

The prospect of car sharing

Barriers and solutions from a transition theory perspective
in the city of Groningen



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Preface

Dear reader,

This thesis is the final product of my educational journey. It is about future and current transitions in society: from unsustainable to sustainable, from private to shared, and from disconnected to connected. I have enjoyed writing the thesis. For this moment I want to thank a number of people.

First, I would like to thank the respondents who were willing to do an interview with me and share their thoughts about car sharing. Second, I would like to thank my supervisor Farzaneh Bahrami for her feedback and patience. Third, I would like to thank Sweco for providing a productive and sociable working place. Finally, I want to thank family and friends for their feedback and support.

I now stand for a transition in my own life, having completed 21 years of education, I'm looking forward to keep developing myself in a professional environment.

On to the next phase!

Daniël Peereboom

Groningen, July 2019

Abstract

Current mobility patterns are predominantly based upon car usage. However, the literature shows that younger people are less likely to own a car than previous generations. Still, the total car usage is growing, and this results in congestion and pollution issues. Other sustainable forms of mobility, such as public transport and the electric bicycle, are being promoted, but can't compete against the advantages of the car. Innovations to make car usage itself more sustainable are there but are not widely implemented yet. This thesis will investigate if car sharing can become a new mobility paradigm and can help to make car use more sustainable. The transition theory of Loorbach (2007) is used to theorize the transition. The city of Groningen is used as a 'progressive qualitative case'. Results show that the innovation of car sharing in Groningen finds itself in the take-off phase. Landscape developments such as the Green Deal car sharing and the MaaS pilots have no connection to the regime level. At the regime level, a car sharing policy is lacking. The foundation of the Mobility Innovation Center could provoke a breakthrough to the next phase. At the niche level, many different car sharing experiments are taking place. However, the current market is too small, and the number of users needs to grow for the companies to be able to invest in green shared cars. Car sharing in Groningen has the potential to contribute considerably to a transition towards sustainable mobility. From a transition management perspective could be advised to create a link between landscape developments and the regime through the creation of a transition agenda, transition images and transition paths. This process could take place at the Mobility Innovation Center. Transition management is a useful method for the steering of mobility changes in a city context.

Keywords: Transition management, sustainable mobility, sharing economy, shared mobility, Mobility as a Service, car sharing.

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1. Introduction

The first chapter of this thesis will describe the origins of our current car-oriented system and the problems this has created. Then, three technological innovations and four behavioral changes will be presented that could provoke a shift towards sustainable mobility. Car sharing will be chosen as one of the most promising behavioral changes and will be the focus of this thesis. To give this research a concrete specific case, the city of Groningen in the Netherlands is chosen to test if car sharing can be adopted by a wider public. The final section provides the research questions and the structure of the thesis.

1.1 The impact of the car

Cars have been our most dominant and most influencing mode of mobility for the last hundred years. Private cars offer speed, personal transport, independency seamless travel, flexibility, convenience, reliability and freedom (Urry, 2004). Other forms of mobility such as public transport, biking and walking clearly fall short on one or more of these benefits of the private car. This supremacy has molded the image of possessing a car into an image of ultimate individual freedom. Cars have become much more than just a means of transportation, they have changed our system into a car-oriented culture (Sheller and Urry, 2000). The more we started using our cars, the more infrastructure was needed to keep up. Especially from the Second World War onwards, investments in road infrastructure have increased ever since (Heeres et al., 2012). This focus on accommodating the car has resulted in so-called car-only environments: places only accessible with a car. People in some areas have a need for mobility that only the car can accomplish (Freudental-Pedersen, 2009). For example, people tend to live further away from their work, stretching the geographical boundaries of the living and working environment (Kalter et al., 2010). This dependence on the car to fulfill our mobility needs has made us being caught in a trap of hypermobility (Khisty & Zeitler, 2001). This means that investments in our infrastructure networks have led to overpressure of those networks. The investments can't keep up the pace of increased usage. Currently, there are more than 1 billion cars in the world (Worldometer, 2018). This number is expected to grow due to a rapid motorization of China and India. This unprecedented car growth has created (among others) two persistent problems which offer a sharp contrast to the once untouchable image of the car: (1) increased congestion and (2) environmental pollution (Geels et al., 2011).

First, congestion pressures rise both on roads and on parking spaces. Congestion on roads results in enormous traffic jams twice a day. In the Netherlands, the impact of traffic jams (time versus length) has increased at a rate of more than 6% per year since 1990 (Geels et al., 2011). These traffic jams decrease livability levels. There is also an increased pressure on parking spaces in inner cities. Due to urbanization processes, cities are becoming more crowded. More people want to make use of the public space in inner cities in more flexible ways (Gemeente Groningen, 2016). However, the available public space is fixed, and urban planners need creative ways to accommodate all these people and activities. Analysis shows that cars are parked for 95% of the time (Reinventingparking, 2013). This means that many parked cars are just occupying valuable space in inner cities. At the same time, the current car-oriented culture almost sees it as

a right for everyone to have their own car at the front door. This grant idea is just not feasible in inner cities.

Second, cars generate many polluting particles using the internal combustion engine (NASA, 2010). These particles are causing a worldwide climate change as well as many health problems to people living in bigger cities. Concerning climate change, NASA (2010) explains that motor vehicles are the greatest contributor of all activities because they “*produce significant amounts of pollutants that warm climate such as carbon dioxide, black carbon and ozone*”. Moreover, air pollution through vehicle emission is also causing damage to the health of people in the short term. Emission of harmful air pollutants drastically lowers the living conditions of urban dwellers, affecting morbidity and mortality (Zhang and Batterman, 2013).

Besides these two persistent problems, four general trends will have an increasing influence on our mobility system. Those are climate change (again, because it is not only influenced by mobility), peak oil, digitalization and the emergence of the sharing economy. These trends will be further explained in section 2.4. Important to mention is that they are expected to provoke a fundamental shift in our mobility system in the 21st century (Dennis and Urry, 2009). However, our orientation on the car has created a severe lock-in situation. Other more sustainable forms of mobility such as public transport, bicycling and walking have been available for decades, but have not been able to get people out of their cars (Geels et al. 2011). Therefore, besides investing in these sustainable forms of mobility, we need a solution for the persistent problems our car culture has created. The next paragraph discusses some of these sustainable car innovations.

1.2 Emerging sustainable car innovations

This section investigates what type of car innovations there are and what type of car usage we possibly will have in the future. The first subsection will focus on technological innovations such as hybrid, electric and hydrogen cars and the second subsection on behavioral changes regarding car usage.

1.2.1 Technological innovations

Nowadays, we are used to driving in our diesel and benzine gasoline cars. However, when cars were invented in the late 19th century, they were powered by electricity and steam. Some of the recent innovations concerning the empowering of cars are therefore not new, but they have improved to the point where they are able to compete again. I will subsequently discuss hybrid, electric and hydrogen cars (Dennis and Urry, 2009; Geels et al, 2011). These are called ‘green cars’ and are characterized by unconventional fuel principles.

First, the hybrid car is an intermediate between the internal combustion engine and electric cars. They have a battery that is charged through braking and acceleration. Therefore, the hybrid model is perfect for inner city driving where it is not possible to drive at a constant speed. For longer distances, the internal combustion engine is used to provide reliance (Moriarty and Honnery, 2008). The hybrid car received global attention thanks to the high sales of the Toyota Prius, which currently has sold more than 10 million cars (Geels et al., 2011; Toyota Europe Newsroom, 2017). The plug-in hybrid is a hybrid car which can also be charged, just as electric cars (Moriarty and Honnery, 2008).

Second, electric vehicles have existed since the invention of the car. Apart from the first years, they never really managed to get a foothold in the car market. Recent enthusiasm surrounding electric vehicles has grown thanks to the success of Tesla. They are the first company that succeeded in expanding the travel range of electric vehicles. Also, public transport organizations are heavily investing in electric vehicles to be able to fulfill their sustainability goals. The momentum for the electric vehicle is mounting. However, there is also skepticism, mainly concerning the production of batteries. There has been research that predicts that only 20% at maximum of the current car fleet could become electric in 2050 (DvhN, 2019). Another electric innovation worth mentioning here is the electrification of bikes. E-bikes and speedpedelecs are increasingly popular because they double the action radius of normal bikes (Van Boggelen et al., 2013). For speedpedelecs even distances of 30 kilometers are possible. These bicycles are increasingly competitive for car-users (De Kopgroep, 2018).

Third, hydrogen fuel cells offer another opportunity for a change away from conventional fuel. The idea to use hydrogen technology as a fuel has existed for quite a long time, as early as 1839. Also, the Nazis did invest quite a lot in hydrogen powered vehicles. However, the current hype for hydrogen is based upon a much cleaner principle than the previous ones. Dennis and Urry (2009, p.74) call it "basically a box that takes in hydrogen and oxygen and produces electricity and water". However, problems regarding the full implementation of hydrogen remain, concerning technology, selling price, and market development (Gigler and Weeda, 2018).

1.2.2 Behavioral changes

Besides technological innovations, different behavioral changes have taken place or are expected to take place. These changes will have consequences for the way we use our cars. Technological changes alone are unlikely to solve the energy problem. We also need behavioral changes, and these changes are happening. I will discuss Mobility as a Service (MaaS), transit-oriented development (TOD), the autonomous car and finally car sharing.

First, MaaS embraces a new vision for mobility, where someone finds and pays door-to-door trips via one platform. MaaS stands for 'Mobility as a Service'. In the current system, every part of a trip must be organized solely. MaaS organizes mobility just as a telephone abonnement: you pay per period the amount of mobility you want to use (Hietanen, 2016). MaaS ideally builds upon the public transport network and adds first and last mile transport in the form of (shared) bikes, scooters, steps or cars. This will provoke a possible behavioral change: the private car will be less desirable, since MaaS can also deliver door-to-door transport and will be cheaper in many cases.

Second, transit-oriented development "*can be understood as the integration of public transport infrastructure and spatial development*" (Heeres et al., 2012, p. 155). As such, it connects to the idea of a compact city where public transport can flourish because of high volumes. Curtis et al. (2009) argue that this trend discourages car use and thus could provide a way out from the lock-in situation of the car culture.

Third, the development of the autonomous car is for a great deal a technological and juridical matter (Heinrichs and Cyganski, 2015). A lot of literature already exists on this subject (see KiM, 2017). However, when these questions are solved, the introduction of the level 5 autonomous car will have substantial influence on our mobility behavior. Drivers licenses will be unnecessary and subsequently, we can spend our time differently when we use a car. We can

work, sleep, watch movies, etc. (Ministry of Infrastructure and the Environment, 2017). This trend will, however, negatively affect developments such as MaaS, since cars provide direct door-to-door travel without mode switch.

Finally, car sharing is a behavioral change that has received increased attention in the past ten years. The term carsharing is used in different instances. Therefore, it is therefore wise is to elaborate on these differences, because not all forms are used in this thesis. When some people use the term car sharing, they sometimes mean ridesharing. Ridesharing happens when a driver offers a place in his or her car when (part of) the points of departure and destination correspond. (Circella et al., 2018). This is also called trip sharing, ride hailing or the classic form of carpooling. This type exists for a long time and has been central to many policies to lower the number of cars on the road. In the Netherlands, many carpool places have been made, however, not with the desired effect (Geuze, 2017). Nevertheless, due to increased use and convenience of online apps, new forms of carpooling have emerged offering more flexibility. An example of this is Blablacar. Also popular on-demand ride services such as Uber and Lyft belong to the category of ridesharing. In contrast to ridesharing, car sharing is *“a system that allows people to rent locally available cars at any time and for any duration”* (Frenken, 2013, p3). It is different from ridesharing and other taxi-affiliated services because the car is driven by the renter and it is also different from classic car rental because the cars are locally and at any time available (Münzel et al., 2019). Within car sharing there are further specializations, which will be discussed in subsection 2.5.2. Car sharing is an interesting development because it is on the one hand is more sustainable than private car ownership (Münzel et al., 2019) and on the other hand integrates more smoothly within the current car-oriented system than more sustainable forms of mobility such as public transport, bicycling and walking. Moreover, it connects nicely to the four behavioral changes mentioned earlier. It also offers better opportunities to make the car fleet sustainable integrating the three previously mentioned technological innovations. This makes car sharing a good study object.

1.3 Groningen as a geographical case

The focus of this research will be on the adoption of car sharing in the city of Groningen, the Netherlands. Literature confirms that car innovations such as shared cars have the most potential in cities with a young and dense population, a university, low numbers of car commuting and green mobility policy (Bardhi and Eckhardt, 2012; Münzel et al., 2019). KiM (2017) shows that car-ownership in the Netherlands is the lowest in Amsterdam and Groningen. Amsterdam already possesses the biggest car sharing fleet of the Netherlands, according to Ritjeweg (2019). Groningen, in comparison, does have, surprisingly, a low number of shared cars (Ritjeweg, 2019). Groningen is also known as a very compact city and has one of the youngest populations of the country. This makes Groningen an interesting case to study the potential shift to shared cars. Chapter 4 further elaborates on Groningen and its mobility system.

1.4 Research questions

The goal of this research is to investigate how Groningen can move towards a sustainable mobility system and in what manner the adoption of car sharing can contribute to such a transition. The main research question of this thesis is therefore:

How can car sharing contribute to a transition towards sustainable mobility in the city of Groningen?

To be able to answer this question, the following sub-questions must be answered:

1. What are mobility transitions and which method can be used to manage mobility transitions towards sustainable mobility?
2. Which global trends affect our future mobility?
3. What is sustainable mobility and how is car sharing a part of sustainable mobility?
4. What does the current mobility system of Groningen look like in terms of sustainability?
5. What are factors that advance or hinder the introduction of the shared car in Groningen?
6. What could be advised to condition a transition towards sustainable mobility in Groningen concerning car sharing?

1.5 Research structure

This thesis is structured as follows. Chapter 2 discusses transition theory and the transition management approach that will be used to increase car sharing. Furthermore, it will be argued that global trends, such as climate change, peak oil, digitalization, the sharing economy and sustainability will irrevocably lead to fundamental mobility changes. The chapter finishes with an elaboration on the literature on car sharing and the conceptual model. Chapter 3 presents the methods in which the research is designed, the data is collected and analyzed. Finally, ethical considerations will be discussed. Chapter 4 presents the mobility system of Groningen and its sustainability aspirations. An overview of current car sharing practices is also given. Chapter 5 presents the most important findings from the interviews. Subsequently, chapter 6 analyses the differences and similarities between the transition management theory and the findings. Finally, chapter 7 gives the answers to the research questions as conclusions of this thesis.

2. Theoretical Framework

This chapter will present an overview of the literature on transition management, the sharing economy and sustainable mobility. The chapter will give answers to the first three research questions: (1) What are mobility transitions and which method can be used to manage mobility transitions towards sustainable mobility? (2) Which global trends affect our future mobility? (3) What is sustainable mobility and how is car sharing a part of sustainable mobility? First, we will look at complexity theory as a theoretical foundation of transition theory. Second, transition theory is taken to find adequate starting points to manage a changing world in a sustainable direction. Here, specific attention will be given to the multi-level and the multi-phase model. Third, the activities that are executed during transition management are explained.

Fourth, the global trends that will affect our future mobility system will be elaborated upon. Fifth, the transition theory is put within the perspective of sustainable mobility and finally, the theoretical considerations are put into a conceptual framework forming the main guide during this research.

2.1 Changes in our systems

This section will provide a theoretical background for transition theory. The first subsection will take complexity theory to explain recent changes in the way we view our world. The second subsection will explain what changes in steering mechanisms these changes in worldviews have resulted.

2.1.1 The complexity of our world

The world we live in is rapidly changing. Society is experiencing increased interconnectedness in many areas. At the same time, we discover more and more that the ecological system has always had this interconnectedness, we were just not aware (Duit and Galaz, 2008). This societal and ecological interconnectedness implies a shift from our perceived causality of the different systems of our world towards an understanding based on a complexity perspective (Duit and Galaz, 2008). Viewing the world as a complex system has been very influential in the academic world the last couple of decades and is increasingly gaining ground among politicians and other policy makers. Complexity theory consists of the combination of a couple of notions, namely: uncertainty, non-linearity, co-evolution and adaptation, self-organization and emergence (Loorbach, 2007). Uncertainty about the future can be divided into five levels whereby Kwakkel et al. (2013) note that level 4 (deep) uncertainty is increasingly prevailing. Non-linearity means a small change can have a big impact and vice versa. Co-evolution is the adaptation between different systems to each other, and between the system and the environment through interaction processes. Self-organization means that the perceived organization of a (sub-)system is coincidentally and spontaneously established and this process is called emergence.

The problems we face nowadays can be characterized from a complexity perspective as persistent problems (Loorbach, 2007). These are problems that:

- occur (differently) on different levels of scale;
- involve a variety of actors with different perspectives;
- are highly uncertain in terms of future developments;
- can only be dealt with in the long term;

- are hard to 'manage' in a traditional sense;
- are rooted in different societal domains.

The current over-dependency on the car is a very good example of a persistent problem. Such a persistent problem often follows a path-dependent trajectory. This means that current developments are often the result of choices in the past (Booth, 2011). It has proven to be quite hard to change certain paths when these paths are deeply embedded in society. Literature calls this a 'lock-in' situation (Klitkou, 2015).

2.1.2 A shift towards governance

The way we view the world is of great importance for the steering capacity of society. Traditionally, we tried to steer society through a political system in which power was divided between a restricted number of actors (Bickerstaff and Walker, 2005). In the Western world, power was organized in a governmental system often based on staged elections. In this way, the central state could make decisions for society. However, in recent years we have seen a shift from a centrally organized government towards both a more locally organized government as well as a more continental or even globally organized government. This process of both decentralization as well as centralization has made state powers more dispersed (Zuidema and De Roo, 2015).

Power is becoming even more dispersed through growing influence of the market and the society. This shift of dispersing power outside state actors is called governance. The shift towards the market is called the neo-liberal turn. Power within the market is dispersed through competition. Similarly, the shift towards society is called the communicative turn. Power within society is based upon interpretation and the creation of an agreed reality (Lemos and Agrawal, 2006).

Within this 'governance triangle', institutions are guiding the decision-making process. Institutions can be described as 'the rules of the game' and consist of two types: formal and informal institutions (Sorensen, 2015). The first type exists of rules which are formally written down. Examples are the law, a cooperation agreement and a user's guide. Other rules are not written down but are verbally or even non-verbally communicated. These are called informal institutions. Examples of these are the type of greeting when you meet somebody or being on time for an appointment. Both informal and formal institutions constitute all daily life processes, from buying something in the supermarket to making a new law.

2.2 Transition theory

Complexity theory has fundamentally changed our worldview and the shift towards governance has drastically altered the ways we try to steer society. It makes sense to use a governance approach to steer an increasingly complex society. However, we still need a theory and a method to make governance better tangible. This section will describe transition theory.

2.2.1 Societal transitions

A transition at the level of society can be considered as a fundamental shift from one relatively stable system to another (Loorbach, 2007). Because different types of processes at different levels are continuously influencing the transition, a 'finished' transition can only be recognized properly in hindsight. Transitions happen through the getting together of many co-evolving developments with a non-linear influence (Loorbach, 2007). These developments can for example

be found in markets, networks, institutions, technologies, policies, individual behavior and autonomous trends. When these developments come together, they can form a momentum where it can break down existing structures, institutions, culture and practices and establish new ones (Loorbach, 2007). Smaller, supportive elements of transitions can happen very fast, but a whole transition generally takes a long time to materialize.

This theory of transitions can be applied to many types of systems. However, there are three conditions: 1, the system should be open; 2, the environment is continually changing and influencing the system; 3, the system co-evolves in a non-linear way with the environment (Loorbach, 2007). Examples of these types of systems can be found in biological, political and technological realms.

The theory of transitions consists of two important models: the multistage model and the multilevel model. On these will be elaborated below.

2.2.2 The multiphase model

The societal change from one stable system towards another can be categorized into four phases: pre-development, take-off, breakthrough and stabilization (figure 1). This model is developed by Rotmans et al. (2001) to theorize a transition.

The model begins with the pre-development phase. The first system is still in its stable form, but small experiments are taking place which are not in line with the reigning system. This is a very normal situation since many experiments prove not to be very influential on the long term.

In the take-off phase, influential experiments are picked up by a greater public and start to have an impact on the effectiveness of the system. The alignment with the environment starts to dwindle and adaptation is needed.

A change of system is taking place in the acceleration phase. Here, confusion about what to do or use is at its highest, since the methods applied before aren't as effective anymore. The new methods, however, are not ready for full implementation because the system is not yet totally adapted, it still exists of 'old' infrastructure. This phase can be understood as a crisis in which it is very hard to determine what methods will come out on top and thus what is worth investing in. A crisis does not last very long, but relatively big changes occur in these periods.

A turning point is reached in the stabilization phase. Actors now agree on which route to take and the system and its environment are well aligned again. The new structure is the dominant mode. It is now impossible to return to the old structure. From hindsight it is clear which experiments have been worth the investments. This theory could describe any transition. An example could be the transition from horse wagons as prime means of transport to the motorized car.

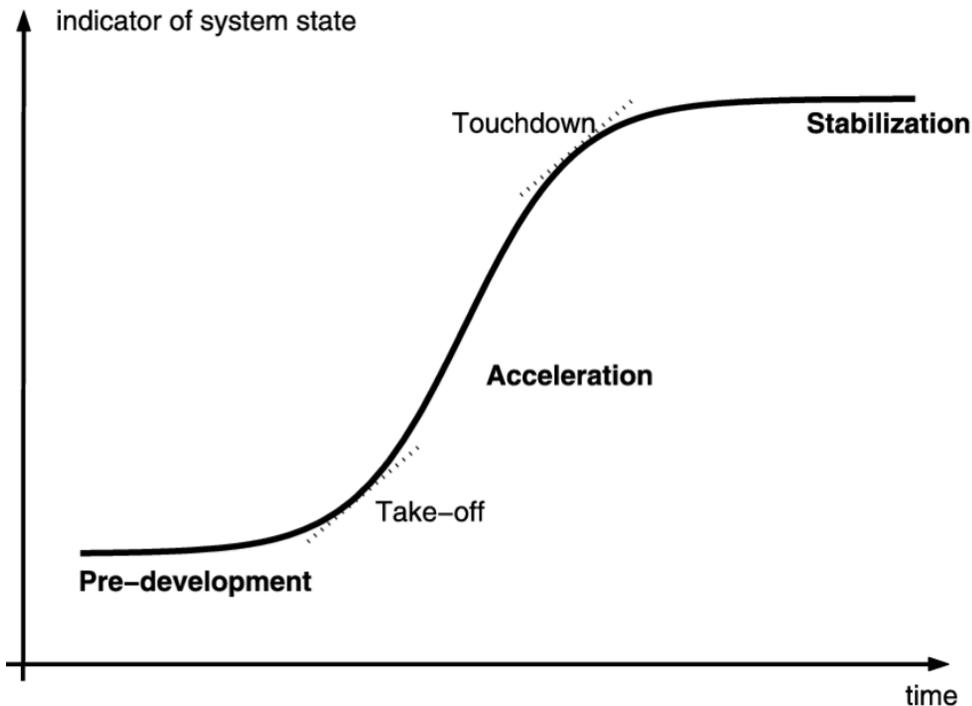


Figure 1: The multiphase model (Loorbach, 2007)

2.2.3 The multilevel model

As discussed in section 2.1.2, society exists of the combination of different steering mechanisms. These steering mechanisms are important for the analysis of societal transitions. They form a coherent network of actors influencing each other. These actors can be categorized into three broad levels: niche, regime and landscape (Geels and Kemp, 2000; figure 2). As with the multiphase model, the number of levels is not fixed in reality but simplified to be useful for theory.

First, the landscape level is the place where relatively autonomous trends are ongoing and influencing both the regime and niche levels. These trends consist of social values, political cultures and economic developments. Key is that these trends are not to be influenced by a single actor but must be generally agreed upon. The landscape level can, from a systems perspective, be seen as the external environment.

Second, the regime level is the combination of the dominant structure, culture and practices. Structure is the institutional setting, culture the prevailing perspective and practices are rules, routines and habits. The regime level is characterized by a certain rigidity which provides stability for the societal system. This means that both physical as well as immaterial relations remain relatively constant. Examples of stable physical relations are roads and power grids, and examples of immaterial relations are actor-networks and regulations. This rigidity is beneficial for the functioning of the system when the system is stable. However, when a transition is starting, this rigidity slows down the transition because most of the institutions have not changed yet. Therefore, the regime level is the focus of transition management, which will be explained in 2.3.

Third, the niche level is characterized by a lot of experimentation and innovation. Examples of these experiments are new technologies, new rules and legislation, new

organizations or even new projects, concepts or ideas. The goal of these experiments is to reach into the regime level, however only few do.

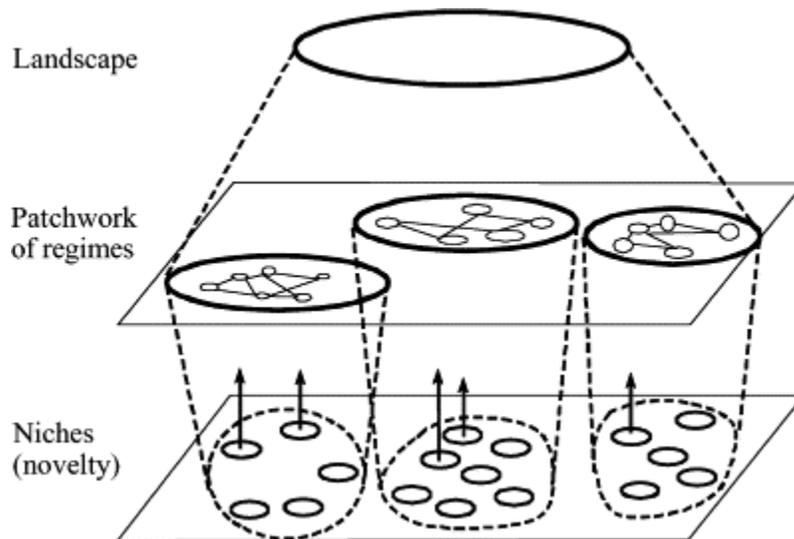


Figure 2. The multilevel model. (Loorbach, 2007)

2.2.4 Modelling the transition

The combination of the multilevel and multiphase models offers a good insight in the complexity of societal transition. A transition only takes place when developments at all three levels move into the same direction (Loorbach, 2007). Only then it is possible to leave the pre-development phase. As explained in 2.2.3, the regime level is the focus of transition management because structure is both a barrier to and medium of change. The remainder of this section will describe how a hypothetical transition would map out according to the aforementioned models.

In the pre-development phase, a lot of innovation and experiment is going on at the niche level. These are constantly trying to upscale to the regime level to become more influential. The regime however, inhibits this innovation because they could form a danger to the status quo. However, when the innovative experiments coincide with ongoing trends at the landscape level, the pressure becomes too strong to resist for regime actors. The emergence of a window of opportunity could form the tipping point to provide more room within existing institutions for innovation.

In the take-off phase, these pressures from the landscape and niche level do mount on the regime level. The existing regime reacts to these mounting pressures and starts to irreversibly change through processes of co-evolution and self-organization in a non-linear way.

In the acceleration phase, the new organization starts to emerge. However, uncertainty about the new regime is very high, due to many different promising experiments. It remains unclear which ones will grow into dominant modes. It is important in this phase to try to prevent an unsustainable lock-in situation from happening, because it is very hard to recover from path-dependent decisions.

In the stabilization phase, uncertainty is decreasing, and new regimes are formed based on new institutions. The new regime will constrain new experiments with its gained power (Van der Brugge et al., 2005; Geels, 2018).

2.3 Transition management

Transition theory is a helpful theory to describe past and ongoing transitions. However, as complexity theory points out, it is very difficult to steer a transition in one way or the other. As discussed in 2.1.2, the old, top-down way of government is no longer enough to manage the increasing complexity of society. Transition management is the proposed method here to manage this complex society into a sustainable direction. This section will describe the ins and outs of transition management from a multi-level perspective.

2.3.1 Steering transitions

Transitions happen in many shapes and sizes and they bring forward both desirable and less desirable outcomes. For example, the transition towards motorized transport based on fossil fuels brought on the one hand enormous increased accessibility. On the other hand, it resulted in a lot of pollution with all its negative consequences. Therefore, it is needed to try to manage any transition towards more sustainable pathways (Loorbach, 2007). This is the goal of transition management as discussed in this section.

Transition management builds on the multi-level perspective as explained in section 2.2.3. The different levels (landscape, regime and niche) of governance actors form a good start for a multi-scale, action-oriented approach to guide the transition through the subsequent phases mentioned in 2.2.2. At each level, different types of activities can be recognized. These activities are divided into three different steps: a strategic, a tactical and an operational step. In the transition management literature, a fourth step is added to complete the so-called transition management cycle: reflexivity. These four steps form the anchor of transition management (Loorbach, 2007). The steps of the management cycle do have different time horizons, ranging from long (30 years) to short (5 years). There is no clear sequence regarding the steps, there only is the need to connect the steps to each other. An overview of the steps is shown in [table](#). Reflexivity is not mentioned here because it is an integral part of all the other steps and it thus does not link one-on-one to the multilevel model. The transition management cycle will be elaborated on in the next subsections.

Level	Activity	Focus	Time scale	Main product
Landscape	Strategic	Culture	Long range 30 years	Transition arena
Regime	Tactical	Structure	Mid-range 15 years	Transition agenda
Niche	Operational	Practices	Short range 5 years	Transition experiments
Reflexivity				Monitoring, evaluation and learning

Table 1. Overview of transition activities (Loorbach, 2007)

2.3.2 Strategic activities

Strategic activities link to the landscape level in the multi-level model. At this level, activities should be deployed that are able to influence the culture of a society (Loorbach, 2007). Cultural changes are generally very slow processes, stretching over multiple generations. Therefore, strategic activities towards sustainable development should be guided by a strong vision. This vision is a result of a dynamic envisioning process of multiple influential individuals. According to transition management theory, these individuals form a transition arena in which the envisioning process can take place (Loorbach, 2007). Specific attention goes to the selection of these so-called 'frontrunners'. These are persons who attend on a personal basis, have a good overview on the subject and have fine networking skills. The frontrunners come from different backgrounds and together they try to form a shared vision of a desired future from a sustainability perspective. Loorbach (2007) indicates that frontrunners originate from the initiating organization, experts in the field under study, transition management experts and process facilitators. It is highly likely that the frontrunners will not end up with a unanimous vision. However, this does not need to be detrimental, since the envisioning process is also very important. The transition arena is not a physical place but is better described as a succession of coincidental informal networks.

It is not likely that governmental actors will attend the transition arena. Governmental actors are often more focused on short term decision-making and results while the transition vision should aim at more or less a time span of 25 years. It is of course possible that individual frontrunners are employed in governmental layers. Also, the government could find ways to stimulate the creation of a transition vision, without being too prescriptive.

2.3.3 Tactical activities

Tactical activities link to the regime level in the multi-level model. At this level, activities should be deployed that should be able to influence the structure of a society. The long-term transition vision developed at the landscape level is being connected to short term, concrete activities at the regime level. These activities are targeted by established governance stakeholders who possess a significant influence in actions and institutions (Loorbach, 2007). These stakeholders are called 'governance entrepreneurs' and they try to innovate the governance system to make it more sustainable.

Governance entrepreneurs use the instrument of a 'transition agenda' to translate the transition vision towards concrete actions. The transition agenda consists of transition images and transition paths (Loorbach, 2007). Transition images are collective images of the future which offer guiding criteria to be able to reach the transition vision. Transition images evolve due to newer insights regarding the overall transition. Transition paths are routes towards the transition images which can be described quantitatively.

A barrier for the execution of the transition agenda can be institutional fragmentation (Loorbach, 2007). This may arise when governance entrepreneurs work in different institutional settings and have limited networking mechanisms to exchange the developments in the transition agenda. This ultimately raises the risk of mis-investments and slowing down the transition process.

2.3.4 Operational activities

Operational activities link to the niche level in the multi-level model. At this level, activities should be deployed that should be able to influence the practices of a society (Loorbach, 2007). These activities are called transition experiments and focus at the very short (within five years) term. All experiments that fit within the transition vision and connect to the transition agenda fall into this category. Experiments are executed by as many individuals and organizations as possible. Experiments can take a long time and could be very costly, therefore it is advised to build the experiments on existing infrastructure. However, by definition, the most innovative experiments do have a poor fit with the present society and challenge the existing regime (Loorbach, 2007). To fully benefit the transition experiments, governance entrepreneurs at the regime level should try to create protected niches in which the experiments can flourish. Successful experiments can be upscaled to the regime level for greater influence.

2.3.5 Reflexive activities

Reflexive activities are not connected to a specific societal level. Instead, they form an integral activity at every level and within each type of activities. Reflexive activities consist of monitoring and evaluation (Loorbach, 2007). Monitoring does concern developments from the transition itself as well as the progress and the process of transition management. Evaluation means to test the objectives of transition management and analysis of the causes.

The results of monitoring and evaluation should form the basis of a social learning process. Learning is essential during the transition because needs to be able to adapt to changing circumstances at the different societal levels (Loorbach, 2007). A mechanism of learning provides the transition actors with vital information about which choices to make.

Reflexive activities can be undertaken within the existing institutions as well as by outsiders like the media.

2.4 Global trends

This section will describe four global trends that will have an influence on the type of mobility we will encounter in the coming decade: climate change, peak oil and digital innovation (Geels et al., 2011) and the sharing economy. This section will answer the second research question: Which global trends affect our future mobility?

2.4.1 Climate change

Human caused climate change is a heavily disputed subject in recent years. Many scientists agree nowadays that more than half of the current global warming is caused by humans (Ligtvoet et al., 2015). Consensus is growing that we as a society need to act to keep our planet livable. The climate is a complex system, so our forecasts on what is going to happen are probably wrong. For countries located in delta's, such as The Netherlands, sea levels are going to rise. In 2015, the UN climate agreement was signed by most countries. This agreement recognizes climate change as human caused and tries to reduce global warming to a maximum of 2 degrees. CO2 is one emission that contributes the most to climate change (Provincie Groningen, 2019). Concerning mobility, Hoen and Meerwaldt (2017) have calculated that personal car mobility must

be emission free by 2025 for the Netherlands to reach the climate goals. Furthermore, the volume of road transport needs to be reduced by 25% (Hoen and Meerwaldt, 2017)

2.4.2 Peak oil

Our current mobility system is largely based on the depletion of oil. It is strange to think that the first cars drove on electricity or steam. However, soon after the discovery of cheap oil in the beginning of the 20th century, the internal combustion engine easily won the competition due to increased speed and reliance (Dennis and Urry, 2009). From this first discovery onwards, we have found many more oil reservoirs all over the world, predominantly in the Middle East. Despite the enormous stock, we will run out of oil sooner or later. The rate of discovery of oil has already had its peak in 1964, and the production of oil exceeded the rate of discoveries during the mid-1980s (ASPO Australia, 2015). Peak oil is the moment in time when the rate of oil production starts to decline. However, consumption of oil is still growing because of the motorization of China and developing countries. Therefore, it could be questioned if peak oil would happen any time soon. Something already happening is the rise of oil prices. This is because the large oil fields have passed their peak and oil companies are heavily investing in unconventional oil resources such as tar sands, shale, heavy oil, and coal. It is expected that these higher prices will not affect choice of modality very much in the short term (Geels et al., 2011). Nevertheless, in the long term, it could result in more significant changes. There is a possibility that the public acceptance for conventional cars will get lower because of the negative features. These pressures may result in increased purchases of greener cars.

2.4.3 Digital innovation

The third trend that could be of influence on our mobility is the digitalization of society. This trend has two broad consequences for mobility: (1) possibly less travel, and (2) smart mobility.

First, increased digitalization has made it possible to work, order online food or products, and connect with people independent of your location (Cohen-Blankshtain and Rotem-Mindali, 2013). As mobility concerns, this means that less necessary trips are being made. Employees can choose to work at home, to not travel at rush hours or to work when using public transport (Krabbenburg and Daalhuizen, 2016). Online food or product companies can deliver multiple packages in one trip, instead of multiple trips of customers. Also, leisure activities can be undertaken without making a trip. However, for all these three categories, it depends on the type of activity if it can be undertaken from home. It is expected that more activities will have an online component, but the relationship with mobility remains complex (Cohen-Blankshtain and Rotem-Mindali, 2013).

Second, digital innovation influences the way we travel. This process is called smart mobility: roads, intersections and cars all communicate with each other and can influence traffic flow. This also means that users can have access to real time data about their travel options. In this way, the seamlessness of other forms of mobility such as public transport is increased. Another type of innovation is happening concerning the automation of cars (KiM, 2017). It is expected that self-driving cars will be available within the coming decades. This will fundamentally alter the value of time we spend in traffic.

2.4.4 The sharing economy

For the past ten years or so, there has been a significant growth in services and platforms associated with the sharing economy. This subsection will briefly describe the current literature on this subject.

The sharing economy started with the idea to share products which were not used so often, so other people didn't need to buy them themselves (Botsman and Rogers, 2010). This type of sharing has existed for a very long time, however, since the rapid development of digitalization, it became easier to share products with strangers (Frenken, 2015). This has resulted in platforms such as Peerby and Couchsurfing. This type of sharing can be characterized as peer2peer and is based on the assumption of utilization instead of ownership (Schor and Fitzmaurice, 2015). Through the very disruptive growth of Airbnb and Uber, sharing platforms became very influential. Platforms took a small part of the sharing fee and worries rise about the monopolistic and oligarchic characteristics these platforms develop (Belk, 2010).

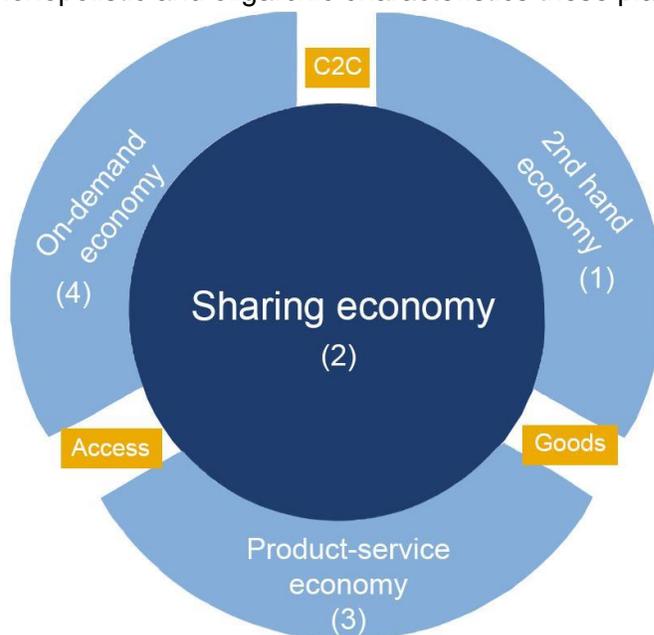


Figure 3. Dimensions of the sharing economy. (Frenken, 2015)

According to Schor (2016), the sharing economy begins when someone chooses not to buy something at first hand. Sharing activities fall into four categories (Schor, 2016): (1) recirculation of goods, (2) increased utilization of durable assets; (3) exchange of services, and (4) sharing of productive assets (see figure 3; table 2). The first category aims at the second-hand market. The second category aims at using products in a more efficient way by letting more people use them. This leads to less production overall. The third category aims at service exchange based on time spent. The final category aims at sharing workspace for companies.

		Type of provider	
		<u>Peer to peer</u>	<u>Business to peer</u>
Platform orientation	<u>Non-profit</u>	Marktplaats	FabLab
	<u>Profit</u>	Airbnb, Snappcar	Car2Go

Table 2. Examples of sharing economy platforms (Schor, 2016).

For users, there are different reasons to start using the sharing economy. Schor (2016) mentions economic, environmental, and social factors. First, sharing platforms create safe and easy opportunities for people to earn money next to their own job. Some people can even make a living out of it. Second, the sharing economy has been associated with sustainability goals from the beginning onwards. If consumer goods could be shared, then there is no need to acquire them, resulting in less production and depletion (Heinrichs, 2013). However, clear studies who underline this argument are lacking for many sharing economies (Schor, 2016). An important issue here is the ‘ripple effect’: if the destination of the earned money is not sustainable, the sharing economy can’t be considered as sustainable (Cheng, 2016). Schor (2016) also points out that platforms such as Airbnb and Über are attracting more travel. Lastly, sharing platforms create social interactions which would not have existed otherwise. The products shared, such as houses and cars, can be quite personal. The platforms reduce the risk of a mismatch by a system of feedback and rating scores (Schor, 2016).

2.5 Sustainable mobility

It is explained in sections 1.1 and 2.4 that our mobility is going to change. Different interdependent developments will have such an influence that the mobility we use nowadays will not prevail at the end of this century (Dennis and Urry, 2009; Schiller and Kenworthy, 2017). However, the question remains what these new forms of mobility will look like (Geels et al. 2011). One thing is certain, mobility will be more sustainable than it is nowadays. This section will answer the third research question: What is sustainable mobility and how is car sharing a part of sustainable mobility? The first subsection gives a transition perspective on sustainable mobility and the second subsection argues how car sharing could contribute to sustainable mobility, based on the literature.

2.5.1 Perspectives on a transition towards sustainable mobility

The term ‘sustainable mobility’ first appeared in the 1992 EU Green Paper on the Impact of Transport on the Environment. This was in response to the Brundtland rapport of 1987 that put sustainable development on the international agenda. According to Holden et al. (2019), four subsequent streams of research on sustainable mobility have developed into a mature research

field. The first stream focused on the improvement of technology, however, it soon became apparent that technology alone would not solve the persistent problems car mobility had created (Moriarty and Honnery, 2008). The three subsequent streams therefore pointed out these limitations and incorporated other research fields such as sociology (second stream), psychology (third stream) and innovation studies (fourth stream). Sustainable mobility can now be described as: “*promoting better and healthier ways of meeting individual and community needs while reducing the social and environmental impacts of current mobility practices*” (Schiller and Kenworthy, 2017, p.1). It focuses more on societal than on technological developments. Banister (2008, p.75) explains how this societal shift can be achieved: “*The sustainable mobility approach requires actions to reduce the need to travel (less trips), to encourage modal shift, to reduce trip lengths and to encourage greater efficiency in the transport system*”. Holden et al. (2019) argue that achieving sustainable mobility will be one of the most challenging tasks. They continue by arguing that a step forward would be to create sustainable mobility narratives. These are stories society can believe in and consequently people behave accordingly. These stories can be found in developments in the niches (Moriarty and Honnery, 2008). As we saw in section 1.2, many sustainable mobility innovations are developing and are becoming more mature. Concerning urban planning, Schiller and Kenworthy (2017) recognize a shift away from car-oriented planning towards smaller, slower and closer urban mobility plans. Future mobility will give us more choice in the way we can travel.

Shared mobility is one innovation that has grown in popularity in recent years due to improved technology (e.g. smartphones), the economic crisis, and social and environmental concerns (Shaheen et al., 2017). Vehicles that are shared are for example cars, bicycles, scooters, steps, vans etc. In line with the sharing economy, users of shared mobility gain short term access to a mode of transportation when required in exchange for a fee. Among these different types of vehicles, car sharing clearly offers the most potential to challenge the current private car regime. Car sharing is more easily adopted since it still makes use of cars, car infrastructure and car institutions, such as legislation and driver licenses. The next section investigates the literature on car sharing.

2.5.2 A transition towards car sharing

A broad definition of car sharing is provided by Shaheen et al. (2015, p.20): “*A program where individuals have temporary access to a vehicle without the costs and responsibilities of ownership*”. Car sharing started in Switzerland in the 1950’s, however, it remained very marginal due to its non-profit organization style (Machado et al., 2018). The rapid rise of car sharing the last decennia is due to for-profit organizations. Nowadays, car sharing has many different appearances (see figure 4).

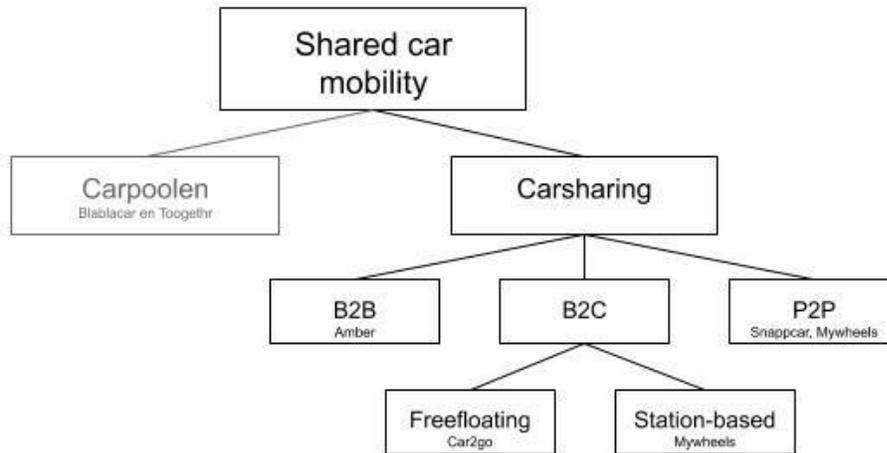


Figure 4. Forms of car sharing (Münzel et al., 2019, edited)

First, car sharing is positioned next to carpooling to show that it is something different. Carpooling has already been touched upon in section 1.2.2.

Second, car sharing can be divided into three categories: business to business, business to consumer and peer to peer (or consumer to consumer, C2C). The B2B variant indicates that shared cars are distributed to companies. Companies can use them to offer their employees automobility when they arrive at the company by public transport or bicycle for example. When these employees have an appointment, they can take one of these poolcars. It is striking that this model of car sharing is not mentioned in literature. An example of a B2B car sharing company is Amber. Amber started its services in 2016 and currently has almost 4000 users (DriveAmber, 2019). They have created car sharing hubs around big offices and make sure that users will never miss a car.

The B2C model has attracted most attention internationally. It consists of two further distinctions, the free-floating model and the station-based model. In the latter model, cars can be picked up at pre-selected parking spots and should be returned to those reserved spots after usage. In some cases, the car must be returned to the exact same spot. A benefit of this variant is that car availability is guaranteed, which is a benefit for the car sharing organization. However, from a user point of view, it is not a flexible system. The first model, the free floating, offers maximum flexibility for users to drop the cars within a designated zone (often a city region). However, this also implies that the cars could be everywhere, and not necessarily close to the location where you need a car. Therefore, free floating car sharing organizations should make sure to provide enough cars, which could be very costly. In recent years we have seen a hold on the growth of free-floating schemes after initial success. For B2C shared cars it is essential to be rented out many times a week. If the car stands still, it is worse for the environment as it is occupying valuable parking space and the provider would not make any profit. As a consequence, companies within this car sharing model, such as Car2Go and GreenWheels, will make sure that their cars are rented out much of the time. This has an additional benefit: the car fleet of these companies has to be replaced with new models much sooner than privately owned cars. Therefore, they are up to date with the latest technology and environmental friendly innovations (Martin et al., 2010).

Lastly, the P2P (or C2C) car sharing variant is a model that has seen significant growth in recent years. This model is based upon existing car ownership. The company offers only a platform on which prosumers can find each other and take care of insurance in case of accidents (Machado et al., 2018). There are many P2P shared cars, and most of them are only rented out a couple times a year. This is one important difference with B2C cars. They have to be rented out many times a week to deliver profit. The advantages and disadvantages of the different models are described in table 3.

	B2B	B2C		P2P
		<u>Free-floating</u>	<u>Station-based</u>	
Company	+ Profit is guaranteed, since companies are responsible for usage	- Invest in a lot of cars and free parking tickets - Profit is not guaranteed + Does not have to care about location	- Maintain a minimum amount of cars per hub - Profit is not guaranteed	+ Does not have to invest in a fleet of cars + Users can be also producers
User	+ Companies can create less parking space for employees - Companies have to ensure good connections with alternative travel modes	- Cars could be everywhere + Cars can be dropped everywhere - no payment when the car is not driven	+ Cars are at fixed locations	+ Lots of different models and price ranges + community interaction - Cars should be picked up at the owners house
Sustainability	+ Less cars on the road and parked	- Extra cars in the beginning + Cars are more energy efficient	+ Cars are more energy efficient	- Cars are older

Table 3. Advantages and disadvantages of the different car sharing models (Based on Shaheen et al., 2015; Machado et al., 2018; Santos, 2018; and Münzel et al., 2019)

According to Münzel et al. (2019), differences between the adoption of car sharing business models by contextual factors of a specific city or region. For example, France boosts many P2P cars, while cars in Germany are mostly operated from a B2C model. For Belgium, the United Kingdom and The Netherlands, the results were more level. Furthermore, small differences can be found between the two systems (see table).

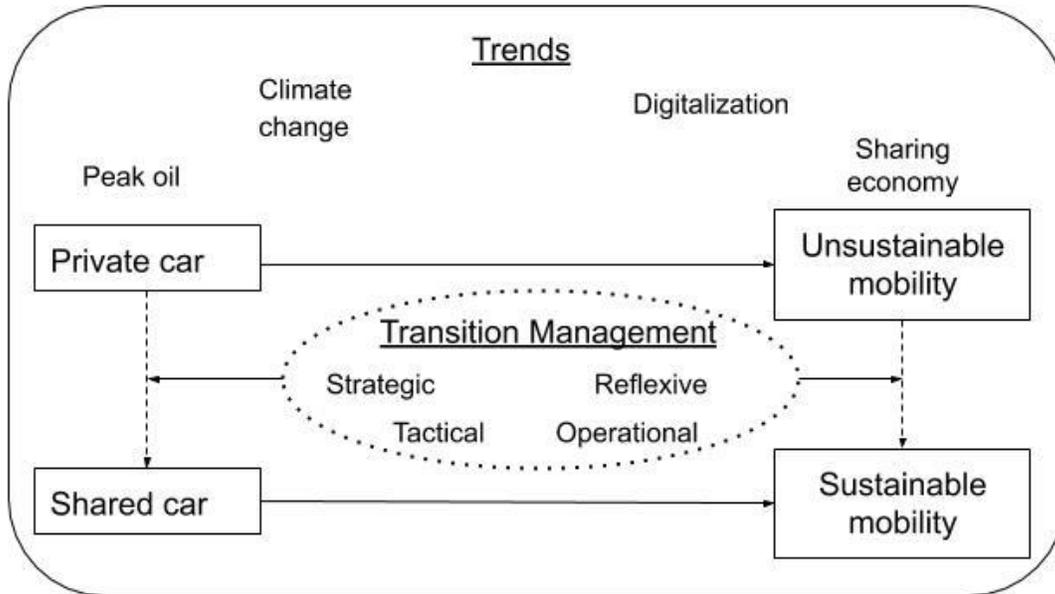
	B2C	P2P
Positive	University Green Party voters A large fleet of P2P cars Pedestrian and bicycle policy	Educated population Public transit commuting A large fleet of B2C cars
Negative	Car commuting Public transit commuting	University Green party voters Density

Table 4. Differences between attractiveness towards B2C and P2P models (Münzel et al., 2019).

Regardless of the model, car sharing in general does offer some important benefits to society and to its users. Research indicates that private cars are parked 95% of the time (Aal, 2017). A shared car can replace 6,5 private cars (Machado et al., 2018) and therefore parking space can occupy less room. This could be an important benefit in dense cities with high parking pressure. Three other benefits are listed by Nijland et al. (2015). First, car sharers are 30% less likely to own a car than before. Second, car sharers drive 15% fewer car kilometers than before. Third, car sharers are responsible for up to 13% less car CO2 emissions. Santos (2018) confirms that, based on their literature review, car sharers have a lower car ownership, delay their car ownership or give up their second or third car. Shaheen et al. (2015) mention that car sharing offers promising opportunities in combination with multimodal hubs. In these scenarios, car sharing can help to reduce the first and last mile issues of public transport. There are also benefits for individual users. Shaheen et al. (2015) mention that car sharing is often cheaper than owning a car, especially in cases when the car is infrequently used. Moreover, car sharing offers more convenience than public transport for instance (Shaheen et al., 2015). Schaeffers (2013) adds that lifestyle and sustainability arguments can play a role as well.

Despite all these positive reasons to start car sharing, regime actors and users only slowly incorporate these services into policy and lifestyle. For the regime, Santos (2018) notes three reasons why governments have not started to make incentives for car sharing: first, the recent upheaval is relatively new speaking in policy years; second, it could be that the benefits of car sharing are not clear enough; and finally, it could be that they are not interested. Machado et al. (2018) refer to the fact that car sharing is often organized by private firms with their own business model. Therefore, governments are reluctant to integrate these services into public transport services because of ownership and responsibility implications. For users, the literature suggests some barriers as well. Vergragt and Brown (2006) mention that people are often very attached to their cars. Moreover, they often do not feel the high costs owning private cars bring over (Vergragt and Brown, 2006). Furthermore, the convenience of using car sharing schemes decreases when one requires the car for daily commute (Bieszczat and Schwieterman, 2012). Giffi et al. (2014) add that despite enthusiasm among young urban dwellers to use car sharing, most of them still are planning to buy a car. Finally, users aspire seamless travel journeys and the use hared cars create a bigger threshold in journeys than private cars, be it less than public transport.

2.6 Conceptual model



3. Methodology

This chapter will give information on the type of data gathering techniques used. Furthermore, the research methods are embedded in a theoretical background, providing the necessary justification. This leads towards a discussion on the quality of the interviews used in the case study of car sharing in the city of Groningen. The chapter consists of a research design, where the research decisions and methods are explained. It continues with information on the data collection considering the literature and the interviews. Subsequently, an explanation of how the data is analyzed is given and the chapter ends with some ethical considerations.

3.1 Research design

This section will first deal with three distinct research decisions obtained from Verschuren and Doorewaard (2007), then it continues with elaborating on the choice for a single progressive case study.

3.1.1 *Research decisions*

The research design of this thesis is based on three major research decisions proposed by Verschuren and Doorewaard (2007). These are: (1) width versus depth, (2) qualitative versus quantitative and (3) empirical versus desk research.

The first decision is about the point of focus: width versus depth. Width means a broad approach with a lot of data. This is good for generalization, but limits detailed insights. Depth means a small approach with detailed information, but limits generalizations. This thesis investigates the adoption of car sharing in the city of Groningen, which makes a focus on depth more convenient. Results count at least for the specific case and can be translated with care to other contexts.

The second decision is between qualitative and quantitative research. Quantitative research makes use of big numbers to provide legitimacy to make conclusions (Verschuren and Doorewaard, 2007). In contrast, qualitative research makes use of in-depth data about experiences and opinions of people (Hennink et al., 2010). Here, the emphasis is on describing a single case study, or a small number of case studies (Clifford et al., 2010). Furthermore, Reulink and Lindeman (2005) mention that a qualitative approach is particularly useful for gathering subjective data concerning the decision-making processes, opinions, and actions of stakeholders in a specified action arena. This means that a qualitative method combines well with a focus on depth and thus is the most appropriate choice for this thesis.

The third decision is between empirical and deskresearch. This thesis will make use of both, since the research questions need different types of information to be answered. This will be elaborated more on in section 3.2.

3.1.2 *Research methods*

There are different possible data gathering options that fit with the decisions made in 3.1.1. Verschuren and Doorewaard (2007) mention five research strategies: survey, experiment, funded theoretic approach, case study and deskresearch (table 5). However, the strategies survey and

experiment can be marked as quantitative research approaches focussing on width. Hence, they will not be used in this thesis. Verschuren and Doorewaard (2007) further mention that within qualitative research a combination of the remaining strategies, funded theoretic approach, case study and deskresearch, often happens. This thesis will thus use all three. They are further described beneath the table.

	Point of focus	Type of research	Location of research
Survey	Width	Quantitative	Empirical
Experiment	Width/depth	Quantitative	Empirical
Funded theoretic approach	Width/depth	Qualitative	Empirical
Case study	Depth	Qualitative	Empirical
Deskresearch	Width/depth	Primarily qualitative	Desk

Table 5. Types of research and strategies (Verschuren and Doorewaard, 2007).

First, the funded theoretic approach is a method used in situations where the researcher does not have a readybuild theory to test in practice, but slowly builds the theory during the research. Within this thesis, theory of car sharing will be gathered and compared to the situation in Groningen. A real world phenomenon is compared to theories of other investigators. This is a subcategory of the funded theoretic approach and is called the secondary theoretical comparison.

Second, the case study is a method where in depth and integral knowledge is gathered about a specific process bounded by time and space (Verschuren and Doorewaard, 2007; Zainal, 2017). Verschuren and Doorewaard (2007) further describe seven characteristics of a typical case study: (1) one or few research unit(s), (2) labour intensive, (3) depth, (4) strategic case selection, (5) conclusions are about the total, (6) on site observances and (7) qualitative data and research methods. Moreover, Yin (2003) argues that a case study should be considered when the focus of the study is to answer a 'how' question. Verschuren and Doorewaard (2007) mention two different types of case study: the single and the comparing. This thesis will focus in depth on a single case study: car sharing in the city of Groningen. No sub variances will be used.

Third and finally, deskresearch is a method where already published material is critically reflected upon to come to new insights (Verschuren and Doorewaard, 2007). There are three types of published material: (1) literature, (2) secondary data and (3) official documents. This thesis will make use of all three, but with a focus on the literature.

3.2 Data collection

This section will elaborate on the practical side of the data collection process. The research questions will be connected to a specific method, followed by an explanation of the methods used.

3.2.1 Methods

This research will investigate how a car-sharing paradigm can be established. This will be tested via a single case-study in the city of Groningen. Data will be based on expert knowledge on car-sharing and transition management from literature, practical knowledge from car-sharing companies and implementation knowledge from different government layers. Information from the first category will be gathered through an extensive literature research and semi-structured interviews. Information from the latter two categories will be gathered through semi-structured interviews with the car-sharing companies and government layers (table 6).

Main research question: How can car sharing contribute to a transition towards sustainable mobility in the city of Groningen?

Sub research questions:

1. What are mobility transitions and which method can be used to manage mobility transitions towards sustainable mobility?
2. Which global trends affect our future mobility?
3. What is sustainable mobility and how is car sharing a part of sustainable mobility?
4. What does the current mobility system of Groningen look like in terms of sustainability?
5. What are factors that advance or hinder the introduction of the shared car in Groningen?
6. What could be advised to condition a transition towards sustainable mobility in Groningen concerning car sharing?

<u>Question</u>	1	2	3	4	5	6
<u>Part</u>	Theory	Theory	Theory	Practice	Practice	Analysis
<u>Data</u>	Knowledge about transition theory and transition management	Knowledge about global trends	Knowledge about sustainable mobility and shared cars	Information about the mobility system of Groningen	Knowledge about factors advancing or hindering adoption of The shared car in Groningen	-
<u>Retrieval</u>	Literature	Literature	Literature	Policy documents	Interviews	-
<u>Documentation</u>	Conceptual framework	Conceptual framework	Conceptual framework	Chapter 4	Transcripts	Chapter 6
<u>Analysis</u>	-	-	-	-	Coding	Comparison between chapter 1 and 5

Table 6. Methods of data collection

3.2.2 Literature

According to Verschuren and Doorewaard (2007), literature should be assessed through an extensive literature investigation. Via the search device Google Scholar, numerous articles on transition management, the sharing economy and sustainable mobility have been collected and read with a focus on car sharing. Two different techniques have been used to find the most relevant and influential articles on these topics: 'snowballing' and 'cited by'. Snowballing is a method to find new articles via the article you have found making use of the reference list. However, this method only finds older literature. Therefore, I also used the method 'cited by' on Google Scholar. This option shows by whom other articles an article is cited and it makes you find the newest material. Tools to find the most influential articles are to choose the most cited articles and look after multiple publications from influential thinkers.

3.2.3 Semi-structured interviews

According to Verschuren and Doorewaard (2007), information from persons can be retrieved through interrogation. Interrogation can be further divided by surveys or interviews. Following section 3.1.2, surveys do not align well with our research decisions. In contrast, interviews are an appropriate method to gather in-depth information about experiences and opinions of actors. Verschuren and Doorewaard (2007) recognize three different roles for interviewed persons: (1) as a source of information about himself, the person is a respondent; (2) as a source of data about others, the person is an informant; and (3) as a source of knowledge, the person is an expert. This thesis treats the interviewed actors as respondents and experts, since data needed is about landscape developments (experts), governments and companies (respondents).

There is a difference between structured interviews and semi-structured interviews. The advantage of semi-structured interviews is that the questions are not fixed upfront, but that they can be adjusted during the conversation if one of the parties considers it important (Reulink & Lindeman, 2005). As preparation for the semi-structured interview, a simple interview guide was used to guarantee that all interviews will cover more or less the same topics (see appendix 2). According to Blumberg et al. (2011), interview guides are made with two important objectives: (1) gathering information about the perspective of the respondent and (2) confirmation or rejection of insights the researcher already holds. The interview guide will reflect these two objectives. The interview guide will be related to the main concepts of the conceptual model. As a result, the answers to the interview questions can be more easily coded. For the different types of respondents (government or company), the guide has been updated with relevant questions.

3.2.4 Participant selection

Participants are selected to represent the different levels (landscape, regime and niche) with regard to the city of Groningen (table 7). The goal was to create maximum variance within the levels among respondents. A minimum of three respondents per level was maintained to confirm certain ideas within a level. The initial goal for the niche level was to interview car sharing companies active in the city of Groningen. However, it soon became clear that they are part of (inter)national companies with their focus not specifically on Groningen. Moreover, they all responded negative towards interview proposals. Therefore, in consultation with my supervisor, I

broadened the scope towards car sharing initiatives that could have potential for the city of Groningen.

#	Level	Position	Organization	Method	Date	Duration (min)
R1	Landscape	Mobility advisor	Sweco	In person	29-5-19	56:23
R2		Policy advisor sustainable mobility	Rijkswaterstaat	Skype	6-6-19	56:56
R3		Senior researcher	Kennisinstituut voor Mobiliteit	Skype	3-6-19	43:01
R4	Regime	Programme manager mobility policy	Province of Groningen	In person	21-6-19	47:08
R5		Policy maker sustainable mobility	Municipality of Groningen	In person	5-6-19	51:35
R6		Mobility management advisor	Groningen Bereikbaar	In person	5-6-19	47:34
R7		Smart mobility advisor	Groningen Bereikbaar	In person	28-6-19	47:14
R8	Niche	Project manager New Mobility Solutions	PSA Groupe Netherlands	In person	29-5-19	52:20
R9		Director	Stapp.in Nederland B.V.	Telephone	18-6-19	48:09
R10		Manager	Easy Driving	In person	28-6-19	38:23

Table 7. Overview of participants

3.3 Data analysis

This section will elaborate on how the data is analyzed. It first explains how the literature is analyzed and then how the semi-structured interviews are analyzed.

3.3.1 Literature

The literature is carefully read, converged and rewritten to build a comprehensive theoretical model.

3.3.2 Semi-structured interviews

Each interview will be recorded and transcribed to full sentences according to the standpoint of the respondent. This makes the text easier to read and to analyse. The transcripts will be coded in order to find connections and differences between the different respondents. Codes are organic labels that connect corresponding sentences. The origins of the codes can be traced back to the conceptual model and to the research questions. However, they evolve during the coding process. The codes group the statements the respondents make about the same subjects. These subjects will form the subsections of the chapter on findings.

3.4 Ethical considerations

This research is carried out with great care in order to give the findings the most legitimacy. Nonetheless, it is always possible that the research contains flaws due to subjectivity or ethical considerations. This section shows how choices are made and consequently argues how flaws are tackled. The goal is to gather the data in a legitimate manner and to analyze it accordingly.

Data gathering happens in this research through semi-structured interviews. It is necessary to make several ethical considerations when conducting a semi-structured interview, since the interviewer gets in contact with respondents. First, the interviewer should create a comfortable interrogation atmosphere for the respondents. This is taken care of through a neutral meeting location, a good temperature, drinks during the interview, easy introductory questions and a present afterwards. Second, during the interview, the interviewer should not ask for sensitive information. In order to respect the privacy of the respondents, they have the opportunity to pass over a certain question and/or to remain anonymous. Furthermore, the questions are not made with the goal to gather sensitive information, since the respondent is not the object of the thesis. Lastly, it was asked beforehand, using a form of consent, if the interview may be recorded and used for the master thesis.

It is also important to give some thought to the subjectivity of this research. Flowerdew and Martin (2005) discuss a few ways to enhance objectivity. First, the researcher must not steer the behaviour and answers of the respondent through a certain physical attitude or asking suggestive questions during the interview. Second, the interpretation of the data is the subjective interpretation of the researcher. Therefore, the researcher must remain open to new insights during the data analysis, to prevent tunnel vision. Third and finally, the collected data is the result of the subjective interaction between the interviewer and respondents, based on own perspectives and experiences (Flyvbjerg, 2001). In order to guarantee good understanding of the meaning of the interview by both the interviewer and respondent, at the end of the interview, room is reserved to reask or change a certain question or answer if one of the parties is unsatisfied.

4. The Groningen mobility system and its context

This chapter will elaborate on the current mobility system of Groningen. Groningen is a city in the northern part of the Netherlands with 200.000 inhabitants (figure 5; Allecijfers, 2019). This section will answer the fourth research question: What does the current mobility system of Groningen look like in terms of sustainability? First the climate goals will be discussed. Then the focus will shift towards the mobility system of Groningen in general. Finally, the third subsection will zoom in on current car sharing numbers in Groningen.



Figure 5. Position of Groningen in the Netherlands. (ArcMap)

4.1 Regional climate goals for mobility

This section briefly describes the climate goals the municipality of Groningen has set for mobility and how they want to accomplish their goals. The municipality of Groningen wants to be CO₂ neutral by 2035 (Groningen CO₂-neutraal2035a, 2019). Mobility accounts for a quarter of the total CO₂ emission of the city (Groningen CO₂-neutraal2035b, 2019). In 2023, Groningen wants to lower the CO₂ emissions by 10% (Groningen CO₂-neutraal2035b, 2019). However, Nijland et al. (2012) estimate that the growth of car mobility will continue until 2040. Currently, transport is almost completely dependent on fossil fuels (Nijland et al., 2012). To fight this challenge, the municipality of Groningen has adopted a threefold strategy: first, don't travel; second, travel differently; and third, travel sustainable (Gemeente Groningen, 2018). They plan to make city logistics emission free by 2025 and public transport will be emission free by 2030. Furthermore, they expand the network of electric charging stations for electric cars so that individuals will easier switch towards electric cars. However, there are only 600 electric cars registered at the moment (Gemeente Groningen, 2018). A final possibility is to shut down the inner city for the most polluting vehicles.

4.2 Urban mobility system

This section will elaborate on the mobility system of Groningen. It will provide information about age categories, modal split, car ownership and travel behaviour.

The population of Groningen is quite young compared to the Netherlands (figure 6). This is partly due to the fact that many students reside in Groningen. However, also the age category for young urban professionals (25-45) is higher than the average in the Netherlands. This statistic is important because young generations are often the first in adopting a transition (Bardhi and Eckhardt, 2012).

The modal split of Groningen is also dissimilar compared to the Netherlands (figure 7). The population of Groningen is less car oriented and more bike oriented. The percentages of usage of public transport and walking are slightly higher as well. This is partly due to the fact that Groningen is quite a compact city and it has had multiple car restrictive policies. Therefore, the modal split of Groningen is already more sustainable than the modal split of the Netherlands. This is something the amount of cars per household points out as well. Groningen has 0.1 less car per household than average in the Netherlands (figure 8). Moreover, the figure shows that this number decreases slightly faster than the Netherlands on average. The total amount of cars is nevertheless expected to rise due to urbanization (Sociaalplanbureau Groningen, 2019)

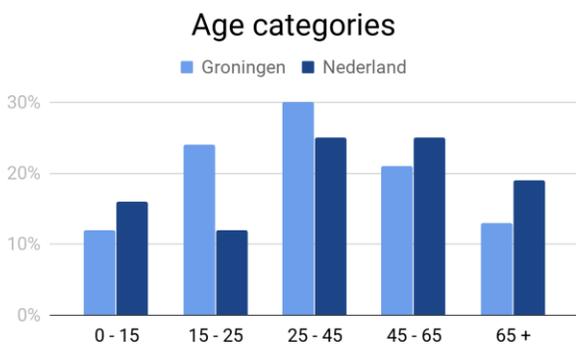


Figure 6. (Allecijfers, 2019)

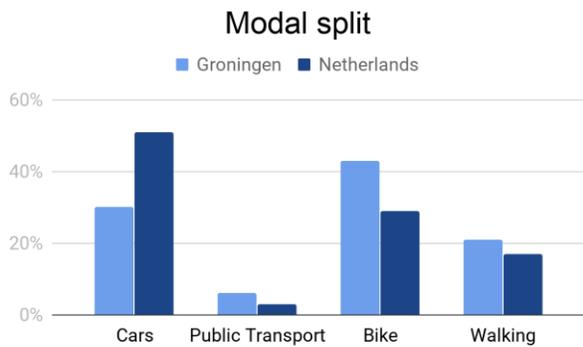


Figure 7. (Basismonitor-groningen, 2019a)

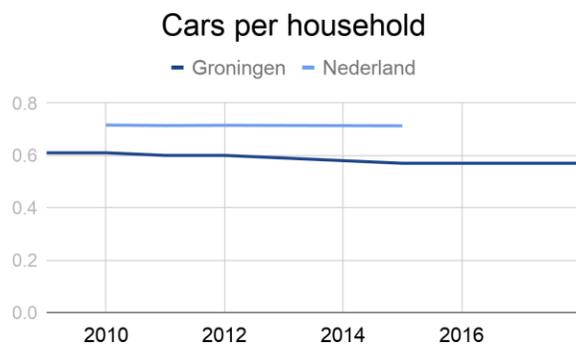


Figure 8. (Groningen.buurtmonitor, 2019)

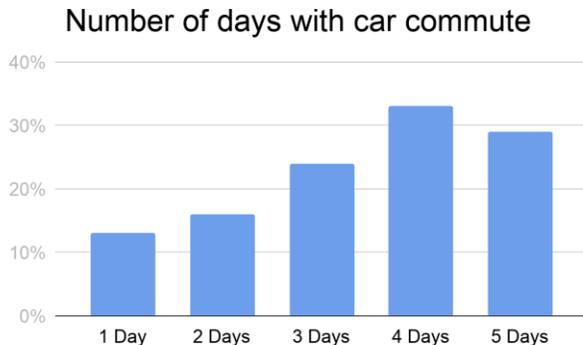


Figure 9. (Groningen Bereikbaar, 2018)

The daily urban system of Groningen reaches some 30 kilometres into the surrounding rural area and to bigger urban centres like Assen (Groningen Bereikbaar, 2018). More than 30.000 people commute per car to work in Groningen (Groningen Bereikbaar, 2018). 53% travels three days or less by car (figure 9). From 2016 to 2017, the amount of car kilometers dropped by 3% (Groningen Bereikbaar, 2018).

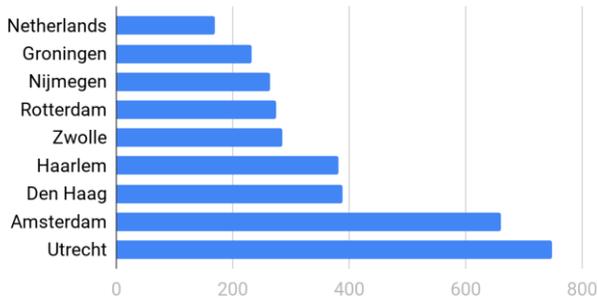
4.3 Car sharing in Groningen

This section will describe the amount of shared cars in Groningen compared to other cities, the growth of shared cars and situational aspects of designated car sharing parking spots.

Groningen had 233 shared cars per 100.000 inhabitants in 2017 (figure 10). This is above the national average of 170, however, it is lower than some smaller Dutch cities like Zwolle and Haarlem. Amsterdam and Utrecht are particularly high on the list. Both cities have adopted car sharing as a potential strategy to combat parking pressures and make car use cleaner (Gemeente Amsterdam, 2018; Gemeente Utrecht, 2018).

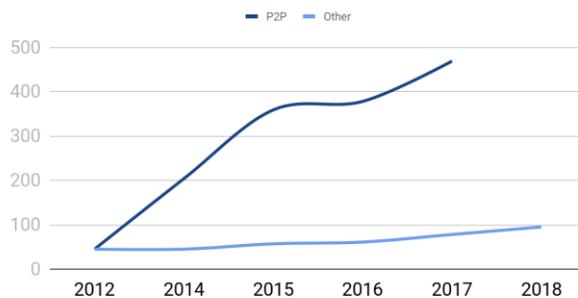
Both P2P car sharing as well as car sharing via B2C and B2B are rising, however the growth of P2P car sharing is much faster (figure 11). This is because P2P car sharing don't have to invest in new cars like the other models have to do. P2P models like Snappcar and MyWheels only have to invest in a platform.

Shared cars per 100.000 inhabitants



10. (Basismonitor-groningen, 2019b)

Growth car sharing



11. (Basismonitor-groningen, 2019b)

Ritjeweg (2019) monitors available shared cars in Groningen (figure 12). Groningen offers shared cars from the platforms MyWheels, ConnectCar, Snappcar, Greenwheels and Witkar. Unfortunately, there is no data about B2B car sharing in Groningen, so this category is not included in this analysis. MyWheels is an organization who offers both P2P car sharing as well as B2C car sharing. Nevertheless, there market share for both categories is lower than the share of Snappcar and Greenwheels respectively, who are market leaders in their category. Witkar is the only one who offers a free floating car sharing system in Groningen, so the location of these cars is not fixed, as is the case with the other businesses.

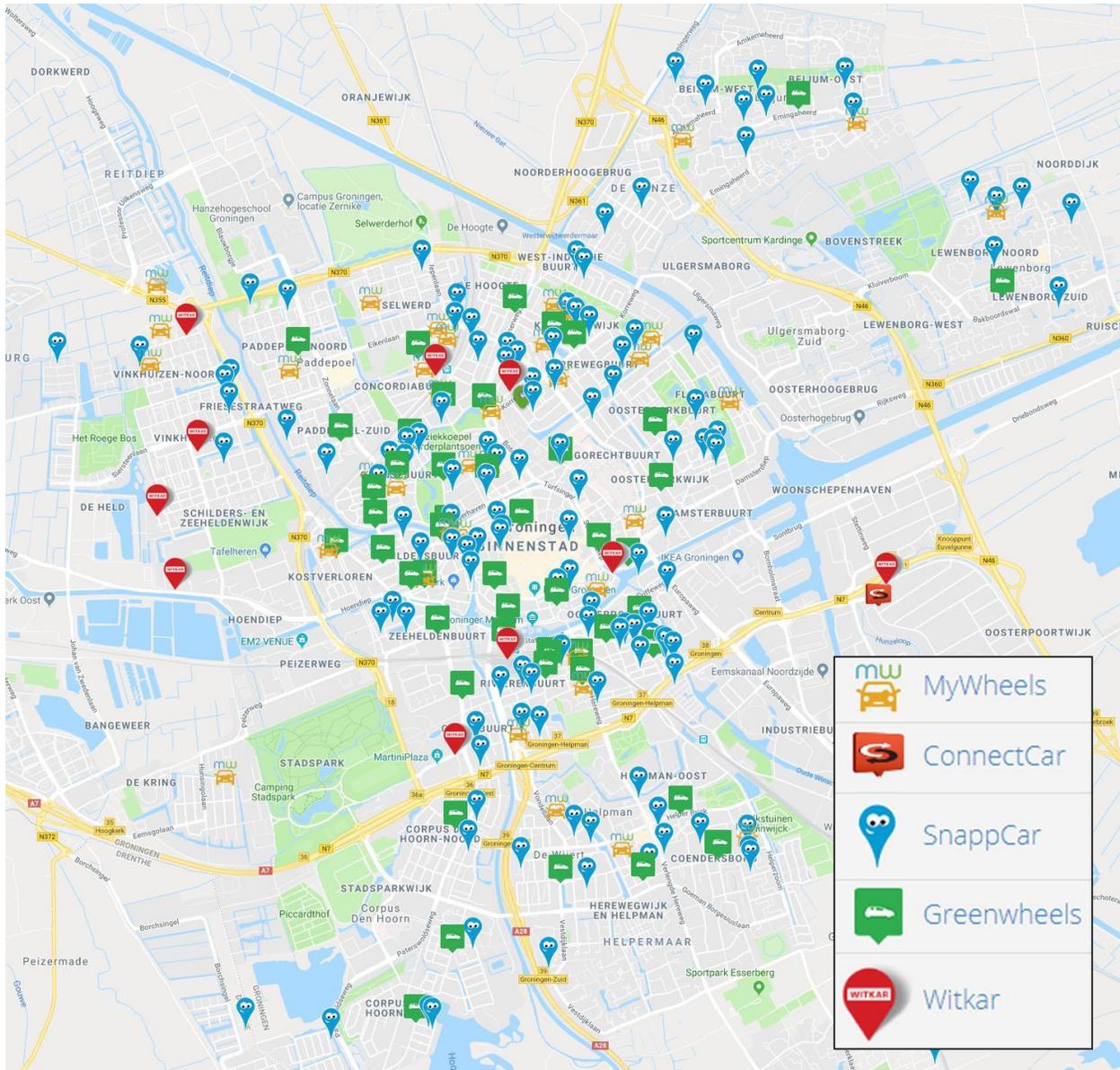


Figure 12. Shared cars in Groningen (Ritjeweg, 2019; Witkar, 2019)

We now direct our attention towards the location of designated parking spots marked as 'autodate' locations. Only Greenwheels cars and B2C MyWheels cars are allowed to park on these parking spots. Users of those cars are thus obligated to return them to the same place. This is called roundtrip station based car sharing, as explained in subsection 2.5.2. I used a dataset of 56 autodate locations in 2018, provided by the municipality of Groningen. The autodate locations shown in figure 13 slightly differ to the locations in figure 12 because of a different date of retrieval. The location of these autodate parking spots is interesting because these cars need to be rented out much more than the P2P shared cars of SnappCar and MyWheels. The figures 13 and 14 show that car sharing is predominantly located near the city center. This is probably because in the outskirts there is more parking space available. Figure shows that the number of inhabitants does not really influence the number of autodate locations. Looking to the number of cars per

neighborhood, we see that less cars are registered in the inner city and that this number slowly increases towards the outskirts (figure 14). Neighborhoods with more than 58 cars per 100 households offer little autodate locations. No conclusions can be made for lower amounts of cars per households and autodate locations. These locations are probably more influenced by proximity to the city center and parking regulations than affected by the number of inhabitants or cars per 100 households.

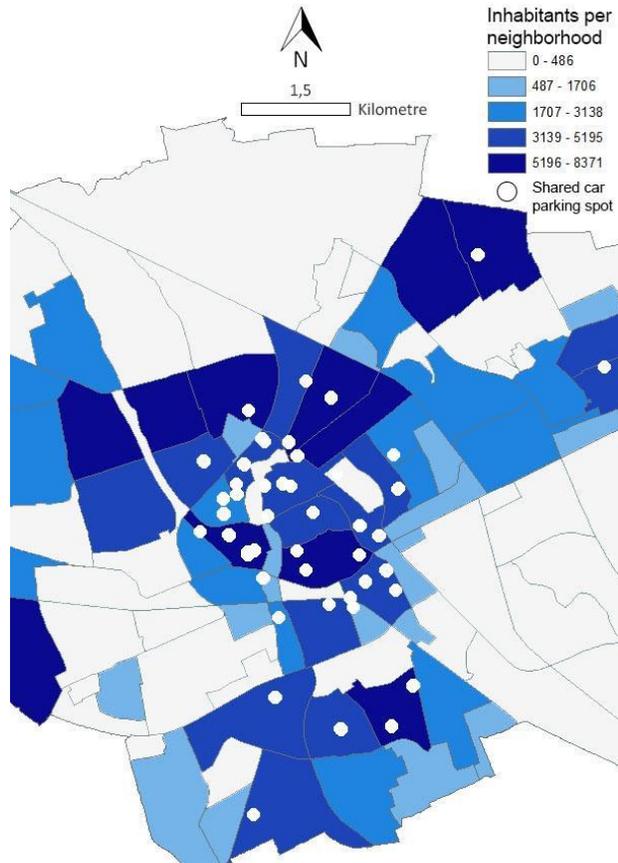


Figure 13.

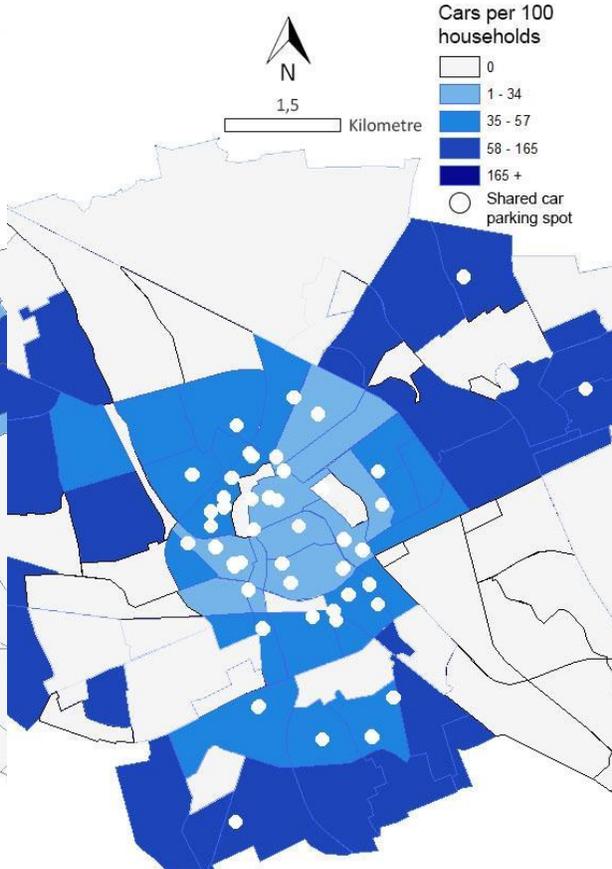


Figure 14.

5. Findings

This chapter will present the data gathered during the fieldwork that has been carried out. The chapter will give an answer to the fifth research question: What are the factors that advance or hinder the introduction of the shared car in Groningen? The structure of the chapter is borrowed from the landscape, regime and niche division of Loorbach (2007).

5.1 Landscape

With regard to the mobility transition in Groningen, the landscape level is defined as national developments. There are three issues that will be discussed: sustainable mobility, the green deal policies and the MaaS pilots.

5.1.1 Sustainable mobility

Sustainable mobility is already elaborated upon in section 2.5, however, this section will describe the vision the experts have on the issue. Sustainability is a theme that does have increasing resonance within the mobility sector. Bigger companies have more or less 90% of their footprint in the area of mobility (Respondent 1, 2). According to respondent 1, it is almost the only thing you can really influence as a company. There is a general understanding that the internal combustion engine will not remain dominant for the rest of this century. However, the experts disagree on the manner in which this will happen. Respondent 3 argues that he rather believes in 'evolution than revolution'. Slightly dissimilar, respondent 1 and 2 believe that the current transition will accelerate because of ongoing developments such as digitalization (smart apps), node development, car restrictions in urban planning, less growth of car usage and growth of other modalities. Respondent 2 mentions the climate agreement from Paris 2015 and the responsibilities this brings for mobility in the Netherlands. The Netherlands wants to make structural improvements into mobility before 2030 in order to reduce 49% CO2 emission (Klimaatakkoord, 2019). In 2050 all mobility has to be emission free (Klimaatakkoord, 2019). This pressure will be felt in all mobility domains. Concerning current car innovations, the experts agree that the most sustainable car is the shared electric car. However, this poses a significant step away from our current car system. Therefore, respondent 2 advocates that people need to start sharing their cars first. She quotes the study of Nijland et al., (2015, p10), which has shown that *'car sharers drive around 15% to 20% fewer car kilometres than before they started car sharing'*. Respondent 3 poses that the electric car may cause less environmental damage, but if this electricity is induced by nuclear power stations or coal plants, the electric car is still not very sustainable. In addition, respondent 1 argues that car driving will never be completely sustainable, for example because of tire wear.

This subsection has shown that there is significant pressure from the landscape level to make car mobility more sustainable. However, the experts show that enough issues remain concerning this subject. The following two subsections will elaborate on two initiatives from the national government to speed up the energy transition.

5.1.2 Green Deal 1 and 2

The national Dutch government has started in 2011 with a Green Deal approach. These Green Deals concern more than 200 subjects within different fields of study. They aim to collectively steer society into a more sustainable direction. Essential to the Green Deal approach is that the government works together with many other parties such as companies and citizens (Green deal, 2019a). Respondent 2 mentions the first Green Deal on car sharing, that started in 2015, followed by a second in 2018. She explains that the first Green Deal had the aim of 100.000 shared cars in 2018. Besides that, it offered networking opportunities that resulted in business to business collaborations and knowledge diffusion between municipalities. Despite the fact that the aim of 100.000 was not achieved in 2018 (the amount of shared cars grew from 16.617 in 2015 naar 41.000 in 2018 (Green Deal, 2019b), the other two goals were achieved and the partners decided that they wanted to continue the program with a second Green Deal (respondent 2). This second Green Deal continued to aim for 100.000 shared cars in 2021. Furthermore, the amount of 700.000 users was added. Respondent 2 explains:

“Because actually. Yes, the fact that someone shifts from car ownership towards car sharing, there is actually the real behavior effect. And how many shared cars you then need to meet the needs of those car sharers is actually a derived demand.”

Respondent 1 acknowledges the fact that this Green Deal can eventually bring about more results. However, he also mentions the fact that the partners of these agreements are also in competition with each other. This means that they are willing to perform a collective lobby for certain things, but they won't go into extremes.

5.1.3 MaaS pilots

As explained in 1.2.2, MaaS incorporates a mobility system based on multimodality and data applications. The shared car will be one of many modalities this system will offer. The national Dutch government has recently initiated seven regional pilot studies with the potential to be upscaled. Each pilot has a different policy objective, such as accessibility, social inclusion or reducing congestion (Ministry of Infrastructure and Water Management, 2019). The goal of the pilot is threefold: (1) develop a user-friendly, trouble-free app that can be used for planning, booking, paying for and actually making a journey, (2) share data and (3) finance it without additional funding (Ministry of Infrastructure and Water Management, 2019).

The experts consider the development of MaaS positive with regard to the shared car. Respondent 3 even views the development of MaaS as a prerequisite of a potential breakthrough of shared cars. Respondent 2 confirms that the introduction of MaaS will give the shared car a better visibility for the general public. And this will result in more users, she argues. The car gives added value to a MaaS system. However, concerns that the car will be too dominant within a MaaS system will not prove to be true (respondent 2): first, cars will always be more expensive, even when exploited into a MaaS system; second, many travellers do not have a driver's licence; and third, public transport gives the user the opportunity to spent the travel time alternatively, cars do not (yet). Another important thing is that these MaaS pilots offer learning opportunities for the government. Before MaaS can upscale to the national level, these MaaS pilots test in which situations MaaS works best.

5.2 Regime

The regime level is defined as the daily urban region of the city of Groningen with a focus on the city itself, since literature prospects that the adoption of car sharing will here be the highest. The following subjects will be discussed: car restrictive policies, car sharing policy, new neighborhood projects, the installment of the mobility innovation center and the emergence of autonomous and electric vehicles.

5.2.1 Groningen: a history of car restrictive policies

In 1977, Groningen introduced the much renowned traffic circulation plan with the main goal to hinder traffic through the city core. This was a clear statement that restricted the unlimited movement of the private car (respondent 5). Since then, Groningen has had many more policies that prevented an unlimited flow of cars through the city and aimed at giving priority to the bicycle and pedestrian. The latest policy of the city is 'Bestemming Binnenstad' (2016) which poses further restrictions on cars and proposes shared spaces as mixed zones of traffic where pedestrians determine the pace. Respondent 5 points out that the municipal council is investigating if the traffic circulation plan could be upscaled to a system that operates within the ring road.

These car restrictive policies are not beneficial for the upscaling of the shared car in Groningen. Cars will be used less for inner city traffic and bikes will gain more momentum. This is, with the aim of sustainable mobility, a tendency that can only be applauded. However, when the autonomous car level 5 is introduced, it could be that shared autonomous (electric) cars are reintroduced in the city. However, this scenario is less desirable, since cars form a physical barrier (respondent 1).

5.2.2 Car sharing policy

The city of Groningen does not have a specific car sharing policy (respondent 5). This is because: (1) they don't have the capacity, (2) their priority is first to initiate an effective electric charging station infrastructure; (3) shared cars are already being organized in the market; and (4) the share of shared cars is not that big yet (respondent 5). However, even without policy, car sharing companies can get a parking permit for all neighborhoods in order to promote a flexible system (respondent 5).

Also Groningen Bereikbaar, an organization with the purpose of keeping Groningen accessible during some bigger infrastructure projects, does not offer the shared car as a solution for higher accessibility. Respondent 6 calls the shared car 'a pretty expensive measure'. This respondent opts for other travel advice such as public transport, electric bikes and working from home. Respondent 6 further argues that the municipality must take the lead for a successful shared car system. He argues that when car sharing has proven its worth, Groningen Bereikbaar will add it to its travel advice list. Respondent 7 adds that a certain measure will be adopted faster if the municipality works with commandments and prohibitions: *"At one hand, you have to make car sharing more attractive to the public, for example using subsidies, and at the other hand you have to restrict private car ownership, for example through increasing the parking prices"* (respondent 7, adapted). However, this instrumentarium of 'hard measures', belongs to the municipality, and not to Groningen Bereikbaar (respondent 6). They opt for a travel behavior change through collaborations with the biggest companies of the city.

In contrast to Groningen, other Dutch cities do have a successful car sharing policy, for example Utrecht and Amsterdam. It could be argued that their higher amount of shared cars (see section 4.3) is the result of an effective car sharing policy. Respondent 2, who has investigated these policies tells that an effective car sharing policy exists of: (1) a link with other mobility policy, (2) sufficient information devices about car sharing, (3) fast parking permit procedures, and (4) effective policy about designated parking places (for example: towing private cars).

The car sharing companies differ in opinion about the question if the municipality should develop a car sharing policy. Respondent 8 mentions that the lack of policy in Groningen results in less car sharing initiatives in the city. He has shifted his attention to other Dutch cities because of this lack of policy. Respondent 10, however, is more satisfied with the type of support and mentions that the municipality is '*very willing to think along*'. She does add that some sort of financial support would be beneficial. In particular in the first few years, initiating a car sharing startup is very costly. Respondent 9 is more vocal in his opinion, claiming that the municipal procedures are too slow to keep up with the speed of innovation.

5.2.2 New neighborhoods projects

An opportunity to stimulate the use of shared cars is through (re)developing new neighborhoods with new parking norms. Respondent 5 mentions that the parking norms are fundamentally changing when new plans have been submitted by the council. Now, a new housing project has to make sure they provide at least 0.4 parking place per house. However, the new parking norm will no longer hold a minimum of parking places per house, but a maximum. This will stimulate another kind of behavior, both from housing project developers and citizens. The first category will increasingly turn their attention towards the possibilities that car sharing brings (respondent 5). In this way, they are able to provide less parking places and keep more room for other developments. However, the housing project developers are not used to carry the responsibility to provide mobility accompanying their houses. Not every project developer will be happy with this added responsibility (respondent 5 and 9). Citizens who are moving towards such newly built housing projects, willingly choose for a house without a parking spot. Such a choice could be compared with the choice to buy an apartment in the middle of Manhattan (respondent 1). Someone like this also willingly chooses for other modalities for their mobility needs. We should move to such a system, respondent 1 argues.

Another opportunity for car sharing, related to the changing parking norms, would be the redevelopment of neighborhoods (respondent 5). When the municipality chooses to drastically change public parking spaces and trade them for other purposes, the shared car could also make an entry into older neighborhoods. However, such plans are currently not expected soon.

5.2.3 Mobility Innovation Center Groningen

During the autumn of 2018, five parties initiated an intention agreement to set up a Mobility Innovation Center (MIC) for Groningen. Among them, there are three knowledge institutions and two governments. The goal is, respondent 3 and 4 explain: (1) to share knowledge and experience about mobility innovations between the parties, (2) to create better networking opportunities, also for businesses, (3) more exposure, and (4) to create a consortium that is better able to attract funding. Together the parties form an innovation agenda with five themes: (1) smart logistics, (2) open and shared networks, (3) autonomous transport, (4) sustainability, and (5) smart vehicles.

Respondent 4 summarizes: *“The MIC has everything to develop a vision on how car sharing can be successful in the city of Groningen. The MIC offers excellent opportunities for the upscaling of shared cars. It is a platform where failed and succeeded samples are documented and eventually connected to other systems of mobility.*

However, respondent 4 also reveals why the shared car is not as high on the agenda as the autonomous car for example. Autonomous cars have far greater potential for the public transport system and governments are responsible for the functioning of public transport. Car sharing is much more something developed by the market.

5.2.4 Autonomous and electric vehicles

The view that our mobility will drastically change is further supported by the possible emergence of the autonomous car. The Ministry of Infrastructure and the Environment (2017) has opted for five different steps to this future. These are described in table 7.

Level	Description	Example	Role of driver
Human driver monitors the situations on the road			
0	No automation	Lane departure warning	Driver performs all driving tasks. Driver-support systems are possible.
1	Driver assistance	Adaptive Cruise Control	The car can perform some driving task. The driver monitors the situation and performs other driving tasks.
2	Partial automation	Parking Assistance	The car can self-navigate. The driver continuously monitors the situation.
The automated system monitors the situation on the road			
3	Conditional automation	Highway Chauffeur	In certain situations, the driver can engage in other activities (reading, Skyping), but must intervene/take over if the system requires it ('fallback-ready user').
4	High automation	Highway Chauffeur, Parking Garage Pilot	Driver can engage in other activities, even sleep, in all situations.
5	Full automation	Robot Taxi	No driver required.

Table 7. Levels of autonomous cars. (Ministry of Infrastructure and the Environment, 2017)

In combination with the shared car, level 5 autonomous cars can give interesting forecasts about future mobility providing door-to-door travel via automated people movers (Ministry of Infrastructure and the Environment, 2017). Respondent 3 and 5 mention that car sharing could take a flight after the autonomous car has reached level 5, because only then, cars could drive themselves to your door and pick you up, providing true door-to-door transport. The autonomous car will also provide a solution for the parking problem (respondent 8).

Whereas the autonomous car level 5 is a prospect for the future, the electric car is already on the rise. Many respondents argue that eventually the electric car will make our car mobility green. A barrier is, however, that electric cars require new infrastructure of electric charging stations. This is a priority at the municipality at the moment (respondent 5). Some car sharing companies, like Easy Driving, only provide electric shared cars (respondent 10). They are dependent on this infrastructure. The expansion of the market share of electric cars makes many

people think about their next car. This is a moment when information about car sharing should be provided (respondent 2). A doubt concerning the electric car is the limited capacity of batteries. Respondent 3 argues, however, that innovation of these batteries will solve these issues.

5.3 Niche

In this thesis, all experiments concerning car sharing that are executed in Groningen, or are possible to execute in Groningen are taken into account. These experiments are partly already discussed in chapter 4. This section will add information of the respondents. First, different views of the respondents on user adoption will be discussed, because this ultimately leads to success of experiments. Then, the perspective of companies will be elaborated upon. The section closes with the subject of competition between companies.

5.3.1 User adoption

Current users of car sharing can be characterised in transition terms as the early adopters. They are often young and highly educated, residential in cities, make above average use of public transport, and vote relatively green (respondent 2). Forecasts show that between 10 to 20% of the Dutch population show interest in car sharing (respondent 2). Currently, only 1% of the Dutch population makes use of car sharing, which means that there is growth potential. However, people are heavily accustomed to their travel behaviour and it is really hard to change this. Respondent 8 argues that the majority will only use car sharing when it proves to be cheaper, more comfortable and easy to use; sustainability as a reason comes fourth. Another impediment to adoption of the shared car by a wider public is the current level of (second) car ownership. Even when the shared car proves cheap, comfortable and easy, people will still say: *“but I have my own car in front of my house”* (respondent 8). Therefore, car owners are least likely to use the shared car. A window of opportunity exists when they cannot afford their (second) car and are in search of something else, or when they are thinking about buying a (second) car (respondent 9). That is an ideal moment to inform them about the opportunities of car sharing (respondent 9). However, respondent 10 adds that many potential car sharers can be very well informed about the benefits of car sharing, they often still want to own a private car. Reasons for this can vary from: ‘I like to drive my own car’, to ‘I don’t want to share my car’. For some people it will not be beneficial any time soon to share a car. Respondent 2: *“if you have to be in a place 4 days a week you should definitely not do that with a shared car”*.

5.3.2 Company perspective

Respondent 8 and 10 have both tried to set up a car sharing initiative in the city of Groningen, but were not successful yet. Respondent 9 has adopted many car sharing strategies in the Netherlands and therefore has a good view on what could work in Groningen. This subsection will describe their strategies.

The strategy of the company (PSA) of respondent 8 is to use their current fleet of cars and make them available for car sharing. They already possess a large amount of cars of the brands Peugeot, Citroën, DS and Opel. They are stationed at auto dealers and are meant for purposes such as demonstration, leasing and renting. For these cars to become shared cars, they only need a ‘black box’ which sends and receives data and makes it possible to open the car without

keys. The benefit of this strategy is that the cars are already available. However, the individual dealers must be convinced to cooperate with the system. Moreover, to grow from a one-way station-based car sharing model into a two-way station based car sharing model, the dealers must intensively cooperate to make the system work. This is not easy. The target audience is people who incidentally need a car. The vision of PSA is to create a worldwide, free-floating network. They already have put 550 free floating cars in Paris. However, respondent 8 does not expect this system to come to the Netherlands, and to Groningen specifically, any time soon.

The strategy of the company (Stapp.in) of respondent 9 has seen a couple of turnarounds in recent years. They started as an independent car dealer that wanted to share their cars with their customers. However, because they were in a high segment, the shared cars were too expensive and Stapp.in had to change their strategy. They set up a national network with other independent car dealers and provided them with the technology to share their cars. The target audience was people who stood before the choice to buy a new car. However, many independent car dealers didn't want to join the program. Respondent 9 said: *"the model works, however, the market is not ready yet"*. Therefore, they are now unfolding their third strategy. Businesses do have a much stronger push to change their footprint than individuals. They want to reduce their CO2-level, lower their parking pressure, improve their green image etc. Moreover, the new generation of trainees and young employees change their job more rapidly than most lease contracts expire. Car sharing gives employers more flexibility. For these reasons, Stapp.in is now active on the business market. They are waiting for the consumer market to improve to step into this market again.

In contrast, the company of respondent 10 (EasyDrive) is focussing on the consumer market. They are developing a network of two-way station based car sharing in the three northern provinces. Their strategy is to place electric cars in villages and neighborhoods with a warm circle of users. The idea is to grow into a network of 1500 shared cars within the next few years. Respondent 10 mentions that it is crucial that the users know each other. This means that they leave the car more cleanly, because it could be their neighbor who uses it next. Because they find this one of the core values of their strategy, they are not entering the inner cities with their concept. The cars have to be used approximately 40 hours a week to make profit from it. Currently this is not happening, but they expect, and hope, that it will come soon.

5.3.3 Competition

As we have seen in sections 1.2.5 and 5.3.2, there are different types of car sharing. These different concepts all try to gain a foothold in the current market. However, the total market share of car sharing in the car market is marginal. It is too low to make the business profitable for the companies. On the other hand, because there are such big differences between the strategies, companies are not in competition with all car sharing companies, only with the companies in their specific niche (respondent 10).

Other respondents differ in their opinion if competition is beneficial for the growth of the car sharing market or not. Respondent 1 disagrees. He thinks that it is better if the municipality writes a tender so that the winner would be able to set up a solid business case. This system would look the same as currently is the case with the tender of public transport. However, other respondents do not see the competition as a problem, but as an advantage. *"Competition belongs to an open market system"*, respondent 5 explains. He expects that one concept will eventually

lead the way and concepts will merge into one provider. This has happened with Swapfiets as well.

There is another competitor on the market: private lease. This type of car use is growing significantly in the last few years. According to the Consumentenbond (2019), there were 64.000 private lease contracts in 2016 and 150.000 in 2018. This is an astonishing growth. Respondent 3 and 9 argue that private lease will be a rival for car sharing, because it has some important advantages over car sharing. For a private lease car, you pay a monthly fee and your own fuel. Many times this will be more expensive than car sharing, however, it holds the advantage of having your own car. This will remain appealing for many people.

6. Analysis

This chapter mirrors the findings presented in chapter 5 to the literature research presented in chapter 2. The transition management activities will be discussed as well as both models of the transition theory. This chapter will answer research question six: what could be advised to condition a transition towards sustainable mobility in Groningen concerning car sharing? It should be mentioned that the first section will focus purely on the adoption of car sharing. From this viewpoint, other sustainable mobility innovations could become a barrier. Since the final aim is to investigate if, and how, car sharing can contribute to a transition towards sustainable mobility, the final section will elaborate on some possible trajectories concerning car sharing and sustainable mobility in Groningen.

6.1 Transition management

This section will describe the level in which Groningen has already adopted the transition management approach concerning car sharing. The transition management approach consists of strategic, tactical, operational and reflexive activities. Each subsection will be introduced by a short summary of the content of the activity. In this way, it becomes clear what is already present in Groningen and which actions are still missing.

6.1.1 Strategic activities at the landscape level

At the landscape level, according to the transition theory of Loorbach (2007), a group of frontrunners forms a transition arena with a transition vision on how to steer mobility into a sustainable direction. To do so, they take strategic actions which aim at influencing societal values in the long term (25+ years). Developments that play out at this level can't directly be influenced from the regime level. As argued in section 5.1, the landscape level is defined as national (or higher) trends and developments. Developments that are visible at this level are the pressure to move towards sustainable mobility, the Green Deal approaches and the MaaS pilots.

Certainly with the Green Deal approach and the MaaS pilots, one could speak of a group of frontrunners that has been formed. These frontrunners are active in a national network of partly actors from governments and partly actors from car sharing companies. Respondents 1 and 2 are to some degree part of this group of frontrunners. Respondent 1 says: *"I am also connected to that network of, among other things, MaaS and shared mobility"*. Respondent 2 says: *"I provide knowledge to municipalities from the Green Deal. I have a view of the entire field of car sharing and how it is developing"*. So, we can conclude that a group of frontrunners who operate at the landscape level has formed. However, the actions they take are focussing on short term results. For actions that are able to influence societal values in the long term, we have to take the sustainability goals of the Paris agreement into account, and the national and regional climate agreements that have resulted from this. This is the transition vision that is formed. The vision of the Paris agreement only insists on the climate goals being achieved, not the matter in which they are achieved. So the solutions should be found at more local levels.

When we critically reflect upon the way in which the strategic activities find resonance at the landscape level, a few things stand out. First, the sustainable mobility transition vision is not created by the same group as those who are the frontrunners. The vision is created by national

and international governmental actors and the frontrunners reside among other parties. We see that they create visions, but those are focussing on short term instead. Furthermore, Loorbach (2007) mentions that the transition vision is ideally not created by governmental actors. However, visions such as the Paris agreement are almost solely initiated by government actors. Perhaps, this is still the right place to create such a transition vision. Lastly, within the transition theory, it looks as if there is too much of a thought process behind the selection of frontrunners and the creation of a transition arena. They need to possess certain characteristics and need to come from different backgrounds. However, the reality is much more complex and when non-governmental actors are supposed to take the lead, other parties quickly become suspicious. Respondent 8 nicely concludes that only the government can bring competing parties together behind a shared vision, otherwise they will always go for their own profit.

6.1.2 Tactical activities at the regime level

At the regime level, according to the transition theory of Loorbach (2007), a group of governance entrepreneurs forms a transition agenda with accompanying paths and images. They perform tactical actions which aim at the medium term (5-15 years). Actions taken at this level are the result of landscape pressures and niche developments. As argued in section 5.2, the regime level is defined as the daily urban region of the city of Groningen with a focus on the city itself. Developments that are visible at this level are car restrictive policies, car sharing policy, new neighborhood projects, the installment of the mobility innovation center and the emergence of autonomous and electric vehicles.

Where at the landscape level one could already speak of a group of frontrunners from the start of the first Green Deal in 2015, at the regime level only very recent a group of governance entrepreneurs was formed. This group is connected to the Mobility Innovation Center (MIC) which has been officially founded in July 2019. Respondents 3, 4, and 7 are associated with the MIC and respondent 4 is one of the initiators. He says:

“the mobility innovation center is a combination of companies and governments and knowledge institutions (...). So basically you have everything there to, for example, develop a vision on how that shared car can become a success. You have car suppliers who can make those vehicles available, you have knowledge institutions that do research into what works and what does not work and you have governments that can make policy on it and then also include it in legislation and regulations or on stimulate in a different way. And you have a platform through which you can aim for subsidies. (...). We don't want it to stay with one successful trial but the aim is to scale up so it can be implemented everywhere.”

This quote clearly states the role of the MIC in a transition towards sustainable mobility and how car sharing could play a key role in this. Again, we see governmental actors as driving forces behind sustainability goals. The MIC has initiated a mobility transition agenda consisting of five themes: (1) smart logistics, (2) open and shared networks, (3) autonomous transport, (4) sustainability, and (5) smart vehicles. Car sharing is an important aspect of the second theme. A dedicated transition agenda for car sharing would benefit the creation of transition images and paths, since these are missing.

One of the key innovations the MIC will boost is the development of the autonomous car. Respondent 4 argues that Groningen is one of the most innovative regions in the Netherlands for tests with autonomous vehicles. Future images of shared autonomous electric vehicles may seem appealing, however, it is far from certain that level 5 autonomous cars can be realised (respondent 4). Until then, the time and effort that is put into autonomous vehicles can not be put into the shared car. This is something that slows down the development of the shared car. The municipality notes the same. Currently, their attention is focussed on providing the city with electric charging stations. This comes at the expense of creating a dedicated car sharing policy. The regime level is the place where pressures from landscape developments and niche experiments come together. However, both the absence of a dedicated car sharing policy at the municipal level, and the absence of car sharing as a possible travel advice at Groningen Bereikbaar show that these pressures are not high enough. Loorbach (2007) mentions that institutional fragmentation can be a possible risk of failure of the transition agenda. However, this is not the case in Groningen due to the emergence of the MIC.

When we critically compare the transition theory of Loorbach (2007) with the situation in Groningen, a couple of remarks can be made. First, car sharing in Groningen should be pleased with the recent start of the MIC. This could really become a tipping point towards the general adoption of car sharing. On the other hand, important regime actors such as the municipality and Groningen Bereikbaar are not intrinsically motivated to start a project with car sharing. They are waiting until the market has become more mature, or in transition terms, until the niche experiments prove successful. A clear transition agenda that connects to the transition vision at the landscape level is missing. Moreover, transition images and transition paths are missing as well.

6.1.3 Operational activities at the niche level

At the niche level, according to the transition theory of Loorbach (2007), different types of organizations are performing experiments. Operational actions, aimed at the short term (0-5 years), are executed to make a beneficial environment in which these niche experiments can flourish. The goal of these experiments is to gain such a significant foothold in the market that the regime can upscale them. As argued in section 5.3, the niche level is defined as all experiments concerning car sharing that are executed in Groningen, or are possible to execute in Groningen. This is a combination of the information given in chapter 4 and subsection 5.3.2. Experiments that are taking place at the niche level are B2B, B2C (free floating and station based) and P2P.

The municipality of Groningen is investing heavily in a network of charging stations for electric cars (respondent 5). Since most shared cars are also electric cars this sometimes forms a barrier for the expansion speed of car sharing companies such as EasyDrive (respondent 10). One of the experts (respondent 2) therefore argues that the first step is to provide shared cars, and the subsequent step is to make those cars electric. However, other respondents disagree and argue that shared cars should be electric cars from the start (respondents 5, 7 and 10). This point of discussion is recognized by transition literature. They advise for monetary reasons to start new experiments based on current infrastructure. However, transition experiments often are in need of a new type of infrastructure, electric charging stations in this case. Concerning the point of competition, transition theory advocates the existence of many experiments. Respondents had different viewpoints on this subject. Nevertheless, competition is present, so that is an advancing

factor, according to the theory. On the other hand, theory also indicates that successful experiments can be upscaled to the regime level. As noted before, this has not happened yet.

6.1.4 Reflexive activities

Reflexive activities should be deployed at every level and ideally within every activity. Reflexive activities consist of monitoring and evaluation.

At the landscape level, monitoring and evaluation happens within the Green Deal approach and within the MaaS pilots. Also respondent 2 mentions that she has a good view over what happens in the field and many parties come to her to be informed. At the regime level, monitoring and evaluation happens at the MIC where they keep track of the success rate of innovations and experiments concerning the five key themes. At the niche level, monitoring and evaluation happens at the individual companies. The three different strategies Stapp.in undertook are a nice example of possible learning curve within such a company.

6.2 Groningen in a mobility transition

For a transition to take place, all three levels of the multilevel model should move into the same direction at the same moment in time for a transition to be able to start and go through the phases of the multiphase model. The different developments that take place at the levels are already touched upon in chapter 5 and section 6.1. Here, the position of the mobility transition concerning car sharing will be discussed and four possible future trajectories will be presented.

6.2.1 Multiphase model

This subsection will discuss the position of the transition to the shared car in the multiphase model (for a recap, see subsection 2.2.2). The multiphase model consists of four phases: pre-development, take-off, acceleration, and stabilization. I will argue that the transition in Groningen finds itself in the take-off phase.

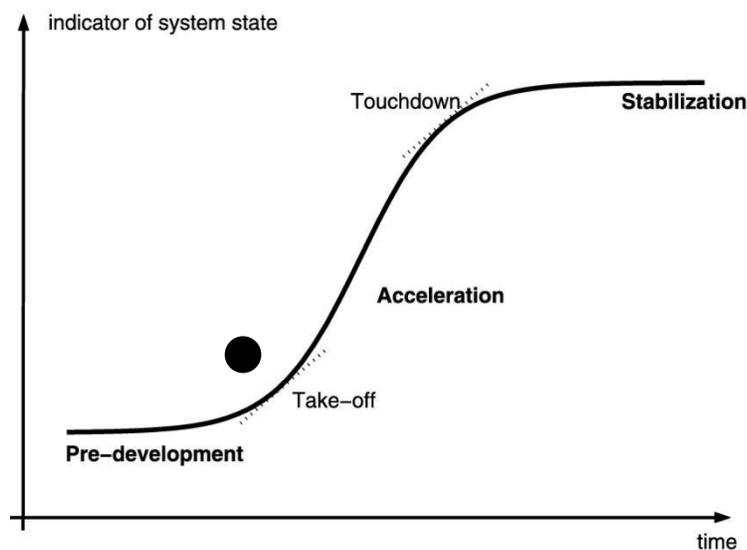


Figure 15. Position of the car sharing transition in Groningen (Loorbach, 2007).

The pre-development phase is characterised by doing experiments. Car sharing experiments have been going on for a couple years now and they are starting to be picked up by a wider public, be it carefully. Especially, P2P car sharing is on the rise (respondent 2). This is an important characteristic of the take-off phase. However, numbers are still relatively small and it is uncertain what will happen next. One reason why the acceleration phase is not yet reached is that car sharing is not picked up yet actively by any regime actor. In cities, like Amsterdam and Utrecht, we have seen that a policy on car sharing is beneficial for faster growth. According to respondent 5, the college council could give a command to make a policy on car sharing in the near future, but nothing is decided yet. This means that landscape activities, such as the Green Deals and the MaaS pilots, and niche experiments, such as those from EasyDrive and PSA, do not offer enough pressure to be picked up by the regime actors. Another characteristic of the acceleration phase is great confusion about effective methods, since old models and networks are being replaced by new ones. In the Groningen case, according to many respondents, the current car sharing market is not mature enough yet to challenge private car ownership. For example, we see that the sustainable fuel market does bring about a lot of confusion. There are many discussions about electric versus hydrogen. Moreover, these experiments are being picked up by the regime. This proves that the sustainable fuel market is one step ahead of a possible transition towards car sharing. In the next subsection, car sharing will be compared and combined with the other technological innovations and behavioral changes touched upon in section 1.2.

6.2.1 Possible trajectories

This thesis has mainly had the focus on a transition towards car sharing. However, the future will definitely not follow one predestined transition path. Next to car sharing, there are many technological and behavioral changes that could bring disruptive effects on our current car paradigm. The best we can guess is that our future mobility will consist of a combination of these mobility developments. The experts and respondents have also elaborated during the interviews about these developments and therefore, it is interesting to sketch four possible future mobility scenarios.

Scenario 1: MaaS and car sharing

On the one hand, car sharing is a service that could provide door-to-door mobility on its own. However, car sharing also forms an essential part of the MaaS strategy, which has been elaborated upon in section 1.2.2. It could be that car sharing starts to flourish when MaaS has arrived. Currently, some sectors of car sharing, for example the free-floating and station based B2C market find it very hard to grow. The high investment costs in their car fleet only are gradually earned back. Many possible consumers don't even know a car sharing market exists. A universal or national MaaS application where shared cars are locally shown on a map could provide a tipping point towards general market adoption. Shared cars will automatically show up on your travel advice. Competition between car sharing companies will happen through pricing in the application. The consumer chooses the travel modality (could also be shared bikes or public transport or all of them) that best fits their needs.

Scenario 2: The autonomous car level 5 and car sharing

The northern part of the Netherlands is heavily investing in autonomous cars. Part of the reason why this is such a relevant region for this innovation is because autonomous cars could enhance the accessibility of the region. Due to urbanization, public transport will become less and less profitable in these parts of the country. The greatest expense of public transport lies in the payment of the bus drivers. Driverless busses would be able to make connections that our current public transport system can't make. If this service proves to be cheap and comfortable enough, society would slowly lower their amount of private cars. This trend will start in the rural area and then make the jump to cities, because the traffic situation is much more demanding in cities.

Scenario 3: P2P and B2B models of car sharing will first rise before B2C car sharing can take a flight.

Chapter 4 shows that in particular P2P car sharing models are gaining ground in the market in recent years. Furthermore, according to respondents 8 and 9, the market for B2C car sharing is not ready yet to enter for many station based or free floating business models. They are waiting for the right moment to step in. Meanwhile, respondent 9 sees a more mature market in the B2B car sharing model. It could be that the concept of car sharing first needs to grow before B2C models may work. Moreover, it is also not clear if the free-floating B2C model is going to work in the Netherlands and particularly Groningen. EasyDrive is building a one-way station based network in the northern Netherlands (respondent 10). PSA is starting with a roundtrip model, but eventually wants to invest in a fully free-floating worldwide system (respondent 8). Stapp.in is not an advocate of the free floating system, and expects more of a one-way station-based model with mobility hubs. This is also something the province of Groningen is aiming for. They are creating a system of 32 mobility hubs in the province where as many modalities come together. In this way, a mobility hub should never be further away than 10 kilometres, an ideal distance to travel with a speedpedelec.

Scenario 4: car sharing remains a niche market

The final possibility is that private car ownership remains the preferred modality for the majority. Car sharing will remain a niche market and car sharing companies will have to battle for the 10%-20% of the Dutch population that wants to use car sharing (respondent 2). Many respondents expect that the current market is too small for so many companies. Respondent 8 argues that eventually, a giant like Google will step into the market and create a free service.

7. Conclusions

This conclusionary chapter will give answers to the research questions presented in chapter 1. Furthermore, it will give a critical reflection upon the findings, contributions to planning theory and practice, recommendations for further investigation, and a personal reflection.

7.1 Answers to the research questions

This section will first answer the sub research questions. Hereafter, the main research question will be answered.

1. What are mobility transitions and which method can be used to manage mobility transitions towards sustainable mobility?

Transitions in general are described by the transition theory of Loorbach (2007). This theory can be used in multiple research domains, among them mobility. Transitions happen autonomously, however, in our current society it is needed to steer them into a sustainable direction. A method to steer transitions sustainable is called transition management (Loorbach, 2007). This method consists of types of activities clustered at the three societal levels: landscape, regime and niche. Moreover, there are reflexive activities at every level to account for learning.

2. Which global trends affect our future mobility?

There are four major global trends that affect our future mobility: climate change, peak oil, digitalization, and the sharing economy. Climate change is also one of the two persistent problems, next to congestion, that car usage involves. Both climate change and peak oil are (partly) caused by our current mobility and important motives for a change in our mobility.

First, climate change is caused by, among others, CO₂ emission from the internal combustion engine. To tackle the root cause, national governments have signed the Paris climate agreement to lower CO₂ emissions. Society needs to shift away from the internal combustion engine towards sustainable alternatives to be able to reach the climate goals with regard to mobility.

Second, peak oil is the moment in time when the rate of oil production starts to decline. Our oil reservoirs are becoming near depletion at one moment in the future. This will result in rising oil prices and the current dependence on oil as fuel for the internal combustion engine will no longer be affordable for the majority.

Third, increasing digitalization results in on the one hand less travel, because activities and information are accessible from one place. On the other hand, it results in smart solutions with regard to our travel behaviour. Examples of these are talking traffic, real time travel advice and the automation of cars.

Fourth, digitalization has also enabled an upheaval of the sharing economy. Online platforms enable supply and demand combinations between peers which were previously not possible.

Finally, congestion is a persistent problem caused by our car mobility. There is congestion on roads and increased parking pressure in inner cities. Governments have tried multiple methods

to keep destinations accessible. The classical solution of adding more roads does not work, since this only leads to more car usage.

3. What is sustainable mobility and how is car sharing a part of sustainable mobility?

The trends described as an answer to research question 2 will cause our mobility system to shift from unsustainable mobility towards sustainable mobility. Solution strategies towards sustainable mobility consist of technological innovations and behavioral changes.

First, important technological innovations are hybrid, electric and hydrogen cars. The hybrid cars are an intermediate form between the internal combustion engine and the electric car. The electric car currently is the most promising. The hydrogen car is the last technological innovation, however, this technology is in development and not ready to conquer the market yet.

Second, important behavioral changes are Mobility as a Service (MaaS), transit oriented development (TOD), the autonomous car and car sharing. MaaS wants to offer door-to-door travel in mobility packages. Customers can choose their preferred modality and associated price tag from a range of travel opportunities, among which the shared car. This service is currently tested in seven pilots across the Netherlands. TOD would create clustered mobility streams between nodes. On these multimodal and multifunctional hubs travel would be reduced to a minimum. The autonomous car currently is still a big technological question, however, the introduction of the autonomous car level 5 will cause a major behavioral shift. Currently, car drivers need to focus their attention on the road. In the autonomous car level 5, car drivers become passengers and are able to spend their time alternatively. Car sharing is the final behavioral change discussed here and the focus point of this research. Car sharing is often confused with carpooling or ridesharing. However, with car sharing, cars are shared in stead of rides. Car sharing is interesting because it is more sustainable than private car ownership and it offers a better fit with the car oriented mobility system. Car sharing leads to less trips being made because habitual behavior is filtered. Furthermore, shared cars are used more often and thus faster renewed than private cars. Newer cars are more environmentally friendly. Important to note is that not every shared car provider has the same benefits for the environment. B2C car sharing is often much greener because they have higher occupancy rates and are thus faster renewed than P2P cars. Shared cars are also able to lower parking pressures in cities and offer first and last mile solutions in combination with multimodal hubs.

4. What does the current mobility system of Groningen look like in terms of sustainability?

The municipality has set the climate goal to be CO₂ neutral by 2035. Mobility accounts for a quarter of the CO₂ emission of the city. The municipality has adopted a threefold strategy to drastically lower the CO₂ emission of the city: don't travel, travel differently or travel sustainable. It is surprising that car sharing is not mentioned as a possible method to fight CO₂ emission.

Compared to the Netherlands, the mobility system of Groningen is already more sustainable. The city has less car usage and has higher percentages of public transport use, biking and walking. Moreover, the number of cars per household is decreasing faster than average. Groningen offers potential for car sharing because of its young population, a considerable number of people that travel that car commute only a few days a week and a pedestrian and bicycle oriented policy.

5. What are the factors that advance or hinder the introduction of the shared car in Groningen?

There are seven factors that advance the introduction of the shared car in Groningen: (1) global trends, (2) national developments (Green Deal and MaaS pilots), (3) neighborhood redevelopment projects, (4) Mobility Innovation Center (MIC), (5) autonomous cars, (6) electric cars, and (7) fast user adoption (table 8). First, global trends, which are described at the second research question influences the mobility system of Groningen through national and regional policy and changing institutions. Second, national developments also follow global trends and respond to those at a national scale. Concerning car sharing, the government has adopted a Green Deal approach and has initiated 7 MaaS pilots. These two landscape developments have not reached the regime in Groningen, but positive results will increase the pressure on the regime. Third, the municipality sees potential in promoting car sharing as a method to lower parking pressures and increase public space. This could happen through initiating neighborhood redevelopment projects, and through creating new parking requirements. The former will not happen in the near future, but the latter is on the agenda of the city's council. Fourth, the recent foundation of the Mobility Innovation Center enhances the visibility of car sharing in Groningen, as it is a part of one of the five research themes. Furthermore, the MIC is a networking platform and a place where learning occurs. Fifth, the introduction of the autonomous car level 5 could accelerate the acceptance of the shared car, since using these cars does not require a drivers licence. Furthermore, it will probably be a more convenient and integrated system than private car ownership. Sixth, many car sharing companies are expanding their electric car fleet. However, they are dependent on the municipality to provide enough charging stations. Seventh, car sharing is not common knowledge yet and car sharing companies miss out on many potential customers. B2C business models assume future growth to repay the car investments. Faster user adoption through increased knowledge about car sharing would increase usage and lower private car sales.

There are 3 factors that hinder the introduction of the shared car in Groningen: (1) car restrictive policies, (2) absence of a car sharing policy, and (3) slow user adoption (**figure**). First, Groningen has a history of restricting unlimited car use in the inner city and this will probably be executed on a greater scale in the near future. This would limit the use of the shared car, but it would promote other sustainable mobilities such as public transport and bicycling. Second, Groningen does not have a specific car sharing policy and this limits tacit knowledge, easy introduction of new car sharing models, publicity in general, and publicity via Groningen Bereikbaar, an organization focussed on enhancing the accessibility. Third, slow user adoption would hinder the expansion of car sharing companies because they are dependent on extra users to add extra (green) cars to the system.

Level	Advancing factors	Hindering factors
<u>Landscape</u>	Global trends National developments	
<u>Regime</u>	New neighborhood projects Mobility innovation center Autonomous cars Electric cars	Car restrictive policies Absence of a car sharing policy
<u>Niche</u>	Fast user adoption	Slow user adoption

Table 8. Advancing and hindering factors in a transition towards the shared car

6. What could be advised to condition a transition towards sustainable mobility in Groningen concerning car sharing?

The answers will be presented in table 9.

Level	Type of activity	Conditions	Present in Groningen?
Landscape	Strategic	Frontrunners Transition arena Transition vision Aims at changes in the culture	There is a group of frontrunners active that are given network opportunities within the Green Deal approach. Green Deal aims at 700.000 car sharers and 100.000 shared cars in 2021. The vision aims at the very short term instead of long term.
Regime	Operational	Governance entrepreneurs Transition agenda Transition images Transition paths Aims at changes in the structure	The foundation of the MIC gathered a group of governance entrepreneurs. However, their focus is not purely on car sharing. The agenda is initiated by the MIC. Car sharing is mentioned, but could receive more focus. Car sharing policy by the municipality is absent as well as car sharing as a possible travel advice at Groningen Bereikbaar. Transition images and paths are not yet mapped out due to the short time span since the foundation. This should receive attention. The agenda consists of experiments with the potential of upscaling.
Niche	Tactical	Individuals and organizations Transition	There are five car sharing companies active in Groningen and some others are trying to settle. They execute different strategies in

		experiments Aims at changes in the practices	which they try to gain market share and influence mobility patterns of society.
All	Reflexive	Monitoring Evaluation Learning	At the landscape, this happens within the Green Deal approach and the MaaS pilots. At the regime, this happens within the MIC. At the niche, this happens within the individual car sharing companies.

Table 9. Transition conditions present in Groningen

Main research question: How can car sharing contribute to a transition towards sustainable mobility in the city of Groningen?

The benefits of car sharing are increasingly endorsed in Groningen. To accelerate the transition towards sustainable mobility, the two recommendations can be given.

1. Develop a transition agenda with transition images and paths

The transition agenda should consist of ‘a number of joint objectives, actions points, projects and instruments to realize the objectives’ (Loorbach, 2007, p.121). The local transition agenda could take an example from the national Green Deal approach. They could aim for a number of car sharers for each of the car sharing business models as well as a number of shared cars. This would ideally be connected to the MIC, the municipality and Groningen Bereikbaar. These three organizations have enough projects and instruments to realize the aims.

2. Establish a connection between landscape trends and regime actors.

The national government has adopted the Green Deal approach for car sharing and has initiated the MaaS pilots to accelerate development towards one mobility service. Groningen is not connected to both initiatives. For the MaaS pilots, this is less of a problem since Groningen can benefit from the positive results of these pilots. It is necessary to remain updated about the results. The MIC is a good location to track this development. For the Green Deal, it is advised to join this approach since this will increase the visibility of car sharing, increases knowledge distribution and accelerates user adoption.

7.2 Contribution to planning theory and practice

7.2.1 Scientific relevance

The popularity of the private car has had enormous impacts on mobility behavior and city planning (Norton, 2008). However, we are on the verge of a new sustainable mobility system and we can only have an educated guess on where we are going (Goodwin and Van Dender, 2013). Cohen and Kietzmann (2014) argue that shared mobility is probably part of the shift. Due to improved information and communication technologies, they argue, renewed attention has turned to shared mobility solutions such as car-sharing, bike-sharing and ride-sharing. Shared mobility connects to the debate on the shared economy, and its possible contribution to sustainability. Cohen and

Kietzmann (2014) argue that the sharing economy has the potential to provoke a radical shift towards another economy system. Subsequently, they call for more research on this subject.

Transition theory can help in answering the question when and how a shift to car-sharing can take place. Transition theory is often used within transportation systems (Whittle et al., 2019) and will also prove a useful theory to be used here. This thesis aims to add knowledge to the transitions in (sustainable) mobility, the sharing economy, and how the shared car may play a major role in this transition.

7.2.2 Societal relevance

Sustainability is the common denominator present in all innovations. Regarding mobility, the most sustainable ways of transport are walking and bicycling, followed by public transport. Private car ownership ranks among the most polluting. However, current mobility patterns are predominantly based upon private car ownership, and this is hard to change (Banister, 2008).

The advantages of the private car, such as convenience, speed, comfort and individual freedom have proven to be very important to current car users (Urry, 2004; Durand et al, 2018; Moriarty & Honnery, 2008; Anable, 2015). Policy makers have put a lot of effort in trying to promote public transport or cycling as an alternative to the car. As a result, data about mobility preferences shows that younger people choose to own a car less often than before (Kim, 2017). However, the car remains very dominant. Therefore, to come to better sustainable mobility, we not only need to focus on promoting alternatives, but also on how to make the usage of the car more sustainable. Governments are also pushing towards more sustainable car use through promotion of the shared car (Rijksoverheid, 2018). This thesis gathers tacit knowledge about car sharing in Groningen. Results are valuable for the transition towards sustainable mobility in Groningen.

7.3 Critical reflection and recommendations for future research

This research has been carried out with great care, however, there are also some limitations.

First, it was not possible to arrange interviews with (at least one of the) car sharing companies in Groningen. They declined all my requests. Therefore, I broadened my scope and interviewed other companies with plans to move to Groningen or with a car sharing model that would be possible to implement in Groningen. A recommendation would be to interview active car sharing providers in Groningen or arrange something else to grasp their tacit knowledge.

Second, it was also not possible to interview a P2P car sharing company, for the same reason. An interview with a P2P car sharing company would really improve the quality of the findings. Especially because P2P car sharing is the one model that shows extraordinary growth.

Third, the theory of Loorbach described in the second chapter is a bit broad. This could have been better aligned towards a transition towards sustainable mobility, instead of sustainability in general.

Fourth, it was not possible to create a complete image of the development of B2B car sharing and in Groningen, since this is organized at the level of the individual company. Moreover, car sharing regularly happens with new housing projects. No complete data was found here either. Future research would be advised to incorporate those business models. Especially since they were mentioned by some respondents as important developments.

7.4 Personal reflection

The writing of this thesis started with a brainstorm on possible thesis subjects in October 2018. Ten months later, this sixty page research has been created. It has been a long but increasingly productive journey, as the biggest contribution has been made in the final two months. During the process of writing, I have learned a few things that I want to share.

First, deadlines are not anybody's friend, but no deadlines are no one's friend either. I tend to work more productively with clear deadlines, imposed from another party. This is something I will definitely ask for in a future situation when I think the deadline is too loose.

Second, I like to work alone, but I genuinely believe that it is more productive to work together, no matter the size of the task. Writing this master thesis alone was a good test, and I think I have been able to produce a logical structure to the thesis. However, an additional pair of eyes would have spotted some flaws quicker and should have resulted in more quality, I believe.

Third, after reading the theory, I was not expecting that governmental actors would have such a big influence in a sustainable mobility transition. There has of course been a shift from government to governance, but this shift is in theory much stronger than in reality. Sustainability goals have a weak profile. This means that no company focussed on profit will bet all his money on the transition. Governmental actors are the designated party to initiate sustainable development and bring the parties together.

Fifth and finally, I really liked doing this research. Unfortunately, I reached the deadline of this project, but I still have many ideas about how I could improve the research. I expect, this is not the last research document I will write and I hope I can put these ideas into next projects.

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Appendices

Appendix 1: Letter of consent

Beste,

Bedankt dat u wilt meedoen aan mijn onderzoek naar de rol van deelauto's in de transitie naar een duurzaam mobiliteitsstelsel. Het onderzoek wordt uitgevoerd in het kader van de Master Environmental and Infrastructure Planning aan de Faculteit Ruimtelijke wetenschappen van de Rijksuniversiteit Groningen. In deze brief wordt beschreven wat u kunt verwachten van het interview.

Onderwerp

Ons huidige mobiliteitsstelsel is voornamelijk gebaseerd op individueel gebruik van de auto. Deze vorm van mobiliteit is niet duurzaam en binnen afzienbare tijd zal er een nieuw stelsel moeten ontstaan dat wel duurzaam is. Op dit moment zijn er verschillende initiatieven die op deze transitie inspelen. De opkomst van de deelauto is één van deze initiatieven en staat centraal in mijn onderzoek.

In het interview dat wij hebben gepland wil ik er graag achter komen wat uw visie is op deelauto's en hoe een transitie van de individuele auto naar de deelauto vormgegeven kan worden vanuit uw expertisegebied. In het gesprek zullen we het hebben over uw visie op aanstaande veranderingen in de mobiliteitssector als geheel, de positie die deelauto's kunnen vervullen en factoren die het uitrollen van dit concept versnellen of beperken.

Afspraken voor het interview

Het gesprek zal de vorm hebben van een semi-gestructureerd interview. Dat wil zeggen dat ik een aantal vragen heb voorbereid die ik aan u wilt stellen. U kunt zelf echter ook informatie toevoegen aan het gesprek als u deze waardevol acht. U kunt tijdens het gesprek altijd aangeven dat u wilt stoppen of een pauze wilt nemen. Ook kunt u aangeven als u een vraag niet wilt beantwoorden, u hoeft hiervoor geen reden te geven. De streeftijd van het interview is drie kwartier en maximaal één uur. Dit is natuurlijk afhankelijk van het verloop van het gesprek. U hoeft het gesprek niet speciaal voor te bereiden.

Wat gebeurt er met uw gegevens?

Om de antwoorden goed te kunnen analyseren, zal het gesprek worden opgenomen met een audiorecorder. Er wordt vertrouwelijk omgegaan met de verstrekte informatie. Alleen ondergetekende en mijn begeleider dr. Farzaneh Bahrami zullen toegang hebben tot de gegevens.

Ik hoop dat alles zo duidelijk is. Wanneer er toch nog vragen zijn kunt u contact opnemen met:

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Telefoon: 050 36 33895

Met vriendelijke groet,

Daniël Peereboom

Appendix 2: General interview guide

Voorafgaand

- Voorstellen: Naam, opleiding
- Thematiek onderzoeksonderwerp (transitietheorie, duurzaam mobiliteitsstelsel)
- Afbakening onderzoeksonderwerp
- Interview: semi-gestructureerd, onderwerpen (landscape, regime, niche), lengte
- Ethiek: Stoppen, overslaan, Vragen voor opnemen
- Heeft u nog vragen voordat we beginnen?

Introductie

1. Kunt u iets vertellen over uw functie en organisatie?

Landscape

Strategic actions, Lange termijn (25+ jaar), frontrunners, Transition arena, Transition vision

2. Wat zijn algemene ontwikkelingen die van invloed zullen zijn op ons mobiliteitsstelsel?
3. Op welke manier kunnen we onze mobiliteit duurzaam maken?
4. Bestaat er volgens u eenduidigheid over een duurzame mobiliteitsvisie?

Niche

Operational actions, korte termijn (0-5 jaar), iedereen, transition experiments

5. Wat zijn uw ervaringen met deelauto's?
6. Welke deelauto concepten bestaan er?
7. In welke toepassing zijn deelauto's het meest kansrijk?
8. Op welke manier past de deelauto in een duurzaam mobiliteitsstelsel?
9. Hoe groot acht u de kans dat de deelauto opgeschaald kan worden?
10. Welke barrières zijn er (gevestigde belangen)?
11. Wat zou het proces versnellen (window of opportunity)?
12. Wat zijn onzekerheden die spelen?

Regime

Tactical actions, Middellange termijn (5-15 jaar), governance entrepreneurs, transition agenda, paths and images.

13. Wat is het huidige beleid op het gebied van deelauto's?
14. Is dit beleid erop gericht deelauto initiatieven te stimuleren?
15. Op welke manier wordt bepaald welke mobiliteitsexperimenten werken en welke niet?
16. Hoe wordt voortgang gemonitord en geëvalueerd?

Slot

- Heeft u het idee dat u op alle vragen een goed, volledig antwoord hebt kunnen geven? Is er nog iets dat u wilt wijzigen of terugnemen?
- Wilt u nog iets toevoegen dat nog niet ter sprake is gekomen?
- Zijn er nog mensen binnen uw kring die ik zou kunnen interviewen?
- Heeft u nog interessante bestanden voor mijn onderzoek?
- Wilt u een exemplaar van de scriptie ontvangen?

Hartelijk dank voor het interview en uw tijd!

Overhandigen cadeautje

Wat vond u van het interview?

Appendix 3: Transcripts (not included)