2019b).

As described in the previous section, Nobina Technology's approach to MaaS does not target housing specifically. The aims mentioned here, involving influencing travel patterns and car ownership, and the influence of parking standards, were not directly involved in the design of the pilot in Barkarbystaden, despite the fact that they were described as specific aspects which made the location interesting in terms of piloting MaaS. I elaborate on this in the next section, and return to the relationship between the pilot and housing development later in this chapter.

8.4 The roles established when MaaS became part of the collaboration

In 2018, the pilot for MaaS was incorporated into the structure of the governance assemblage. Funding for developing the MaaS pilot also formed part of the funding from Vinnova for the collaboration. As outlined in Chapters 5 and 6, the collaboration has its own structure, with one specific working group allocated for developing the MaaS pilot. As part of the overall collaboration, Nobina was responsible for taking the lead in the project group and the different working groups. This was layered on top of Nobina Technology's existing responsibility for leading the development of one of the Stockholm RPTA's MaaS pilots. This, in turn, shaped the relationships amongst the municipality, Barkarby Science, Nobina Technology and the RPTA in the specific group established for MaaS within the collaboration.

MaaS does not have the same connection to the contract as the development of the driverless shuttle buses, which emerged through the existing contract for public transport in the area. The RPTA itself emphasised this distinction in an interview:

> "[This MaaS pilot] has nothing to do with the contract. It is totally separate ... And because it is Nobina, you think that it is connected, but that is a coincidence. So, it is not connected to them being the operator in the area, or the contract. Instead, it was a different part, Nobina Technology, who had experience with how to develop this type of service when we were asking what different companies could offer a couple of years ago, and which of them wanted to run pilots with us. And so, they were one of the ones who had an interesting solution and were chosen. And then time, and other factors, have meant that we took the opportunity to launch in Barkarby now." (RPTA 1, 2019)

While this gives an indication of how MaaS developed from a separate project, the MaaS pilot is nevertheless now included under the umbrella of the overarching collaboration between the municipality, the bus operator Nobina, and Stockholm's RPTA. In interviews, it was mentioned that efforts had been made by Nobina Technology to contact different businesses in the area prior to the establishment of the collaboration (Barkarby Science 1, 2019). This ongoing work on the development of a MaaS pilot was then woven into the larger collaboration, and the funding from Vinnova was also used to fund the development of the platform. As discussed in Chapter 6, the operator Nobina had considerable influence in shaping the collaboration, so it is difficult to argue that the MaaS pilot is separate from Nobina's role as operator in the area or in the contract.

As part of the collaboration, a specific working group for MaaS was established and led by Nobina Technology, incorporating the MaaS pilot into the overarching collaboration. This overlapping role was highlighted in an interview with Nobina Technology:

> "We have said that all the services should be available in Barkarby, all carpool services, taxis, and Järfälla had no e-scooters before we started this project … and it is connected with the whole Barkarby project to ensure that, as Barkarby[staden] grows, the inhabitants there are able to live there without a privately owned car." (Nobina Tech 3, 2019)

The development of the governance assemblage outlines in Chapter 6 now means that the MaaS pilot is linked more closely to this collaboration, making it harder to delineate it as a totally separate project. The fact that the pilot was developed as part of the collaboration is based on the suggestion submitted by Nobina Technology to the RPTA in 2017 (Nobina Tech 3, 2019), and while Barkarbystaden had been identified as an interesting site for testing the pilot, the municipality became more closely involved in the pilot as part of the structure of the collaboration. As in the previous chapter, the pilot can also be seen here as an obligatory passage point around which the actors converge.

While the RPTA and Nobina Technology began negotiating and developing their roles in relation to MaaS between 2016 and 2018, interviews in December 2018 with people from the municipality involved in the working group for MaaS revealed that working with the concept was relatively new to their department. Nobina Technology briefly explained the concept in initial meetings in the working group in January and February 2019, but I understand that no deeper discussion of the concept itself took place between Nobina, SL and the municipality within the MaaS working group. A transport planner at the municipality explained that it was around the time the collaboration was first initiated that they had heard of the concept, and that it was in the initial round of

interviews I carried out in late 2018 that they had first had the opportunity to put MaaS into words:

> "… well, MaaS is a way to … simplify everyday life. And not use the car. In other words, good alternatives to the car, which really shouldn't be alternatives, but should be the first alternative … The discussion often focuses on what you can use instead of the car. What can persuade you not to choose the car, like we talked about at the kick-off ... the first thing that's brought up is that cars are the norm. And MaaS would be a shift (*omställning*). There might be a paradigm shift in 20, or no, it will probably take longer, 10, 20, … no probably 20-30 years." (Järfälla municipality 4, 2018)

Here, the connection between MaaS and the private car is reiterated. This quote again shows how MaaS is linked to the idea of a paradigm shift, but also to the fact that this will not happen overnight and is likely to take time. The interviewee also refers to the kick-off event held internally as part of the collaboration, highlighting how this, too, has shaped how those involved understand and relate to the concept.

Both the municipality and Barkarby Science explained that their work with MaaS drew attention to specific challenges linked to public-private partnerships. As with the RPTA, what the municipality is legally allowed to do in relation to private actors, or the private market, is an important aspect influencing how they can interact with the MaaS pilot. Within this collaboration in general, Nobina is understood as a commercial actor, and its choices in terms of working with the services under development are understood as commercial choices (Järfälla municipality 1, 2018). In relation to the MaaS pilot specifically, in interviews with Barkarby Science and the municipality, it was explained that the municipality's role within the MaaS project would need to balance how far the municipality, as a public actor, could contribute to the development of MaaS when it is a service provided by, and involving commercial actors (Järfälla municipality 1, 2018). Interviewees from the municipality and Barkarby Science explained that they understood that Nobina had developed an app, and that this was a commercial service (*kommerciella lösning*) (Barkarby Science 1, 2018), so the municipality did not quite fit in. However, Barkarby Science also has a different role from the municipality, partly representing the municipality as well as other actors. Barkarby Science therefore has more of a mediator role, straddling both the municipal perspective and its role as an innovation company (Barkarby Science 1, 2018). The individual actors from the municipality therefore seemed to find themselves in a situation where they needed to judge and negotiate the effect of the pilot on behalf of their organisation as a whole (cf. Sandoff et al., 2019).

Based on this process, those who were assigned to develop the concept from the municipality began working with it from a different starting point to the RPTA and Nobina Technology. The concept was presented to them through the working group for MaaS, giving the municipality less of an opportunity to negotiate their own role in relation to the MaaS concept, or influence a pilot concept which had already been developed by Nobina Technology. Seen through the lens of translation, this highlights that some actors have more influence on defining what is being worked with than others. The pilot project for MaaS highlights how the pilot, as a point of passage which can bring actors together and anchor them, is an uneven process when certain actors have established links to MaaS earlier than others. In this case, the MaaS pilot was brought into the collaboration as a partially formed idea, or point of passage, with the roles of the RPTA and Nobina Technology already established, and the municipality was asked to relate to the concept on these terms.

8.5 Public transport with the device – a digital ticket?

I now move on to discuss how the MaaS platform can be understood as an intressement device (Callon, 2007 [1986]). The intressement stage of translation often involves different kinds of devices, referred to as intressement devices, which make material ideas formed at earlier stages of translation. This process is often "delegated to non-human entities such as technologies" (Murdoch, 2005, p. 66, cf. Pelizza, 2020). In the next part of this chapter, I begin to explore the MaaS platform as a particular type of device with which the different actors in the collaboration engage in different ways, and which also engages the different actors in specific ways in line with the main principles of the MaaS concept, one of these being the sale of public transport tickets through the platform (See Figure 7, a screenshot from Travis showing a map overview of the area between Barkarby commuter station and some of the services in Barkarbystaden. The bikes are marked in the app with a bicycle symbol in a green circle, and the carpool with a car and a key in a purple circle).

By framing MaaS as an intressement device, I understand the sale of public transport tickets as part of a platform owned and built by another actor, as a crucial aspect of determining public transports position as part of MaaS. Ticket integration was also one of the main aims of the pilot, and is a specific part of the MaaS concept which links the RPTA and Nobina Technology. In this section, I discuss the question of ticketing as an aspect of realising MaaS as an intressement device, and specifically as an aspect of the technological infrastructure of the app which is realised through the roles established between Nobina Technology and the RPTA (Pelizza, 2020).

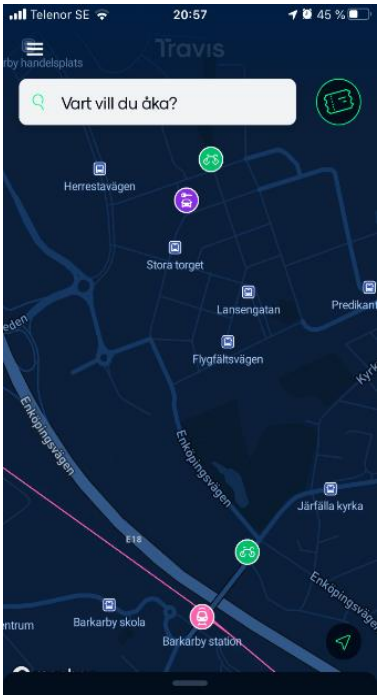

Figure 7. Image of a screen shot of the Travis app taken from author's phone. (Taken 04-10-2020 on an updated version of the app). Photo: Author's screen shot from mobile phone reproduced, with permission from Nobina.

The integration of ticket sales refers to the terms of interoperability between digital platforms, which can be expressed as the ability of two (or more) interfaces to speak to each other. In this case, this can be expressed as the way in which Nobina Technology's platform, Travis, is able to communicate with the RPTA's platform for ticket sales, which, in this case, was developed specifically for the pilot with Nobina Technology, and which the RPTA said cost them considerable time and resources (RPTA 1, 2019). The RPTA's IT department was involved in the programming work required to establish the RPTA's side of the platform integration. This process of integrating tickets with the Travis app was described as its main area of involvement, apart from participating in the meetings for the MaaS working group:

> "For our part, it is the integration of digital, or the possibility to sell our single tickets digitally which took place throughout the spring [2019]. It should have been done before summer, but it wasn't quite [ready] … That is the only thing we have been directly involved in." (RPTA 1, 2019)

Establishing interoperability between these platforms for the sale of single tickets is part of a more general effort at national level to facilitate the development of

MaaS and involve new and established actors in these developments. This national ticketing effort is known as the BoB: API.[19] The integration of ticketing between the RPTA and Nobina Technology is based on this national standard. The RPTA explained that this was new territory for them, and was being used to inform the pilot with Nobina Technology:

> "… [the ticket sales] are based on the so-called BoB: API, which is intended to be the same everywhere in order to facilitate technical integration between different public transport companies. But it is a very new standard, so there are no references. There is no knowledge. So that has meant it has taken longer than we maybe hoped for." (RPTA 1, 2019)

Originally, in the initial strategic document where the RPTA established its position as producer in early 2017, it was expected that the first stage of ticket integration would take place in 2017 (Stockholm County Council, 2017b, p. 2). However, the above quote highlights how this process has taken longer than expected, partly because MaaS developments in general have taken longer than anticipated, making the integration of tickets in the pilot in Barkarbystaden the first development of this type of API interface. The links the MaaS pilot in Barkarbystaden forges between actors also develops links to actors outside the specific constellation of actors in Barkarbystaden, connecting them to discussions at national level about public ticket sales and to more general national efforts related to MaaS.

Tickets are an important representation of public transport, and the third-party re-sale of tickets has a number of implications for the RPTA. One aspect of this involves safeguarding the RPTA's continued receipt of income from ticket sales, and that the RPTA is able to keep track of how many tickets are sold through the app. Updates to the barrier system in Stockholm also make the development of a digital ticket possible, as digital tickets can now be scanned at the entrance points to the metro system and buses. However, this digital architecture and organisational interconnection between the RPTA and Nobina Technology should not be noticeable to those using the app, and should be something which happens automatically. These 'behind the scenes' aspects of ticket integration were explained by the RPTA as follows:

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[19] The BoB: API stands for the Ticket and Payment Standard: Application Programme Interface (or Biljett och Betalstandard in Swedish, hence the acronym BoB). An API is the set of routines, protocols and tools for building software applications, and is responsible for guiding how software components should interact (i.e. the different interfaces communicating with each other in terms of ticket sales). More recently, from September 2020 the RPTA's role in developing a national ticket system has been under further discussion (see Region Stockholm, 2020c)

> "It shouldn't be that I need to send an email to someone who then writes an invoice. Instead, it should work automatically. And even that involves a lot of background systems which need to be connected together and … programmed. And it is rather sad that we haven't sold tickets in that way. If we ignore the digital ones, we've hardly sold any tickets to companies at all in recent years. A number of routines and connections need to be made between systems. But people are working on that, and the legal discussion is mostly about prices … and then there is also the security aspect. … I mean, falsified tickets shouldn't start appearing. So, there are those kinds of aspects. We need to ensure information … [isn't] used in the wrong way." (RPTA 1, Oct 2018)

Establishing the API for Nobina Technology to be able to sell tickets as part of Travis has involved taking the above questions into account. The sale of digital tickets is viewed as a key aspect of the success of a MaaS service. For Nobina Technology, the ability to sell public transport tickets through a digital platform was described as playing an essential role in the success of a MaaS offering:

> "… it is so complicated and I believe – above all – that if we don't manage to include public transport … and if you can't sell public transport tickets in MaaS services, that we have lost the battle … Because if 80% of journeys are taking place via one mode of transport (*trafikslag*), which isn't private, then I have a hard time seeing how we can get the other services on board. If that 80% had used taxis, then it would have been important to have tickets for taxis. But today it's possible to create MaaS services without taxi services because there are so many other services you can add on. There are scooters, there are bikes, there are pod-cars and there are carpools. There are so many other things. But public transport has a large share, so if that isn't there, then I don't think MaaS will fly." (Nobina Tech 3, 2019)

The above quote highlights that if public transport is not part of a MaaS platform (at least in the pre-Covid-19 context in Sweden), the platform is thought of as much weaker in terms of being a full service offering. This technical integration between the Travis app and the different services involved has only been realised for the sale of single public transport tickets within the app, and the purchase of other services have not yet been integrated in the same way. Instead, if users select the e-scooter service, for example, they are directed to Voi's application by deeplinking. In practice, this means that users need to have downloaded these apps and registered with these services separately in order to use them in connection with the Travis app. Technological integration therefore straddles different levels of integration in the platform's current form. Integrating the sale of public transport tickets is nevertheless a first step in an ongoing pilot, and this

first step also reflects Nobina Technology's approach to a product, where public transport is a key part of a whole package of services.

Drawing on an understanding of the platform as an intressement device, in this section I have discussed the implementation of digital ticket sales through Nobina Technology's app as an aspect of the platform which structures the relationship between the RPTA and Nobina, and makes this material. The relevance of involving public transport in a MaaS service in Stockholm is also highlighted. Public transport has high user numbers. It therefore plays an influential role in realising the ideas behind MaaS in general, as the quote from Nobina Technology highlights, and other services are not necessarily viewed as relevant without the link to public transport.

8.6 Locating other mobility services in Barkarbystaden – how the device connects to place

As well as integrating the sale of digital public transport tickets within the app, the pilot in Barkarbystaden also involved locating other types of mobility services which were envisioned as part of MaaS and the pilot in Barkarbystaden. Public transport infrastructure is already available in Barkarbystaden. However, other types of shared mobility services, such as a free-floating carpool services, free-floating bike share and e-scooter companies, have commonly chosen to focus on inner city markets, often launching predominantly in Stockholm's inner city. One of Nobina Technology's responsibilities therefore involved leading discussions with other mobility actors, and securing their involvement in the pilot in Barkarbystaden. This was seen as something the municipality could help facilitate and shape as part of the collaboration (Nobina 1, 2018). Continuing the discussion of the app as an intressement device, I now discuss how the MaaS pilot is also made material by locating a number of mobility services in Barkarbystaden. Locating the services in the area is an important aspect of realising the basic conceptual foundation of MaaS in terms of integrating a variety of shared modes, and consequently how the concept is made material through the pilot project.

The Travis app was launched on 16th October 2019 for Barkarbystaden specifically,[20] and across the Stockholm region as a whole. The specific services which had been introduced in Barkarbystaden, in addition to public transport, were bikes and an electric car-hire service from Our Green Car, the free-floating, shared electric scooter from Voi, and taxi services via Cabonline. The electric carpool Elbilio was added to the platform shortly afterwards. On 17th October, I

[20] https://www.nobina.com/sv/press/pressreleaser/ny-rese-app-lanseras-i-barkarbystaden/

took the commuter train out to Barkarby Station to walk over to Barkarbystaden and see the different services in place. When I left the commuter station in Barkarby and made my way up to the bridge which straddles the motorway and the train tracks, the first of the services I saw were the e-scooters from the e-scooter company Voi (see Figure 8). In project group meetings following the launch of the app, the team discussed Barkarbystaden as a new type of location for Voi compared to the inner-city geographical area, and one which could give the company new insights into this type of market and user base.

Figure 8. Voi's e-scooters on the road bridge (Skälbyvägen) over the commuter train tracks and motorway. 17-10-2019. Photo: Author.

As I walked over to Barkarbystaden, which is approximately a 15-minute walk from the commuter station, I saw some of the 20 bikes from Our Green Car which had been included as part of the service. These were allocated a specific stand alongside the ordinary bike stands at the bottom of the slope leading to the commuter station, and had been fitted with information about the bikes as part of the Travis app (see Figure 9).

When I approached what is currently the centre of Barkarbystaden, Stora Torget, I saw one or two of the e-scooters parked on the pavement along the way. In addition, I saw that Voi and the bikes had been installed at Stora Torget,

a square next to the bus stops and supermarket, and the location of the bikes was also visible in the app (see Figure 10). At meetings, and from a previous visit to Barkarbystaden, I knew that four electric cars from Our Green Car had been installed for hire in the garage of the large ICA Maxi, across the street from the main square (also visible as the key and car symbol in Figure 10).

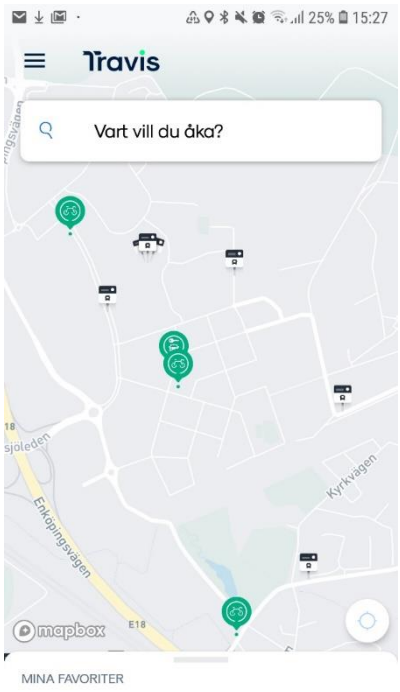

Figure 9. (on the left) Showing the bike stand for the shared bikes close to Barkarby commuter station. 17-10-2019. Photo: Author.

Figure 10. (on the right) Screen shot of the initial version of the Travis app showing locations of bike stands and car hire. Taken 17-10-2019. Photo: Screenshot taken from author's phone, reproduced with Nobina's permission.

Nobina Technology was ultimately responsible for negotiations with the different actors who were intended to be part of the app, and discussions about where to position the different services in Barkarbystaden partly came to light as a recurring topic at the monthly MaaS work group meetings. In an interview, the bus operator had explained that the municipality's involvement had been a way of establishing the conditions for MaaS (Nobina 1, 2018), and the municipality's knowledge about flows of people, possible charging sites, land use and parking

issues fed into the process of locating the services in the area. In February 2019, early on in discussions in the working group for MaaS, the municipality was asked to produce an overview of where people move within the municipality, to show key patterns of movement. This was referred to as a 'mobility map'. At one of the meetings, in response to the municipality's query about who the target group involved, Nobina Technology defined it as everyone living in Barkarbystaden and those working in, and coming to the area. Municipal actors from the traffic office provided the group with a number of maps, to be used by Nobina Technology in dialogues with the service providers who were to be included in the app. Three maps (roughly covering the area from Jakobsberg station, Veddesta to Barkarbystaden, and Barkarby Station) were produced in March 2019. These showed bus stops, bike routes and key destinations within the area.

They show that the highest numbers of people travelling by bus are focused on the municipality's central bus station in Jakobsberg, the buses connected to the Barkarby commuter railway station and the bus stops in the centre of Barkarbystaden. Of the numbers provided, the services established within the app for Barkarbystaden are located to connect Barkarbystaden to the commuter railway station, and provide a connection from the bus stops next to Stora Torget, currently the main square in Barkarbystaden. In initial discussions in the work group, the municipality suggested that the services should not only cover Barkarbystaden but also connect to the municipal centre of Jakobsberg.

Although the municipality provided information on the area covering the current municipal centre of Jakobsberg as well as Barkarby and Barkarbystaden, for reasons which are not clear from my interviews or notes, the services were ultimately only located in Barkarbystaden. In an interview with Nobina Technology, the broader context of the MaaS pilot within the collaboration was described as a "USP", or a unique selling point (Nobina Tech 2, 2018). Therefore, maintaining the focus on Barkarbystaden could have been a way of ensuring the pilot remained in line with the area of urban development. In a meeting, it was also mentioned that funding from Vinnova would be used to support the involvement of Voi and Our Green Car within the pilot (field notes, 2019-04-05). Therefore, in financial terms it may also have been difficult to fund the involvement of other mobility providers across a larger area, and Barkarbystaden was potentially a more manageable size for the range and scope of the services involved in the pilot, which were specifically located in Barkarbystaden for Travis.

Returning to questions of land use, an interview with a member of the MaaS working group from the municipality revealed that the pilot had generated discussions about how public space (*allmän platsmark*) in Barkarbystaden as a development site (*kvartersmark*) may be used for private/commercial purposes, and questions related to parking and charging stations for the different services

and their vehicles (cf. Fearnley, 2020). This seems to have been approached differently depending on the specific services involved. In line with its usual service provision, Voi created a specific geofenced zone for Barkarbystaden. A geofenced zone is a type of virtual boundary, authorised for the use of Voi's e-scooter. This means that the e-scooters can be picked up and dropped off within this area. This is done via a smart phone, through which users unlock the e-scooters, rent the service for their journey for a base cost plus a fee per minute, then park, leaving the e-scooter to be rented by someone else (Fearnley, 2020). There are also specific geofenced hotspots to encourage users to park their e-scooters in specific places.

The bike racks have been installed in public space on specific racks. In interviews, with representatives from the municipality it was noted that the use of public space, is ultimately a legal question, and that the pilot generated questions about where the line should be drawn between public space and when companies are allowed to use public space for their services. This issue was still being negotiated:

> "Something that has been discussed a lot is, really, the line between what is public and where companies establish their business. Because when it comes to the smaller sharing services like the electric scooters, something that is often discussed is that it is often a legal question of what the municipality takes on. As soon as we provide space, or make public space available for private companies, ultimately you are supposed to pay a fee to use that space." (Järfälla municipality 5, 2019)

In this case, the municipality said that it had contributed space as part of the project anyway, which seems to have been specifically for the bikes. The most difficult aspect in terms of public space was described as being where cars could be parked, and that if cars were parked in public space in Barkarbystaden, the companies involved would have to pay a fee (Järfälla municipality 5, 2019). Early on in discussions in the working group, it was suggested by the municipality that local businesses could be used to negotiate questions related to private companies using public space for parking (MaaS field notes, January 2019). These efforts were initially driven by the possibility of the carpool Aimo's involvement in the platform. Efforts to engage local businesses were made at a local business-breakfast event held at IKEA Barkarby, organised by Järfälla business (Järfälla Näringsliv), where Nobina, Barkarby Science and Aimo presented both the MaaS concept and Aimo's floating car-share service. However, Aimo withdrew after the municipality could not provide the necessary parking. Instead parking spaces were rented by Nobina in the garage underneath the local ICA Maxi in Barkarbystaden, in order to locate and provide parking spaces and charging infrastructure for Our Green Car. Our Green Car became involved after

Barkarby Science made contact with the company after hearing about them through E.ON's Agile Accelerator programme.

In terms of how the question of place, and locating services in Barkarbystaden, have shaped relations between actors, questions of land use illustrate more about the municipality's role in the MaaS pilot and suggests an uneven relationship in terms of how public actors can facilitate the development of what they understand as a product which is ultimately the responsibility of Nobina Technology/Nobina. By this I mean that the roles of public actors are somewhat defined by the device itself. The RPTA's role in providing public transport is more clearly delineated as one of the services within the application, through ticket sales. The municipality however does not provide a service in the same way within the platform. Instead, its role focuses on how to mediate questions of land use with the private mobility services connected to the platform. For this reason, the municipality and Barkarby Science frame their role in relation to the platform primarily as a market product. The way the pilot is framed highlights how Barkarbystaden became a site for the pilot, but that the roles the municipality and Barkarby Science can take are mediated through the platform as a commercial device.

The process of intressement and the use of intressement devices have also been seen as a process of inclusion and exclusion. This could be described in terms of how the devices are orientated towards certain actors, which makes it clear how much more influential these perspectives have been on shaping the pilot project. In this case, the device is more clearly shaped by the RPTA and Nobina Technology/Nobina. Overall, this could be said to highlight how the platform is designed from the perspective of an actor more focused on the mobility system, rather than mobility in connection with urban planning contexts. I now explore this aspect of the case study further in the next section.

8.7 What is excluded by the device? MaaS and the municipal planning process

In interviews, representatives from the municipality in the MaaS working group within the collaboration also reflected on the best location for work on MaaS within the municipal organisational structure. Initial members of the working group for MaaS all came from the more technical branch of the municipality, and were involved in the management and operations of mobility and transport questions. One representative (Järfälla municipality 1, 2018) said that questions about mobility and transport usually came to them. However, this type of work was also discussed in relation to another branch of the municipal administration involved with spatial planning (*samhällsplanering*), land use and detailed

development plans (*detaljplaner*). This branch of the municipality was described as the more strategic side, working with urban development plans from an early stage, and was therefore responsible for how the detailed development plans for Barkarbystaden would influence new inhabitants not to use a car. One interviewee elaborated on these different roles:

> "… if you think about a municipal organisation, these questions usually fall under [the responsibility of] the technical administration, so they usually belong to Parks and Streets. It doesn't have to be that way, but if the question is more strategic it can be the responsibility of the municipal administration (*kommunstyrelseförvaltningen*), and more tactical, operational questions lie with us. This question [MaaS] is a bit of both. There are strategic parts that are more future orientated – how should we use Barkarbystaden's detailed development plan, and how should it be shaped so that we create the conditions for people, … or the new inhabitants to be able to refrain from owning a car and to use public transport, or cycle, … and then we have the technical administration who make sure that all of this becomes a reality." (Järfälla municipality 1, 2018)

From this, I understood that the work on the MaaS pilot had gone directly to the technical department in order to implement the pilot, and that there was no clear connection to the strategic department of the municipality represented in the working group. In this first stage of the pilot, and for the launch of MaaS in Barkarbystaden, representatives from the more technical, operative side of the municipality were mainly involved in the working group. This was due to the more operative approach which had been introduced through the way the RPTA and Nobina Technology had framed and problematised the concept. In turn, this meant that a problematisation of the concept from the point of view of the municipality or Barkarby Science was excluded from the process. The question of where the development of MaaS might fit within the municipal planning process was discussed by another representative from the municipality who was involved with the operational side of transport and mobility questions. I asked if he could tell me a little more about what had happened with MaaS from his perspective, and what had taken place at Järfälla municipality in relation to in the development of MaaS:

> "There was no specific steering (*styrning*) that I saw, but at the same time I work here and not in the spatial planning department (*samhällsplaneringshuset*). That is really where [MaaS] should be because [they work with] an earlier stage. I work much more with the later stages. But as I said, [mobility management measures are] part of Barkarbystaden's detailed development plan III (*detaljplan*) ... [Barkarbystaden] is divided up into different detailed development plans, I, II, III, IV, V VI, etc., etc., and they have also worked

> with City Lab on a quality-programme (*kvalitetsplan*). And as part of that, the different property developers, … Bygg Väst, or Peab, or whoever it is, have the option of discount parking norms if they implement different mobility measures. And I think that maybe Barkarbystaden III even involves a stipulation for a mobility plan as part of the building work." (Järfälla municipality 4, 2018)

The quality-programme for Barkarbystaden III (one specific district of the area under development) stipulates that parking in Barkarbystaden be based on Järfälla municipality's parking standard (Järfälla municipality, 2018), as outlined in section 8.3. I understood from the quote that the interviewee was suggesting that the municipal department responsible for planning and detailed development plans could equally have been involved with MaaS and deciding how it could link to existing municipal planning processes. The above quote also highlights how MaaS as a device could be engaged elsewhere in the planning process, in terms of ways in which housing developers can provide alternatives to the car for mobility needs. This train of thought overlaps with other possible approaches to MaaS which have focused more specifically on mobility as an aspect of housing (as mentioned above).[21] This relationship between mobility and housing was also raised in interviews with Barkarby Science, who mentioned that a risk with the current timing of the launch of the pilot for MaaS in Barkarbystaden is that it is not quite in sync with the phases of people moving into the area, and this could affect future take-up and use of the mobility services launched in there as part of the pilot:

> "The land allocations (*markanvisningar*) have been made, and building is going to start at the end of this year [2019] and the start of next year [2020] in a few districts. If you were going to time it, you would do so in a way that required working very closely with Project Barkarbystaden, to know exactly when the launch of the next district was going to be, and maybe add two cars to that carpool, that is if it is still here ... That is going to be an important question, because the more people who use MaaS, the better it will be. At least with regard to the bikes and cars." (Barkarby Science 1, 2019)

It is unclear whether the reflections raised here about the timing of the MaaS launch in relation to housing development will inform future developments of MaaS in Barkarbystaden. However, this quote also highlights more broader questions about where the emphasis is in terms of thinking around MaaS. For example, was there too much of an emphasis in getting the MaaS concept off the ground and launching the pilot, so that the group overlooked an opportunity to

[21] For example, MoBo, https://www.theoryintopractice.se/mobo, as well as EC2B, as mentioned earlier.

develop a service more closely linked to mobility needs in existing and planned housing? A focus on the more general ambitions of the concept, i.e., a service with integrated forms of mobility service, may have risked missing more contextual applications of the MaaS concept. In this case, the RPTA and Nobina Technology were specifically motivated to locate MaaS in Barkarbystaden because it was an area of development with ambitions for low car use. However, the pilot was launched at a time when not many new inhabitants were moving to Barkarbystaden. This suggests that while the initial aims linking the pilot project to low parking norms and influencing the behaviour of people moving in guided the decision to locate the pilot in Barkarbystaden, these have not necessarily directly guided the design of the pilot project itself.

In this section, I have highlighted some aspects which were excluded in terms of how the framing of MaaS created a specific type of device. I have also highlighted how the actors at the municipality had a slightly different departure point from representatives of the municipal organisations in terms of how they conceived the role of MaaS in relation to urban planning processes. Finally, I have highlighted how the launch of the MaaS service was not necessarily in sync with plans for housing development, which raises a general question of timing. The pilot in Barkarbystaden remains a pilot, which also means that housing developers may still have the opportunity to include the Travis app in future as a way of obtaining an exemption from certain parking regulations. Reflections from the municipality nevertheless suggest that a MaaS pilot could have had a different focus or connection to existing planning tools. This suggests that the municipality could be an underutilised resource in this kind of development project if the local authorities involved are unable to shape their engagement actively in line with municipal needs (see Sandoff et al., 2019). Engström (2018) has pointed out that quality-programmes in municipal planning can be used in negotiations between the municipality and developers to include measures for sustainable mobility at an early stage of a development. Though this was not done in this case, it is an area where MaaS could be used to further develop the integration of urban land use planning and mobility.

8.8 A pilot for the local and the regional?

As noted in section 8.6, Travis was launched with services specific to Barkarbystaden, but also as a platform accessible across the Stockholm region. The main focus of my analysis has been on smart mobility within the collaboration (and what I frame as a governance assemblage). However, while I have analysed the development of the pilot for Barkarbystaden through this lens, the fact that the pilot was launched at both regional level and in the specific

context of Barkarbystaden highlights that a parallel process has shaped the Travis app in an overarching sense. I would therefore say that the pilot involves different layers, and because of this it is hard to pinpoint the contours of the pilot itself. The simultaneous regional launch of Travis could also be said to have created a pilot within a pilot.

In an interview with Nobina Technology, I asked about the reasoning behind launching the platform in both Barkarbystaden and the Stockholm region as a whole:

> "Interviewer: And the pilot is in Barkarbystaden and the app is for the whole of Stockholm?
> Nobina Tech 3: … It's like that because it is a digital product … The project and the product are built for Barkarby and Järfälla, but the product works everywhere in Stockholm.
> Interviewer: And has that been the plan from the beginning? To launch both?
> Nobina Tech 3: Yes, in that the project with SL and Järfälla was the beginning, [and] the focus has been on Järfälla and Barkarby, and then … but as I said it works in Stockholm as a whole." (Nobina Tech 3, 2019)

As outlined in section 8.5, a specific set of services was located in Barkarbystaden. However, at the same time the Travis app is available to download and use across the whole of the Stockholm region. These services overlap in that it is possible to buy single tickets for public transport via Travis, as well as other services accessed via deep links for the region, including Voi's established inner-city geofenced area and taxis via Cabonline (Sverige taxi, Topcab, Taxikurir). A month after the launch, the carpool Elbilio was also made accessible in both Stockholm and Barkarbystaden. Bike hire is however only available in Barkarbystaden. In the same interview quoted above, I continued to try and understand the differences between what had predominantly been presented and discussed as a pilot specific to Barkarbystaden, and the simultaneous launch of Travis on a larger scale. Nobina Technology explained that the platform had been built on the basis of the agreement that all services should be accessible for use in Barkarbystaden, so that as Barkarbystaden grows, inhabitants can live without a private car (Nobina Tech 3, 2019). When I asked how the app had been adjusted for Stockholm in general, Nobina Technology explained that, as it already owns the 'Res i Sthlm' app,[22] it had the whole of Stockholm in mind during the design and development period. The interviewee explained that this was so as not to "build something that does not also work in other places, we have had the whole region in mind" (Nobina Tech 3, 2019).

[22] A journey-planning app for public transport in Stockholm.

It is unclear how these different dynamics can or will be reconciled within the same pilot. The regional launch shows how Nobina Technology's work has been shaped by questions about the specific services for Barkarbystaden, as well as a regional launch. As explained in the interview, the pilot fulfils the specific agreement for MaaS within the collaboration, but also goes beyond it. On the one hand, this simultaneous launch has a Trojan-horse quality (Fred, 2018), an analogy which can be used to illustrate how the project introduced something unanticipated, or beyond what it first appeared, because of the dimensions of the platform. Via the larger collaboration, with its specific focus on Barkarbystaden, Nobina/Nobina Technology are also responsible for a pilot with a much broader reach, which takes in the whole of the Stockholm region. I would suggest that this specifically raises questions about how this pilot can be compared with other pilots in the RPTA's more general pilot scheme for MaaS in the Stockholm region, and whether it means this service is in a more dominant position. On the other hand, it is also challenging to launch a digital product restricted to one relatively small area, especially when those living in, or coming to, Barkarbystaden are likely to be travelling from across the whole region. The efforts involved in developing the technical integration of tickets, and the negotiations required with other actors, also potentially explain why the project merited a larger-scale roll-out.

Travis was marketed both locally in Barkarbystaden, via Barkarbystaden's Instagram account, and at the services themselves, such as on the bike racks (as shown in Figure 9 in the previous section). Voi also posted an Instagram story about its involvement in the pilot in Barkarbystaden, and Travis was marketed on the inner-city metro, as well as on larger advertisement boards at specific stations (see Figure 11).

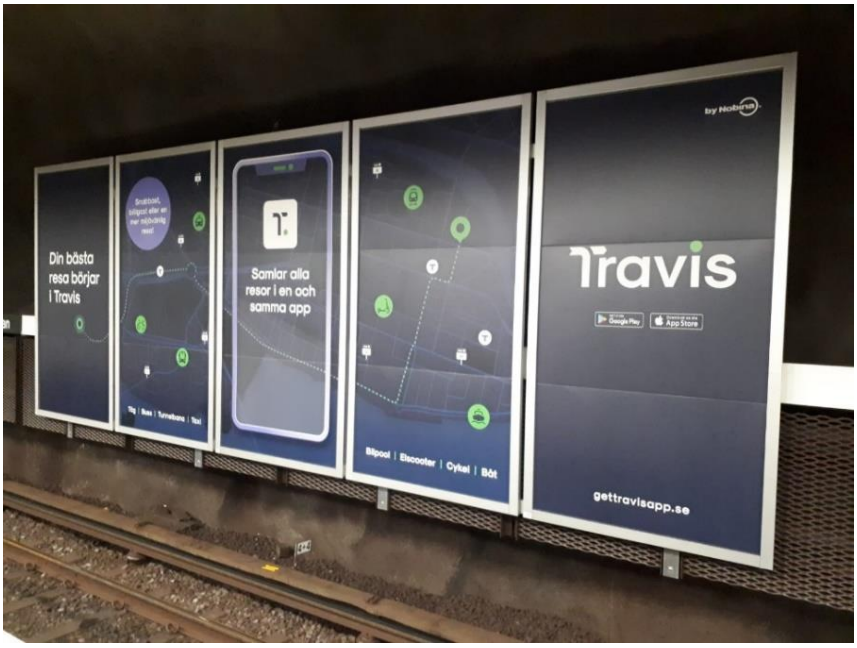

Figure 11. Picture showing a billboard advertisement for the Travis app, taken at Tekniska Högskola metro station, October 2019. Photo: Author.

Interviews also highlighted that the launch of the application brought actors closer to a relatively unknown and understudied aspect of MaaS developments, involving, namely, the users whose everyday behaviour they aim to change through this type of platform. Nobina Technology described this as the beginning of its learning curve, saying that gathering more knowledge about users would start to move the actors engaged in the development beyond the bubble which has formed around the concept within the transport sector:

> "… I think that the most important thing is what happens from now onwards, when we start to get to know the customer. A lot of the discussion when it comes to MaaS has been from the 'inside'. What should the processes between public transport authorities (*trafikhuvudmän*) and MaaS operators (*MaaS leverantörer*) look like, etc.? Really, I think that the most important aspect is to understand what the customer wants. Outside our little group, around the world there is hardly anyone who knows what MaaS is. If you say MaaS to someone who doesn't work in this branch, they don't know what MaaS is. So, I think we need to get much closer to the customers to understand what we have learned, and what we need to learn. And that is what we are doing now that we are launching the product." (Nobina Tech 3, 2019)

This quote highlights how discussions related to the MaaS concept have generally predominantly taken place 'backstage', involving considerable talk and minimal insights into the use of specific services (see Smith, Sochor & Karlsson, 2019; Smith, 2020). By following the development of the pilot, this research has sought to understand the discussions between transport authorities and operators about what processes should look like. It was therefore interesting to hear Nobina Technology give importance to understanding and learning as something which begins now that the product was out in the world. It also establishes the idea of users as a group on which products and ideas are tested, as opposed to them being involved earlier in the design of the product itself. Given that citizen dialogues have become an established part of formal planning processes, it is interesting that the public has not been involved in the development of this pilot. This is despite the close involvement of public actors, whose organisations have established mechanisms for involving people affected by developments within their local and regional jurisdiction (cf. Hedegaard Sørensen & Paulsson, 2020).

8.9 Discussion

In this chapter, I aimed to analyse how relations between actors take shape around the MaaS concept as a form of smart mobility, and how relations are potentially moved around, changed or linked in new ways. I began this chapter by highlighting the influence of the stages prior to the establishment of the collaboration, when the RPTA decided on its position as producer of public transport as part of MaaS pilot project in the Stockholm region in order to learn more about the concept, and as this was the position it considered it was possible to take based on its assessment of MaaS in 2016/2017 and for legal reasons. As part of its decision to pilot MaaS, the RPTA gave Nobina Technology the opportunity to develop its own version of MaaS in a pilot. The RPTA's decision to participate in the pilot, seen as just one of a number of shared services in Nobina Technology's platform Travis, means that existing roles in public transport involving the RPTA and Nobina have been re-ordered, and Nobina/Nobina Technology is able to test and develop a broader role as both public transport operator and potential MaaS provider. The repositioning of the RPTA as a service provider within Travis is made material through the integration of public transport as a digital ticket.

In general, the RPTA and Nobina Technology frame MaaS as a challenge to the private car, reflecting the broader framing of the concept, and what is often expected of it. The interview material analysed here highlights how public transport has been seen as the most influential service in a MaaS offering, because of its capacity and market share in Stockholm, at least prior to Covid-19.

Therefore, public transport is thought of as an important link in the MaaS service, and without it, Nobina Technology considers it difficult to develop MaaS as an attractive alternative to the private car. This suggests that public transport is key in shaping MaaS and highlights how the platform and the associated shared system which is supposed to involve both public and private actors is dependent on publicly funded infrastructures (Stehlin, Hodson & McMeekin, 2020).

Piloting Nobina Technology's suggestion for MaaS was linked to Barkarbystaden through the RPTA's interest in testing a number of pilots in different contexts across the Stockholm region. Barkarbystaden was attractive as a site because of the influx of new inhabitants, as well the parking norms for the area, which had already been introduced by the municipality. However, these are ultimately what could be described as background motivators for the app, which were not incorporated into the design of the platform. Although new types of shared mobility services are located in Barkarbystaden because of the pilot, the pilot itself is more of a service which overlays the contextual specificities originally used to motivate situating the pilot there.

Unlike the RPTA, the municipality does not have a specific role within the platform. Instead, its role in relation to the app is mediated predominantly through the use of public space for the private actors involved in Travis. The role the municipality and Barkarby Science could take was also affected by the stage in which they became involved in the pilot for MaaS. While the RPTA and Nobina/Nobina Technology had already started to negotiate their role in relation to this MaaS pilot in 2017, the municipality became more specifically involved in the pilot via the collaboration in 2018, at a later stage than the other two actors. This therefore meant that the municipality had to accommodate to the framing of MaaS already agreed upon between the RPTA and Nobina Technology, with less time to explore and problematise their role in relation to MaaS. Municipal actors speculated in interviews about the possibility of integrating MaaS more closely with negotiations between the municipality and housing developments, in terms of parking norms and mobility initiatives within housing units. This highlights how the pilot in Barkarbystaden could have situated MaaS within a context of housing development, and it may be possible to develop this in future. I also suggest that municipal involvement from an early stage could be an important method of using MaaS as a tool for integrating land use and mobility planning. However, launching the Travis platform as a specific service for Barkarbystaden, but at the same time for use at regional level, suggests that future ambitions for Travis involve the app playing a role in a wider system of shared mobility services conceptualised for the whole region.

While a regional perspective is not surprising, when the pilot was officially launched it was interesting to note that the different levels on which the pilot

would operate had not been clearer in the meetings I had followed in the MaaS group. This could be an oversight on my part as a researcher and interviewer, as I did not fully pick up on this aspect, although when I looked back at an earlier interview with Nobina Technology, they had, in fact, mentioned that the platform would also be released more broadly (Nobina Tech 2, 2018). This therefore made me wonder if this aspect of the platform was also visible to the municipality, and whether this had influenced their ability to negotiate their role in the pilot. The launch of the pilot specifically for Barkarbystaden and the region however made it clear that Nobina Technology was working with both these scales in mind.

Based on this reflection regarding the pilot in Barkarbystaden being one dimension of a more general release of the platform, it could be said that the pilot project takes on different forms depending on the context (either local or regional), something which has different implications for the future of this service and how it is planned and governed. The ways in which projects bring change has been analysed in relation to the 'Trojan horse' metaphor to discuss how organising work through projects can both invite change, as well as unanticipated consequences (Fred, 2018). In this chapter I have analysed the MaaS platform as an intressement device, which illustrated the platform as a new form of mediation between the actors involved in the collaboration, and a device which was problematised at different stages by the actors involved and influenced how roles were distributed. If the actors involved have different perceptions of the scope of the pilot, and therefore the platform being governed, questions of how to govern and plan for MaaS are unevenly distributed across the group. The platform could therefore be compared to the metaphor of the Trojan horse as it is unclear what the unanticipated consequences could be as a result of the uneven governance proportions of the MaaS platform.

9 Concluding discussion

The overarching aim of this licentiate thesis has been to provide insights into the governance and planning of smart mobility, and more specifically the ways in which public transport governance and planning is shaped or reshaped by these processes. To do this, I have explored two specific areas of smart mobility: small, automated driverless shuttle buses and the Mobility as a Service concept, and how these were introduced in a collaboration to develop public transport in tandem with urban development in Barkarbystaden in Järfälla municipality in the north-west of the Stockholm region. In order to analyse the process through which the collaboration emerged, I drew on assemblage thinking, and specifically the governance assemblage. I then used the ANT concept of translation to look at the processes through which the driverless shuttles and MaaS have been introduced.

As mentioned in the introduction, this study has followed ongoing developments in Barkarbystaden, and these have been moving slightly faster than the process of writing up an academic text. The above analysis is therefore only a partial representation of a process to govern and plan smart mobility which have continued during the writing up of this work. The conclusions drawn therefore based on insights into a developing process.

In this section, I draw together the findings from each chapter, and discuss them in relation to the main aim, namely the ways in which public transport governance and planning are shaped or reshaped by these processes. I begin by summarising the main findings of the main three empirical chapters, after which I consider the broader theme of who represents whom in the ongoing development of smart mobility.

9.1 A governance assemblage characterised by existing roles and relations

In the first empirical chapter, I used the analytical concept of the governance assemblage to discuss the roles, responsibilities and links between organisations and smart mobility which characterise the collaboration around 'Modern mobility in Barkarbystaden'. I drew on the concept of the governance assemblage to conceptualise the collaboration as a site for the governance of smart mobility, and as a contextual set of relations which allow governance to emerge in certain ways (Savage, 2020). Drawing on Li (2007), I specifically focused on the process through which the governance assemblage took shape, and the types of alignments forged between actors. Previous research has raised concerns about

the ways in which smart mobility often risks bypassing public institutions (Docherty et al., 2018). In this case, the collaboration was underpinned by the responsibilities of public authorities at a regional and local level.

In Chapter 6, I concluded that this collaboration, or governance assemblage, was characterised by the established dynamic between the RPTA and the operator. The collaboration had its starting point in the large-scale urban development process taking place in Järfälla municipality, and how this was taken into account by the RPTA. I located these overlapping concerns in the formal contract for the area, which also involved the role and responsibility of the operator in this context, and how the operator acted as an extension of the RPTA in terms of public transport provision. Smart mobility became a new aspect of this governance context after the RPTA requested that Nobina develop new ideas for public transport during urban development, and this request set in motion the process which became visible in the establishment of the collaboration, supported by the additional external funding for services to be tested. The collaboration therefore emerged through the existing dynamic between the RPTA and the operator, but draws in the municipal role more clearly within the project structure for the collaboration around the BRT, the driverless shuttles and MaaS. However, the collaboration was still dominated by the operator, whose role began to take on new significance in relation to smart mobility.

This relationship with smart mobility is something that Nobina had started to cultivate through its innovation company, Nobina Technology. Within the specific collaboration in Barkarbystaden, the ideas and services which had been developing at Nobina Technology became new elements grafted onto the operator's existing contractual role. In this case, Nobina and Nobina Technology became the provider of the concepts and services piloted within the collaboration. The way in which the existing dynamic between the RPTA and its operators took precedence in this case highlights how innovation plays out along existing lines in public transport. This creates new links to smart mobility within the existing processes of public transport provision.

This dynamic becomes clearer if it is compared to the municipal approach to Barkarbystaden as a test bed. In Chapter 6, I also concluded that the governance assemblage was characterised by urban development as a site for testing new ideas in public transport. The municipality itself facilitated this by creating a separate organisational organ, Barkarby Science. Here the municipality's interest in communicative placemaking around Barkarbystaden as an attractive and innovative urban development site overlaps with the regions interest in testing new ideas in relation to public transport. While the municipality has a separate organisation for mediating this test bed approach, the RPTA does not have an equivalent organisational body, and mainly manages its involvement in various

pilots, such as the ones analysed here, through its Strategic Development department, as described in Chapter 2. Participating in this pilot project therefore means that the RPTA participates via Nobina and Nobina Technology when the contract is used as a tool to motivate the operator's role. This dynamic has critical implications for the roles and responsibilities of RPTAs and operators. In this case, in practice, the operator is assigned responsibility for driverless shuttles and MaaS as part of the collaboration. As discussed in Chapter 6 and 7 this is in line with the with the RPTAs framing of the operator role. However if, as in this case, the main responsibility for smart mobility in public transport is delegated to operators on an ongoing basis this potentially has larger implications for the formal role of RPTAs and the public sector in actively shaping these developments. This highlights an ambiguous dynamic in terms of who is ultimately responsible for the development of public transport, and who shapes its future. If public transport is increasingly shaped by the services which the operators choose to provide, this potentially gives them considerable influence over the future of public transport.

At an overarching level, this is a question of which actors have the most influence in shaping the form public transport takes in the future is also related to the broader rhetoric which mentioned in Chapters 6 and 8 about the role of public transport in a shared mobility system. When certain actors suggest that public transport will ultimately be subsumed into a shared mobility system, the question of which organisations ultimately shape the form of this shared system is a dynamic which will continue to emerge over the coming years. The development of a new, so-called shared mobility system involving smart mobility is a dynamic process which will involve different many different actors. However what is clear is the existing public service obligation RPTAs have to citizens as well as in relation to political goals at national levels. Although there may be complex and unanticipated consequences if public actors do not manage their roles in the system strategically (cf. Pangbourne et al., 2018; Reardon, 2020). The shape of public transport, and who or what shapes it, is still open, and looking specifically at the driverless shuttles and MaaS provides further insight into the relationship between smart mobility and public transport. Each of these have different implications, which I now explore based on the conclusions from Chapters 7 and 8.

9.2 Shaping smart mobility, or being shaped by smart mobility?

In Chapters 7 and 8, I posed the same question to the pilot projects for MaaS and driverless shuttles within the collaboration. I asked how relationships take shape

around driverless shuttles and MaaS, and how relationships moved around, changed, or became linked in new ways. To do this, I used the concept of translation. Callon (1986b) notes that processes of translation are closely linked to the circumstances in which they develop. The conclusions from both chapters highlight how the driverless shuttles were shaped by the specificities of this collaboration, and by the avenues of development this particular constellation of actors afforded. This is highlighted by the particular points of passage which brought the actors together, and the different characteristics of driverless shuttles and MaaS as devices which engaged the actors in certain ways.

Overall, the analysis in Chapter 7 shows that the driverless shuttles are situated clearly within the existing structures for organising public transport. They may be a new technology, which could ultimately challenge and potentially displace the role of the driver (cf. Brundell-Frej et al., 2020), but they do not necessarily challenge the existing governance structure of public transport provision guided by the contract. In Chapter 7, I discussed the contract as a point of passage used to introduce the driverless shuttles into public transport in the form of the pilot project. The character of the contract as an existing standard within public transport acted as a passage point which enabled a relatively easy, or smooth, passage for automation. Relationships were not moved around as part of the pilot project, but instead the driverless shuttles were linked to the existing roles of the RPTA and Nobina, strengthening the operator role as the actor through which smart mobility innovations are introduced in public transport. The overarching contract for public transport for the area which includes Barkarbystaden paved the way for this pilot project. However, the broader effects of this, and the ways in which it could affect the development of automation as a future service within public transport, remain to be seen. This could influence both the content of future procurement contracts, and the type of bus-service model Nobina can offer.

The development of the driverless shuttles within this pilot project framework, which simultaneously places them within the boundaries of public transport, means that the buses have been given the privileged position of developing within public transport, while still operating as only a partial service. As the funding from Vinnova runs out in December 2020, this is when the collaboration in its current form formally ends. However, plans to develop the buses go beyond this. I assume these are based upon the continuing contractual relationship between the RPTA and Nobina, and the commitment made in when the collaboration was initiated in terms of developing the driverless shuttles throughout the contract period. A critical question relating to the buses is therefore where the pilot project ends, and at what point a decision is made to consider the buses a 'proper' public

transport service, no longer subject to the exceptions made because of technological development.

Unlike the driverless shuttles, MaaS is a concept which, even in its conception, envisages a different kind of ordering of mobility provision. As discussed in Chapter 8, the influence of the MaaS concept was based on the RPTA's strategic decision in January 2017 to pilot the concept with a number of actors, including Nobina Technology, thereby defining its role in relation to MaaS. The culmination of this plan became part of the broader collaboration established between Järfälla municipality, Stockholm's RPTA and Nobina. The material analysed in Chapter 8 highlights how MaaS had a history outside the collaboration. Nor did it 'fit' into the contractual RPTA-operator relationship in the same way as the pilot project for the driverless shuttles. Instead, the pilot created a space where the roles of the RPTA and the operator were re-ordered within the platform. Public transport is just one of a number of services to choose from in Travis, and this is in line with how the MaaS concept actively aims to re-make existing structures, and envisions a re-ordering of the actors, both public and private, who are involved in the platform. The Travis app provided by Nobina/Nobina Technology is therefore part of an effort to engage with a future dominated by a shared mobility system, and also to foster its development through this type of platform.

The analysis in Chapter 8 demonstrates how being responsible for Travis also potentially creates a new role for Nobina and Nobina Technology within this shared system in terms of the creating a "joint digital channel [which] enables users to plan, book and pay for multiple types of mobility services" (Smith & Hensher, 2020, p. 56). Looking at the platform as an intressement device, I show how the relations between the public actors take shape differently in connection to Travis. The re-sale of digital tickets for public transport represents a clear role for public transport within the platform, while the municipal role, on the other hand, is shaped by its responsibility for public space, which directs its relationship towards the private actors involved in the platform A platform with a clearer connection to the municipality's responsibilities, such as housing development, could have generated clearer links to municipal planning responsibilities., and highlights an alternative way in which MaaS platforms can be approached in general. Finally, the empirical material also highlighted the launch of the pilot at both regional and local level, suggesting that the ambitions for the platform go beyond a single municipality towards a larger-scale mobility market development (cf. Fenton et al., 2020). How this would change Nobina's existing role as a public transport provider is unclear, and was beyond the scope of this research.

Smith (2020, p.5) notes that there is still uncertainty over how the MaaS concept will be rolled out, and as mentioned in Chapter 3, "public sector roles …

are much discussed yet poorly understood", and that "how public sector actors can and should govern MaaS developments are still open questions". Based on this case, I suggest that while public actors were involved in, and enabled the development of MaaS, their relationship with the pilot was uneven. The public actors involved in the Barkarbystaden pilot interact with different framings of MaaS depending on the point at which they came into contact with the pilot project as it was being developed. MaaS could therefore be described as emerging in different, 'patchy' forms (cf. Karvonen, et al., 2019), with unclear regional, and potentially even national, ambitions. This potentially makes it difficult for municipal actors to grasp the full contours of the ambitions behind MaaS. As a result of this, municipalities are in a particularly challenging position in terms of negotiating their role in MaaS developments.

The analysis highlights how the main public actors involved in the pilot understand the platform as a commercial product. As local and regional actors take secondary roles to the market, the question of who ultimately governs a commercial product remains unanswered. The only level of governance above the regional and local levels in a potential position to define regulations for MaaS is the national level (Fenton et al., 2020). If the development of a new shared system is to be predominantly in the hands of private actors, issues still remain as to whether or not market actors see themselves as accountable for sustainability and accessibility, two primary goals of public actors. If public actors take a position subordinate to the idea of a shared (market) system, private actors will have increasing influence over the definition this type of future system. In general, this raises questions about the role of public actors in facilitating this path of development towards the so-called shared mobility system (cf. Pangbourne et al., 2020). The question of who can guarantee public values, ecological accountability, democratic forms of decision making and social justice is at risk of being compromised in favour of market determinism. It therefore seems appropriate to quote Reardon here (2020, p. 139), who emphasises that with the deluge of new technologies and concepts, and the promises they are considered to hold, "it is easy to get distracted by what these innovations can (potentially) do, rather than what we want or need them to do", especially if they are to assist in meeting societal goals.

With this in mind, it is useful to return to the analogy of the Trojan horse as a metaphor for making sense of the potential changes these types of pilot projects potentially bring with them (Fred, 2018). The development trajectory of the driverless shuttles and MaaS highlights how these examples of smart mobility were part of the collaboration, but also how they preceded and spilled over beyond its boundaries. This emphasises how a project should not be considered an island unto itself (Engwall, 2003, cited in Fred, 2018). Instead, projects and

the platforms and technologies tested within them, translate their effects to the institutional and organisational contexts in which they are embedded. In the context of public transport planning and governance, I suggest this has specific implications for questions of representation in the ongoing development of smart mobility, as the roles different actors take on in pilot projects influences how smart mobility develops moving forward.

9.3 Who represents whom in the development of smart mobility?

To round off the discussion, I would like to finish this chapter with a more general reflection on the question of who represents whom in the ongoing development of smart mobility, and also end with some suggestions for future research on this topic. In existing smart mobility literature, public and private actors are often discussed as two apparently separate groups (Docherty et al., 2018; Marsden & Reardon, 2018a). Although technically a private actor, the bus operator is contracted to perform a public service. In this case, the role of the operator illustrates a less discussed actor in the development of smart mobility, and provides insight into how actors in the public transport industry are influencing the development of smart mobility. The fact that smart mobility was grafted onto the existing role of the bus operator raises questions about the shift in power dynamics involved if these developments are driven by the operators. Though power has not been a guiding analytical tool in this work, questions of power are closely tied to processes of translation, and how interests align between actors. "Interests lie between actors, 'thus creating a tension that will make actors select only, what, in their eyes, helps them reach [their] goals'" (Latour, 1987, p. 121 in Murdoch, 2005, p. 63). Questions of interests go beyond a cursory interest in what technology can do, and involve broader themes of public values, goals for sustainability, gender equality and social justice. How this negotiation of interests aligns, or not, at the intersection of smart mobility, public organisations and market interests is an important avenue for further research.

While the relationship between the RPTA and the operator is a closely knit one, it is important to remember that these actors are not one and the same. This case study suggests that a trajectory where the operator increasingly represents the RPTA in the development of smart mobility. Going forwards, this raises questions about how the RPTA will make the distinction between itself and its operators, and how pilot projects like this influence the overall strategy and stance the RPTA takes in relation to smart mobility. Although the RPTA and its

operators clearly converge around the delivery of public transport, their roles also diverge in terms of the public transport authority's responsibility for public transport as a public service (Stjernborg & Mattisson, 2016), and what amounts to regional political accountability for public transport provision. Questions of representation concerning the relationship between operators and public transport authorities and how the organisational dynamics between these two actors influence the development of smart mobility are therefore important issues for ongoing research as driverless shuttles and MaaS continue to develop.

Questions of responsibility and accountability also extend to the citizens who rely on public transport. Ongoing trends which frame citizens as consumers and users, and the shift from a collectivist to an individualist approach to planning (Khakee, 2006), also feed into how smart mobility is framed as an 'attractive' development trajectory for public transport. It has already been noted that citizens are an under incorporated group in smart mobility developments, despite the fact that the changes smart mobility could bring are heavily dependent on the public(s) with whom they set out to engage (Hedegaard Sørensen & Paulsson, 2020; Smith, 2020; cf. Tironi & Valderrama, 2019). Involving citizens from an earlier stage in deliberations, and making use of existing tools for citizen dialogues and participation in planning, could be important tools in fully understanding the role smart mobility can play in people's everyday lives.

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Appendix 1. Example interview guide

These questions are an example of questions used during interviews, the exact questions varied based on the organisation in question, and in interviews themselves space was left to follow up avenues of discussion which arose during the interview. Driverless shuttles are abbreviated to DS.

- *Collaboration*
  - How did the collaboration develop? Can you describe the process? Where did the idea(s) for the collaboration come from?
  - What is the role of your organisation in 'Modern mobility in Barkarbystaden'?
  - Which part(s) of your organisation are specifically involved? Why?
  - In what way is the collaboration connected to existing formal regulations (e.g. the procurement contract, formal planning documents and strategies)
  - How did MaaS &/DS come to be part of the collaboration?
  - Which are the overarching aims of the collaboration?
- *MaaS/DS*
  - How long has your organisation been working with MaaS &/ DS?
  - Can you tell me about the pilot for MaaS/DS in Barkarbystaden? Where are you in the process of developing the pilot at the moment?
  - What are the aims for the pilot? What is the aim of the pilot for your organisation specifically?
  - Why is Barkarbystaden an interesting site for the pilot project? What is MaaS &/ DS supposed to contribute to Barkarbystaden?
  - How does the pilot project for MaaS &/ DS connect to the work happening in your organisation more generally?
  - Have there been any challenges, e.g. with the technology/ with realising the MaaS concept/ legal questions?
  - How may what happens as part of the pilot project be integrated (or not) into your organisation moving forward?
- *More general questions*
  - How has external funding influenced the development of the collaboration and the pilot projects as part of the collaboration?
  - Are there any other actors outside of your organisation or the collaboration who have had an influential role?
  - How do you think smart mobility will affect the urban environment/ public transport more generally?
- Is there anything that I have not covered in these question that you feel is important to bring up?