UNDERSTANDING THE POTENTIAL FOR SCALING UP CAR SHARING: A CASE STUDY OF UTRECHT

by
Marilin Sadu

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Graduation committee	Prof.dr.ir. Dick Ettema	Supervisor
	Dr. Egbert van der Zee	Second reader
	Sebastiaan van der Hijden	City of Utrecht, internship supervisor

Utrecht University

Gemeente Utrecht

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Marilin Sadu

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Abstract

This research examines the potential for scaling up car sharing in the context of sustainable mobility transitions with a focus on identifying the challenges and opportunities. Drawing on insights from the multi-level perspective, the impact of external landscape and regime developments on car sharing are examined. Furthermore, the three internal niche processes crucial for the successful diffusion of the innovation are explored: network formation, learning processes and voicing of expectations. Utrecht presents a case study where car sharing is no longer in the experimentation phase, but it has not yet managed to scale up. Semi-structured interviewed were conducted with experts and stakeholders involved in car sharing, including three car sharing operators, the municipality, external consultants and the national government. Interviews revealed that the main challenge will be to erase the knowledge gaps in the areas that are crucial for car sharing to scale up. These include information about car sharing users and their travel patterns as well as the larger-scale impacts and dynamics of car sharing in the city. In order to achieve this, the municipality is best positioned to take a bigger role as network manager, to provide guidance for the research agenda and coordinate the exchange of information between stakeholders. The results of the study provide insights to policymakers on the do's and don'ts of carsharing policy.

Key words: Car sharing, scaling up, strategic niche management, multi-level perspective, governance of sustainability transitions

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1. Introduction

Mass motorization of the 19th century has led to mobility systems in urban areas across the world where the car is central. However, growing awareness about environmental issues and the negative impacts of car-based mobility, such as pollution, the consumption of non-renewable energy and allocation of public space, have prompted the growth of alternative solutions to daily mobility (Srinivasan & Walker, 2009). A quarter of Europe's greenhouse gas emissions come from the transport sector of which road transport accounts for more than 70% in 2014 (European Commission, 2014). Although the increase in car use in passenger transport has decelerated in several high-income economies and even stopped or declined in some, in most developing economies increases in GDP per capita and disposable income has even increased rates of motorization (OECD & ITF, 2017).

The established car dependency is thus projected to be unsustainable for the future social well-being and viability of cities, while also hindering the transition to a low-carbon economy. Researchers and policymakers alike have started to acknowledge the need to establish alternative and more sustainable systems of mobility in cities, such as developing cleaner vehicles or introducing shared mobility services (Sopjani et al., 2020). However, this is no easy task as the private fossil fuel car is embedded in the centre of an established socio-technical regime, made up of highly profitable structures of production and business, a landscape of infrastructures built for the car, as well as a set of social and cultural norms and practices (Geels, 2012). In this context, the question of how socio-technical system transformations take place has received much attention over the past few decades in both policy and social sciences research. A number of conceptual frameworks have been developed to investigate these processes, such as most notably the multi-level perspective (MLP) (Markard et al., 2012). The MLP observes system transformations on three analytical levels: niche, regime and landscape. The second framework used in this research, strategic niche management (SNM) theory, builds on the MLP and investigates specific factors within the niche which are assumed to be crucial for the successful diffusion of the innovation.

The emergence of a sharing economy in recent decades, powered and enforced by advancements in ICT, has brought to wider attention the concept of shared mobility which can be observed in the growing popularity of short-term rental systems for bicycles, (e-) scooters and (electric) cars in urban areas across the world. Kent and Dowling (2013) suggest that the dominance of the private car in cities is being challenged through unprecedented growth in non-private, although still car-based forms of personal mobility. This research focuses on car sharing, which has been around for several decades and has been recorded to have a positive impact on vehicle ownership, modal shift and reductions in CO2 emissions (Fromm et al., 2019). Carsharing in the context of this research is a product-service system as described by Mont (2002), combining "an asset (a car) and a service which gives customers access to this asset instead of ownership." The basic car sharing business model consists of a membership that provides access to a fleet of vehicles in exchange for a price determined either by time or distance driven. (Tuominen et al., 2019).

In 2019, the total number of shared cars in the Netherlands was 51,000 – a 5% increase from the previous year (Utrecht Monitor, 2020). Utrecht in the Netherlands is one of these cities which has assigned shared modes of transportation a role in their future urban mobility plans.

The city has set the goal of zero growth in car traffic in the city despite an estimated population increase of approx. 100 000 people by 2040 and the municipality has identified shared mobility, including carsharing, as one tool with which to achieve this goal (Gemeente Utrecht, 2021). Utrecht provides an interesting case study of a city where carsharing has existed for some years already and established itself as a viable concept. Among Dutch cities, Utrecht leads with the highest number of shared cars per 100 000 inhabitants in 2020 (Utrecht Monitor, 2020). However, in 2019 only 6% of inhabitants had reported having used a vehicle by a shared car service provider (Utrecht Monitor, 2020). This would imply that car sharing in Utrecht remains on a relatively niche level and it is unclear whether the practice has the potential to challenge the dominant car ownership regime. This leads to the motivation behind this research, which is to determine the potential for scaling up car sharing as part of a sustainable mobility transition.

1.1. Research objectives and questions

The goal of the research is to provide insights into governing sustainability transitions in urban areas. The car sharing niche in Utrecht is chosen as a case study and the objective is to identify the potential, including the opportunities and challenges, for scaling up car sharing in the city. For this purpose, transition theories provide an appropriate analytical lens for investigating this topic because in the centre of transition research lies the question of how to scale up alternative solutions (niches) to mainstream practices. The research employs qualitative methods and follows a conceptual framework building on various theories in the field of transition and innovation research. Taking this in mind, the following research question has been formulated:

What are the opportunities and challenges for scaling up car sharing in Utrecht in the context of a sustainable mobility transition?

In the process of developing the theoretical framework, several factors and processes that affect the upscaling of niche innovations have been identified, and these factors and processes form the basis of the sub-questions. The main research question will be answered with the help of the following sub-questions:

SQ 1: What are the landscape and regime factors that affect the scaling up of car sharing in Utrecht?
SQ 2: What is the state of network formation in the car sharing niche?
SQ 3: What learning processes take place in the car sharing niche?
SQ 4: What are the expectations of the actors in the car sharing niche?

1.2. Research outline

Chapter 2 explains the theories used in building the conceptual framework and outlines the factors that have been identified as crucial for the successful scaling up of niche innovations in the context of socio-technical transitions. Furthermore, this chapter introduces the concept of car sharing, including a brief history and previous research on this topic. Chapter 3 outlines the methodology used in this research, including approach to data collection and analysis. Chapter 4 introduces the case study in more detail. This chapter aims to provide an overview

of the current situation of car sharing in the city of Utrecht, based on data from the municipality and other research institutions, as well as an analysis of the policy approach towards car sharing based on policy documents, such as the *Mobiliteitsplan* 2040 ('mobility plan'). Chapter 5 presents the results of the qualitative analysis conducted and aims to provide an answer to the sub-questions, as well as lead to the answer of the main research question. Chapter 6 concludes with a discussion about the results, the implications and limitations of the study as well as a reflection from the author.

1.3. Relevance

This research specifically focuses on car sharing as a subset of shared mobility because it directly addresses the question of private car ownership. Municipalities like Utrecht, but also Rotterdam and Amsterdam, have identified car sharing as a solution with a lot of potential; not only in addressing climate change but also benefiting wellbeing of citizens through better public spaces. Policymakers and transportation planners will need to understand how carsharing impacts transportation planning in the city and how to incorporate this piece of the puzzle into the bigger picture. Furthermore, there are a multitude of actors involved in and affected by this development. It is important to know how these stakeholders, such as companies operating in the carsharing field, view the potential of scaling up these kinds of shared mobility solutions in the city.

From an academic standpoint, there is a lot of research done on carsharing and other smart mobility solutions. These most often focus on individual motives and viability of the system from a consumer or travel demand perspective; or on the impacts of car sharing on emissions, traffic, car ownership, etc. (Firnkorn & Müller, 2012; Nijland & van Meerkerk, 2017; Shaheen et al., 2009). Additionally, several studies have outlined the success factors of car sharing (Kent & Dowling, 2013; National Academies of Sciences, Engineering, and Medicine, 2005). However, these factors do not necessarily address the question of scaling up, as the small group of people who currently use shared cars can be seen as early adopters and a different strategy may be needed to scale up these services city-wide. Furthermore, the processes of niche formation, emergence and diffusion have been thoroughly investigated and explained in the context of sustainability experiments and how to scale up these individual projects. However, much less focus is given to these processes on a city-wide level, and in situations where the technology or solution is no longer a protected niche or experiment, but already operating to some extent as a viable service or product on the market. Ruhrort (2020) claims that sustainability transition research in the transport sector now needs to develop concepts that describe how political actors attempt to manage upscaling and breakthrough processes of former niche innovations. Utrecht provides the setting for investigating just this situation, where car sharing has exited the niche or experiment status but not yet scaled up on a city-wide level.

2. Theoretical framework

This chapter provides an overview of the theoretical approaches used in the building of the conceptual framework for this research. Socio-technical transition theory lays the groundwork for the conceptual framework, as it explores the processes of structural change in systems such as the mobility system. The multi-level perspective (MLP) has been chosen for this research as it expands from socio-technical transition theory and is especially useful in considering sustainability transitions. The MLP provides a way of investigating factors that influence transitions on three analytical levels: niche, regime and landscape. The second framework used in this research, strategic niche management (SNM) theory, builds on the MLP and investigates specific factors within the niche which are assumed to be crucial in the scaling-up of the niche innovation.

2.1. Socio-technical transition theory

New technologies are developed, experimented with, and rolled out to society to supplant old technologies or replace them altogether. In essence, transition theory describes how these technological innovations emerge and incorporate into society. Some of the earlier theories that transition research builds on are evolutionary theory, complex systems theory, and innovation theory (van Den Bosch & Rotmans, 2008). Transition research investigates a specific type of social change – a transition –, which is a fundamental change in the dominant way a societal need is fulfilled (Geels, 2002). These societal needs, such as food, housing or energy, are fulfilled through socio-technical systems of interacting material, social and institutional elements. The term 'socio-technical' suggests that infrastructure systems are not only determined by their material components such as technology, but instead simultaneously shape and are shaped by various social aspects like citizens and their cities (Edwards, 2002). This means that socio-technical systems go beyond single industries or sectors and are represented by entire value chains, including not only production but also, for example, consumption and waste management. In addition to technical and economic dimensions they include infrastructure, culture, knowledge and politics, as well as different actors and interests (European Environment Agency, 2019).

According to Geels (2004), the various components in socio-technical systems co-evolve over time, establishing fairly stable configurations of technologies, regulations, user patterns, infrastructures, and cultures. In the context of this research, it is perhaps best illustrated by the emergence of the automobile as the dominant mode of land transport in the 20th century. This was accompanied by the development of the car production industry, road infrastructure, systems to produce and deliver fuel, tyres and other accessories, traffic regulations, urban design, services, user practices, and more (European Environment Agency, 2019; Markard et al., 2012). The elements of this system are maintained and reproduced by its incumbent actors, such as companies, consumers, lawmakers, and civil society groups. The actions and views of these actors are shaped by the prevailing socio-technical system elements which include shared rules, practices and institutions. For example, interactions between users, media and society create the cultural and symbolic value of cars, while industry structures are the result of mutual positioning and strategies of car manufacturers and suppliers (Geels, 2002).

Due to the inherent stability of these complex systems and the interlinkage between its different elements, there are often strong economic, social and psychological incentives that lock society into particular ways of meeting its needs (European Environment Agency, 2019). Existing socio-technical systems are therefore characterized by lock-ins and path dependence that create barriers to change (Geels & Raven, 2006). Examples of lock-ins include economic barriers, e.g. sunk costs in the form of substantial investments in long-lasting assets like transport infrastructure; social barriers, e.g. cognitive biases among users that can deter lifestyle change; and political barriers, e.g. groups with vested interests using corporate political strategies to actively oppose change (European Environment Agency, 2019). This means that radical innovation has a hard time to break through because all the above-mentioned dimensions of the socio-economic system are aligned to the existing regimes. Fundamentally changing these systems will disrupt existing investments, employment, consumer behaviour, cultures and values, thus leading to conflicting interests and resistance from actors. In the case of sustainability transitions, this limits the government's ability to implement measures such as regulations and pricing tools which are needed to reach long-term environmental goals (European Environment Agency, 2019).

Socio-technical transitions can thus be conceptualized as a shift from one socio-technical system to another, involving far-reaching changes along all its different dimensions. These transitions are highly social and dynamic, involving a multitude of stakeholders, and typically develop over a relatively long timeframe (Markard et al., 2012). They include changes in infrastructure, networks, regulation and user practices (Geels, 2002). Hughes (1987) introduces the concept of system builders who are actors driving the system development and construction. On the other hand, there are actors who advocate for sustaining the existing system and are opposed to any transition. Exploring the external landscape also includes understanding political, technical, or social barriers alongside what causes and governs change (Hughes, 1987). The key questions that transition research focuses on are what conditions encourage innovation, why some innovations succeed and not others, and how successful innovations diffuse (Evans, 2012). Thus, it can be concluded that transition theory provides a relevant framework to approach the topic of this research.

The socio-technical transition approach is a broader category term and its fundamentals have inspired several other theories aimed at exploring transition processes. Two of these theories, the multi-level perspective (MLP) and strategic niche management (SNM) theory are explained further in this chapter.

2.1.1. Multi-level perspective

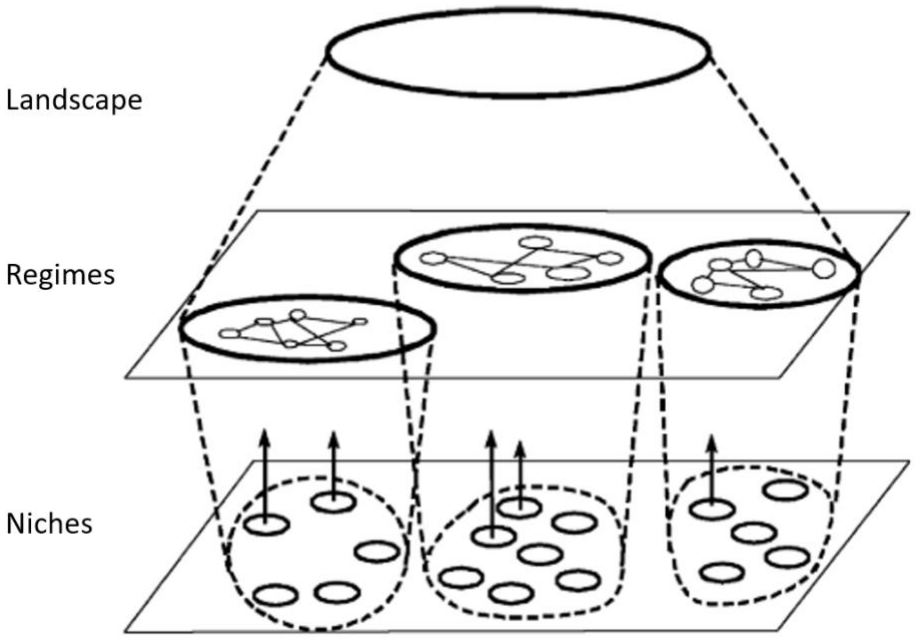
The MLP on socio-technical transitions is a useful starting point for exploring the role of shared mobility in transition processes as it explores the interplay of dynamics at three levels: regimes, niches and landscapes (Geels, 2002; Markard et al., 2012). Dominant socio-technical systems such as the automobile system are stabilized in the form of a socio-technical regime, characterized by strong path dependencies. Rip and Kemp (1998) define a regime as "the coherent complex of scientific knowledge, engineering practices, production process technologies, product characteristics, skills and procedures, established user needs, regulatory requirements, institutions and infrastructures". The regime represents the venue of established practices and rules, seeking to maintain its configuration and resist transition.

The relationship between different actors form interdependent social networks, which further stabilize the regime through shared expectations, commitments and vested interests (Geels, 2005).

Niches, in contrast, are protected incubation spaces and the locus for radical innovation, characterized by uncertainty and experimental disorder (Geels, 2002). Van den Bosch and Rotmans (2008) define the niche as: "a societal subsystem which can be understood as a (local) constellation of culture, practices and structure that deviates from the regime." In these niches, actors can learn about new technologies and their uses, while innovations are protected against the selection pressures of the mainstream market or regime (Geels, 2002).

Finally, the landscape represents the external factors impacting the regime and providing context for the interaction between actors (Geels, 2002). It is an important concept for understanding the conditions, pressures and environment of transitions (Hodson & Marvin, 2010). The term implies relative 'hardness' and materiality of the factors such as the material and spatial layout of a city and its infrastructure. But changes in landscape also include economic growth or recession, changing oil prices, climate change, or changing cultural values. Under certain circumstances, the interplay of dynamics on these levels can unlock windows of opportunity, allowing niche innovations to gain momentum and threaten the established socio-technical regime (Geels, 2002). This can lead to changes in regime structures or to the creation of an entirely new regime.

Figure 1: Levels in the multi-level perspective



Source: Geels, 2002

There are several valuable contributions to the MLP from other authors worth mentioning in this research. Meadowcroft (2011) draws attention to the political dimensions of sustainability transitions. They argue that sustainability transitions are inherently political. Firstly, because politics provides both context and direction in each of the three levels of the MLP. Secondly, because sustainability transitions often require changes which can only be engineered and enforced through political processes, such as introducing a carbon tax or subsidizing electric vehicles. Hodson and Marvin (2010) suggest to consider the role that city governments play in urban socio-technical transitions. They argue that urban transitions need intermediary organizations to help negotiate between different interest groups and often this role is taken on by the city. From this perspective, the political landscape is not exclusively external as city governments have a range of policy tools available to promote or hinder a transition. Considering the role of governments in shaping transitions and the role of politics in shaping the landscape are valuable additions to the MLP in building the conceptual framework for this research.

2.1.2. Strategic niche management theory and upscaling processes

The second important theory used in this research is strategic niche management theory. SNM theory investigates specific factors within the niche which are assumed to be crucial in the scaling-up of the niche innovation. The basic assumption of SNM theory is that innovation journeys emerge from technological niches which allow nurturing and experimentation with the co-evolution of technology, user practices, and regulatory structures (Schot & Geels, 2008). Scaling up can be seen as the process whereby a constituency forms around the new technology and the niche grows in scale, scope and intensity (Kemp et al., 1998). An important process for scaling up is niche nurturing which involves three important steps: shaping of expectations, learning, and networking (Schot & Geels, 2008). Thus, SNM theory specifies the key processes that determine the success of the niche (Geels & Raven, 2006; Weber et al., 1999):

1) the formation of a broad and aligned network of niche actors;
2) actors have developed similar, or at least converging expectations about the future of the niche;
3) learning processes aimed at finding solutions for overcoming barriers to the development and introduction of the niche innovation.

The three niche processes are explained in more detail below.

Network formation

Networking contributes to create alignment inside a niche and reduce complexity, investments, risks and uncertainty (Weber et al., 1999). Interactions between actors both within and outside the niche combine to form social networks made up of producers, users, policymakers and other interest groups (Ruggiero et al., 2018). Smith (2007) states that an influential niche recruits a broad network of actors in support of its socio-technical practice and the future regime it suggests. In the early stages of niches when experimentation takes place, the social networks are smaller and connections weaker. As niches develop, the network may experience a more stable form. Weber et al. (1999) highlight the importance of coordinating the participation of this diverse set of actors from the very beginning. A network manager is needed to guide and drive the network around the niche as they serve the function

of interconnecting activities, facilitating exchange of information, and elevating debate over niche technology to a higher (political) level. Caniëls and Romijn (2008) also draw attention to the role of users in the network – they should be considered more than just sources of market information.

Learning processes

Learning serves the function of finding solutions to overcome barriers that prevent an innovation from functioning properly (Mourik & Raven, 2006). It can be described as a process wherein different actors across society develop new ways of thinking (culture), doing (practices) and organizing (structure) (van Den Bosch & Rotmans, 2008). In other words, the aim of learning is to contribute to a transition. Learning processes are concerned with both the development of knowledge needed for the innovation to succeed as well as processes through which the knowledge is spread among the different actors (Geels & Raven, 2006). Learning includes gaining insights about technological characteristics and performances, the economic feasibility of the new solution, as well as any institutional and policy changes needed to stimulate further niche growth (Smith, 2007). Schot and Geels (2008) specify that in order for niches to be successful, two types of learning processes need to occur. First order learning is concerned with the immediate surface features of a socio-technical practice. Second order learning takes a deeper look at the underlying values and assumptions of the practice.

Expectations

The shaping of expectations is an important aspect of niche development because it attracts attention from other actors and provides direction for learning processes (Geels & Raven, 2006). Expectations can contribute to successful niche development if they are shared, supported by facts and experience, specific and coupled to certain societal problems which the existing regime is thought to be unable to solve. (Kemp et al., 1998) Convergence into robust expectations is assumed to result in a common and coordinated strategy for the future development of the niche (Mourik & Raven, 2006). Through expectations, actors define the envisioned niche innovation's role in the wider regime (Kemp et al., 1998). Expectations are help construct a shared research agenda and to guide learning processes (Mourik & Raven, 2006). Furthermore, they attract attention and resources from other actors (Geels & Raven, 2006).

Thus, strategic niche management theory provides us with a handy summation of factors expected to give rise to the scaling up of innovations. This theory aims to illustrate the three niche internal processes (learning processes, building of networks, articulation of expectations) and their impact on the resulting innovation journey. Shared expectations contribute to the forming of a broader network of actors in the niche. They also provide direction for a shared research agenda and thus contribute to the learning processes. The lessons from these learning processes in turn are shared within the network. If the results of the learning processes match the established expectations, a new cycle is initiated that enables further refinement of the shared rules and expectations.

2.2. Car sharing

The growth of popularity of shared mobility systems has been observed in cities around the world. Carsharing (or short-term auto use) is one of these innovative transportation solutions and appeared in Europe as early as in the 1940s, although it did not become particularly popular until the early 1990s (Shaheen & Cohen, 2007). Since then, car share use has grown, and different types of car sharing, business models, technologies (e.g. automated or electric) have emerged.

One of the first recorded experiments with car sharing in Europe is that of a cooperative called Sefage (derived from the German 'Selbstfahrergemeinschaft' translating to 'self-driver community') from Zurich, Switzerland, which operated from 1948 until 1998 (Shaheen & Cohen, 2007). This initiative was motivated by affordability and provided a way for those who could not afford a personal car to use a shared one instead. The mid-1980s saw several commercially successful projects launched elsewhere in Switzerland and Germany as well. By 2018, car sharing had reached 47 countries and around 32 million members sharing over 198,000 vehicles (Shaheen & Cohen, 2020).

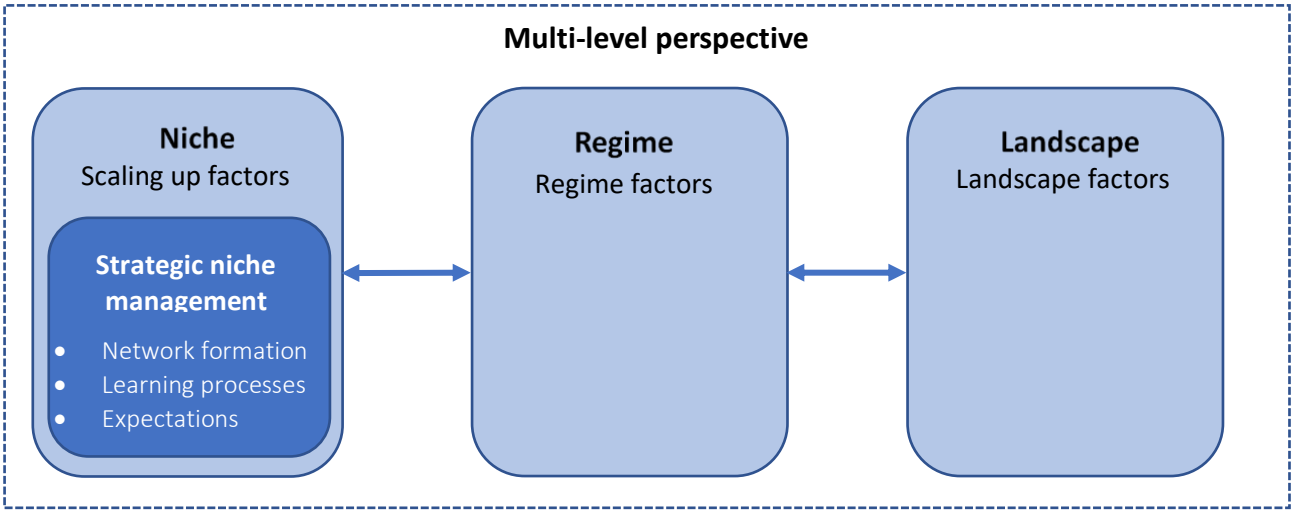
Several types of car sharing business models can be distinguished. In peer-to-peer (P2P) carsharing, private car owners temporarily rent out their cars to other users when not needed (Ballús-Armet et al., 2014). The platform for matching drivers with cars as well as additional services like insurance, is provided by a P2P car sharing organization, such as Snappcar in Europe. The second type is business-to-consumer (B2C) car sharing which provides a service where users can access a car owned by the provider on a temporary basis (Münzel, 2020). An important recent development is the emergence of one-way car sharing systems. Compared to traditional car sharing models where users return the car to where they collected it, one-way car sharing systems allow users to leave the car at defined places (one-way), sometimes even at any free parking space within a certain area (free floating) (Burghard & Dütschke, 2019).

There is a growing body of empirical evidence for the numerous social and environmental impacts of car sharing. However, as Shaheen and Cohen (2007) report, results from these studies are not always consistent, which has to do with differences in data collection and study methods, limited data samples and location-specific factors. Most of the evidence on the impacts of car sharing services concerns to the role of car sharing practices on car ownership and use, together with their impacts on environmental emissions and congestion. Shaheen et al. (2009) provide an overview of 10 years of carsharing experience in the US and Canada and include a summary of studies which showed that 15% to 32% of carsharing members sold their personal vehicles, and between 25% and 71% of members avoided an auto purchase because of carsharing. A study in the Netherlands found 30% less car ownership amongst car sharers and they drove 15% to 20% fewer car kilometres than prior to car sharing (Nijland & van Meerkerk, 2017). According to the study, shared cars mostly replaced a second or third car. Car sharers emitted between 240 and 390 fewer kilograms of CO2 per person, per year. This is between 13% and 18% of the CO2 emissions related to car ownership and car use. On the social side, Firnkorn and Müller (2012) explain that "car sharing challenges much of the subjectivity inherent to car ownership as a mode of self-expression, "selling mobility instead of cars"".

2.3. Conceptual framework

Figure 2 shows the conceptual framework for this research. This framework visualizes the theories, the factors which are looked at in this research and how they relate to each other

Figure 2: Conceptual framework



The multi-level perspective consists of the three analysis levels: niche, regime and landscape. The strategic niche management approach focuses on the dynamics within the niche level. The aim is to analyse the potential of scaling up in the context of transitions, considering both the dynamics of the conditions which produce the change and the level of change. By analysing developments at every level, insights can be gained in assessing the factors at niche level which contribute to the niche scaling-up, and possible barriers of the implementation and development of the argued scaling-up phase. This conceptual framework forms the basis for this research. It delivers the theoretical background for the upcoming case studies. This will be explained in the next chapter…

3. Methodology

This section explains the methodology of this research.

3.1. Research methods

This research uses qualitative research methods. The observed processes occur in a social context with various different actors. Qualitative data is suitable for exploring social phenomenon because this type of data allows for the most nuance in expressing and describing social processes from a multi-actor perspective. The first stage of the study follows the following five steps for literature research (Punch, 2014):

1) searching;
2) screening;
3) summarising;
4) organising (or analysing, synthesising);
5) writing.

Various online databases and libraries have been used in the literature search (1), such as SAGE Journals, Elsevier's Science Direct and Taylor & Francis. The terms used in the search can be found in Table 1.

Table 1. List of key terms used in the literature search

Theoretical concepts	**Research on shared mobility**
Transition	Shared mobility
Sustainability transition	Smart mobility
Multi-level perspective	Car sharing / carsharing
Strategic niche management	Impacts
Upscaling / scaling up	Success factors
Governance	

Found titles that were deemed relevant were then screened (2) further based on the abstract/summary and assigned a concept tag based on the research approach or subject. If articles were considered irrelevant, the references were searched for other relevant literature. This is known as the snowball method used in empirical research when sampling is made through referrals (*Information Literacy History: Search Methods*, n.d.). The next step involved summarising the articles (3). Within each concept group, articles were analysed and synthesized in order to gain a more complete and focused picture of the theoretical concept (4). This led to the final step of writing (5). Throughout the process, snowballing was applied whenever additional information was needed.

3.2. Case study

In addition to the literature review, further background information is gathered in the form of document review with publicly available information about the city of Utrecht's mobility agenda, specifically the role of car sharing. The '*Strategie Smart Mobility 2040*' and *'Plan van aanpak autodelen'* are the two main documents. Although the policy documents mentions car sharing as a tool to achieve several goals that the city has set itself in the framework of Healthy Urban Cities, it offers no specific (quantifiable) goals for this mode of transport, therefore further information from experts in the field is required.

3.3. Data collection and analysis

The second stage of the research involves gathering data. The main data collection method employed was semi-structured interviews. The interviews were conducted with key stakeholders in the process. Semi-structured interviews were chosen because this method allows for enough flexibility to consider and adapt to each subject's specific role in the process. A short-list of candidates was produced based on research and with the help of the supervisor and contacted via email to arrange interviews. The interviews followed a similar pattern and employ the same template for questions, however, room was provided for any additional comments and information that may be relevant. The interview guide was built based on the developed conceptual framework and touched upon the factors that have been identified in the literature review as important in scaling up car sharing in the city. The interviews were be recorded, transcribed and coded using the software Nvivo. The coding used was determined with the help of insights from the theoretical framework. The results were analyzed and conclusions and recommendations drawn.

3.3.1. Interviews

Interview were conducted with stakeholders in the car sharing niche from the period of May to July 2021. All interviews followed a semi-structured interview guide. A basic set of questions was worked out beforehand based on the conceptual framework developed in the theoretical chapter. The interview guide is presented in *Appendix A*. The questions were intended to be conversational, general and open-ended. Other questions were created during the interview providing both parties flexibility to probe for details or discuss issues (Keller & Conradin, n.d.).

The snowball sampling method was used to find other interview candidates which involved asking the interviewee if they knew other important actors to speak to (*Information Literacy History: Search Methods*, n.d.). The interviewees were considered as representatives of their respective actor groups. The actors chosen for interviews were the municipality of Utrecht, car sharing operators, the Ministry of Infrastructure and Water Management, and external consultants in the field of mobility as presented in Table 2. In the interview with the latter, two respondents were present.

Table 2. List of interview participants

ID	Organization	Role
#1	Municipality of Utrecht	Policy Advisor, Smart and Shared Mobility
#2	Municipality of Utrecht	Manager, Smart and Shared Mobility
#3	We Drive Solar	Founder
#4	Greenwheels	Network Manager
#5	Amber	Network Manager
#6	Ministry of Infrastructure and Water Management	Program Manager, MaaS
#7	Goudappel	Public transport advisors

For car sharing operators, the number of interviewees is higher than other actors and this is due to the fact that these providers operate under different service models and their market share in Utrecht varies as well, so it was important to get different perspectives. It is also important to note that one actor is not included in the interviews, namely the users. Although users are definitely an important actor in the car sharing niche, user viewpoints and preferences fall outside the scope of this research as the focus has been placed on the governance aspect of scaling up car sharing.

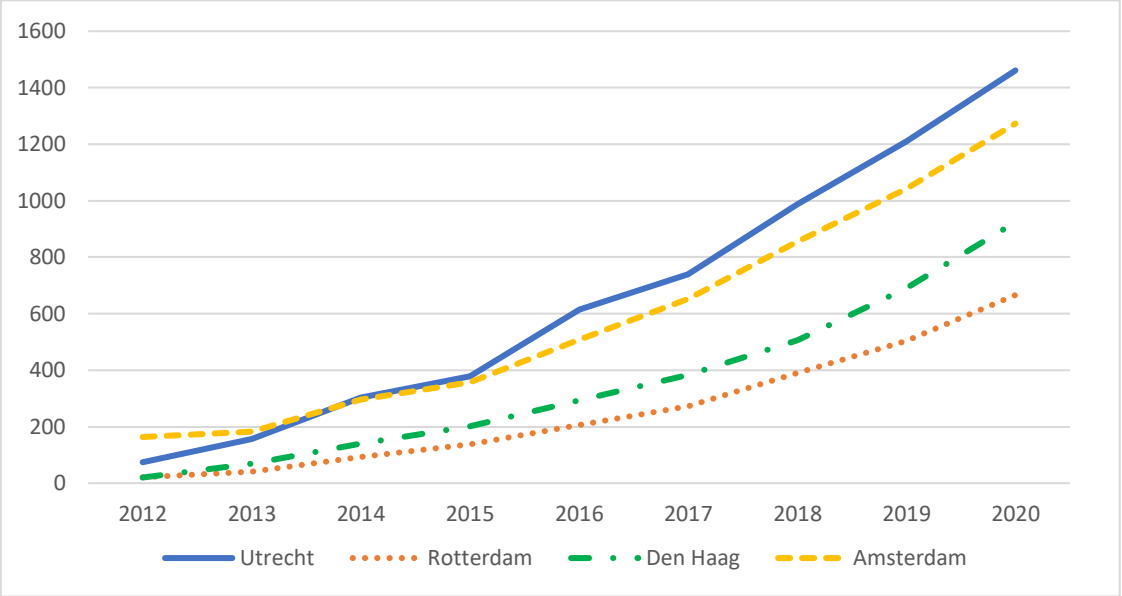
3.3.2. Coding

All interviews were transcribed and then coded. Coding refers to the process of identifying segments of meaning in your data and labelling them with a code (Linneberg & Korsgaard, 2019). Coding helps reduce large amounts of empirical material into bits accessible for analysis. The theoretical framework of this research was converted into the initial code structure. This is known as deductive coding whereby the codes are theoretical concepts or themes drawn from the existing literature (Linneberg & Korsgaard, 2019). The created code tree can be found in *Appendix B.*

4. Case study – Utrecht

Over the past several years, the number of shared cars has increased significantly in the four largest cities in the Netherlands. As shown in figure 3, Utrecht is the leading city by number of shared cars per 100 000 inhabitants (1,461), followed by Amsterdam with (1,273) (CROW-KpVV, n.d.). As of March 2020, there were in total 5,225 shared cars in use in the city, which was a 23% increase from the previous year. Carsharing is recognized by the municipality as an opportunity because the growth of the city (expected to reach 400 000 citizens by 2025) requires new approaches to mobility (Gemeente Utrecht, 2017).

Figure 4: Number of shared cars per 100 000 inhabitants



Source: CROW-KpVV, n.d.

In 2017, the municipality published a document titled '*Plan van aanpak autodelen*' as part of the action plan '*Schoon Vervoer 2015-2020*' outlining the activities planned for further stimulating the use of car sharing. Carsharing is positioned with activities from the field of Mobility as a Service (MaaS). In 2017 an expert session with participants from e.g. Utrecht University and various carsharing companies was organized, the result of which was the drawing up of a number of new measures with a focus on finding solutions within the existing city and small-scale new developments. For larger scale new development sites such as the Cartesiusdriehoek, the municipality identified the possibility of offering residents guaranteed (shared) mobility by creating multimodal mobility hubs, as a first step on the way to implementing MaaS in the city's mobility solutions.

New measures to increase car sharing in the city were introduced under three categories: removing barriers, communicating and stimulating. For example, one goal was to make the concept more familiar to new users by experimenting with introducing a shared mobility hub to the city (Gemeente Utrecht, 2017). In the following years, several mobility hubs have been created in the city which offer different modes of transportation including shared cars. On the side of communication, successful campaign titled 'Utrecht Shares' was ran in 2017 with two shared car providers in a couple of neighbourhoods in order to raise awareness of the car

sharing possibilities through social media and letters to residents. The city has also identified so-called life events of residents as potential targets for promoting car sharing, for example, by prompting real estate agents to name benefits of carsharing during the process of selling a house, especially if the neighbourhood has a high parking demand. Another stimulating measure is the scheme '*Spijtoptantenregeling*' wherein residents can hand in their parking permit in exchange for car sharing credit. This program has previously shown good results in Amsterdam.

In 2020, the city published the Smart Mobility Strategy which also mentions shared mobility. The city has identified smart mobility as an innovator and accelerator, necessary to achieve the desired transition towards a more efficient and sustainable mobility system (2020). This strategy outlines the ways in which smart mobility will be used to achieve the city's goals as outlined in the policies '*Ruimtelijke Strategie Utrecht'* (RSU) and '*Mobiliteitsplan 2040*'.

The Smart Mobility Strategy has identified three necessary transitions to achieve the set ambitions:

1. From passive to active mobility – putting walking and cycling even more central. Active modality is more space efficient and healthier. Central areas are seen to still have a lot more potential for walking.
2. From ownership to use – shared mobility stays central in achieving this transition. More sharing means more efficient use of space and fewer still standing vehicles. This also includes developing mobility hubs and a digital infrastructure (MaaS).
3. From static to dynamic use of space – not only can modalities be shared, but also public space can be in dynamic use. The strategy concludes, however, that multifunctional/multi-use space concepts still need further investigation and development in Utrecht.

In 2015, the first '*Green Deal Autodelen*' was signed, a covenant between governmental organisations, private partners and knowledge institutes to promote and increase carsharing as alternative sustainable mobility. In 2018, the covenant was renewed, aiming to reach 700.000 users and 100.000 shared cars by 2021. The first goal has been reached in November 2020, but the second is still to be achieved (CROW, 2020).

5. Results

In this chapter, the results of the analysis are presented. The structure of this section follows the order of the four sub-questions in this research. First, the impacts of external landscape pressures and developments in the city's mobility regime on car sharing are presented. Then, each of the three niche internal processes (network formation, learning processes, expectations) are analysed in order. At the end of each section, an interim conclusions for each factor is presented.

5.1. Landscape factors

The interviews revealed that climate change is the most important landscape pressure impacting the growth of car sharing niche. Car sharing was viewed by interviewees as a solution that attracts consumers that have a higher awareness of the negative effects of cars on the environment. Environmental concerns were seen an important motivation behind people's choice to give up their private car (or not purchase one at all) and start with car sharing. From the companies' perspective, Utrecht citizens are increasingly aware of these negative effects and are seeking more sustainable solutions to their day-to-day mobility. One electric car sharing operator explained that in addition to the switch from owning a car to sharing one, another important environmental transition is from fossil to electric:

"*We see a lot of demand, especially for electric car sharing because driving fossil cars is becoming more and more out of touch with reality. We see a lot of people who want to switch to electric mobility but that is quite expensive if you want to lease an EV*." (Respondent #3)

Respondents from the public sector revealed that sustainability is an important aspect in all city policies, including mobility. In Utrecht's approach to mobility, minimizing the car's share in the city's modal split is an important goal. Car sharing was seen as a mobility solution that can curb the increase of car traffic in the city, in line with their principle of promoting active and sustainable mobility.

Also, the ongoing COVID-19 pandemic was mentioned as an important development which has drastically affected people's mobility habits and choices:

"*We see that due to COVID people are asking themselves why they have 2 or 3 cars in their household when they are not being used that much. Many people are selling their cars and using car sharing instead*." (Respondent #4)

To conclude, all landscape pressures mentioned were seen to be positively affecting the scaling up of car sharing. On one hand, environmental concerns affect consumers' mobility choices by discouraging private car use and ownership; on the other hand, they are also an important motivation behind the municipality's active approach to promoting the scaling up of car sharing the city.

5.2. Regime factors

For regime factors, interviewees were asked the most important developments in the Utrecht mobility regime that have an effect on car sharing. Respondents from the municipal and national government levels cited mainly urban policy goals such as sustainable, active mobility and improved quality of public space. The city's ambition to achieve these goals at least partially through shared mobility is reflected in all mobility plans and strategies as well as echoed by the interviewees from national and municipal government. As one interviewee explained, for the first time, shared mobility is among the words that are constantly mentioned in mobility discussions: walking, biking, public transport, and the car – shared mobility is now listed between public transport and the car. This signals a shift *at least in the perception of the city's mobility regime by stakeholders on the government level*.

Furthermore, Utrecht is estimated to receive 100 000 new people and 85 000 new jobs by the year 2040 so the growth of population in the limited space available was seen as a crucial issue to address.

"In Utrecht over the past years in policy we have seen that we do not have that much space, that has led to us stimulating active mobility and reducing the amount of cars in the city – so this has stimulated the growth in car sharing as well." (Respondent #1)

These estimations are also mentioned in the '*Mobiliteitsplan* 2040' and they support the necessity of the three transitions which the city aims to achieve, as explained in the previous chapter: from passive to active mobility, from ownership to use, and from static to dynamic use of space. Car sharing is seen as a solution that directly impacts the latter two of the transitions – ideally, if people give up their private car and take up car sharing, less space is needed for parking spaces and that space can be used for other purposes:

"Over 25% of the cars in Utrecht are used less than 3 times a month which means that if we can get those cars out of the city (over 30 000 cars) then we create 52 football pitches worth of space in the city, for increased liveability, for other functions, which I think is very impressive." (Respondent #2)

Car sharing operators confirmed that the mobility regime in Utrecht has shifted over the recent years to provide an opportunity for car sharing to grow. One respondent stated that the proactive approach taken by the municipality has positively impacted the growth of car sharing and described the recent change in attitude as follows:

"*We see that the municipalities are really asking for car sharing because they see the trouble they have with parking and space. So that is a big change, because in the last 10 years the initiative was coming more from us. […] Now they even ask us to place cars and offer parking permits in some places, so that really helps*." (*Respondent* #4)

Furthermore, car sharing operators observed a shift in the city's mobility culture. High costs of parking in certain parts of the city were seen to discourage private car use and ownership. Coupled with the increasing number of shared mobility types and service providers available,

this has provided an opportunity for car sharing to become a more obvious choice for modality.

Interim conclusion landscape and regime pressures

Developments in the external landscape and current mobility regime were seen as encouraging the scaling up of the car sharing niche. Climate change was considered the most crucial factor in the landscape. It affects consumers' mobility choices by discouraging private car use and ownership. It also steers cities towards designing more sustainable systems of mobility where the car plays a smaller role. To cope with an increasing population while curbing car use in the city, the city has identified three necessary transitions in mobility: from passive to active mobility, from ownership to use, and from static to dynamic use of space. Car sharing has been identified as a tool that can contribute to achieving these transitions and therefore the city has assigned it a bigger role in their future mobility plans. It can be concluded that factors outside of the niche are considered mainly positive and may point to a possible regime shift in favour of car sharing.

5.3. Network formation

Network formation category of factors relates to extent to which a broad and aligned network of niche actors has formed. Two elements of network formation are distinguished. Composition of the network explains the types of actors that the network consists of and degree of collaboration between them. Market formation specifies the extent to which a network of users and suppliers has developed around the niche.

5.3.1. Composition of network

The most important stakeholder mentioned by car sharing companies was the municipality. All three of the operators described a close working relationship with the city government and to a lesser extent with other commercial parties such as supply or service partners. The partner most crucial for success was the municipality and that is due to necessity, as permits are needed to place shared car in paid parking areas. Other partners mentioned were those involved in research and (vehicle) technology development, but as one operator explained it:

"A lot of these partners you can get rid of eventually but it's just an easy way to scale up or to use their tech to set up your fleet or collaborate with leasing partners – but these are not really vital for your company […] The most important partner is the city." (*Respondent* #5)

The respondents from the national and municipal government levels mentioned a much broader network of stakeholders and collaborators than the car sharing operators. Whereas operators viewed the network as mainly consisting of single lines of communication between operators and the municipality, the municipality described a much larger network of collaborators and initiatives that have formed around car sharing over the last years. The municipality mentioned working together with other municipalities as well as with the Ministry of Infrastructure and Water Management. The '*Green Deal Autodelen*' was mentioned by municipal and national government level respondents as a positive initiative which has brought the sector together to share knowledge and discuss common issues.

Furthermore, the interviewed mobility consultants mentioned the initiative '*Krachtenbundeling Smart Mobility*' which brings together the central government, provinces, G5 cities, metropolitan and transport regions to share knowledge. The goal of the initiative is to arrive at a joint approach for smart mobility and to embed this in the regular working method.

5.3.2. Market formation

With regards to the extent of which a market has formed for car sharing in Utrecht, two rough distinctions can be made: customer market and supplier market. The interviews revealed a general consensus that car sharing in Utrecht is no longer in the experimentation phase but that its user base has not yet managed to reach further from the early adopter stage. Of the current state of the market, one operator said:

"*There are all kind of little and bigger companies trying to get their spot in the mobility market, so it's really growing. I think it's a bit of chaos period where a lot of players show up, and in a later stage, later in approx. 3 to 5 or maybe 10 years some consolidation will take place and a few big players will grab up the market*." (*Respondent* #5)

Utrecht was seen as a well-performing and growing market by interviewed operators and policymakers. With regards to the user base, two of the operators stated that currently one of the main demographic groups among their customers are young adults between the age of 25 and 35. The third operator stated that they have a wide range of users and do not focus on targeting a specific demographic group. Higher educated people, singles and students were also mentioned as forming a significant portion of the early adopters of car sharing. Young adults were often mentioned as being seen as an attractive user group because they are less likely to own a car. Several interviewees mentioned the changed attitudes, especially among young adults, on how it has become "normal" to not own a car in the city.

Furthermore, as the number of car sharing operators in the market has increased over the past years, so has the supply of vehicles on the streets and, through that, familiarity with the concept of car sharing and willingness to try it out. Respondents seemed to agree that car sharing in Utrecht can be expected to grow even more and that there is still an untapped demand in certain segments. One operator cited high occupancy rates of current vehicles and the number of requests from customers for new locations for cars as positive signs that confirm this expectation.

As for the supplier market, in this case there is not so much a supplier market formed around car sharing but rather the type of relationship an operator might have with such partners depends on the car sharing company. As the car sharing niche depends mostly on the supply and service network that already exists for private cars and is seen to be sufficiently developed, this was not seen as a crucial issue for scaling up.

Interim conclusion network formation

Differences can be observed between the actors' perspectives on the composition of the car sharing network. Car sharing companies viewed the network mainly as a set of relationships

between themselves and municipalities where they operate. The municipality described a broader network with collaboration between actors through initiatives on a national scale. Users or communities were not mentioned by any of the respondents. The most important stakeholder in the network is arguably the municipality as they issue the permits that companies need to place their cars on the streets. The car sharing market in Utrecht is no longer in the experimentation phase but its user base has not yet managed to reach further from the early adopter stage. Nevertheless, all stakeholders agreed it can be expected to grow even more and that there is still an untapped demand in certain segments.

5.4. Learning processes

Learning processes refer to the development of knowledge needed for the innovation to succeed as well as processes through which the knowledge is spread among the different actors (Geels & Raven, 2006). In this section, the extent and ways in which knowledge is shared within the niche are described, followed by the most important learning processes in technology, society and policy.

5.4.1. Knowledge development and diffusion

The extent of knowledge sharing within the car sharing network was assessed to be in general on a relatively high level by most respondents. The '*Green Deal Autodelen*' was mentioned by national and municipal level interviewees as an important network in which stakeholders like municipalities and car sharing operators come together and share knowledge. For smaller municipalities who have less experience with car sharing, these interactions were seen as valuable in that they can learn from other cities and their experience. Practical issues discussed between municipalities included learning about how to draft appropriate policies and procedures around car sharing as well as what to do when there are too many competitors in a city. One specific example was a successful communication campaign about car sharing from Amsterdam which Utrecht is planning to replicate in their city. It was stated that companies also discuss common issues like insurance, prevention of crime and abuse of shared mobility, as well as situations when there have been hacker attacks on the technology or data leaks.

The operators expressed a different opinion on knowledge development and diffusion in the car sharing sector in the city. Formal networks such as the '*Green Deal Autodelen*' were not mentioned by companies when asked about knowledge sharing within the network. Rather, companies listed actors they work together with for operational questions, such as with the municipality regarding permits or other location-specific issues. Two of the companies also reported working together with other institutions on technology development. For example, one operator explained that they are working together with the research organization TNO on battery technology and with one major car manufacturer on autonomous driving technology. The third operator expressed that there was not much knowledge sharing taking place but that they would like to be more involved in research.

Regarding knowledge that is currently missing in order for the sector to grow, the main topic mentioned by interviewees was knowledge about car sharing users. The municipality respondents expressed that the city does not currently have any data about the use of shared

cars in Utrecht, other than the number of permits issued to companies, as companies are not required to share it under the current collaboration model. Therefore, it is difficult to assess the success of car sharing policies and to determine new areas for growth. The companies collect data on the use of their cars, so they are able to make analyses about trends in their own fleet. But due to the fact that there is no aggregate overview for the whole city, even operators do not know how big the market is and also, what the impact of car sharing is, for example, on people's travel behaviour or the climate. This makes it complicated for companies and the government to promote car sharing as a sustainable alternative to the private car, as it is often advertised, when there is no data to refer to on the actual impact from a sustainability perspective.

In addition to how people currently use car sharing, another important question mentioned by both companies and the municipality was how to grow and bridge the gap from the early adopters to the masses. In this question, respondents agreed that data on current shared car usage is not enough and that more research is needed on the motivations and triggers that make people give up their private car and start car sharing:

"*We are still learning more and more about what makes people start car sharing and what are people struggling with, what makes them hesitate to start. That answer is still not completely clear, […] we're not sure what works best*." (*Respondent* #1)

As one respondent from the municipality explained, another one of the issues that the city hopes that car sharing can address is transport poverty, as it can be cheaper than owning a private car, but very little is known about potential users outside of the so-called car sharing "hot spots" currently in the city. Therefore, is not clear how to make those other areas more attractive for car sharing operators.

5.4.2. Technological development and infrastructure

With regards to learning processes related to technology, the most mentioned development in recent years is the growth of information and communications technology. Advancements in these technologies have enabled car sharing to grow to the level that it is today, and further advancements were seen by respondents to help make the service even better and easier in the future. As one respondent explained, digitalization has made it possible to introduce zone floating car sharing into the city:

"*In the past we worked only with reserved parking spots so that people knew exactly where the car was […]. Now we see more and more cars that are zone floating, so there's no reserved spot, you know that the car is in a certain zone and when you need it you can see on your phone the exact location, which will make it a lot easier and I think in the next few years that will be even more prevalent*." (*Respondent* #1)

Another important learning point mentioned by two of the operators was regarding the technology needed to monitor and analyze data collected from the fleets. One of the car sharing operators interviewed explained that in order to provide a level of service that eventually has the potential to be better than the private car, they needed a platform that would constantly monitor the fleet, assesses the demand for mobility and match that with

the supply. The company developed this algorithm inhouse as there did not exist anything for this purpose yet. In addition to managing the supply and demand of the fleet, this data is also used to gain valuable insights into the market and usage of cars. Another respondent from a car sharing provider who currently only operators with the station-based concept expressed that with the technology available in the next years they hope to offer a mix of station-based and zone floating cars. A challenge for them will be to find a way to know where exactly each of the cars is at any given moment and translate that to the customers.

Most respondents also mentioned the advancement of electric car battery technology as an important element affecting car sharing. Operators expressed the importance of staying on top of recent technological trends in vehicle technology and as electric cars become more and more popular, their fleets need to adapt accordingly. Two of the interviewed companies already operate a fully electric fleet, which was seen by both as an advantage. One of these respondents explained their decision to focus on 100% electric car sharing:

"*We decided to do this already 5 years ago as we saw that the entire car mobility would become electric, so it's good to have a seat there and have an advantage over competitors. I think electric car sharers will be the winners. It's a completely different kind of service you need to provide, it's not just replacing your fossil fuel car with an electric car*." (*Respondent* #3)

The municipality expressed ambitions to require an all-electric fleet from car sharing operators in the near future, however, at the time of the interviews no agreement had been reached as to the intended deadline. The municipality explained that they want that target to be ambitious yet realistic:

"*For car sharing companies which still have a lot of fossil-driven cars on the streets. But also for the users, because when you own a car and you decide to use a shared cars, it's a big step – but even bigger if you drop your fossil car for an electric one*." (*Respondent* #2)

While the third operator agreed that electric cars will be a huge development in the car sharing sector, they also expressed uncertainty over how long the transition to an electric fleet might take. One major concern was that electric cars are quite different from fossil cars in costs, operation and technology and as such require considerable investments to adjust. Furthermore, car sharing providers rely on the sufficiency of the charging infrastructure in the city to be able to support the electric fleet. In Utrecht, the municipality uses data from existing charging stations to determine if and where new charging points should be added. However, operators cannot significantly increase the supply of electric shared cars before the sufficient number of charging stations are available.

Another important development affecting car sharing currently is the growth of MaaS concepts. Most respondents agreed that MaaS platforms would make it easier for users to navigate between different mobility options, including the numerous car sharing companies. As one respondent explained it:

"*It is quite complex that you have to sign up for each operator, check which one is available in your neighbourhood, which one will suit you best, etc. – if these different operators work*

together with MaaS operators, it will make it much easier for users because you then only have to sign up with one party." (*Respondent* #1)

5.4.3. Societal learning

Interviews revealed that the most crucial determinant of success for car sharing from the perspective of societal learning is how people feel about cars and more specifically, how willing people are to get rid of their car. On one hand, companies and government respondents both agreed that it has become more accepted, especially among the younger generations, to not own a car in the city. This is due to several reasons, such as high costs of parking in the city and the relatively well-developed public transport system. More recently, the COVID-19 pandemic has left a lot of cars standing still in their parking spaces on the streets as daily commutes to the office were paused. On the other hand, Netherlands is still relatively high in car ownership, and this is seen an obstacle for car sharing to really grow. As one respondent from the municipality explained, many Dutch people feel that it is a right to own a car and to park it in front of your house on a public street.

The second most important aspect was familiarity with and trust towards car sharing and this was also seen as having increased significantly in recent years. As car sharing steadily grows in the city, so does the public's awareness of this as an alternative to the private car. As a potential indicator of societal readiness to embrace car sharing, two respondents referred to different studies done in the Netherlands that had looked at people's willingness to get rid of their (second) car:

"*Around 7% of people said that within 2 years they plan to get their private car out, which doesn't look that much, but if this happens every 2 years and we can provide them with good alternatives, that will make a huge difference.*" (*Respondent* #2)

Nevertheless, respondents stated that many people still are not aware of car sharing, or might recognize only the bigger operators' cars on the streets. Communication around car sharing could be improved, both on a municipal and national level.

5.4.4. Policy and regulatory framework

On the subject of policy and regulatory framework that affects car sharing, the interviews revealed several policy areas where changes are needed in order for car sharing to scale up. Unlike many smaller municipalities, Utrecht already has a car sharing policy and process for issuing permits in place. However, in thinking of what is needed to significantly scale up car sharing in the city, the main question that respondents returned to was how to disrupt the car-dominated regime and make car ownership less attractive.

Respondents from the municipal, national and company level all mentioned restrictive policies as an important tool in curbing private car use. As one respondent explained, the private car is a very easy and convenient mode of transportation and it is difficult to get people to break from their mobility habits – it is not enough to have an excellent supply of alternatives available, an additional incentive is needed to make the private car less attractive than those alternatives. Higher costs of parking, limiting the number of parking permits issued

per household, and restricting car access in the city were the restrictive measures mentioned in interviews. Whether such measures will be implemented or not, depends a lot on the political climate in the city, as one respondent explained:

"*The thing is, politicians need to decide. And you need a brave politician to restrict car use*." (*Respondent* #2)

In addition to restrictive measures to discourage car ownership, three of the interviewees also mentioned the importance of aligning the parking policies in the city with car sharing policies. One respondent from the municipality confirmed that car sharing does indeed play a bigger role in the new parking policy scheduled to be discussed in the city council in the summer of 2021. In the new policy there is a rule that developers of new housing areas can replace a certain number of private car parking places required with a parking spot for a shared car. This was seen as a positive development that can have a major impact on the mobility habits of new residential areas.

The interviews also revealed some criticism with the current car sharing policy. In the current system, companies apply for a permit at the municipality to place their shared car on a specific paid parking spot in the city. In the interviews it was revealed that the municipality is working on developing a new model for collaboration with car sharing operators as the current model has been found to be lacking in certain areas. As one respondent from the municipality explained, the permits that are currently issued to car sharing companies have no expiration date, meaning once an operator has claimed a paid parking spot for their car, they can hold on to it forever. The current car sharing policy dates to 2007 when there were fewer competitors in the city. Now the municipality wants to change that, to ensure that there is competition and users get the best proposition. They would also like to have more say in the future on where in the city and which operators get the permits. One possibility considered is that in the new system, operators would need to meet certain requirements in order to receive the permit:

"*They really don't have too many rules to comply with and that is something that we want to change with the new cooperation model, so that we can require from them that they have more electric cars or that they work together with MaaS operators, for example*." (*Respondent* #1)

This dissatisfaction with some aspects of collaboration with the municipality was confirmed by two of the car sharing operators. Companies expressed the desire to grow swiftly and place more cars in new locations quicker, but due to the processes from the municipality's side they are not able to move as quickly as they would like. One respondent stated that responses to requests often take too long and this was thought to be due to unavailability of staff:

"The first problem is that they are busy and don't have immediately the time to look at your request, so that may take 3-4 weeks […] Some locations are not always accepted […], which takes another 2 or 3 weeks. And then once approved, we have to wait 6 to 8 weeks for customers to give objections." (Respondent #4)

Another barrier to scaling up car sharing mentioned by one company was that the current car sharing policy does not allow for one-way trips, for example, from another city to Utrecht or even from one parking region to another within the city. They argued that there is a big need for one-way trips from users but they are unable to provide this service due to the differing parking rules. One respondent from the municipality confirmed that in order for car sharing to grow outside of the city limits, they need to work more together with the province.

Interim conclusion learning processes

The level of knowledge sharing was generally considered to be on a good level, although the types of learning actors are most involved in differ between the stakeholder groups. Car sharing users, their travel patterns, and impacts of car sharing are important topics where more understanding is needed. Another crucial question is how to bridge the gap from the early adopters to the masses. In this question, respondents agreed that data on current shared car usage is not enough and that more research is needed on the motivations and triggers that make people give up their private car and start car sharing.

Regarding technological learning, advancements in ICT technologies have enabled car sharing to grow to the level that it is today, and further advancements were seen by respondents to help make the service even better and easier in the future. Advancement in electric vehicle technology is another important development– as they become more popular, more shared electric cars can be expected on the streets. However, it is not clear how long the transition to an electric fleet might take as this is not only a big step for companies, but for users as well. The charging infrastructure in the city also needs to be able to support an electric fleet.

A crucial determinant of success for car sharing from the perspective of societal learning is how people feel about cars and more specifically, how willing people are to get rid of their car. Netherlands is still relatively high in car ownership, and this is seen an obstacle for car sharing to really grow. Second important factor is awareness and familiarity with the service, which, although it has grown over the last years, is still not at the highest level. Communication about car sharing could be improved on both a municipal and national level.

On what is needed to significantly scale up car sharing in the city from a policy perspective, the main question is how to disrupt the car-dominated regime and make car ownership less attractive. Restrictive policies such as increased parking tariffs are an important tool in curbing private car use. Parking policies also need to be aligned with car sharing goals. The current system allows for little flexibility in use of shared cars as only station-based and zone floating concepts can be offered.

5.5. Expectations

The results reveal that expectations regarding the growth of the niche vary among different stakeholder groups. Although all respondents believed that car sharing in Utrecht is showing promising signs of growth, most respondents stated that it was difficult to estimate the exact numbers. All three car sharing operators were revealed to have positive expectations about

the growth of their services in the city. One car sharing operator referred to the success of a competitor who had doubled the size of their fleet within the last year as an indication of the potential of the market growth. Another operator expressed that they expect to be the largest electric car sharing company in Utrecht within the next two years. The third operator explained:

"*It's a fairy tale to believe that carsharing will be the right kind of mobility for every Utrecht citizen. I don't think that's going to happen but a substantial part of car ownership can be substituted by car sharing. How big, is insanely hard to predict. […] I think it can be substantial, but only if it is better than their own car, especially cheaper*." (*Respondent* #5)

All three operators perceived there to be a large group of potential new users to attract. This includes potential new customers in areas that are already being serviced, as for example more people are willing to give up their private car, but also in new areas where currently little or no car sharing service is provided.

From the municipality's side, the ambition to see car sharing scale up exponentially in the upcoming years is evident in various policies and strategies. These expectations were also reflected in the interviews. However, respondents from the municipality found it difficult to estimate in any specific detail to what extent car sharing can be expected to scale up. The city does not collect much data from operators and therefore does not have a holistic overview of the use of shared cars in the city. The respondent from the ministry also stated that there are still many questions around car sharing to be answered:

"*What is going to happen if, for example, the early masses all fully embrace car sharing – are they also making more sustainable choices? If suddenly the market landscape changes and we get an extra 10 players in every city – is that favourable? How does it play out for people with smaller budgets?*" (*Respondent* #6)

As was already mentioned under the topic of technological learning, the different actors' expectations regarding the nature of the fleet of future shared cars (electric vs fossil) also differs. For those operators who are already running an electric fleet, the transition from fossil to 100% electric cars in the near future seems inevitable. The municipality also confirmed the ambition to eventually demand electric vehicles from car sharing operators in the city, however, as was expressed by several respondents, the speed of this transition will depend on the how quickly the charging infrastructure will be able to match that demand.

Interim conclusion expectations

Expectations towards the niche differ among stakeholder groups vary, both in the degree of specificity and in the extent to which actors imagine car sharing to grow. All interviewed stakeholders believed that car sharing in Utrecht will grow. Those actors not operating a shared car service do not have sufficient data to voice specific expectations. Companies are better positioned to make predictions about their own market growth based on performance data. However, it is much more difficult to evaluate car sharing and its effects on a larger scale, and thus, to evaluate policy efficiency. There are still many unanswered questions.

6. Discussion

In the following chapter, the results of the study are discussed and placed in context with relevant academic and social discussions on the topic. Furthermore, the limitations of the study and applicability of research are presented. Finally, the author reflects on the research methods used and provides recommendations for further research.

6.1. Conclusions

The dominance of the private car is being challenged in many urban mobility systems around the world as the emergence of a sharing economy has powered the growth of shared mobility concepts such as car sharing. This research has investigated the car sharing niche in Utrecht and aimed to answer the following research question: *What are the opportunities and challenges for scaling up car sharing in Utrecht in the context of a sustainable mobility transition?*

Major developments on the landscape and regime level suggest that a transition away from the car-dominant regime is in the making. However, these developments do not reveal whether car sharing can be expected to replace the existing regime. Although the importance of regime and landscape dynamics on niche development cannot be understated, this research revealed more important factors on the niche level that are expected to have an impact on the future of car sharing.

Taking the composition of a car sharing network into account, this research discovered the municipality as the most important stakeholder. This is perhaps expected, considering the permit-based nature of the system whereby companies have to work closely with the municipality in order to launch or expand their services in the city. However, the municipality can also play a bigger role by coordinating the participation of the diverse set of actors and their interests in the network. According to a Weber (1999), a network manager can serve the function of interconnecting activities, facilitating exchange of information, and elevating debate over niche technology to a higher (political) level.

The need for a network manager also links to the question of knowledge development and diffusion, as the network manager would be better positioned to address the current knowledge gaps. Missing knowledge needed to scale up car sharing includes information about car sharing users, their travel patterns, and impacts of car sharing. Learning about these aspects will help answer the crucial question of how to bridge the gap from the early adopters to the masses. Currently the data is segmented – operators have data for their own fleets but as they are not currently required to share it, the municipality is lacking a holistic overview of car sharing trends in the city. Developments such as the national MaaS programme are seen as steps in the right direction, but knowledge sharing within the network could be further improved. Once more the municipality can play a bigger role by coordinating the exchange of information among the stakeholders in the city. Users should also be considered more than just sources of market information (Caniëls & Romijn, 2008), therefore, more effort could be shown in also including the voices of local communities.

There are also important learning processes taking place that relate to technology, societal learning and policy. According to Schaefers (2013), one of the key challenges for car sharing providers as well as for municipalities will be to grow consumer acceptance of the service. This relates to second order learning, as defined by Schot and Geels (2008), which touches upon the underlying values and culture of a practice. Although both first and second order learning processes were seen as crucial by stakeholders, the niche actors are currently involved more with first order learning processes such as operational or technical questions. This may be due to lack of coordination or data/research.

Car sharing is unlikely to scale up until private car ownership becomes less attractive. There is a need for both policies that directly promote car sharing and those that discourage private car ownership. An effective policy instrument to achieve the latter are restrictive policies such as higher parking tariffs. Meadowcroft (2011) argues that sustainability transitions are inherently political. Also in this case the political nature of the discussion around the car should not be discounted. The extent to which restrictive policies curbing car use will be implemented depends largely on the political climate.

Having considered the state of internal processes within the car sharing niche, as well as the external landscape and regime factors influencing it, the challenges and opportunities for scaling up can be summarized. The main challenge will be to erase the knowledge gaps in the areas that are crucial for car sharing to scale up. These include information about car sharing users and their travel patterns as well as the larger-scale impacts and dynamics of car sharing in the city. In order to achieve this, the municipality is best positioned to take a bigger role as network manager, to provide guidance for the research agenda and coordinate the exchange of information between stakeholders.

6.2. Implications

This research provides insights into the governance of sustainability transitions in urban contexts. In the heart of transition theory lies the question of how to scale up alternative niches to mainstream practices. Ruhrort (2020) claims that sustainability transition research in the transport sector now needs to develop concepts that describe how political actors attempt to manage upscaling and breakthrough processes of former niche innovations. This research has contributed to this academic discussion by focusing on the car sharing niche on a citywide level, wherein the municipality plays an important role. Furthermore, other work on strategic niche management theory is usually concerned with experiments or local projects. This case study on Utrecht presents an example of a niche that has exited the experimentation phase but not yet scaled up, thus providing insights into these processes in a slightly different context.

Regarding the practical implications of this study, the results can be applied to policymakers on a municipal level but also on a provincial or national level. Although the context where the niche operates may be different in other locations, the framework used in this research – strategic niche management – describes a universal set of processes that take place in a niche. Therefore, the results of this study can still be translated to lessons for all kinds of stakeholders. For example, a municipality that is just starting to design a policy for shared

mobility can take note of the challenges and opportunities identified here and view them as a sort of 'do's and don'ts' list.

6.3. Limitations and further research

A qualitative approach was chosen for this research, as it was seen to allow for the most nuance in expressing and describing social processes from a multi-actor perspective. However, the downside of a qualitative method is that due to the small size of the respondent group. Only seven respondents were interviewed and this limits the extent to which generalizations can be made based on their statements. The extent to which the results can be applied to other cities in the Netherlands remains to be seen, but this was not the purpose of this study. Further research could compare different cities and their approach to car sharing to gain better insights into different scenarios.

The results showed that alignment and coordination within the network could be improved. Whereas this research has identified the areas where tighter collaboration is needed, it has not specified the steps on how to improve and structure cooperation between different stakeholders. This could be included in future research. Further research could also examine the differences between carsharing providers and which operating models are most successful in Utrecht's context. This could create better insights in how to overcome barriers to upscaling car sharing and provide more concrete recommendations.

6.4. Reflection

A qualitative approach was chosen for this research, as it was seen to allow for the most nuance in expressing and describing social processes from a multi-actor perspective. However, the downside of a qualitative method is that a generally smaller respondent group limits the applicability of the results. Only seven respondents were interviewed and this limits the extent to which generalizations can be made based on their statements. Users or local communities were not included in the research at all but as lack of understanding about users was mentioned by respondents on several occasions, it would be valuable to get their insights as well.

The extent to which the results can be generalized for other Dutch cities remains to be seen, but this was not the purpose of this study. It would have been interesting if different cities were included in the research in order to compare their approaches. Combining qualitative data with quantitative data would have also provided additional insights into the dynamics of car sharing in the city.

Lastly, the usefulness of the strategic niche management theory for this specific case study can be considered. The framework was helpful in conceptualizing the processes within a niche that support scaling up. However, more effort could have been put in "translating" the elements of the framework into an interview guide for when talking to people actually involved in the field. In some occasions the questions remained too abstract for interviewees so the answers were either very superficial or not in line with the interviewer's intention. Therefore, several factors analyzed were revealed to be not very crucial for answering the main research question. Caniëls and Romijn (2006) also observe that users of SNM and the

multi-level perspective find it difficult to allocate certain influencing factors uniquely to either the regime or the landscape. This was also the case here – in reality most of the answers given by respondents touched upon several of the factors simultaneously.

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Appendix A – Interview guide

Sample questionnaire – car sharing operators

1. Introduction
    a. Short explanation of the research by the interviewer.
    b. Permission request for recording the interview
    c. Introduction by the interviewee including their role and responsibilities within the organization.

2. External factors
    a. Regime level – what are the current most important developments in the Utrecht mobility regime (system)? How does this affect car sharing?
    b. Landscape level – what are the most important developments or trends in the larger scale (outside mobility) that can have an effect on car sharing? E.g. on a global or national level, concerning laws or regulation, or any trends that may affect the future of car sharing.

3. Internal niche processes

Process	Aspect	Interview question
Network formation	Network composition	Who are the main stakeholders and collaborators?
		How would you assess the reliability of the network?
		What is the type of relationship between you and the stakeholders/collaborators? What is exchanged (knowledge, access to market)? Who has more power in the transactions?
	Market formation	What is the current state of the market? Both consumer market as well as supplier/producer/service market
		What is the expected future market size? Is the growth sufficient?
		What are important issues for scaling up business?
Learning processes	Technological development and infrastructure	What is the current state of technological development and infrastructure? How are various technological developments going to influence car sharing in the future?
	Knowledge development and diffusion	Is there sufficient knowledge sharing between stakeholders? E.g. between science institutions and government, business.
		What kind of knowledge (if any) is missing within the network, that is required for the sector to grow?
	Societal learning	What are the current attitudes (in society, among residents) towards car sharing?
		How aware are Utrecht's residents about the options for car sharing?
	Policy and regulatory framework	What is the current state of policy and regulatory framework around car sharing? Is it promoting or hindering the growth of the sector?

		What are the possible threats/opportunities to car sharing with regards to regulations?
Expectations	Robustness, specificity	What are your expectations/vision towards car sharing for the near/mid-future? Social level, economic level, policy level, technological level
	Alignment	Do these expectations align with other stakeholders' expectations?

4. Conclusion
    a. What are in your opinion the most important challenges for car sharing now? In the near future?
    b. What are in your opinion the biggest opportunities for car sharing now? In the near future?

Appendix B – code tree

Code tree created for the interview analysis

Appendices C - I

Interview transcripts have been redacted from this version.