University of Groningen
Master Thesis

# The future is near! Are we ready?

The role of the regime level in the Dutch transition towards automated mobility.

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*Cover: Interstate 35W (Minnesota, USA) by night (University of Minnesota, 2017)*

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## Preface

An exciting and challenging period in my life is coming to an end. With finalizing this master thesis, an extensive period of studying and education will be completed. This thesis concludes my Master program in Environmental & Infrastructure planning, which has brought me a lot of fun and offered me a new perspective on the world and the future.

For finishing this thesis I would like to thank a handful of people, without them finalizing this thesis would have never happened. First of all, I would like to thank the interviewees which have contributed to this research. I have not experienced any struggles contacting all of them and I am grateful for the time they have cleared for me. I have appreciated the inviting and collaborative attitude of the participants and experienced that my fascination with regard to automated mobility is shared with a lot of people in infrastructure and transport planning.

Second, I would like to thank Goudappel Coffeng for giving me the opportunity to write my thesis within their organization and for letting me use their expertise and knowledge in the field mobility. In particular, I want to thank Johan Munsterman for his critical view on my thesis and his supervision during my final process of graduation.

Third, I would like to express my gratitude to Wendy Tan. Wendy has supported, motivated and guided me for from the beginning to the end of my thesis and has been a great supervisor. A final word of thanks goes to my family for supporting, advising and motivating me in multiple ways for fulfilling my studies.

What lies ahead, is an interesting and challenging world full of opportunities to put my education into practice. I am curious to know how the future will look like and I hope I can contribute to make the world a more comfortable and sustainable place.

I hope you enjoy reading my thesis,

Dedjer Wijmenga

Leeuwarden (The Netherlands), April 2017.

## Abstract

Automated mobility can contribute to a sustainable, efficient and safe mobility system, and requires systemic irreversible changes in the socio-technical system of society for implementation. The transition to automated mobility can be approached from three analytical levels, whereof the regime level (between the landscape and niche-level) is of prime interest. With the help of a case-study in the northern region of the Netherland it is shown that, this regime level in the transition can be changed by a coordinating, facilitating and stimulating key-actor: the province.

The northern provinces of the Netherlands see automated mobility as a feasible solution to the lack of accessibility in remote and depopulated areas, and strive for a - flexible, on-demand, collective - autonomous system to increase this accessibility. For implementation, society has to be involved in a great amount of projects and pilots. Trust and understanding of a new mobility system is necessary for exploitative industry actors to adopt automated-related niches, which in turn leads to a regime shift. Therefore, provinces are determined to continue with the execution of new pilots and stimulation of automated-related innovation at the local level. Along with the regional political willingness, open-mindedness and the powerful position with regard to public transport of the provinces, automated mobility can infiltrate the current regime. Regional coordination is necessary to ensure consecutive learning processes of diverse pilots and the development of a universal automated system.

Finally, a recommendation for the northern region of The Netherlands is to rebrand the region to attract international publicity. It may lead to the involvement of a wide range of stakeholders from different disciplines. This diversity may help overcome obstacles like the adaption of current laws and the involvement of society on a large-scale.

**Keywords**: *Sustainable mobility, Automated Mobility, Transitions, Regime level.*

## List of translations

| English | Dutch |
|---|---|
| National Environmental Policy | Nationaal Milieubeleidsplan |
| National Environmental Vision | Nationale Omgevingsvisie |
| Environmental Act | Omgevingswet |
| Ministry of Infrastructure and Environment | Ministerie van Infrastructuur en Milieu |
| Knowledge Institute of Mobility policies | Kennis Instituut Mobiliteitsbeleid (KIM) |
| Regional strategic vison | Structuurvisie |
| National strategic vision | (Nationale) Structuurvisie Infrastructuur en Ruimte |
| Regional zoning plan | Inpassingsplan |
| Spatial Planning Act 2008 | Wet Ruimtelijke Ordening 2008 |
| National Spatial Strategy 2006 | Nota Ruimte 2006 |
| National Transport Strategy | Nota Mobiliteit |
| Contracting area | Krimpregio |
| Road-authority | Wegbeheerder |
| Provincial Traffic and Transit plan | PVVP: Provinciaal Verkeers- en vervoersplan |
| National Service for Road traffic | Rijksdienst voor Wegverkeer (RDW) |
| Trajectory Act | Tracéwet |
| Trip-chaining | Ketenmobiliteit |

## List of abbreviations

| Abbreviation | Meaning |
|---|---|
| TOD | Transit Oriented Development |
| KIM | Kennis Instituut Mobiliteitsbeleid |
| TM | Transition management |
| RWS | Rijkswaterstaat |
| RDW | Rijksdienst voor Wegverkeer |
| I&M | Infrastructure and Environment (Infrastructuur en Milieu) |

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# 1

# Introduction

"Is the world truly ready for a car that can drive itself? Ready or not, the future is here!", the headline of the Mercedes-Benz (2017) commercial for the brand new E-Class model for 2017 (see figure 1.1). The development of technology regarding fully automated cars has taken a leap in the foregoing years. Major car brands increasingly fast perform research and tests to introduce automated cars and networks. Googles self-driving car already made 2 million test-miles and Tesla's autopilot function already drove over 100 million miles (Dolgov, 2016). In The Netherlands tests take place on public roads (NOS, 2016). The Dutch ministry of infrastructure and environment is interested in the development of automated mobility (KIM, 2015). The ministry intends to become a frontrunner in the development of automated mobility and explores the possible implications for the design of roads (Morsink et al., 2016).The automobile sector is preparing for a new sustainable, efficient and safe future regarding transport mobility (Hengstler et al., 2016). Automated mobility is therefore currently amongst the most intensively researched topics in the mobility field (Beiker, 2012). Tesla, BMW, Audi, Google and Volvo are on the brink of a new future (Hijink, 2017), but the question is: are we governments, society and market players ready for it?

*Figure 1.1: "The future" according to Mercedes-Benz USA (2017), the autonomous F015 Concept Car*

The current transportation networks and systems are a result of continuous improvements to systems that were designed in the course of the past (figure 1.2). Currently, automated mobility is expected to be implemented within only 20 years (Benschop, 2013). This is a short period considering the century-long development of the current systems. For automated vehicles to navigate through our network and spaces, drastic spatial and institutional changes will be necessary. For example, the design of infrastructure can change radically: autonomous cars may not need any traffic signs or speed limit warnings and roads may become less wide (Morsink et al., 2016). Additionally, the legal framework regarding responsibilities, technical standards, public policies and laws needs to be revisited. For example, who is responsible in case an automated car is involved in an accident: the passenger, the software or the car manufacturer (Beiker, 2012)?

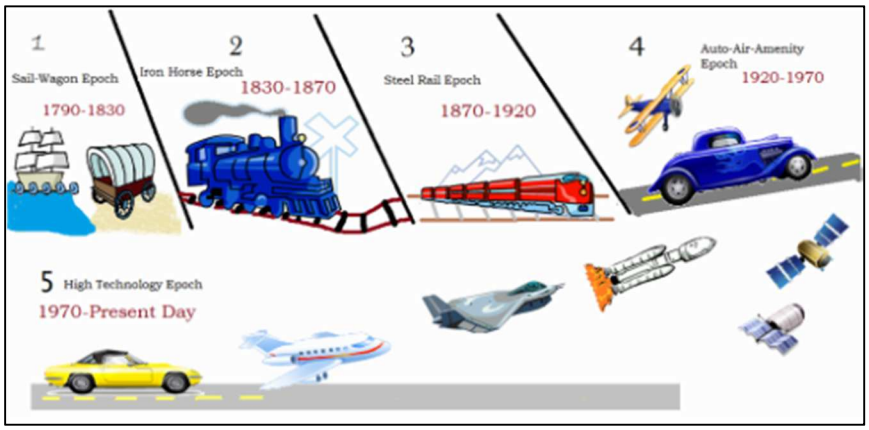



*Figure 1.2: Borcherts five epochs; visualizing the evolution of transport mobility over multiple centuries (Borchert, 1967; Warner, 2017)*

In the world of sustainable transportation solutions, automated mobility has captured the imagination of companies and policy makers. The underlying reasons are the inability of the current system to cope with the increasing traffic density and the associated environmental damage (Kemp & Rotmans, 2004). A growing concern about climate change along with the unsustainable fossil fuel driven current transport system increases the need and interest in automated mobility (Marczuk et al., 2016), which can contribute to a sustainable, efficient and safe mobility system. Moreover, automated vehicles can reduce traffic accidents and move in an efficient way through traffic (Beiker, 2012). Fuel and energy consumptions will decrease along with undesired emission. Automated mobility can contribute to accessibility, livability and an economic growth in regions, as explained in Section 3.2 (Beiker, 2012).

Summarizing, an inspiring future lies ahead if the newest developments in the automated mobility sector are followed. This thesis explores whether other important players in this field, including regional and national governmental bodies, are ready to implement these innovations.

## 1.1 Research objectives

Three provinces in the north of The Netherlands, along with a municipality, have signed a letter of Intent to test automated mobility the coming years (Gemeente Ooststellingwerf, 2016). This is an interesting development in the transport policy arena of The Netherlands. The Netherlands is already seen as a frontrunner in terms of sustainable mobility (e.g. with the European SUMP-plans, see Christeans, 2017; Eltis, 2017). This makes the northern region a relevant case study for exploring the facilitation of automated mobility, since the region faces present and future depopulation of rural areas. The latter will be a tough test for the financial robustness and system capacity of the current transport system. For example, many rural villages in the northern region have been cut off from regular bus services due to a lack of customer base (Leidelmeijer et al., 2011).

To solve issues, a systemic change is required. Such change indicates the need for a transition to occur. In fact, current processes like the ongoing automation of car services (e.g. parking assist and adaptive cruise control) and the gathering of dedicated frontrunners in The Netherlands (CROW, 2017), are signs of a transition in process in which niche practices try to infiltrate in the current mobility system (Geels, 2011; Rotmans et al., 2001). What is required, is an irreversible change in the current mobility system: a deviation from the existing socio-technical system (Geels, 2011). If for example an automated mobility system is fully implemented, road design can change drastically (e.g. no traffic signs and traffic lights) which makes it impossible to use a non-automated vehicle (Mosink et al., 2016). Probably, people's daily lives will even adapt to a new system because activities like work and leisure can change (e.g. other working hours and location). For analyzing such irreversible systemic changes, transition management theory can offer a helping hand (Geels, 2011).

This existing socio-technical system, in which the current mobility system - with self-owned non-automated vehicles - is firmly embedded in society used for decades, is referred to as the socio-technical **regime** in transition theory, or simply the regime level (Elzen et al., 2004). This regime level is of interest for this research because it is the most important level in a transition (Geels, 2011). If the regime level (thus the current mobility system) can be changed fundamentally, thus the currently embedded mobility system, the transition towards automated mobility can be considered finished, and a new regime can be installed.

At the current regime level societal actors - like companies, users of the mobility system and public authorities - are found that have a "vested interest in the existing system and invest [only in] innovations [that] improve its performance" (Elzen et al., 2004, p.252). These activities are so-called tactical activities (Loorbach, 2010). At the regime level institutions and regulations are designed to guide public and private action (Rotmans et al., 2001). In this research, the focus lies on interest-driven actors that strive to exploit the current system and actors that design institutions for the public and private society. The governmental actors at the regime level seem to resonate with the activities of the provinces in the Dutch planning system, because the provincial level is responsible for the regime-related tactical activities. See Section 3.4.5 for an elaboration on the similarities.

On the regime level, governance related struggles are experienced, like e.g. disagreement in focus for investment or a lack of resources. The concepts of *automated* versus *electric* versus *sustainable* mobility are often mixed up with each other and referred to in different ways by different actors (see Section 2.1). Sustainable mobility can be seen as concept that requires change in many systems to be successful e.g. improved technology and personal information services (Banister, 2008). However, these different systems have developed apart from one another (Tan et al. 2014) leading to multiple perspectives on sustainable mobility. To optimize efforts and reduce failures, actors involved in sustainable mobility should use a common frame of reference for dealing with the systemic change described above. Therefore, in this thesis a framework is developed that positions automated mobility in relation to sustainable mobility and defines sustainable mobility as: *a fully automated electric driven mobility system that meets the needs of the present without compromising the ability of future generations to meet their own needs* (based on i.a. Brundtland, 1987; Banister, 2008; Nykvist & Whitmarsh, 2008; see Section 3.1).

Another struggle is found on the local level. The northern region of The Netherlands targeted specifically the rural areas for automated mobility to be implemented (Gemeente Ooststellingwerd, 2016). However, it is hardly to be expected that the relative small rural municipalities have enough expert knowledge, capacity, willingness and means to foster niches and deal with the transition to automated mobility (Gupta, 2007; Zuidema, 2016; see Section 2.1). This lack of capabilities can form a serious bottleneck since niches are "the seeds for a transition" (Elzen et al., 2004, p.253).

Furthermore, in the described transition several governance barriers are experienced and to be expected, like a stable institutional design with the right diversity of involved actors. Stakeholder involvement and participation is needed to solve barriers towards automated mobility. However, the involvement of stakeholders and society seems to be a challenge (Banister, 2008), at the regime level stakeholders are interest-driven and these interests differ between stakeholders, which hampers the desired collaboration (Bos & Temme, 2014). In addition, society has a skeptical attitude towards automated mobility (Hengstler et al., 2016) but acceptance is necessary to enhance support for the (eventual) implementation of a new mobility system.

Despite the optimism for automated mobility as an innovative future development, systematic analysis regarding the point of departure for a possible transition towards an automated mobility system is lacking. This is particularly so in the northern region in The Netherlands. For example, regional media report the test with automated mobility in the northern region as a failure and as a waste of investment. An involved scientist even admitted that "In hindsight, letting a wide vehicle drive [...] over a narrow bicycle lane was not very astute" (Berg, 2017, p.1). It has been argued that involved actors have not prepared the test well enough, as it was rejected already after three days (Berg, 2017; Wel, 2016). Since the roles of actors differ per phase of a transition (Loorbach, 2010), a point of departure is needed to reduce the above mentioned bottlenecks.

This research, therefore focuses on the governance aspects and the actions of actors at the regime level of the mobility system under transition in the northern region of The Netherlands. To structure the research, the main research question is derived from the issues and context mentioned above:

***How should the transition towards an automated mobility system be facilitated at the regime level in the northern provinces of The Netherlands?***

In support of this main question, additional sub questions have been derived:

1. In which phase is the Dutch transition to automated mobility currently at, particularly in the northern region of The Netherlands?
2. What are the main barriers towards implementing an automated mobility system?
3. How can the regime level of the mobility system in the transition towards automated mobility be influenced and changed in the northern region of The Netherlands?
4. Which actors are involved at the regime level of the mobility system in the transition towards automated mobility in the northern region of The Netherlands?
5. Which strengths and opportunities at the regime level are present in the provinces Friesland, Groningen and Drenthe to foster the transition towards automated mobility?

### 1.1.1 Scientific relevance

Sustainable mobility is used widely and emphasizes the practical aspect of implementation (COM, 2001). It is a term born of policy desires within transport planning in the EU. As stated by the Commission of the European Communities: "sustainable transport system needs to be defined in operational terms in order to give the policy-makers useful information to go on" (COM, 2001, p.19). There is a lack of critical discussion on the implementation of the proposed elements in a specific context. Current discussions on sustainable mobility are mainly prescriptive and superficial (Banister, 2008). Also, Beiker (2012) argues that there is a need for academia to "recommend actions [...] on the subject [of automated mobility]" (Beiker, 2012, p. 1156). This thesis adresses the calls of COM (2001) and Beiker (2012) by contributing to the discussion about sustainable mobility with the aid of operational (governance) recommendations regarding automated mobility.

The suggested systemic changes in the current socio-technical system require a framework of understanding that is offered through transition management theory. The current research contributes to the scientific debate in combining theory regarding sustainable mobility, automated mobility and transition management theory into a framework of understanding. It positions automated mobility in the broader concept of sustainable mobility with the help of several perspectives on the issues.

Moreover, this thesis offers empirical evidence of a transition in process by applying the framework of understanding of systemic changes to the northern region of The Netherlands.

### 1.1.2 Societal relevance

The aim of the research is to understand the current process of transition towards automated mobility in the pursuit of sustainable mobility. This exploratory research focuses on the northern region of The Netherlands and will lead to policy recommendation for the three northern provinces Friesland, Groningen and Drenthe. To determine possible miscommunication and a lack of alignment in visions, ideas and investments, all provinces in the northern region are interviewed. This overview can contribute to efficient and successful future pilots, projects and policies.

The societal relevances constitutes in the first place, an increased understanding of the transition towards sustainable mobility, which can be used by policy and decision makers in the field of mobility and transport planning. Secondly, this research can be seen as a contribution to urgent socio-technical changes in the North and the sustained accessibility of the region. These issues in depopulated areas are not unique to The Netherlands. Across Europe, similar regions are present (Kohler et al., 2009). The results of this thesis therefore may be of interest for international purposes and possibly contribute to solving similar issues elsewhere. Thirdly, the research contributes to understanding the transfer of ambition from a national level to a regional and local level. The Dutch Minister has expressed to become a frontrunner in the field of automated mobility (Morsink et al., 2016). The transfer of ambition can be a source for lesson-drawing and policy transfer for other countries, because strong leadership is one of the prerequisites for successful sustainable transport (Banister, 2008).

## 1.2 Scope of the research

The Dutch ministry of Infrastructure and Environment is a frontrunner in designing policies in the field of automated mobility in Western-Europe (Morsink et al., 2016). Tests take place with automated mobility and actors are mobilized to evaluate those tests (NOS, 2016; CROW, 2017). At this national level, there is awareness of the need for systemic change for automated mobility to be implemented and consequently a transition perspective is accepted in the National Environmental Policy (In Dutch: Nationaal Milieubeleidsplan) (VROM, 2001; Kemp & Rotmans, 2004). Therefore, the northern region of The Netherlands has been chosen as a study area, since it is a region in transition (Provincie Drenthe, 2017; Gemeente Ooststellingwerf, 2016; see Section 3.4). Furthermore, political willingness is present in the region to test with automated mobility (Gemeente Ooststellingwerf, 2016), space is available for experiments and the main infrastructure network is as good as up-to-date. This makes the region an interesting and useful unit of analysis (see Section 2.4).

Additional, the concept of sustainable mobility is focused on two pillars**: the modal shift element** and **the automated mobility element** (based on i.a. Banister, 2008; Nykvist & Whitmarsh, 2008; see Section 3.1). This thesis is mainly focused on the latter pillar. Finally, there are many reports examining the technological aspects of automated mobility. However, as Banister (2008) and Rietveld & Stough (2004) argue, the most important barrier for implementing sustainable transportation is one that is institutional in character. Therefore, this research focuses on governance activities in the northern region of The Netherlands and only briefly touches upon the technology of automated vehicles.

## 1.3 Research design

The research employs an exploratory nature to understand how the transition towards automated mobility in the northern region can be facilitated. The research is divided into two phases as illustrated in figure 1.3: a theoretical and an empirical research.

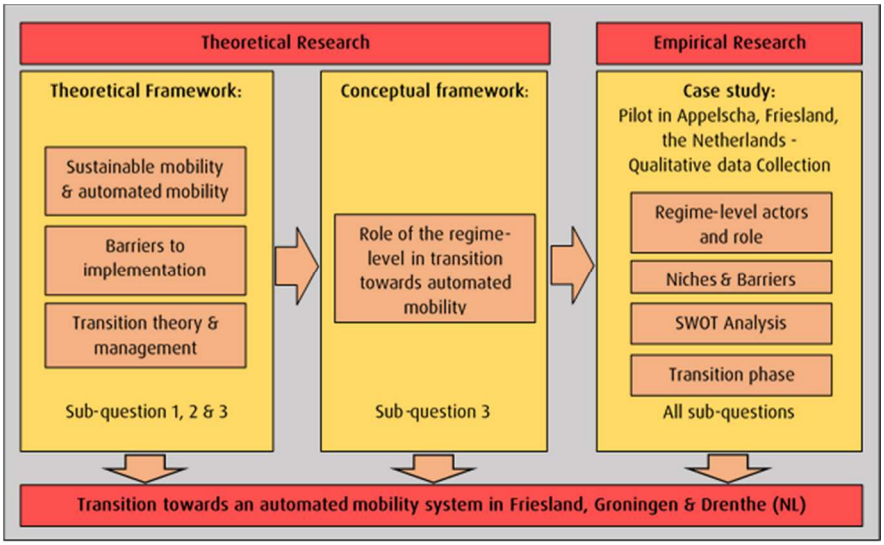



*Figure 1.3: Schematic overview of the research design*

In phase one, the contextual conditions for automated mobility are explored and a theoretical framework is developed. The framework offers insights for systematic analysis regarding the point of departure for a transition. It helps to answer the first sub-question; the transition phase. Governance struggles, like understanding the position of automated mobility with regard to sustainable mobility and the involvement of society and stakeholders, are analyzed in this phase for answering the second sub-question; the main barriers towards implementation. This regime is crucial for implementing automated mobility (Geels, 2011). A conceptual model is therefore developed which offers a tool to determine how systemic change in the socio-technical regime can be induced; this helps to answer sub-question 3 (how to change the regime level?). Tools are offered to identify regime level actors which help to answer the call of COM (2001). Finally, on the basis of the theoretical framework, a method is given to determine a suitable case for analysis for answering the research questions in the second phase.

In phase two, a single case-study (Appelscha, province of Friesland) has been analyzed. On the basis of qualitative data collection, the case-study offers evidence how 'the seeds of a transition' (niches) can infiltrate the regime level and what kind of actors are present and influential at the regime level. The case-study presents which and how governance struggles are experienced and possibly are cleared. Besides the case-study, policy analysis is done, to determine a point of departure in The Netherlands. On the basis of a SWOT-analysis, operational recommendations are presented for policy and decision makers, as requested by COM (2001) and Beiker (2012).

## 1.4 Outline of the report

This research starts with an elaboration of the context wherein this research takes place in chapter 2. In chapter 3, a theoretical framework is developed wherein the theories regarding sustainable mobility and transition management theory are reflected on. The methodology in chapter 4 is based on the theory and explains the research method.

The second part of the report deals with answering the sub-questions based on qualitative data. Chapter 5 shows the results of the interviews and Chapter 6 elaborates with a discussion on this data. Chapter 7 forms the conclusion and gives the answer on the main question.

# 2

# Context

In the northern region of The Netherlands, a letter of intent has been signed to test automated mobility in the years to come (Gemeente Ooststellingwerf, 2016). Improvement of the mobility system is seen as one of the key an0073wers to address livability in areas that face depopulation. Implementing an automated mobility system comes along with many hurdles, amongst which are governance issues (see next Section). The context, in which this research is positioned, determines the approach to overcome these issues and is worked out in this Chapter.

## 2.1 Problem description

The provinces of Friesland, Groningen and Drenthe and the municipality of Ooststellingwerf (the northern region) have expressed the will to test with automated mobility in the coming years, which is captured in a letter of intent (Gemeente Ooststellingwerf, 2016). Their interest is motivated by the wish to explore possibilities for automated mobility in depopulated 'contracting areas' (In Dutch: krimpgebied). Livability and accessibility are main problems in these, often, rural areas (Leidelmeijer et al., 2011). From the economic perspective of transport operator it is not feasible to maintain a dense and frequent network in these areas; the customer base is too small. The northern region sees collective automated mobility as a solution to increase accessibility in depopulated rural areas (Gemeente Ooststellingwerf, 2016). Implementing a new mobility system comes with struggles between actors. These struggles are explained in this section.

*Differences between concepts*

The definition of sustainable mobility in literature is not clear cut; the concepts of automated vs. electric vs. sustainable mobility are often referred to in different ways. For example, Netwerk Duurzame Mobiliteit (2017) sees automated mobility as a means towards sustainable mobility but not per definition based on electric vehicles. However, in WerkenvoorNederland (2016), automated mobility is assumed to be electricity-based.

Hence, sustainable mobility can be interpreted in multiple ways. To illustrate, Bos & Temme (2014) argue that sustainable mobility is an umbrella term, covering multiple concepts. For example, sustainable mobility is often seen as a shift towards an electricity based mobility

system (TNO, 2017), but others see sustainable mobility as a shift away from the car, towards other modalities (Kemp, 2012). The question is how automated mobility should be positioned in this concept: as an additional modality, as explored by the northern region (Gemeente Ooststellingerwerf, 2016), or as a replacement of the current mobility system? Different perspectives are recognized in literature (Banister, 2008; Nykvist & Whitmarsh, 2008; Goldman & Gorham, 2006). In chapter 3 automated mobility is positioned with respect to sustainable mobility.

*Lack of resources & knowledge of local authorities*

The Netherlands has adopted a decentralized planning system, intended to shift away from a coordinative governance form by national government, towards a governance model on regional and local levels. Zuidema (2016) argues, that in this decentralized planning system "many municipal departments cannot be expected to employ experts on all [specific policy] fields" (ibid., p. 50) and that even larger municipalities experience problems "in attracting or accommodating individual experts in different fields" (ibid, p.50). He continuous, that decentralization "runs the risk of handing over tasks to local units that will find it difficult to perform those tasks" (ibid, p. 50).

Although the example of environmental policies is used by Zuidema (2016), it can be argued that this is also the case in the northern region, when it comes to resource and knowledge requiring automated mobility. Automated mobility, which involves the newest high-end technologies requires expert-knowledge and recourses to deal with (Hengstler et al, 2016; Beiker, 2012). In practice, mostly large companies, acting on a global level, are innovating at high speed with new technologies. They have the capacity and resources to test new niches (Google, 2016; Dolgov, 2016; Transportationx.io, 2016). See Section 3.2 for a more extensive elaboration.

In the northern region there are municipalities that are capable and have the resources to deal with automated mobility, like the municipality of Groningen, Assen and Leeuwarden as provincial capitals all three urban centers in the region. In these municipalities, multiple staff members are present in separate departments dealing with infrastructure, transport and land-use planning. For example, the municipality of Groningen has a leading role in the design and realization of the ring-road Groningen, which implies intensive collaboration between the province of Groningen, the Dutch ministry of Infrastructure and Environment, several constructors along with a challenging procedure of civil engineering. To illustrate, the projects costs have been estimated over 600 million euros (ARZ, 2017).

However, a closer look reveals possible hurdles regarding local capacity. In the rural areas of the region, being a significant part of the catchment area targeted to implement automated mobility in the future (Gemeente Oosstellingwerf, 2016), there are municipalities which may have only one or a few employee(s) charged with mobility and spatial matters. For example, the department of spatial planning in the municipality of Tynaarlo is responsible for: *spatial planning, economy and businesses, development of rural areas, sustainability, cultural history, archeology, landscape development, architecture, urbanism, recreation and tourism*. Mobility is part of one of these topics, but no independent theme

(Tynaarlo, 2017). It is hardly to be expected that the smaller municipalities prioritize automated mobility and/or are capable to deal with it (in terms of human and financial resources).

This thesis is focuses on the question whether it can be expected that these rural municipalities have enough willingness, knowledge and resources to deal with the topic of automated mobility? If these capabilities are not present, does this results in a conflicting situation, and how are these conflicts solved?

*Responsibility for niches*
Elzen et al. (2004), amongst others (e.g. Van den Brugge et al., 2005), argue niches are the seeds for a transition. Niches are innovations by single-actors and *originate* "within existing regimes, often to solve *local* problems" (Geels, 2004, p.39). It can be argued that such novelties can best be noticed and dealt with (in early phases) by local levels due to their proximity to society and local businesses (Rotmans et al., 2001). However, in practice Rijkswaterstaat (RWS) and the National Service for Road traffic (RDW), both as part of the national ministry, are the driving forces behind facilitation of automated mobility (Rijksoverheid, 2016f). Also this seems to contradict the dictum of the ministry to decentralize as much as possible (Nadin & Stead, 2008, see appendix 2). Additionally, in transition management theory, Loorbach (2010) and Van den Brugge et al. (2005) argue that strategic long-term visions are executed at a national level. This indicates that the ministry should be involved in activities that are not concerned with the local level or single actors and and, for activities on the local level, provide a relevant policy framework.

The question of interest for this thesis is how niches are facilitated: If capabilities are absent at the local level, take provinces responsibility or is the ministry involved with single-actors that execute niches? In other words, what actors are the driving force behind systemic change in the transition? Which actor act as a crucial link in the transition? These questions are relevant for this research because the answers offer insights in how automated mobility can be facilitated.

## 2.2 International context

The pursuit for automated mobility has caught international interest, owing to for example its potential contribution towards sustainability in general, defined by the European Commission (2011) as a global race towards sustainable mobility. Tests with automated mobility take place all over the world, like in the USA (Waldrop, 2015) and Europe (EU, 2016). Also on the international level, the search for automated mobility meets several barriers towards implementation (Beiker, 2012). For example, the legal framework has to be adapted in all countries (ibid, see Section 3.3). The Dutch efforts to stimulate the development of automated mobility are paralleled in Germany and the UK, where automated driving is a hot topic for research (Hengstler et al., 2016; Waldrop, 2015). The European Union expressed to become a world leader in innovative mobility (EU, 2016), the Dutch ministry of infrastructure and environment (Ministry of I&M) wants to be a frontrunner in the EU in this field (Morsink et al., 2016). Hence, ambitions are way high. The exploration for automated

mobility in depopulated areas in the northern region of The Netherlands (Gemeente Ooststellingwerf, 2016) takes places in this ambitious and dedicated context.

In addition, the targeted problems in the northern region are not unique either. As shown by Van Tuijl & Bergevoet (2014), across Europe depopulation of rural areas in found, often with unemployment, lack of perspective and lack of infrastructure as root causes. Also Kohler et al. (2009) acknowledge the problem of "reduced accessibility to basic services in some regions" (p. 2985) across Europe. The exploration of the northern region can possibly be of interest in this international context.

## 2.3 National Context

In the national context transport and infrastructure planning are arranged via a system of multiple levels of governments: The national ministry, the provincial and municipal level. Between these levels institutional conflicts between these policy fields may occur. Needham (2005) for example mentions how interrelationships complicate separately developed policy-sectors like transport and land-use planning. This may lead conflicting interest at the national level, even more than at the provincial and local levels because their "lines of commutation are shorter" (Needham, 2005, p. 330). An additional example is given by Tan et al. (2014): as they argue that the goals and framework of national transport policies have changed significantly over the last forty years, which hindered the development of long-term strategies. In addition, the accomplishment of long-term strategies hampered, through miscommunications and conflicting interests between the national level versus the regional and local levels (Needham, 2005).

Hence, to understand the suggested systemic changes, multi-layer governance has to be kept in mind. To considerate this type of governance, the multi-layer perspective of transition management theory can be used as a tool of analysis (Kemp & Rotmans, 2004).

In appendix 2 a more extensive elaboration of the Dutch transport and infrastructure planning system is given, with corresponding responsibilities of the authorities.

## 2.4 Local context: Friesland, Groningen and Drenthe

The northern region consists of the provinces of Friesland, Groningen and Drenthe (figure 2.1). As a region in transition, these provinces are of special interest for this thesis: tests take place with automated mobility and the region has a political will to deal with automated mobility (Fryslan, 2016b; Gemeente Ooststelingwerf, 2016). Additionally, the region is coping with urgent spatial and socio-demographic needs in terms of accessibility, the main infrastructure network is nearly completed and space is available for testing with automated mobility.

The northern region has lowest population densities of The Netherlands (Ekamper et al., 2003) and is designated as one of the largest 'contracting areas' (Dutch: krimpregio; Rijksoverheid, 2016d). Due to depopulation and a drop in investments, there are less possibilities to maintain the standard of accessibility inhabitants were used to in the past.

This makes the region less livable (Leidelmeijer et al., 2011). At the same time this exacerbates the problem of a lack of jobs and investments: a vicious circle. Automated mobility can improve this situation by enhancing accessibility and on its turn livability (Geurs & Van Wee. 2004).

*Figure 2.1: The northern region of The Netherlands, encompassing the provinces of Friesland, Groningen and Drenthe (OTIB, 2017)*

Two additional context characteristics make the region an interesting case. First, roads in the region are relatively quiet in the sense of low traffic densities (Havermans & Schouten, 2006), which makes the region suitable for tests with automated mobility. This space can lead to opportunities that are not present in the densely populated provinces in the southwestern part of The Netherlands. Secondly, the main infrastructure network in the region can be considered completed when all currently executed infrastructure projects are finished, like Leeuwarden Vrij-Baan and the ring roads of Groningen. Therefore, provinces have to think in a different way to cope with increasing pressure on the network. More important, resources may come available for smart mobility.

In summary, along with political willingness, a priority to deal with 'contracting areas' and a complete infrastructure network, it seems that the conditions in the northern region are optimistic towards automated mobility.

*[In the remainder of this thesis, the northern region of The Netherlands, covering the provinces of Friesland, Groningen and Drenthe, is simply referred to as 'The northern region']*

# 3

# Theoretical framework

In the theoretical framework in this Chapter, it is explained how to position automated mobility in relation to sustainable mobility, and that automated mobility is regarded as a form of sustainable mobility. Next it is clarified that, the regime level is the most important level to change in the transition to automated mobility.

## 3.1 Sustainable mobility and automated mobility

Sustainable mobility is a concept used widely in several policies and documents at multiple levels; from local to global levels (COM, 2001) being a challenge all over the world (EC, 2011). Different perspectives are taken in literature, in order to achieve sustainable mobility. Some perspectives focus on sustainable urban design. For example, smart land-use to shorten travel distances (Banister, 2008). Others focus on transport policies, like the promotion of sustainable modes of transport (Nykvist & Whitmarsh, 2008).

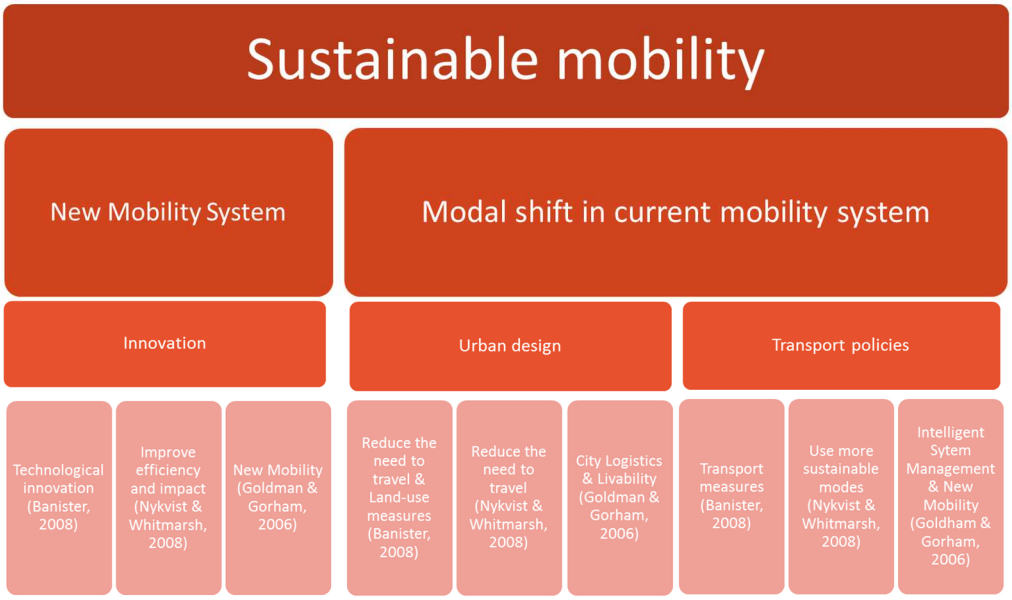



*Figure 3.1: Schematic overview of different perspectives on sustainable mobility (based on Banister, 2008; Nykvist & Whitmarsh, 2008; Goldman & Gorham, 2006).*

In figure 3.1 an overview of different perspectives on sustainable mobility is shown, composed of the views of Banister (2008), Nykvist & Whitmarsh (2008) and Goldman & Gorham (2006). On the basis of the commonalities between different perspectives, it can be concluded that sustainable mobility is focused on two major pillars: a pursuit for a modal shift (see also Bonsall, 2006) and a quest for new technologies to replace the current environmental unfriendly mobility system. The modal shift pillar can be divided in two sub-pillars: urban design and transport polices.

The next Section explains how differences and commonalities of the different perspectives lead to the two pillars where sustainable mobility is based on (figure 3.1).

### 3.1.1 Definition

In the debate on sustainable mobility, some describe it as an alternative paradigm (Banister, 2008), where others frame it as a plan or strategy (Arsenio et al., 2016) that contributes to "social and economic welfare, without damaging the environment" (Nykvist & Whitmarsh, 2008, p. 1373). There are several definitions alluding to meet needs of current and future generations (Brundtland, 1987; WBCSD, 2004).

In most definitions sustainable mobility is characterized by a long-term vision, which aims to prevent the limitation of the abilities of future generations, either through technical or policy and institutional innovations. Additional, there is general agreement that implementing sustainable mobility requires citizen involvement (Banister, 2008; Arsenio et al. 2016; Kemp & Rotmans, 2004).

However, these definitions do not explore the specific details of how the concept can be accomplished. To achieve an encompassing understanding of sustainable mobility the concept needs be defined in more detail.

### 3.1.2 Perspectives on sustainable mobility

Like the definition, there are several perspectives on sustainable mobility, meaning not a single perspective can be adopted to analyze transport issues (Kemp & Rotmans, 2004). The different perspectives of Banister (2008), Nykvist & Whitmarsh (2008) & Goldman & Gorham (2016) are reflected on in this Section, to make a common frame of reference. As turns out, the perspectives seem to have a lot of commonalities.

Banister (2008) comes up with four approaches, which combined with the involvement of society, should lead to successful sustainable mobility. First, *the need to travel needs to be reduced (1)*, meaning measures to ensure that a trip can be replaced by non-travel activity e.g. working and shopping at home. Second, *transport policies (2)* are needed to reduce the use of the car by facilitating a modal shift. Other modes like cycling and public transport needs to be promoted. Third, *land-use policies (3)* are needed for reducing trip-length. A smart urban layout ultimately leads to a switch towards environmental friendly modes of transport and a net reduction of traffic e.g. transit oriented development. The final approach is aimed at *technological innovation (4)*, to increase the efficiency of the mobility system by vehicles depending on renewable energy. It can be argued that Banisters

paradigm is mainly focused on inducing a modal shift, which can mainly be achieved by behavioral change (Bonsall, 2006). Banister intends to change people's framing of transport, which explains why Banister stresses the need for involving society.

Remarkably, the perspective of Nykvist & Whitmarsh (2008) agrees strongly with the one of Banister, without referring to each other or using the same sources. Nykvist & Whitmarsh (2008) adopt three approaches to sustainable mobility. The first approach is aimed at *improving the efficiency and impact of vehicles (1)* which corresponds with the technological innovation of Banister. The second approach, *using more sustainable modes of travel (2)* (in other words: promoting the use of public transport and modes other than the car by changing societal behavior) is almost identical with the transport measures of Banister. The final perspective of Nykvist & Whitmarsh mentions the first and third approach of Banister in the same breath: *reduce the need to travel (3)* with the aid of land-use policies and demand management.

Goldman & Gorham (2006) however, frame sustainable mobility in a wider context of society and therefore differ from the goal-oriented approaches mentioned above. The first approach of Goldman & Gorham: a quest for *new mobility (1),* aims on new technologies to reduce the environmental footprint, matches with the technological innovations mentioned earlier by Banister and Nykvist & Whitmarsh. However, the remaining three approaches seems to differ from the others: improved *city logistics (2),* to regulate the movement of goods to reduce freight traffic by e.g. introducing central drop-off points; *Intelligent System Management (3),* to discourage the use of cars and encourage public transport e.g. congesting charging; and finally, increased *Livability (4),* concerned with the integration of society by e.g. designing public space in such a way that modes as cycling are promoted and social interaction increases. Especially in the final approach a wider perspective can be recognized.

The last three approaches of Goldman & Gorham are categorized differently, but the intentions show overlap. The *new mobility* and *the intelligent system management* approaches are aimed to reduce the environmental footprint and car occupancy and to increase the use of public transport. These approaches agree with the modal shift approaches mentioned earlier. The *livability* approach fits in the quest of Banister (2008) to design space for the people instead of space for transport, and thus match with the aim of a sustainable urban design.

### 3.1.3 Combination of perspectives

A combination of different perspectives provides an umbrella view and helps to understand why automated mobility and sustainable mobility is often referred to in the same sentence. Figure 3.1 shows the relations between the different perspectives and clarifies what perspectives corresponds and where authors overlap. When comparable intentions and corresponding actions are combined, three sub-pillars can be distinguished: Innovation, Urban Design and Transport policies. The last two sub-pillars, in turn, also have overlapping intentions: a shift towards sustainable modes of transport, or a modal shift. Summarizing, the approaches to sustainable mobility seem to be divided in two pillars: the quest for new technologies for new mobility system on one side and the modal shift in the current mobility system on the other.

Despite this bifurcation, the two pillars of sustainable mobility do not seem to be widely separated. Banister (2008) argues that involving society is crucial in transport planning. The transfer of the rationale behind policy change to the people is needed for behavioral change when radical changes are suggested. A new mobility system can be seen as a radical change in the socio-technical system of society, thus both pillars of sustainable mobility are in need of involvement of society to be successful.

## 3.2 Automation

Within the pillar of a new mobility system (figure 3.1), there is an increased intention towards automated mobility. Currently this is one of the most intensively researched topics within the mobility realm (Beiker, 2010). As such, automated mobility can be seen as a type of sustainable mobility. With the intention to reduce environmental emissions and increase the traffic efficiency, automated vehicles can contribute to societal and environmental sustainability.

### 3.2.1 Urgency of automated mobility

There is a sense of urgency regarding the implementation of automated mobility, linked to the near future impact of climate change (Backlund et al., 2008). Current policies are insufficient to deal with the increasing pressure and footprint of the current network and ways of transport (Kemp & Rotmans, 2004). Automated mobility contributes to the reduction of the environmental footprint, by significantly increase safety and efficiency of the current mobility system (Beiker, 2012).

Automated vehicles are also aimed to reduce 'human errors' in mobility. According to Beiker (2012), this would lead to a reduction of traffic accidents (95% caused by human error) and congestion. An automated vehicle can move in an efficient way through traffic and may be electricity based. Efficient techniques make sure that energy consumption for travelling is as low as possible. The surplus on energy can be used for other purposes. Besides fuel efficiency, time efficiency stimulates economic growth and jobs (Goldman & Gorham, 2006). Additional benefits are a contribution towards social equity: people who are currently unable to drive (children, elderly, disabled and invalided) will be given the opportunity for increased accessibility.

### 3.2.2 Reflection

Summarizing, sustainable mobility can be defined in several ways and be approached from differnt perspectives. Automated mobility is distinguished here as a type of sustainable mobility. In this thesis, sustainable mobility is defined as:

*A fully automated electric driven mobility system that meets the needs of the present without compromising the ability of future generations to meet their own needs* (based on i.a. Brundtland, 1987; Banister, 2008; Nykvist & Whitmarsh, 2008; see Section 3.1).

Although automated mobility may sound like a far spot on the horizon for some, others see it happen in the near future (Schenk, 2017; Waldrop, 2015). The current mobility system will change and automation will likely be a part of it.

### 3.2.3 Automated and autonomous mobility

In the current era constant innovations of automation of the transport system take place. The Google Company is one of the major developers of the driverless car. Since 2010 Google is testing and improving their own Google Self-driving Car project with the newest technologies (Figure 3.2, Google, 2016). Besides Google, almost every major car brand is involved in a particular development towards an automated mobility system.

*Figure 3.2: Googles prototype autonomous car (Google, 2016).*

There is a significant difference between **automated** and **autonomous** mobility. The differences between the concepts lies in the used technology. Automated, also called cooperative vehicles, are characterized by connection and communication between vehicles. Traffic efficiency and safety is reached with *Vehicle to Vehicle (V2V)* and *Vehicle to Infrastructure (V2I) communication.* Automated vehicles cooperate with each other (e.g. platooning) and with infrastructure (e.g. traffic centers and lights) to be efficient as possible, also called 'talking traffic' (Waldrop, 2015). The major benefits of talking traffic are a more constant speed with better aerodynamics which saves fuel, improved road occupancy and reduced congestion due to minimization of the "accordion effect" (Volvo Group, 2016).

Autonomous vehicles however, act on their own. Regardless the environment, the vehicle is able to navigate over the infrastructure and through traffic. It is an 'avoiding' vehicle which is constantly mapping its direct environment. Autonomous vehicles are equipped with mapping hardware and software to determine its location on the road. Example of these autonomous cars are the Google prototype-car and the Tesla models (Rathenau institute, 2017). Besides, both automated and autonomous cars make use of a broad spectrum of general technologies like mapping software (GPS for navigation purposes), additional sensors for Park Assistance Control and Adaptive Cruise Control.

*Having noted these differences, in the remainder of this thesis, automated or autonomous mobility is referred to as simply automated mobility.*

### 3.2.4 Levels of automation

The degree of future automation in mobility is unclear. The Dutch Knowledge Institute of Mobility policies (Dutch: Kennis Instituut voor Mobiliteit) designed four scenarios to inspire and help policy makers to deal with this uncertainty (KIM, 2015). The scenarios are based on six degrees of automation and are relevant for this research, which differ in the degree of sharing and the level of automation in a vehicle:

1. *Mobility as service, any time, any place (level 5)*: A high degree of vehicle sharing. Vehicles are a public good which can be summoned on command.
2. *Fully automated private luxury (level 5):* Private ownership of fully automated cars. Vehicles are brimming with technology for safety and comfort purposes.
3. *Letting go on Highways (level 3-4):* Partly public and partly private ownership of vehicles. In dense urban areas people still steer their own car (level 1-2), where at the highway they can let go of steering (level 3-4).
4. *Multimodal and shared automation (level 3-4):* High degree of vehicle sharing, automated driving is not present due to a lack of support in society. Therefore, high interest in (automated) public transport.

The first scenario, with 'level' 5 vehicles, is pursued by the northern region (Gemeente Ooststellingwerf, 2016).

| Level | Degree of automation | Example |
|---|---|---|
| Human driver examines driving environment | | |
| 0 | No automation | Lane Departure Warning |
| 1 | Driver assistance | Adaptive cruise control |
| 2 | Partial Automation | Park assistance |
| Board computer examines driving environment | | |
| 3 | Conditional automation | Highway Chauffeur |
| 4 | High automation | Parking garage Pilot |
| 5 | Full automation | Robot taxi |

*Table 3.1: Levels of automation, by the Society of Automotive Engineers, in KIM (2015).*

## 3.3 Barriers to implementation

Waldrop (2015) and Burns (2013) argue that with the current speed of innovation, technology will not be the biggest challenge to overcome. According to Waldrop (2015) questions regarding a new mobility system can only be answered by experience and that that experience is accumulating very fast: Googles self-driving car already made 2 million mostly urban test-miles, Tesla autopilot function already drove over 100 million miles (Dolgov, 2016), Volvo is equipping real families with fully autonomous XC90's for testing on public roads this year and BMW - in collaboration with technology giant Intel - already set its target on 2021 for manufacturing productions automated vehicles (Transportationx.io, 2016). These examples illustrate the speed of innovation towards a new mobility system. However, Banister (2008) and Rietveld & Stough (2004) stress that the main barriers to implementation are institutional of character.

Given the confusion and connection between sustainable mobility and automated mobility, serious barriers are to be expected towards implementing automated mobility. The main

barriers are: (1) Process of decentralization, as it results in the challenge to implement a comprehensive mobility system and in rural municipalities with limited resources and capabilities; (2) Stakeholder cooperation, which is indispensable for a shared perspective, diversity of policy fields and the design of stable institutional structures; and (3) Involving society, necessary for experience, trust, acceptance and understanding (Banister, 2008; Beiker, 2012; Waldrop, 2015; Gupta, 2007). The main barriers are explained in more detail in the next Sections (see figure 3.3 for an overview).

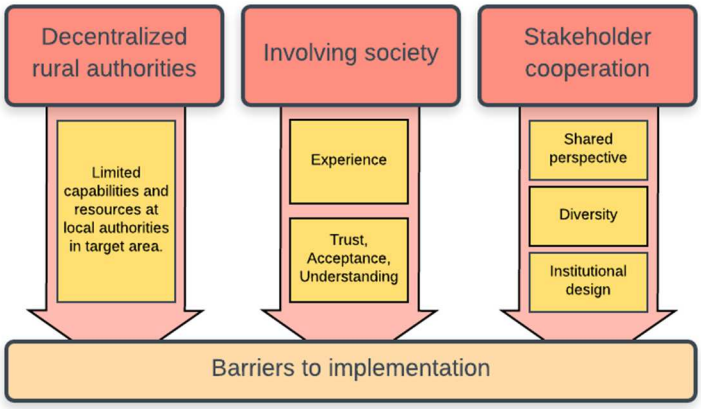



*Figure 3.3: Barriers to implementation (Based on i.a. Waldrop, 2015; Gupta, 2007; Savini, 2013; Banister, 2008; Beiker, 2012)*

### 3.3.1 Decentralization in transport planning

Savini (2013) argues that national governments are struggling to implement national interests at the local level, due to institutional decentralization. Decentralization of responsibilities for spatial and transport planning has taken place and erodes the involvement of the national government in local spatial objectives. This process increases the dependency on the willingness and capacities of local stakeholders and municipalities (Busscher et al., 2013; Savini, 2013). The national entity – the national ministry in place - is no longer responsible for regional and local transport planning. Provinces are responsible for the public transport and municipalities become responsible for local objectives (Nadin & Stead, 2008). Zuidema (2016) states that a decentralized approach is specifically useful for dealing with specific local circumstances. However, this does not take away the observation that decentralized authorities struggle with implementing national policies.

First, relevant for this thesis and in this specific context, is the decentralization of responsibilities towards the local level. Gupta (2007) argues that decentralization of power is not always accompanied by the transfer of associated and sufficient resources, which limits the abilities of municipalities to take the necessary action. Also Savini (2013) argues that vertical integration of the planning system does not guarantee "to steer local authorities in the desired direction" (Savini, 2013, p. 1594). Moreover, the target areas in the northern region for automated mobility encompass the rural depopulated 'contracting areas' (Gemeente Ooststellingerwerf, 2016). These areas are, instead of the larger urban municipalities, less capable and have less resources and knowledge to deal with this complex and

expertise requiring topic (Beiker, 2012; Gupta, 2007; Section 2.1). **It is hardly to be expected that rural municipalities have enough expert knowledge, capacity and willingness to deal with this transition and foster innovations**.

Second, the process of decentralization may lead to a fragmented approach at local levels dispersed over the region towards the topic of automated mobility. However, as argued in Chapter 1, systemic change is required to implement an automated mobility system. Such change requires the role for an upper coordinative body. Bertolini (1999) argues for example, people increasingly cross municipal borders on a daily basis for work and leisure which indicate the supra-municipal catchment area of the mobility system. Additional regional support is therefore desired (Bertolini, 1999). Therefore, the role of the provinces is crucial in this transition process, by supporting municipalities with knowledge and resources (e.g. money, staff members and coordination). This supportive role will also be stressed with the implementation of the new Environmental Act (Dutch: omgevingswet) in 2019 wherein municipalities are expected to deal with more comprehensive planning objectives (KING et al., 2015).

Finally, road management has partly been decentralized which may lead to challenges for automated mobility. In The Netherlands, three road authorities are responsible for maintenance and management of the road-network: Rijkswaterstaat (In short: RWS; national), provinces (regional) and municipalities (local roads). If a comprehensive automated system (designed for vehicles which drive on national as well as regional and local roads) is desired, all road authorities need to align interest and have to agree about funding measures. Romein et al., (2003) refer to this as the multi-scalar complexities of infrastructure planning, where multi-actor involvement may result in struggles in the process due to different interests. It asks for an intense planning process between different levels and for collaboration between stakeholders, it may possible lead to unsatisfactory compromises (Tan et al., 2014). As argued in the following Section, stakeholder cooperation seems to be challenging and needed to overcome barriers (Banister, 2008).

### 3.3.2 Involving society and stakeholders cooperation

In Section 3.1 it has been argued that a broad public acceptance is needed to achieve successful sustainable mobility and for this reason, stakeholders have to be involved in different policy fields like transport and urban design (Banister, 2008). Aligning those stakeholders can be challenge. More possible obstacles are defined in literature, of which the following are regarded to be the biggest challenge to overcome (figure 3.2):

- *Shared perspective*: It has been argued that perspectives on sustainable mobility differ. Creating a common frame of reference amongst stakeholders at the regime level may a challenge, because of different interests. Current parties at the regime level like to maintain the status quo and will therefore perhaps not collaborate to implement new niches (see Section 3.4). Others may acknowledge the need for a new system, but differ in the design of it.
- *Diversity*: for a new system to be implemented, a diverse network of frontrunners has to be mobilized. It should consist diverse stakeholders, not only e.g. energy companies and governments, but also experts in the field of mobility effects and social issues have to be involved, from consumer to vehicle industries (Bos & Temme, 2014). *Interdependencies* have to be stressed. Only if all stakeholders recognize the same barriers,

the same challenges and share the same goal, the transition can be successful. There is a need for a broad coalition, forming this is a challenge in itself. In the northern region frontrunners are gathered, but the necessary diversity is lacking (Gemeente Oost-stellingerwerf, 2016).

- *Institutional structure*: the foregoing barriers go along with the institutional structure regarding mobility. Banister (2008) argues that institutional design is important for implementing sustainable mobility. Policy dilemmas have to be overcome. If radical change is intended, the region, ministry - or even the EU or comparable international structures - have to introduce radical policies and institutions. Therefore, courage, strong leadership and commitment is needed. The electoral cycle can have a big influence on the transition. Currently, the ministry is dedicated to automated mobility, but a new elected cabinet this year could obstruct current long-term sustainable visions.
- *Legal barriers:* Beiker (2012) argues that the most critical barrier is the legal responsibility of automation. He states that special insurances are needed and e.g. mandatory data recorders (like the black box in an airplane) have to be present. To come up with legal solutions, again, broad partnerships are needed.
- *Experience*: Waldrop (2015) has given perhaps the most challenging barrier, which can be seen as an overarching challenge to all questions regarding a new system. He stresses that experience is the answer to most of the questions, such as: who owns the new vehicles (see also scenario 1 of KIM (2015)), how to deal with legal responsibilities? Will people accept a new system? Banister (2008) mentions that public acceptance only can occur when there is a comprehensive collaboration with all stakeholders, to successfully adopt controversial policies.
- *Trust, acceptance and understanding:* According to Banister (2008) and Kemp & Rotmans (2004), involving society is necessary to implement sustainable mobility. Sustainable and automated mobility will only succeed when there is an understanding and acceptance amongst society. To create understanding, learning processes are of high importance. Banister (2008) continues, that a proactive approach is required in that respect.

Reflecting on these barriers, only few can be influenced by the public authorities in the northern region. For example, legal barriers cannot be changed by the provinces or municipalities. Also a stable institutional design at a national level can hardly be influenced by the region, nor the desire for intended projects. The regional and local authorities can only provide input to the Ministry for changes in the legal framework. However, the involvement of society is a suited task for the region. The proximity to the people of the municipalities and provinces can be crucial to overcome this hurdle (Rotmans et al., 2001). Learning process have to take place within society to increase experience and trust. As Kemp & Rotmans (2004) comprehensively argue: “The only way forward is to try and in a process of learning-by-doing gain experience of what is possible in practice” (Ibid., p. 188). The region can thus contribute to involving society, by keep executing new pilots and projects, and thus strive for a learning-by-doing approach

In conclusion: In rural areas, municipalities cannot be expected to come up with automated mobility related initiatives; **stakeholder cooperation** is needed for a shared perspective, the necessary diversity and to design stable institutional structures; and **involving society** is needed for experience, trust, acceptance and understanding.

## 3.4 Transition to automated mobility

The implementation of automated mobility is expected to face many hurdles, mostly because of the radical changes that are required for an automated mobility system to become reality. The whole process implies an irreversible systemic change, or, in other words, a deviation from the existing socio-technical system (Geels, 2011). Such change indicates the need for a transition to occur. As argued in Section 1.1, current processes like ongoing automation of car services and the mobilization of actors, indicate that a transition is already in process: niches are trying to infiltrate the current regime, which is noticed by influential institutions (CROW, 2017). For analyzing such irreversible systemic changes, transition management theory offers a helping hand (Geels, 2011).

Van den Brugge et al. (2005) distinguish three key concepts for analyzing a transition: the basic principles of the (1) different phases of a transition, the (2) multi-level perspective and (3) transition management. Transitions are "transformation processes in which society changes in a fundamental way over a generation or more" (Rotmans et al., 2001, p. 15). Transitions imply "a shift from an initial dynamic equilibrium to a new dynamic equilibrium" (Kemp & Rotmans, 2004, p. 140) and apply to societal complex system, like the mobility system. The involved transition in this thesis is the transition from the current environmental unfriendly non-automated mobility system, to a level 4 or 5 automated mobility system. The level of automation is based on the "Mobility as a service" scenario of KIM (2015), which is strived for by the northern region. Due to the needed fundamental changes in society, it takes at least 20 to 25 years before a new equilibrium with a new mobility system is reached. This depends, amongst other things, on the current phase of the transition (Rotmans et al., 2001).

Inducing, analyzing or even steering a transition is not a straightforward activity or process, due to the non-linear behavior of a transition (Rotmans et al., 2001). This makes it hardly possible to outline a step-by-step approach for actors at the regime level to follow (Kemp & Rotmans, 2004). For example, a needed innovation by an energy company for large scale electricity-based car production comes not on command.

### 3.4.1 Point of departure

Despite the optimism for automated mobility, there has been a lack of systematic analysis regarding the point of departure for a possible transition towards an automated mobility system. (Berg, 2017; Wel, 2016). A point of departure can be useful to reduce frustrations and obstacles in the planning process, as the roles of actors differ per phase of a transition (Loorbach, 2010). If the current phase of the transition can be recognized, the corresponding roles of the governments for the northern region can be determined. Therefore, the characteristics of the phases of a transition are needed.

A transition consists of four phases: *the pre-development, take-off, breakthrough and the final stabilization phase.* The phases are distinguished by the size and speed of the fundamental changes that are taking place, as illustrated in figure 3.4 (Loorbach, 2007). For this research, especially the first and second phases are of interest because it goes without saying that automated mobility is not yet widely adopted or implemented in the current system: a breakthrough has not taken place. The final two phases are characterized by

structural changes and a broad acceptance of society (via learning processes) of automated mobility, which is currently absent (Hengstler et al., 2016). Therefore, only the first two phases are elaborated on.

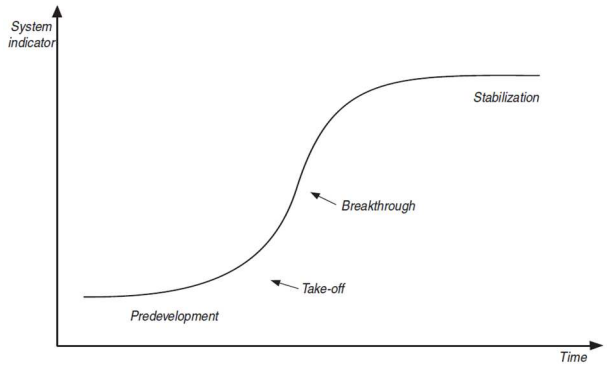



*Figure 3.4: Transition S-curve with the four phases, adopted from Loorbach (2007)*

First, in the *pre-development* phase niches occur without visible changes in the status quo. Current vehicles and infrastructure are put to the test with new technologies like adaptive cruise control, platooning and fully automated vehicles (Waldrop, 2015, Volvo Group, 2016). In this phase, governments should catalyze and facilitate these innovations (Rotmans et al., 2001). Governments can stimulate niches with e.g. subsidizing electric cars (ANWB, 2017). Second, in the take-off phase the process of change is starting and the current mobility system is slightly shifting e.g. advanced automated technologies are implemented in production cars and infrastructure is adapting. In this phase an accumulation of developments has to be created by governments and frontrunners (actors) have to be mobilized. Without a network of frontrunners, innovations will perhaps not be noticed by rigid regime-actors, and will not get an opportunity to become widely accepted or implemented.

Reflecting, the first two phases can be distinguished by the differences in the speed of systemic change. What is lacking however, is the speed of change in tangible terms: no indicators are offered by literature. For the take-off phase to be reached, part of society has to accept automation to some extent, because otherwise the system would not start to shift. (Rotmans et al. 2001). This characteristic (degree of societal acceptance and involvement) may help to determine the current transition phase.

### 3.4.2 Multi-level perspective

The transition that is addressed in this thesis, can be seen as a systemic change in the socio-technical system of society, in a multi-level governance context of the Dutch planning system (see Section 2.3). The multi-level perspective of Geels & Kemp (2000) is useful to analyze such changes (Kemp & Rotmans, 2004). This perspective (figure 3.5) distinguishes between "three levels of heuristic, analytical levels" (Geels & Schot, 2007, p. 399): Niches, socio-technical regimes and the socio-technical landscape (Van den Brugge et al. 2005), whereof the regime level is the most important level in a transition (Geels, 2011). Analyzing this perspective offers insights in what levels and what kind of actors are influential in a transition, specifically in the northern region.

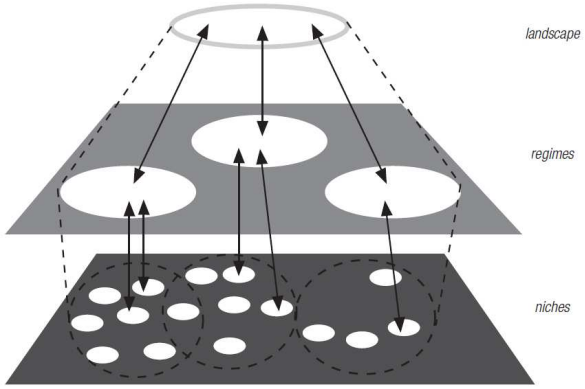



*Figure 3.5: Multi-level interactions, edited from Geels & Kemp 2000 (in Loorbach, 2007)*

*Landscape-level*

The *socio-technical landscape* can be seen as the wider context wherein the transition takes place (Geels, 2011). The landscape is determined by large scale and slow developments, found in e.g. culture and paradigms. The current culture is that society possesses privately owned non-automated vehicle, which has to change significantly for automated mobility to become reality in the northern region. This change in culture takes time, which means that the landscape has high influence on the speed of a transition. Changes in paradigms and cultures, cascade to the regime level. Therefore, it cannot be expected that the current mobility system, which is deeply rooted in culture (Nykvist & Whitmarsh, 2008), will dramatically shift within a few years.

*Regime level*

At the *regime level* (formal and informal) institutions and norms are established based on shared beliefs and assumptions. This level is the hardest to change because the regime level is occupied with (governmental and non-governmental) organizations and institutions that strive to optimize the current system (Rotmans et al., 2001). Strategies are focused on "optimization and protecting investments rather than system innovation" (Van den Brugge et al., 2005, p. 167). Current policies are focused on optimizing the fossil fuel based system rather than stimulating or prescribe a safer and environmental friendly system. For example, large companies are benefiting at large scale from the current oil-consuming system and make large profits. For these actors there is less urgency to dramatically innovate for a new system (Nykvist & Whitmarsh, 2008). Change can even be a threat to current profit.

Most relevant for this research, is that the regime level can be considered as the most important level (Geels, 2011), since transition is a shift from one regime to another. Thus when the status quo at the regime level has shifted to another status quo the transition can be considered as finished

*Niche-level*

At the *niche-level* new innovations and technologies are developed by individual actors like individual companies and inventors. These technologies are a significant departure from the status quo and are aimed at systems innovation. Entrepreneurs guide start-ups

and spin-offs of new technologies (Geels, 2011). Tesla and Google for example, can be seen as entrepreneurs for automated vehicles who guide new innovations into production cars. Their aim is to have their new technologies be implemented eventually at the regime level, replacing old technologies. Not every niche will reach the regime level in the end, but the niche-level is where the transition starts (Elzen et al., 2005).

Reflecting, two factors are important for the transition towards automated mobility. First, **the regime level is the most important level in the transition**. Second, **niches are crucial, it are the "seeds" of a transition** (Geels, 2011; Elzen et al, 2005).

### 3.4.3 Exploration and exploitation at the regime

The multi-level perspective gives insight in what kind of actors are interesting for this thesis, namely regime level actors: *involved in tactical governance activities, interest driven, making mid-term projects, plans, institutions and regulations and additional are in the first place concerned with optimization of the current state of the system*. (Van den Brugge et al., 2005, Rotmans et al., 2001)

However, the conservative attitude of regime-actors seems to contradict the search for crucial niches (status-quo vs. innovation), but at the same time regime-actors are crucial to overcome the barriers mentioned in Section 3.3.2: Regime-actors can design institutions which can facilitate society with the right institutions to increase trust, involvement and experience with automated mobility. So the regime level can withhold a transition but at the same time is crucial for the development of this transition.

The distinction between exploration and exploitation is useful to express the attitudes of the actors at the regime (Duit & Galaz, 2008). *Exploitation* expresses the degree of activities of an actor in which it seeks for refinement and efficiency of current activities to reduce costs and increase production. Trust and cooperation between actors in a governance system is needed to increase exploitation mechanisms (ibid.). On the contrary, *exploration* expresses the qualities of an actor to reflect and evaluate current activities but more important involves activities of testing and experimenting with new forms of governance practices, like trial-and-error processes. These explorative activities resonate perfectly with the quest for new niches, which are also most of the time trial-and-error processes (only few niches make it to a new regime). Additional, exploitation processes are more costly and require knowledge and resources but are of high importance for automated mobility. Applicable to the rural area: governance actors with limited resources are often characterized by little capacity for exploration (ibid.).

Hence, **for the transition to accelerate, actors at the rigid regime need to become more explorative by stimulating innovation**, but are in reality more exploitative due to its wish to keep the status quo (Nykvist & Whitmarsh, 2008).

To overcome barriers for implementing an automated system, foster niches and to influence the regime, all require a high degree of citizens and stakeholder involvement (Banister 2008; Duit & Galaz, 2008; Kemp & Rotmans, 2004). It can thus be argued that decentralized authorities are suited for the process, given their proximity to society (Rotmans et

al., 2001). However, at the same time (see Section 2.1 and Section 3.3.1), these rural decentralized local authorities in the northern region are less capable of dealing with the complex objective of automated mobility. Also the need for more explorative actors in the transition is in conflict with these less resourceful actors, as exploration requires a lot of resources (Duit & Galaz, 2008). Local rural municipalities may thus be in need of support of provinces or even the ministry, when automated mobility is strived for.

### 3.4.4 Transition management

With the multi-level perspective in the previous Section, it has been argued that specifically regime level actors are of interest of this thesis. When the actors in the northern region can be positioned in a multi-level perspective, transition management (TM) offers insights in what activities have to be executed by these regime level actors. TM is as approach to manage, guide, mobilize and accelerate social innovation by coordinating multiple actors at different levels (Loorbach, 2010). TM is most needed in the first two phases where niches need to co-evolve with other developments to infiltrate the rigid regime. To initiate change, as is the goal of TM, four different governance activities are distinguished:

- *Strategic activity at landscape-level*: The transition arena is established, wherein frontrunners are gathered in a network. Long-term visions are developed: goal formulation, anticipation and sense of urgency of the transition.
- *Tactical activity at the regime level*: Steering activities to determine the transition agenda. Long-term visions of the strategic level are translated into concrete mid-term focused plans and projects (incl. barriers, scenarios and transition paths).
- *Operational activity at the niche-level*: Experiments with new innovation are executed with a short-term focus, regarding "societal, technological and institutional practices that introduce [...] new structures, routines and actors" (Loorbach, 2010, p. 170).
- *Reflexive activity*: this is an ongoing important process of TM. Here the progress of the transition is monitored and evaluated, and the process of TM itself is monitored. Thus how far is the system changing and how successful policies are set out at the tactical level and experiments at the operational level?

Actually, all activities are important for the actors in the northern region. Although for this thesis tactical activities are most relevant (linked to regime level actors), the region cannot foster the transition without e.g. reflexive learning processes take place. Reflexive activities include learning processes (like learning-by-doing) which are needed to overcome the barrier of experience, trust and acceptance. Just as operational activities are crucial for the emerging of niches (Elzen et al. 2005; Loorbach, 2010).

### 3.4.5 Multi-level transition management and Dutch planning

Remarkably, the multi-level perspective, transition management and the division between landscape, regime, and niches resonates strongly with the decentralized planning system in The Netherlands. The national government sets out the strategic long-term visions and is occupied with nationwide interest (Tan et al., 2014; Janssen-Jansen & Woltjer, 2010). These activities of the Ministry, put forward in the National Spatial Strategy (Dutch: Nota Ruimte), complies with the activities of the strategic landscape-level: a long-term focus on large scale vision with a sense of urgency (KIM, 2015; Nadin & Stead, 2008).

**The provinces match strongly with the regime-actors**, where tactical governance activities takes place. Especially the strategic vision (Dutch: Structuurvisie) can be seen as a

translation of national interest and vision into regional visions and concrete plans and projects, with a mid-term focus of 10 years (Janssen-Jansen & Woltjer, 2010. see also Appendix 2 for an elaboration of the Spatial Planning Act of 2008). Regional transport policies are captured in the Provincial Traffic and Transit plan (Dutch: Provinciaal Verkeers- en vervoersplan, PVVP) with a specific execution program, and form a regional translation of the National Transport Strategy (Dutch: Nota Mobiliteit; Provincie Friesland, 2006). This translation from national to regional level and the mid-term focus matches with the tactical activities described above (Loorbach, 2010; Section 3.4.4). Additionally, the provinces play a crucial role, as regime-actors, which are influential for designing institutions that are useful for overcoming barriers (Section 3.4.3). For example, the provinces can promote desired forms of transport: subsidize the use of collective vehicles to increase the experience with a shared fleet of vehicles. These policies or ambitions can be captured in a renewed Provincial Traffic and Transit plan. Nadin & Stead (2008) even postulate that the central government is in favor of letting provinces take a key role in transport and spatial policies.

The similarities between the niche-level and municipalities are however partly lacking. No examples could be found that municipalities are driving forces behind niche developments. Yet, they are involved in executing projects that involve niches (Provincie Drenthe, 2017; Gemeente Oosstellingwerf, 2016). Local municipal transport policies have to be aligned with the Provincial Traffic and Transit plan to meet ambitions (Provincie Friesland, 2006). This alignment can be seen as a translation from a regional vision towards local action, as this matches with deriving operational activities from tactical activities in transition management (Loorbach, 2010).

Furthermore, there is an overlap in actors at the different levels and activities of transition management, which is not unique to the mobility context. For example, Verbong & Geels (2007) argue that the Dutch Ministry of Economic affairs is an important regime level actor in the transition towards sustainable energy production. Simultaneously, the ministry was involved in the production of so-called decentralized Combined Heat and Power plant (CHP) at the local level at the time that changes in the landscape stressed the consequences of climate change (Verbong & Geels, 2007).

Specifically for the Dutch mobility context, the regime level is not occupied with one single actor. An actor at the landscape level also can act at the niche level. For example, the Ministry can come up with a long-term vision to implement a certain technology that they have tested for a certain amount of time. They do not necessarily have to decentralize the execution of this niche development. Also the implementation of this in the short term can be done by Ministry. For example, RWS is a driving force behind testing V2I-technology on highways (Minsterie I&M, 2017) and RWS is involved in projects with market parties and knowledge institutes for researching automated vehicles (Joostema, 2013). Mostly, these tests are done on highways, which fall in terms of spatial planning under the responsibility of RWS too.

In this way, the Ministry is involved at all three layers of the transition; the macro long-term strategic vision at the landscape level, the tactical plans to implement these long-term vision at the regime level and finally the niches they induce e.g. in collaboration with

a car-manufacturer. Also a market party like Goudappel-Coffeng could be involved in every level to support governmental parties or come up with innovative policy niches. Table 3.2 is an indication of the actor distribution over the levels of a transition.

| Systems level in transition | Actor distribution of Dutch Planning System |
|---|---|
| *(Socio technical) landscape-level* | European Union |
| | National government (Ministry) |
| | Energy companies |
| | Society |
| *Regime level* | National government (Ministry RWS, RDW) |
| | Provinces, |
| | Consultancies |
| | Energy- and Insurance companies |
| | Society |
| *Niches* | Provinces, Municipalities |
| | Individual actors in society |
| | Car developers, Consultancies |
| | Energy companies |

*Table 3.2: Indication of multi-level perspective in the Dutch Planning System*

*Summarizing Section 3.4, it is desired that actors at the regime level become more explorative which is needed to foster niches, instead of exploitative. Awareness is needed of the fact that decentralized local authorities in the rural target area for automated mobility in the northern region, have limited resources and knowledge to be really explorative. This can be conflicting for the fostering of niches by regime-actors. Although, this should not be a problem because niches take place at the niche-level, but, as turns out, in the transition towards automated mobility, often the same actors are involved at these levels.*

## 3.5 Towards a model

In the previous Sections several theories have been reflected on:

- Section **3.1 and 3.2**: Automated mobility is positioned within sustainable mobility. As turns out, sustainable mobility is based on two pillars (Section 3.1.2) and the quest to automated mobility is one of them.
- Section **3.3**: The barriers to implementation are determined: decentralized local authorities (Section 3.3.1), stakeholder cooperation and involvement society (Section 3.3.2) are seen as the biggest challenge towards implementation.
- Section **3.4:** The reflection on transition theory pointed out that the regime level is the most important level in a transition (Section 3.4.2) and that niches are crucial in changing that regime level and for fostering the transition (Section 3.4.2).

The conceptual model in figure 3.6, distinguishes two pillars of sustainable mobility (Banister, 2008, Nykvist & Whitmarsh, 2008, Goldman & Gorham, 2010) and visualizes that the transition to automated mobility is a resources and knowledge requiring process (Beiker, 2012; Section 3.1, 3.2 and 3.3.2). Besides, from a transition point of view, there is a lack of resources and knowledge at the level of local municipalities targeted for automated mobility. This may be a barrier to implementation (Savini, 2013; Gupta, 2007; Beiker, 2012; Section 2.1 and 3.3.1)

Next, the regime level is the most important level in the transition (Geels 2011; Section 3.4.2). Actors at this level need to foster niches, which are crucial within a transition (Elzen et al., 2005; Section 3.4.2). Due to the commonalities between the multi-level perspective and the Dutch transport planning system, the provinces are a key-actor in the transition (Loorbach, 2010; Nadin & Stead 2008; Sections 3.4.3). Provinces are responsible for the tactical activities (Janssen - Jansen & Woltjer, 2010; Section 3.4.5) and need to support rural municipalities. This can be accomplished by the involvement of stakeholders and the creation and stimulation of niches by an explorative attitude at the regime level (Nadin & Stead, 2008; Duit & Galaz, 2008) Section 3.4.3). Besides, involving society is needed to grow acceptance and trust. Even more, without involving society at large, the regime level will not change. (Banister, 2008; Rotmans et al. 2001).

The theoretical answer to sub-question 3 in Chapter 1 - *How can the regime level in the transition towards automated mobility by influenced and changed in the northern region of The Netherlands?* – can be formulated as following:

The **regime level** can be changed by top-down pressure from the landscape level, bottom-up **niches** that gain momentum (Van den Brugge et al., 2005) as well as actors at that regime level have an **explorative attitude** towards these niches (Duit & Galaz, 2008). Reflexive activities and a learning-by-doing approach are needed to grow trust and acceptance in society, which will lead to overcoming the large barrier of **involving society** (Kemp & Rotmans, 2004). If regime-actors (e.g. in a network of frontrunners) accept new niches, new modes or usage of transport will be accepted and trusted by society (Banister, 2008). Furthermore, the regime level can be changed when diverse **actors cooperate**, meaning not only governmental parties work together. Market parties also need to be

included to attract **knowledge** and expertise, which is needed in the transition (Bos & Temme, 2014). The **provinces** play a key role; they have a catalyzing, facilitating and mobilizing role in first phases of the transition (Nadin & Stead, 2008; Rotmans et al., 2001). Provinces have **resources** available to support municipalities, are responsible for transport policies and translate the strategic national vision of the ministry via their regional transport policies towards local policies and projects of the municipality (Nadin & Stead, 2008; Provincie Friesland, 2017). The province should not only design policies that stimulate or monitor the niche-level, but also create opportunities for niches (Kemp & Rotmans, 2004).

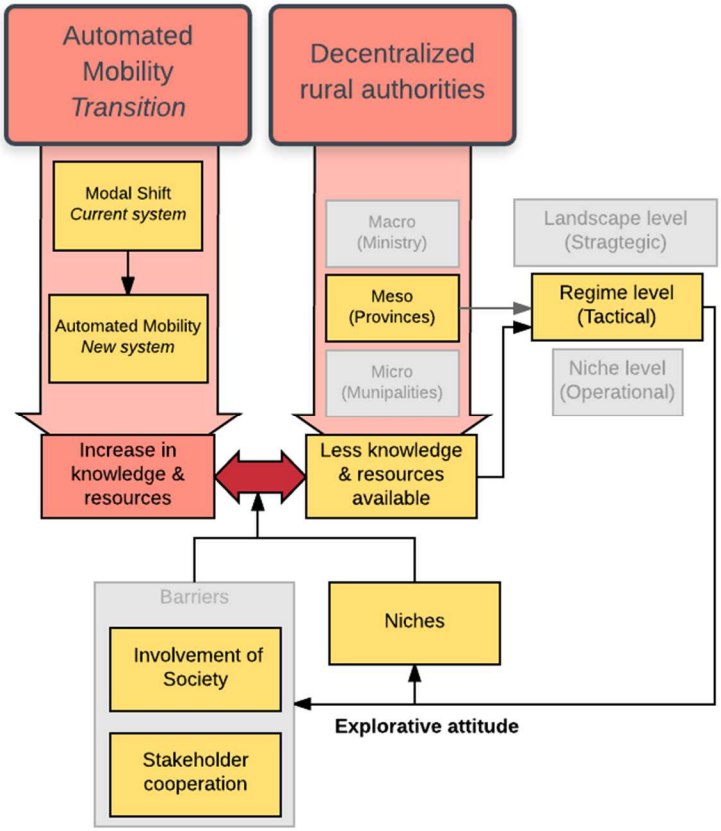



*Figure 3.6: Conceptual Model: the yellow elements are the elements under study in the transition to automated mobility; the red elements represent the two processes in this research (the transition and decentralization).*

The second part of this research investigates the yellow elements in the model (which are the bold words in the previous Section). Empirical evidence will help provide insights in how the provinces act at the regime level, how the lack of knowledge and resources at rural levels is perceived by the diverse governmental bodies, how market parties are involved in the transition, in what way is society involved and how actors collaborate? Furthermore, the model is tested against empirical evidence with regard to the barriers and the increase in knowledge and resources.

# 4

# Methodology

The conceptual model shows that niches are crucial in a transition to change the regime level and two overarching barriers have to be overcome to foster the transition. This chapter elaborates on the methods followed in this thesis, applied to a case study in the rural town of Appelscha.

## 4.1 Research Method

The research question (*How can the transition towards an automated mobility system be facilitated at the regime level in the northern provinces of The Netherlands?*) requires in-depth understanding and exploration of the processes and development of automated mobility in the northern region of The Netherlands.

The choice is thus, to focus on an embedded single case study in the northern region of The Netherlands, in particular the case of Appelscha (See case selection criteria in Section 4.1.1). The nature of the research questions (how and why) necessitates the use of qualitative data collection.

The data collection is conducted through semi-structured interviews with the main and relevant stakeholders in the case study. Qualitative research is perceived as a softer approach than quantitative research. Simply put, qualitative research is a non-numeric approach to describe the complexities of human experience and therefore widely used in the research areas of human geography and spatial sciences (Philip, 1998). It can be considered a non-value-free approach, and therefore allows in this research to compare expectations and roles between (groups) of actors within the case study.

The semi-structured interviews are combined with a document and policy analysis to determine the larger landscape changes, which is needed for answering the first sub-question (What is the current transition phase?). Policy, documents and project information are mainly found and analyzed with the help of two non-structured interviews with senior consultants in the field of smart mobility. These interviews gave general insights in the Dutch transition like the role of the Ministry, landscape activities and currently executed projects. However, these interviews *are not recorded and are thus not referred to* (only notes are taken).

*In sum, three ways of data collection are used. First a qualitative analysis takes place with the help of a single case study. Second, a document and policy analysis is done. Finally, two non-structured interviews are conducted for general insights in the Dutch transition.*

### 4.1.1 Case selection

To choose a suitable case for this research, criteria are needed to guarantee the quality and applicability of the data. The criteria for case selection are derived from the theoretical framework that has been developed in Chapter 3. This framework, based upon the multi-level perspective of transition theory, showed that the regime level is important in the transition and that niches have a huge influence on that regime level (see Section 3.9). Therefore, the following criteria are used:

1. *Niches*: The case should involve innovation and the development or upscaling of niches which are mobility related, due to the important role of niches in the transition.
2. *Focus on automated mobility*: the project should involve automated mobility. Without either innovation or automated mobility, a conclusion cannot be drawn that is applicable to the research question.
    a. *Focus on modal shift*: When it is not possible to come up with an automated mobility related project, is has to be concluded that the region is (still) focused on the modal shift element of sustainable mobility. Still, it can be determined what actors are involved and how niches are adopted.

In table 4.1 suitable projects in the provinces of Friesland, Groningen and Drenthe are listed. Table 4.1 is set up on the basis of project information conducted via a small scale desk research. For example, the case of Appelscha: the main stakeholders and phase are examined on the basis of media (RTV Drenthe, 2016) and policy documents (see Province Drenthe, 2017; Fryslan, 2016b). The criteria of the involvement of niches include the use of the Pod-vehicle from the French Easy Mile (see Section 5.3). The goal of the project is to transport passengers in the fully autonomous Pod. The project is thus focused on the 'automated mobility' pillar of sustainable mobility, so the secondary focus on modal shift is not applicable to this case.

| Project description | Main stakeholders | Project Phase | Involves Niches | Focus on Modal Shift | Focus on Automated Mobility |
|---|---|---|---|---|---|
| Appelscha: Increasing livability with a test with automated shuttles | RDW, Province of Friesland, Groningen and Drenthe, Municipality of Ooststellingwerf & Ministry | Test is finished | Yes | N.A. | Yes |
| Tour of automated shuttles of Appelscha: Increasing experience amongst society by touring the vehicles through the provinces | Province of Friesland, Groningen and Drenthe | Tour is finished | Yes | N.A. | Yes |
| Vesting Bourtange & Hospital Scheemda: Increasing livability with a test with automated shuttles | RDW, Province of Groningen & Ministry, Municipality of Vlagtwedde & OldAmbt | Starts in 2017 | Yes | N.A. | Yes |
| Automation of trains and taxis | Province of Groningen, ProRail, Ministry & Deutsche Bahn | Intention for 2017/2018 | Yes | Yes | Yes |
| Mobility Centre North East Friesland: Increasing livability in depopulated areas via demand management for transit. | Province of Friesland, Municipalities of North East Friesland, Local market parties | Starts in 2017 | Policy niches (Custom transit) | Yes | No |
| Event traffic Leeuwarden: implementing automated traffic during European Capital of Culture 2018 | RDW, Province of Friesland, Municipality of Leeuwarden, Ministry | Intention for 2018 | Yes | No | Yes |
| Additional projects: Testing of Open Source Knowledge transfer with the market – Sensor city - Implementing 5G data | Ministry, Province of Friesland, Groningen and Drenthe, Local and national entrepreneurs | Intention for coming years | Yes | Partly | Partly |
| "TopDutch": inviting Tesla to build a factory in the northern part of The Netherlands | Province of Friesland, Groningen and Drenthe, Regional entrepreneurs | Intention | Yes | No | Partly |

*Table 4.1: Suitable cases for data collection in northern Netherlands*

Based on table 4.1 it can be concluded that the pilot in Appelscha is the only executed project in the northern region and other projects are mainly derived from it. This pilot also marks the start of the intention for a Living lab in the region. Additional, all the projects in the region involve more or less the same actors, which is telling about the actors involved at the regime level.

Concluding, qualitative data is collected via the main stakeholders that are involved in the Pilot with automated vehicles in the town of Appelscha. What the projects exactly entails, is explained in the next chapter.

### 4.1.2 Data collection

Table 4.2 includes all the interviewees that have contributed to this research. The stakeholders in this table are selected with the help of the project manager of the pilot. The project manager was interviewed first and provided contact information to approach the other stakeholders. The project manager also gave a description of the contribution of the various stakeholders. Based on this, the main stakeholders were filtered. Selected stakeholder are approached via phone and mail to determine the right contact persons and to make an appointment for an interview. Additionally, stakeholders (not listed in Table 4.2) are involved within this case-study, but their minor role in the project was not enough to influence a transition or the regime level (e.g. a gardener to mow the roadside for the automated vehicle), see Section 5.3.

All interviews were conducted via a face-to-face interview and took on average just over an hour of time. The interviews with the regional and local level were (partly) double interviews, where two respondents of the same organization were interviewed at the same time.

The last three respondents are not involved in the case study. As mentioned, additional interviews are held to determine the large landscape changes. Via their wide experience in the field of actor involvement and Smart Mobility, gained through careers at i.e. the Ministry, TNO and other consultancies, these interview provided insights about role of market parties at the regime level. The interview guidelines with all question is found in appendix 3.

| # | Respondent | Represented organisation | Function | Place |
|---|---|---|---|---|
| Regional and local level | | | | |
| 1 | Mr. A. Janssens | Municipality of Ooststellingerwerf | Project manager of Pilot Appelscha | Oosterwolde |
| 2 | Mr. J. Gropstra | Municipality of Ooststellingerwerf | Policy officer Sustainability | Oosterwolde |
| 3 | Mr. D. de Vries | Province of Friesland | Junior Project manager Infrastructure and Spatial planning | Leeuwarden |
| 4 | Mr. H. Dijkman | Province of Friesland | Policy officer Sustainable innovations | Leeuwarden |
| 5 | Mr. H. Jellema | Province of Friesland | Policy officer Road Safety | Leeuwarden |
| 6 | Mr. R. Meerbach | Province of Drenthe | Policy officer Spatial Planning and Economics | Assen |
| 7 | Mr. M. Duisterwinkel | Province of Drenthe | Trainee and Project employee in Pilot of Appelscha | Assen |
| 8 | Mr. H. de Haan | Province of Groningen | Trainee and Project employee in Pilot of Appelscha | Groningen |
| 9 | Mr. D. Koelikamp | Province of Groningen | Project manager sustainable and innovative Public Transport | Groningen |
| National level | | | | |
| 10 | Mr. P. van der Stoep | Rijksdient Wegverkeer (RDW) | Account Manager for Automated Mobility | Amersfoort |
| 11 | Mr. T. Tillema | Kennis Instituut Mobiliteit, Ministry of Infrastructure & Environment | Senior Researcher and Project manager Automated Mobility | Groningen |

| # | Respondent | Represented organisation | Function | Place |
|---|---|---|---|---|
| Other | | | | |
| 12 | Mr. H. Zwijnenberg | GoudAppel – Coffeng | Senior Consultant Smart Mobility | Deventer |
| 13 | Mr. P. van Beek *(Non-structured interview and not recorded)* | GoudAppel – Coffeng | Senior Consultant Smart Mobility | Deventer |
| 14 | Mr. W. Korver *(Non-structured interview and not recorded)* | GoudAppel – Coffeng | Team manager Mobility & Spatial planning | Deventer |

*Table 4.2: Respondents for interviews*

### 4.1.3 Data analysis

The interviews were recorded (except the non-structured). For analyzing and processing these interview data software is used: *Atlas TI* is a tool specifically designed for qualitative data analysis. It guides to transcribe interviews and consequently helps processing the output transcript with the help of useful coding software.

In advance, the questions of the interviews were connected with the elements under study of the conceptual model. These questions are connected with a 'family' that contains of codes, see figure 4.1. The answers on the interview questions are consequently marked with the code and then can via the family be connected with the conceptual model.

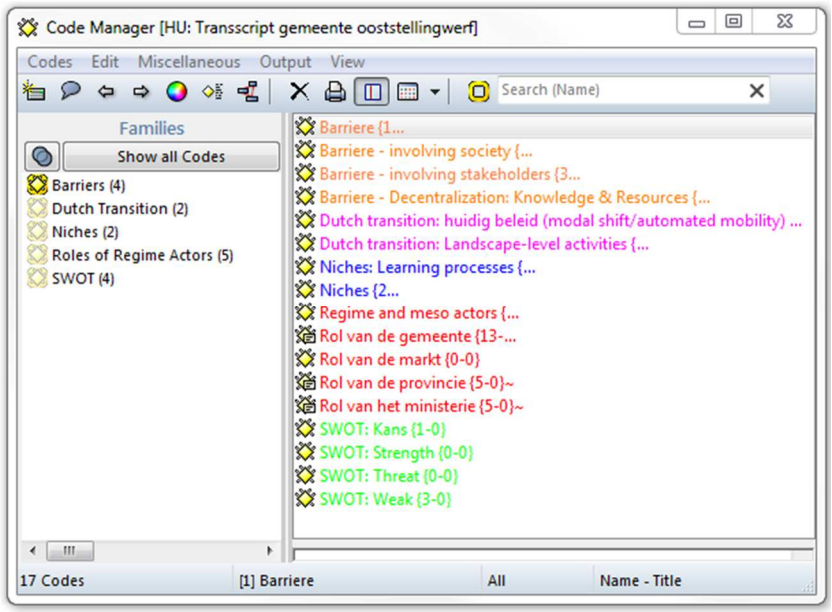



*Figure 4.1: In the left panel the families are shown, in the right panel the corresponding codes. The families are connected with the conceptual model. For example, the family "Barriers" is connected with the main barriers involving society, stakeholder cooperation and decentralization.*

For example, one of the questions for the provinces was: which tools are available to adopt and stimulate niches? This question is linked to the element of Niches in the conceptual model and with the family 'Niches' and the corresponding codes. The answer on the question is then coded with the code 'Niches' and additional in this question with the 'Role of market', see figure 4.2. Finally, the coded answers were combined to explain the elements of the model and then to answer on the (sub) questions.

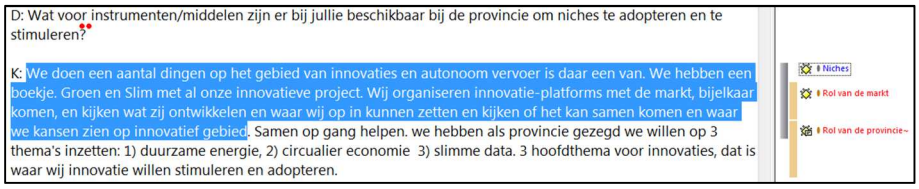



*Figure 4.2: Example of coding a question, related to Niches*

### 4.1.4 Ethics

When conducting interviews certain research ethics have to be respected. This research is about a future transition and therefore it is expected that it does not contain sensible topics that will harm interviewees in any way. However, it has to be recognized that in some cases the interviewee is not willing to share all information; this is respected. Interviewees were asked for approval for recording. Besides, if they wished to remain anonymous this is respected. The interviewee were given the possibility to receive a version of the published thesis. All the interviewees received before the interview an overview of the core questions of the interview and information about the background of the research, to prepare the interview.

### 4.1.5 Document and policy analysis

As mentioned, a document and policy analysis is conducted to determine the larger landscape changes. These documents are found on the basis of a desk research and with the help of recommendations of mostly the non-structured interviewees. Mainly, the following document and policies are used (shown with relevancies for this research):

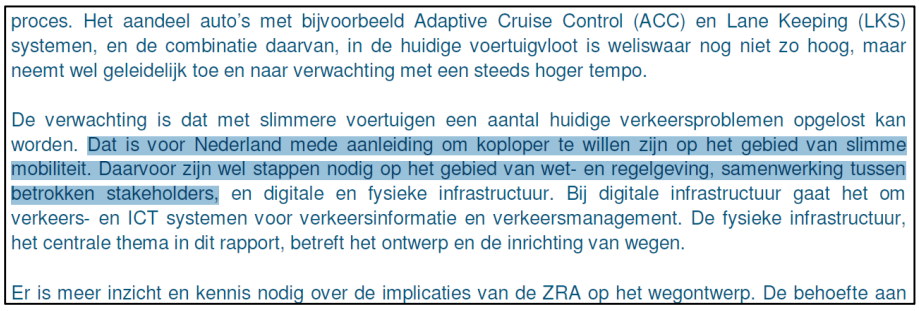
- *White Paper: European transport policy for 2010* (COM, 2001); Perspective of European commission on sustainable mobility e.g. landscape is aware of needed future changes.
- *National Environmental policy (Nationaal Milieu beleidsplan 4;* VROM, 2001); Shows how the Dutch ministry has accepted a transition perspective to approach automated mobility.
- *Declaration of Amsterdam* (EU, 2016), an intention of the European Union for a joint agenda and vision.
- *Document over projects in The Netherlands, like the Automotive Campus (AutomotiveNL, 2017) and 'Spookfiles'* (Ministerie van I&M, 2017); several projects are conducted and read to get insights in the Dutch activities on automated mobility;
- *Report: Driver at the wheel* (KIM, 2015): elaborates on different scenarios for automated mobility and what has to change with regard to the current situation (shared economy).
- *Report: Converging Roads, linking self-driving cars to public goals* (Timmer et al., 2015); concludes that society has to be involved on a larger scale.
- *Report: Implication of Automated mobility on the design of roads* (Morsink et al., 2016); elaborates on the impact of new mobility, based on what is currently known.

- *Report: Truck platooning, driving the future of transportation* (Janssen et al., 2015); although it is focused mainly on platooning, it elaborates on the current view of the Dutch Ministry towards automated mobility, such as intentions to change laws.

Besides conducting documents and policies to determine the landscape, regional documents and policies were used to determine the ambitions and focus of the northern region. Examples of used documents and policies are:

- *Letter of Intent of the northern region* (Gemeente Ooststellingerwerf, 2016): intention of the northern region towards automated mobility.
- *Provincial Traffic and Transport policies* (Provincie Fryslan, 2011; Provincie Drenthe, 2007) with the corresponding transport concession in the northern Region: Current visions on transport policies of the region. Including the corresponding *Provincial Execution policies for Traffic and Transport* (Provincie Friesland, 2016), encompassing executed projects in the light of the PVVP.
- *Sustainable mobility strategy* (Dutch: Nota Duurzame Mobiliteit; Provincie Groningen, 2014): elaboration on the urgency for sustainable mobility for the regional level.

In the processed documents relevant passages for this research were marked and consequently saved and possibly quoted or referred to in relevant Sections in this thesis, an example is given in figure 4.3.


proces. Het aandeel auto's met bijvoorbeeld Adaptive Cruise Control (ACC) en Lane Keeping (LKS) systemen, en de combinatie daarvan, in de huidige voertuigvloot is weliswaar nog niet zo hoog, maar neemt wel geleidelijk toe en naar verwachting met een steeds hoger tempo.

De verwachting is dat met slimmere voertuigen een aantal huidige verkeersproblemen opgelost kan worden. Dat is voor Nederland mede aanleiding om koploper te willen zijn op het gebied van slimme mobiliteit. Daarvoor zijn wel stappen nodig op het gebied van wet- en regelgeving, samenwerking tussen betrokken stakeholders, en digitale en fysieke infrastructuur. Bij digitale infrastructuur gaat het om verkeers- en ICT systemen voor verkeersinformatie en verkeersmanagement. De fysieke infrastructuur, het centrale thema in dit rapport, betreft het ontwerp en de inrichting van wegen.

Er is meer inzicht en kennis nodig over de implicaties van de ZRA op het wegontwerp. De behoefte aan

*Figure 4.3: Example of a marked relevant passage in an exploration of TNO & RHDHV, commissioned by the Dutch Ministry of Infrastructure & Environment (Morsink et al., 2016, p.1). This passage is relevant for this research due political willingness at the Ministry and the recognition for cooperation between stakeholders. This passage has been used in the introduction, as well as for identifying barriers.*

# 5

# Results & Analysis

The results of the interviews are presented in the following Sections. A general recap is given of the results from policies, documents and interviews. Next, the Dutch-transition is outlined, showing it is either in the pre-development phase or the take-off phase. Using the elements of the conceptual model, the case-study is explained. Finally, a SWOT-analyses elaborates on opportunities and threats.

## 5.1 General recap of results

### 5.1.1 Recap results interviews

For this research, 14 people have been interviewed. Nine different interviews are held: five with a single interviewee (national level and market) and four with multiple interviewees at once (local and regional level). It has led to seven extensive coded transcripts. The interview guidelines are shown in Appendix 3. A short recap of the results:

The municipality of Ooststellingwerf initiated the pilot and consequently involved the RDW and supplier EasyMile. The provinces of Groningen, Friesland and Drenthe are involved in a later stage. The northern region indicates to focus on a flexible, on-demand collective fleet of autonomous vehicles, a so called Pod system, as a new mode of transport in trip-chaining. The Pod system is seen as more feasible than to maintain the current public transport in depopulated areas.

The pilot is experienced as an instructive project for the local and regional level, as well as for the national RDW. Experience is obtained for future projects and, via the RDW, as input for legislation. For future projects provinces are willing to support municipalities with human and financial resources for involving society and to come up with new ideas for automated related niches, as they are expected to do so by the national level.

In the analysis in Section 5.3 is widely referred to the seven transcripts. The interviewees and their corresponding quotes are referred to as follows: "*Quote*" (interviewee #x, institutional level). The number of the interviewee corresponds with the number in table 4.2 on page 44 and 45.

### 5.1.2 Results of policy and document analysis

Table 5.1 shows the key points for the analysis of the Dutch transition is Section 5.2. To underpin these key points, relevant passages from the documents are shown with the corresponding references.

| Key points for analysis | Reference: policy or document with relevant passage |
|---|---|
| *The urgency of sustainable mobility is widely recognized.* | ■ "The transport system needs to be optimised to meet the demands of enlargement and sustainable development [...]. A modern transport system must be sustainable from an economic and social as well as an environmental viewpoint" (COM, 2010, p.6).<br>■ "Binnen de transitie naar een duurzame energiehuishouding moet ook de nadruk vallen op een duurzame mobiliteit" (VROM, 2001, p. 169)<br>■ "How can the Netherlands use the self-driving car in such a way that it can achieve its policy objectives of safer and more sustainable traffic" (Timmer et al., 2015, p.12) |
| *Automated mobility is seen as a crucial contribution towards a sustainable environment in the European Union.* | ■ "Further automation of vehicles [...] provide excellent opportunities to improve traffic flows and to make transport safer, cleaner and easier" (EU, 2016, p.1)<br>■ "The self-driving car promises us a safer, more sustainable, and more efficient system of transport, one in which traffic accidents [...] could be prevented" (Timmer et al., 2015, p.11)<br>■ "The Netherlands is actively heading towards the self-driving car. The Ministry of Infrastructure and the Environment has announced measures, to enable this country to occupy a place among the leaders in this development" (Timmer et al., 2015, p. 33) |
| *The Dutch ministry is mainly focused on automated mobility instead of autonomous vehicles.* | ■ "Dutch policy focuses strongly on traffic management and cooperative systems because of the favourable contribution these can make to achieving various policy objectives, for example more efficient road use, and safer and more sustainable traffic" (Timmer et al., 2015, p. 33) |
| *To implement automated mobility there is a need for a joint agenda to overcome barriers.* | ■ "Agreeing to develop and maintain a joint agenda with European stakeholders to support the shared objectives" (EU, 2016, p.5)<br>■ "For this system-wide innovation, we suggest to establish an Shared Innovation Programme, based on open innovation principles" (Janssen et al., 2015, p. 2) |
| *The Declaration of Amsterdam is signed to develop a common frame of reference and to design international standards.* | ■ "Common definitions of connected and automated driving should be developed and updated, based on the Society of Automotive Engineering levels (SAE levels) as a starting point" (EU, 2016, p.6) |
| *The Dutch ministry has recognized the need for systemic change and therefore adopted a transition perspective* | ■ "Voor het oplossen van grote milieuproblemen is systeeminnovatie nodig [...] die transformatie houdt technologische, economische, sociaal culturele en institutionele veranderingen in, die op elkaar inwerken en elkaar moeten versterken [...] Transitiemanagament vraagt om een procesgerichte sturing" (VROM, 2001, p. 126)<br>■ "Recognizing the need for a systemic approach to ensure that benefits for the transport system" (EU, 2016, p. 4) |
| *Several pilots and projects take place to increase the experience with automated mobility in The Netherlands* | ■ "Vanuit verschillende invalshoeken wordt onderzoek gedaan naar de ZRA en worden praktijkpilots georganiseerd, in Nederland en de ons omringende landen" (Morsink et al., 2015)<br>■ "At European level, there are a number of EU-funded research projects to investigate the future of smart mobility"(Timmer et al., 2015)<br>■ For concrete projects in The Netherlands see AutomotiveNL (2017) , Ministerie van I&M (2017) and NOS (2016). |
| *The Dutch Ministry of I&M is actively exploring the possible scenarios for automated mobility and the implication of such a system in the current built environment.* | ■ "In deze studie presenteert het KIM vier verschillende scenario's voor een toekomstig verkeer- en vervoersystem met zelfrijdende voertuigen. Daarbij kijken we expliciet naar de bredere maatschappelijke effecten" (KIM, 2015, p.3).<br>■ "Er is meer inzicht nodig over de implicaties van ZRA op het wegontwerp [...] Om te starten met de beantwoording hebben CROW en RWS-WVL aan RHDHV & TNO gevraagd een verkenning uit te voeren " (Morsink et al., 2016, p.5)<br>■ "Large-scale tests on public road networks are not yet legally permitted, but The Dutch Ministry of Infrastructure and the Environment has already reported on a public consultation on how legislation should be amended for large-scale tests on public road networks" (Janssen et al., 2015, p.12). |
| *For automated mobility to be implemented, society has to be involved to a greater extent for acceptance of the suggested systemic change. Society has to be involved not only in the execution of projects.* | ■ "Civil-society organizations and the public currently play hardly any significant role in the development of smart and self-driving vehicles (whether that means the cooperative or the robot car) Indeed, they are conspicuously absent. Users are still not seen as inevitably involved in the social embedding of the self-driving car" (Timmer et al., 2015, p. 34). |

*Table 5.1: Results of policy and document analysis*

## 5.2 The Dutch transition

The urgency of sustainable mobility is widely recognized (COM, 2001) and automated mobility is therefore on the agenda of a variety of policy makers in the European Union (EU, 2016; Timmer et al, 2015). The question is, to what extent the topic of automated mobility has infiltrated the landscape-level. In other words, is the landscape already shifting to a focus on automated mobility?

In the Dutch transition a breakthrough with regard to automated mobility has not yet taken place (Timmer et al., 2015). Experiments and projects with automated vehicles are taking place over the country (AutomotiveNL, 2017; Ministerie van I&M, 2017; NOS, 2016). The most comprehensive automated test so far, was a test of insurance company Aon. They organized a test with more than 50 autonomous vehicles on the national highway to show how far technology is developed, but also to stress the need for change in the law and the insurance system (NOS, 2016). However, an irreversible change has not taken place: the regime has not shifted (yet). The Dutch transition is either still in the pre-development phase or the take-off phase. An exploration of the landscape-level can help distinguish between the two phases (Rotmans et al., 2001).

Activities in The Netherlands indicate that the landscape is slightly starting to shift. At the highest national level, the need for sustainable mobility is acknowledged (VROM, 2001) but more important, automated mobility is actively pursued. The Dutch minister of Infrastructure and Environment, Mrs. Shultz, has lobbied in 'Brussels' for automated mobility to come on the agenda of the EU (Morsink et al. 2016) and with success.

Collaboration between EU-countries for changing laws and international standards for automated vehicles is needed, or, a "shared language" (Timmer et al., 2015, p.19). Therefore, the Dutch minister and the other 27 ministers of the EU have signed the Declaration of Amsterdam. (EU, 2016). The Amsterdam Declaration "lays down agreements [...] for developments of self-driving technology in the EU. [It pledges] too draw up rules that will allow autonomous vehicles to be used on the roads" (EU2016, 2016). The declaration marks a clear direction for the future: "There are two approaches in the field of self-driving car: the autonomous robot car [and] the cooperative car. European policy makers chose the latter, given the contribution that cooperative cars can make to road safety, improved traffic flow, and cleaner mobility" (Rathenau Institute, 2017, p.1; Timmer et al., 2015). The European Union assumes autonomous vehicles to be just an intermediate step towards connected driving, as autonomous vehicles will eventually be expanded with connectivity (EU, 2016). Additional, Janssen et al., (2015); Timmer et al. (2015) argue that the line between autonomous and automated mobility is not diffuse and that major benefits can be obtained when both cooperative and autonomous are combined.

The focus on cooperative mobility can be recognized in practice for example in the project 'Spookfiles A58' in the province of Brabant (Ministerie van I&M, 2017). In this project, V2I and V2V communication is tested with the help of market parties and knowledge institutes, like the University of Eindhoven. The 'AutomotiveNL' campus is settled here, where stake-

holders gather to test with connected mobility (AutomotiveNL, 2017). Besides, the Declaration of Amsterdam strives for a learning-by-doing approach and acknowledges that this approach is needed "to manage societal expectations, to raise awareness and increase acceptance and appreciation of connected and automated vehicle technologies" (EU, 2016, p.5).

The Dutch ministry of I&M wants to be a frontrunner in the global transition towards automated mobility (Morsink et al. 2016) and expects that The Netherlands can adopt an automated system within twenty years (Benschop, 2013). Furthermore, the ministry is visiting foreign companies and countries. The Dutch ministry changed the Dutch law to allow testing on Dutch public roads, as an exemption on the Vienna Convention, which forces drivers to be able to control the vehicle at any time (Rijksoverheid, 2016f). A legislative proposal is currently processing which even allows test with no driver at all (Ad.nl, 2017).

In sum, given the increased policy urgency as evidenced by the developments in the Dutch ministries policies, it is clear that the dominant ways of thinking at the landscape level are moving. However, the developments that are taking place all lack the large scale involvment of society. Therefore, Timmer et al. (2015) argue that society has to be involved to a greater extent for acceptance of the suggested systemic change. In the next chapter a discussion takes place what this results mean for the transition phase.

## 5.3 Case: Testing with autonomous driving in Appelscha

Appelscha is situated in the rural landscape in the province of Friesland. This area is one of the depopulated 'contracting-areas' in the region. Although Appelscha is profiting from tourists and recreational activity, thanks to its attractive and unique landscape, the town and especially the region is struggling with livability and accessibility. This has been the main reason for the Municipality to initiate a test with autonomous driving.
"*From the municipality came the question how the impoverishment of amenities and public transport due to depopulation, could be solved. That is the reason why we are testing with such vehicles*" (Interviewee #1, municipal level).

The underlying thought of the project was to increase the experience with autonomous driving and see how people react on an autonomous vehicle.


*Figure 5.1: The used autonomous vehicles during the pilot, also called the Pod, supplied and programmed by a French company EasyMile (Wel, 2017)*

In this project, fully autonomous vehicles were driving on a bicycle-lane between a visitor center of Staatsbosbeheer and de "Wester Es" in Appelscha as a shuttle (See figure 5.1, 5.2 and 5.3). Tourists and inhabitants of the region could use the two vehicles for free (Koene & De Groot, 2017).

As a start of this project, a letter of intent was signed by governmental stakeholders for intending to test automated mobility in the coming years in the region and become a living-lab (Gemeente Ooststellingwerf, 2016). The pilot started with an intensive period of programming the Pod by the supplier: EasyMile. When the Pod was ready, the pilot stopped after 2 days for reprogramming. It needed to drive closer to the roadside, bicyclists had no room for passage:
*"It turned out that the vehicles were driving too much in the middle, bicyclist where pushed form the road, or felt that way. The vehicle had to be reprogrammed and we arranged traffic warden. Consequently, the pilot has run for 5 weeks*" (Interviewee #1, municipal level).

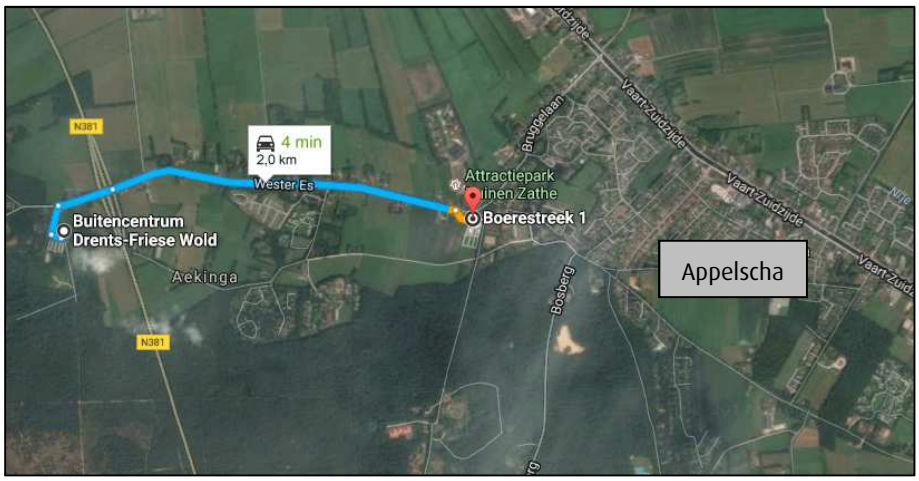



*Figure 5.2: Route of the autonomous vehicle, length approximately 2.0 km (Google, 2017).*


*Figure 5.3: Information sign during the pilot: "Step into the future, for free" (Koene & De Groot, 2017)*

The following stakeholders were involved in the pilot: the three provinces of Friesland, Drenthe and Groningen, the municipality of Ooststellingwerf, the Ministry of Infrastructure & Environment, National Service for Road traffic (RDW) and:
"*Furthermore, Easymile, Staatsbosbeheer [National organization for Nature Conservation], Taxi service 'Kort*" (Interviewee #5, provincial level)
"*A car-garage, for storage of the vehicle and finally an insurance company*" (Interviewee #1, municipal level)

The respondents for the interviews are shown in Section 4.1.2. This overview did not include the Taxi Service, the gardener and Staatsbosbeheer, because these stakeholders had a minor role in the project. Staatsbosbeheer was included because the route started at their center for visitors and is located in the National Park "Drenths Friese Wold". The gardener was involved because:
"*For the vehicles, the roadside had to be mowed. [...] Low-hanging branches and grove were detected as an object and the vehicle stopped"* (Interviewee #1, municipal level).

The garage was involved because the vehicle had to be stored and programmed during the pilot. The insurance-company was involved because the Pod had to be insured, it was driving on a public road. And finally:
"*The taxi service was involved due to the possible decline in profit for the taxi service"* (Interviewee #4, provincial level).

### 5.3.1 Modal shift vs. automated mobility: general focus

The interviewees were asked for the current policy on automated mobility, and if not present, for sustainable mobility (see appendix 3). Remarkable answers are received with different conceptions of the role of such a policy in a relative new policy field.

The ministry of I&M operates from three clear policy goals, namely Traffic Flow optimization, Road Safety and Environment. Automated mobility is just seen an instrument which contributes to these goals:
"*From the policy goals, the ministry is exploring the self-driving car. If the policy goals change, [...] it can be that the role of automation will change. [...] Vehicles that communicate are currently seen as a prerequisite to reach the policy goals.*"
(Interviewee #11, national level)

As example is given, if 'smart usage of travel time' would become a policy goal, automation may be pursued more actively.

The National Service for Road traffic (RDW) has a more clear view on the topic. The RDW is actively involved in the transition, because they are the authorized institution to give permits for automated vehicles to test on public roads. They actively monitor all developments and try to cooperate and think along with the provinces or municipalities. The vision is to share knowledge and cooperate as much as possible, within their assignment of the Ministry to keep it safe:
"*We try to stimulate as much as we can, which makes several things possible, but safety first*" (Interviewee #10, national level)

A consequence of working with these policy goals from the Ministry, is the lack of policy for the provinces for automated mobility:
"*There is no policy for the regional level regarding automated mobility. It is more like the national government wants to be a frontrunner, from that ambition pilot are facilitated*" (Interviewee #11, national level).

Automation is at this level part of larger mobility and sustainability policies.
"*Actually there is no policy for automated mobility, simply said, we just have a general policy for accessibility. The motivation for automation comes from the policies for contracting areas"* (Interviewee #6, provincial level).

All provinces share the vision that automated mobility is a solution to the issue of livability and depopulation in their region. It is the main reason for the provinces to consider automated mobility at all. It is seen a new link in trip-chaining (Dutch: Ketenmobiliteit). All provinces refer to automated mobility as a possible solution to the first and last mile issues in depopulated areas (PBL, 2014), wherein especially in low density areas this concept is an issue. In the current situation is it not feasible for the provinces to maintain a decent timetable to connect the rural areas to the main network:
*"' Our aim [for automated mobility] has always been a new link in trip-chaining [...] a self-driving vehicle is used for the last mile, thus a use of different modes of transport is foreseen*" (Interviewee #5, provincial level).
"*Actually, we have approached automated mobility always from the perspective of trip-chaining, empty busses are becoming increasingly expensive for us [...] For example, Wierum is located near a provincial road, the first and last part of the trip can be done with an autonomous vehicle to connect to the provincial roads and busses.* " (Interviewee #6, provincial level).

The concept of first and last mile is the connection between the origin and destination to the main transport network, which has recently attracted more attention of policymakers for increased efficiency in travel time on a local level (PBL, 2014).

Furthermore, provinces are mainly focused on broader sustainability policies, automation is just a part of it.
"*We have a policy and ambition for sustainable energy for 2050, and a part of that is mobility-related [...] Public transport is a part of that*" (Interviewee #9, provincial level).
"*The current focus is greener fuels like hydrogen (...), but automated mobility is been approached from a Public Transport point of view*". (Interviewee #4, provincial level)

The eventual goal for automated mobility of the Province of Groningen is to become a sustainable part of the public transport within 5 to 10 years. They are focusing on a collective system, where Public transport has to be demand driven:
*"Within 5-10 years, we want that the vehicle can drive independently [...] in 'contracting areas' you need a flexible, demand driven, public transport system, which is available whenever you need it. You do not want a timetable-system over long distances, that you have to wait an hour for a vehicle [...] It is no wonder that the current frequency is so low, it is way too expensive."* (Interviewee #9, provincial level).

At the local level there is a lack of vision or focus of automated mobility.
*"Actually I do not really know if we have a policy or vision for sustainable mobility"* (Interviewee #1, municipal level)

The municipality also focuses more on general sustainability, like constructing energy neutral buildings with solar energy and decent insulation (Gemeente Ooststellingwerf, 2017). Specifically for mobility policies, the municipality indicated it only has a minor contribution to that goal and that they are directed by the provinces:
"*Our leading principal in the municipality is the ambition to become energy neutral before 2030. Sustainable mobility is just a part of that*" (Interviewee #2, municipal level).
*"[Mobility objectives] are more directed by the provinces. We as municipality have only a few chargers for electric cars*" (Interviewee #1, municipal level)

For consultancies the focus is mainly cooperate:
*"We know how traffic reacts and we can come up with a suitable location for decent outcomes and outputs*" (Interviewee #12, market)

For the car manufactures it is rather simple, their vision is to manufacture an automated car. Nissan for example thinks it can produce a level 5 car within the year of 2020, regardless the policies of the government (cooperative driving vs. autonomous) (Schenk, 2017). As will be elaborated on in the discussion, there are some complications:
"*Often is said, all manufactures want automated driving. However, the question is: do they really want to? I spoke to a manufacturer the other day and he said: In the end, it has to be paid. I do not know my client is willing to pay for my developments [...] currently it is not a feasible business case*" (Interviewee #10, national level)

Finally, there is a difference between the organizations in their need for steering. As the RDW and the province of Groningen and Drenthe mention, policy-wise top-down steering will not foster the development. In the current phase, tests are needed with all kinds of automation and automated cars. A clear policy would hinder the freedom to act, and would eventually hinder the adoption of new (and out-of-the-box) niches:
"*[Top-down steering] is not desired yet. It will hinder innovation and will work more as a decelerator than a stimulation. The current freedom gives us space to test with novelties [...] the national government has to take responsibility in the legal framework, and provide stimulation with e.g. money [...] and consequently give the region their own space on how to achieve such goals*" (Interviewee #9, provincial level).

However, the province of Friesland and the municipality express they would like more top-down steering for a direction to explore:
"*From a traffic engineering perspective, we would like to know what we have to take into account for design of new roads. We want to know what is possible or not [...] we would like a platform where we can drop our pilot or ideas and that we consequently receive feedback for suggested improvements*" (Interviewee #5, provincial level).

### 5.3.2 Regime level: actors

The third sub-question of this research is concerned with the kind of actors are involved at the regime level. Within the case-study several actors are interviewed, but it does not automatically mean they are all regime-actors. As turns out from the discussion in Section 6.3, only few can be considered as such.

One actor, which is not interviewed, has been mentioned a couple of times is the CROW, a non-profit knowledge-platform for infrastructure and mobility. The CROW is an interesting actor because they are responsible for the distribution of automated related experience and feedback. The CROW came up with the Taskforce Dutch Roads, where all road-authorities, the ministry, RWS, RDW and consultancies come together to share knowledge and experiences. In this platform, also the evaluation of the pilot Appelscha took place for others to benefit from the experience (CROW, 2017):
"*At the Taskforce Dutch Roads, multiple actors are present. I have been there, it is about learning and sharing experiences so others can profit from it*" (Interviewee #1, municipal level)

### 5.3.3 Regime level: roles

The involved stakeholders are asked to their role in the pilot of Appelscha. From the interviews became clear very quickly, that the roles in the pilot were limited to three main actors. Therefore, stakeholders are additionally asked to their role in the Dutch transition. See appendix 3 for the interview guidelines.

*Roles in the pilot of Appelscha*
The main role in the pilot is taken by the municipality and an externally hired coordinator. The hired employee initiated the project and functioned as a coordinator:
"*The external coordinator did all communication, he contacted the RDW, the provinces, the ministry, insurance company and so on [...] later on, I took over his function on behalf of the municipality*" (Interviewee #1, municipal level)

The municipality has invited the provinces to join them in a letter of intent, to think along, because the problems and challenges in the municipality were similar to those in the whole region: puzzling with maintaining feasible public transport and amenities in low-density areas, resulting in a decrease in livability. A broader vision, to position the pilot of Appelscha in the regional and national transition, is being designed by the provinces.
"*If you look at the underlying thoughts of the letter of intent, We all say that depopulated areas are promising for automated mobility, but in most cases it means it is crossing municipal borders [...] A municipality can facilitate maybe one pilot, but cannot develop a vision to really foster the development in the region, therefore regional authorities are needed*" (Interviewee #9, provincial level).

However, the role of the provinces was only minor. They were involved in a later stage when actually everything already had been arranged:
"*Before the pilot, automated mobility was not even on our radar (...) the municipality said: look what we got here, you are a province and maybe it is interesting for you*" (Interviewee #5, provincial level).

From that moment onwards, the provinces collaborated to form a unity, which makes it easier to communicate with the Ministry and the EU. In this way, the pilot also gained publicity and effectiveness, meaning it is monitored from over whole of Europe:
"*When the pilot stopped after two days, I received mails from the South of Europe: how can you drive on a bicycle lane? They just didn't understand. Media just copy-paste everything and exaggerate*" (Interviewee #10, national level)

Finally, the RDW had a crucial role in the project. They saw it as a learning experience to test with new exemptions and permits for autonomous vehicles. They have been intensively in contact with supplier EasyMile to adapt the car to the regulations:
"*When exemptions for vehicles are involved, the RDW is in the lead. A project manager can desire a lot, but the RDW decides what is happening [...] we take care of the communication and evaluation. It is captured in the law: the RDW is responsible*" (Interviewee #10, national level).

In short, the main roles in the pilot were taken by the municipality, the RDW and EasyMile. The provinces were involved in a later stage to think along and develop a broader vision for the future position of automated mobility in the region.

*Roles in the Dutch transition*
As stated before, the Ministry of I&M has expressed to become a frontrunner in Europe in the transition (Morsink et al., 2016), which is executed in the form by facilitating pilots:
*"[...] the national government wants to be a frontrunner, from that position and ambition they are facilitating pilots and are trying to adapt the law [for automated mobility]*" (Interviewee #11, national level).

The role of the ministry is to make pilots possible, with the help of policies, subsidies and regulations. For 2018 a law is currently processing to become adopted, which makes it possible to test with autonomous vehicles, without the need for a steward or a driver present in the vehicle (telegraaf.nl, 2017; Ad.nl, 2017).

Besides the Ministry has a task to avoid the appearance of different automated systems over the country; coordination is needed. This also applies on the European level, where the Ministry is also a frontrunner. Adapting these regulations is needed to come to a standardization of systems in Europe and globally:
"*You have to avoid a potpourri of unaligned initiatives, a coordinating role is needed [...] on a national level you do not want different systems, [...] the same goes for Europe. That in The Netherlands a car is driving, but a software update is needed when you want to go to Germany"* (Interviewee #11, national level).

The RDW has a crucial role in designing legislation. The RDW provides the ministry with input for EU-guidelines and is operating as an intermediary between the provinces and municipalities, where the pilots take place, and the ministry, where regulations are made:
"*We try to interact as much as possible to gain experience [...] our goal is Europe, where legislation has to be adapted. Interaction with the market is feeding us to give input for EU-guidelines*" (Interviewee #10, national level).

In general, the RDW can be seen as a process manager, providing stakeholders with information and the necessary exemptions on the current vehicle demands. The RDW and the Ministry stimulate the provinces and municipalities to come up with pilots, but also expects them to do so:
"*We are encouraging as much as possible [...] if someone wants to test with automated mobility, we help them wherever needed. The RDW is actually one big process manager, but initiatives have to come from the municipalities and provinces themselves. However, we will help them top to bottom*" (Interviewee #10, national level).

The provinces also have a stimulating role themselves: a proactive, think-along attitude combined with a coordinating role describes the function of the provinces in transition.
"*In the end, we are not the crucial link that can block the transition, but perhaps we are the crucial link to help the transition in motion*" (Interviewee #6, provincial level)

The provinces are responsible for stimulating, facilitating and initiating pilots and niches and additional has to provide the conditions for pilots to be executed:
*"As resonates with the current phase of the transition, (...) we have a coordinative function and we are facilitating [projects and pilots] with the idea that, in the end other market parties will take over"* (Interviewee #6, provincial level)

The provinces can contribute with financial support, internal and external lobbying and bringing stakeholders together. Besides, as will become clear from Section 5.2.5, provinces are pro-actively stimulating niches by creating a demand for it, meaning addressing niches as a solution towards a problem they are experiencing:
*"Often market parties have ideas and innovations ready, but no one is asking for it. In this way we create a demand for such innovations, I think we are eminently suited for such a role.*" (Interviewee #9, provincial level)

Coordination is also one of the main responsibilities of the provinces. As mentioned in the previous Section, the provinces are responsible for designing a broader vision in the region, because municipalities lack an overview. Additional, the so-called Daily Urban System (area wherein daily commuting takes place) does not stop at municipal boundaries, an automated mobility system will also cross this borders:
"*The mobility system does not take into account municipal borders. Often one talks about the Daily Urban System. Administrative boundaries do not correspond with this Daily Urban System. Therefore, you need a higher scale which is more in accordance with that system, then you are able to make better choices*"(Interviewee #11, national level)

A supra-municipal focus is thus needed, especially in combination with the focus of the northern region to use automated mobility as an additional mode of transport in public transport. Current public transport is already regulated at a supra-municipal level in the form of the transportation concession of public transport (see appendix 2):
"*If we want to execute pilots for the years to come, we have to ensure that every pilot succeeds the preceding pilot. In every step we have to learn. This will exceed the local level and cross municipal borders" (Interviewee #9, provincial level*'

Thus, it seems that provinces are crucial for a supra-municipal focus. Relevant for this research is that without this coordination, learning-by-doing effects would be marginal. The pilots should constantly develop step by step: *a consecutive learning process*. Without these reflexive activities, innovations will not develop in such a way that regime-actors are willing to adopt them: a breakthrough would not occur (Loorbach, 2010).

Next, the municipality is more focused on executing projects and implementation rather than coordinating.
"*A municipality is more location-oriented"* (Interviewee #9, provincial level).

Municipalities are expected to come up with initiatives and have to assure that the results of the initiatives are useful (step-by-step learning) and are transferred to a higher level for coordination, as described above, via e.g. CROW or RDW. However, as also explained in Section 2.1, there is a difference in the momentum between municipalities and the provinces are aware of it:
"*I think we mainly have to stimulate [...], we try to make municipalities enthusiastic to come up with ideas, so consequently they approach us [...] however, there is a difference in municipalities: The municipality of Emmen, Assen, Leeuwarden are big municipalities, a lot of people work for the municipality. But there is also the municipality of Tynaarlo. [...] they have maybe one person in charge of everything [...] Do not overestimate the average momentum of a municipality [...] Automated mobility is not a secondary activity, I experience it almost as a full-time job*" (Interviewee #6, provincial level)
"*Therefore, I think it especially the task of the province to be aware of the needed collaboration and the shared issues, the province can strengthen the message of the pilot for more publicity and awareness*" (Interviewee #7, provincial level)

Finally, the role of the market is interpreted in different ways. First, consultancies can be helpful in a supporting role for municipalities and provinces. In the project of Appelscha no consultancy has been involved, the project was executed with internal employees. However, the consultancy was critical:
*"What information will be obtained with the pilot? That is exactly where a consultancy can contribute [...] it was not safe to execute the project like this, they haven't thought it over well enough, we are talking about lives here"* (Interviewee #12, market)

In the opinion of the consultancy the obtained results and struggles were to be expected, meaning the goal of the project was not well defined up front. One of the results for example, was that bicycles were 'pushed' from the road. With the aid of market parties, the northern regions can determine a suitable pilot for an integration of a new system in the existing environment. The results of a pilot could then be more helpful:
*"We know how traffic reacts and we can come up with a suitable location for decent outcomes and outputs [...] you have to know what you want to learn, and consequently create the right conditions for it."* (Interviewee #12, market)

Finally, the car industry is responsible for technical innovation and developing niches. The ministry also holds the industry largely 'responsible' for the transition and stresses interaction as a key-word. The question is however, what do the manufacturers want themselves? After all, they are a profit-aimed organization:

"*At first, the industry is responsible [for the transition], we can demand everything, but if they can't make it, it is not possible. The transition is an interaction between the preferences of the consumer, the possibilities supplied by the industry, and the contribution of the government [...] but if it is not profiting, they will stop developing, like the google glass"* (Interviewee #11, national level)

In the end, in all interviews, **collaboration** between stakeholders at different levels is repeatedly mentioned. Collaboration is seen as the main condition for success in the transition. However, involvement of stakeholders seems to be a challenge (see Section 3.3). How this is turns out in reality, see Section 5.3.5.

### 5.3.4 Niches

*Monitoring of niches*

Niches are crucial to change the regime level as a bottom up influence (Elzen et al., 2005). During the interviews it became clear that all stakeholders are monitoring niches of automated mobility. It turned out that money is one of the main instruments for stimulation and adoption, but also guidance, lobbying and regulations are amongst them.

"*It depends on the innovation, but mostly it is money, but also knowledge. [...] some innovation do not need money, but more space or supervision*" (Interviewee #6, provincial level)

Remarkably, the municipality specifically hired an employee to come up with innovative ideas that could be tested. This does not mean that they are specially searching for mobility related policies, but the pilot of Appelscha is initiated via this way. In the person of the externally hired coordinator, the niche of the autonomous vehicle (the Pod), has been monitored:

*"Policy-wise we have expressed to become innovative, not only sustainability, specifically an external coordinator is hired. [...] he came with the idea, along with the alderman, for self-driving vehicles"* (Interviewee #1, provincial level)

The provinces monitor niches with the help of their network and the personal interest of the policy-officers. Besides, provinces are active in platforms like the taskforce Dutch Roads, where besides knowledge and experience, also niches are exchanged (CROW, 2017):

*"Monitoring niches is mostly motivated by our personal interest, it is not an institutionalized activity, and everyone has its own network of people which feeds us with new ideas. If you think it is promising for the province, we will look how we can deal with it [...] in the end, it is just a part of your job"* (Interviewee #6, provincial level)

The province of Groningen are remarkable actively stimulating niches. They think it is crucial to encourage demand for certain innovations. Otherwise potential niches would never breakthrough. This pro-active attitude is one of the reasons why the province of Groningen was involved first in the pilot of Appelscha:

"*We organize innovation platforms, where we invite the market, to see what they develop and how we can use with them. Together we may help each other. We are also willing to invest in innovations we think are promising for our region [...] often market parties have ideas and innovations ready, but no one is asking for it. In this way we create a demand*

*for such innovations, I think we are eminently suited for such a role.*" (Interviewee #9, provincial level)

The ministry is active on different facets of a niche. The RDW is setting up a special department to monitor niches and developments in The Netherlands and abroad, with regard to technical niches:
"*We are creating a specific department, R&D, an innovation department, which is specifically aimed at exemptions for: the Pod, autonomous vehicles, platooning and tesla models etc.*" (Interviewee #10, national level)

Besides, the RDW gives presentation at different platforms to stimulate institutions to engage with new niches they have encountered. The ministry itself is more future oriented, in order to know where a niche can lead to:
"*The technical engineering is monitored by the RDW, but with respect to the speed of the transition and what is ahead of us, transition pathways, what does it mean for society, that is what I am monitoring. It is approached from a policy perspective, which is currently aimed at facilitating pilots.*" (Interviewee #11, national level)

*Interest in niches*
It has been outlined that all actors are monitoring niches and innovation in different ways. However, actors are interested in niches in different ways:
"*There are three layers within an innovation. First, the vehicle engineering, where different technical systems are developed (**the input**) [...] The second layer is a knowledge-related layer, what is the mobility effect of the niche in terms of speed, traffic flow, safety and costs of a system (**the output**) [..] and finally on top, how does the niche fits into society. It can then be argued for example how the niche can be used in rural areas in the northern region, for amenities etc. (**the outcome**) [...] The first layer is of less interest for us consultants, we are more interested in the effects of the nice. As a consultancy we can help translate the output to an outcome, the outcome is of most interest for the regime*" (Interviewee #12, market)

This explanation can be of interest to discuss the involvement of different actors in different ways in an innovation, as takes place in Chapter 6.

### 5.3.5 Barriers towards implementation

Section 3.3 outlined the main-barriers towards implementation of automated mobility. Interviewees are asked what existing barriers were faced during the pilot and how the barriers from Section 3.3 are experienced. See appendix 3 for the interview guidelines.

*Decentralized rural authorities*
The RDW and the Ministry expect that projects and pilots are initiated bottom-up. The provinces and municipalities are aware of these expectations. The question is if enough capabilities are available at these local levels to meet such expectations. As already mentioned:
*"The RDW is actually one big process manager, but initiatives have to come from the municipalities and provinces themselves. However, we will help them top to bottom*" (Interviewee #10, national level).

*"Where we got a complete department for Traffic and Transport, [the municipality of Tynaarlo] has maybe one person in charge of everything [...] Do not overestimate the average momentum of a municipality"* (Interviewee #6, provincial level)

The pilot in Appelscha is initiated bottom-up (see Section 5.3). The municipality came with the idea and consequently contacted the RDW. However, the municipality had their reservations and acknowledges that the pilot is experienced as an intensive project. Expert-knowledge had to be obtained via the RDW and EasyMile (the supplier and programmer of the autonomous vehicle), so knowledge-wise the contribution of the municipality was minor. Although the municipality did not experience this as barrier, it was energy and time-consuming.
"*As a municipality, **certainly as a rural municipality**, you are rather small. It is very interesting, but to keep executing pilots and new initiatives we are just too small. We have had our pilot, it was nice and instructive, but intense. We cannot keep in charge of something like this [...] we did not interfere between RDW and EasyMile. Our only concern was that the vehicle was permitted to drive. The RDW and EasyMile took care of programming*" (interviewee #1, municipal level)

Additional the provinces are also convinced expert-knowledge is not needed, because it can be obtained externally. Additional, resources are available:
"*I think substantive knowledge of autonomous vehicles is not needed to foster the transition, we need knowledge in other fields which is available... we have a coordinative and facilitating role, especially in this phase*" (Interviewee #6, provincial level).
"*We obtain knowledge from other parties, because a lot of parties are involved [with the topic of automated mobility], but the basic knowledge is present, partly though the pilot. [...] Within the province, like provincial councils, everyone thinks it is promising and therefore, they are willing to make resources available*" (Interviewee #9 provincial level)

The pilot is largely ministerial subsidized. At the local level, not enough budget is available to organize such pilots on a regular basis. Remarkably, the hired employee 'innovations' and initiator of the pilot has been dismissed after the pilot, due to budgetary reasons.
"*His contract has been terminated, it has to stop somewhere [...] the municipality has paid for the pilot, but largely with the help of subsidy, we did not pay all of it*" (interviewee #1, municipal level)

Nevertheless, the municipality feels responsible to contribute to the transition and thinks their close connection with society is crucial:
"*We are closer to the people, thus it is easier to implement things*" (interviewee #1, municipal level).

All provinces largely share the above findings of the municipality. The provinces are aware of the fact they are expected to initiate pilots and stimulate niches. They feel responsible to actively engage with municipalities, think along and come with initiatives themselves.
"*Next year we will execute new pilots, the first actor we approach is the relevant municipality, they are the local authorities [...] it is a combination, it is natural that we take more initiative as a facilitating province, also we can position a loose pilot in a broader vision for the region"* (interviewee #9, provincial level)

"*We will keep executing pilots, off course there can be financial changes, but if you see how expensive the current public transport system is. That makes automation really promising for the future. Therefore, the provinces will come with pilots themselves*" (Interviewee #4, provincial level)

Also enough manpower is present to organize and coordinate pilots and even larger projects. Where the rural municipality indicates it is too small to stay in charge, the provinces see a crucial role for themselves:
"*We have a complete department for traffic and transport [...] we will come with initiatives, but it can differ per province. It cannot be, that we do everything on our own, you need actors that are willing to help. That we do most of the work and pay the biggest share may be natural, it corresponds with the current phase of the transition*" (Interviewee #6, provincial level)

In short, in the local rural area, the municipality is not able to stay in charge of automated mobility related projects. However, all three provinces are willing to support municipalities with money, knowledge and manpower.

*Involving society*
During the pilot, the municipality felt responsible for involving society due to their proximity to the people:
"*In November 2015 a 'Day of Sustainability' was organized which was intensively visited by entrepreneurs and residents. [...] The pod is shown here [...] for residents we organized information evenings in front of the pilot, and at the end. However, only two people showed up. We have taken questionnaires during the pilot, we opened a website where people could give their opinion. People who travelled with the pod, where mostly positive and thought it was promising*" (Interviewee #1, municipal level).

However, it was a disappointment for the municipality only two people showed up at the information evening, especially because not everybody was positive about the project:
"*If you give your opinion via Facebook or Twitter, express it in such a way that we can engage with these people, like at the evenings. Often people say, it is a waste of money, but people do not understand it was is pilot, a test, thus naturally things go wrong*" (Interviewee #1, municipal level).

After the pilot, in the northern region a tour has taken place with the Pod, to introduce the vehicle (also see table 4.1). In Loppersum, a rural town in Groningen, almost 400 residents were interested, and were mostly enthusiastic:
"*If you look at the pilot and the tour, especially children and elderly are skeptical in the beginning, but are quiet fast convinced. An old women stepped out the vehicle and even said: now I am able to visit my grandson again. Also for that kind of people it is a promising mode of transport. It increases their independency*" (Interviewee #9 provincial level).

To a certain extent, the municipality was thus successful in involving society. People were enthusiastic about the Pod as a new mode of transport.

Provincial support could increase the involvement of society. Provinces like to collaborate with the municipality and have a clear vision for involving society:
"*It is very clear: we want to be as close as possible to the people [...] Involving society is a combined task of the municipality and the provinces [...] specifically the pilot and demo are meant to introduce automated mobility and enhance experience, it is an important goal of the letter of intent*" (Interviewee #6 provincial level)
"*Focus on the people that are enthusiastic [...] the rest will follow in a later stage. We need that small group, regardless their age, eventually the enthusiasts will spread the word"* (Interviewee #9 provincial level)

The provinces are convinced that experiencing the Pod system is the only way to convince society of its safety and possibilities:
"*Experience and trust is needed,* ***but it is hard to implement that on a larger scale*** *[...] Society does not simply adopt a message from the government, they have to experience it themselves: what we don't know, we fear*" (Interviewee #3, provincial level).

*Stakeholder cooperation*
As turns out from the case study involving stakeholders was not experienced as a challenge. The externally hired coordinator and the project manager were responsible for coordinating and the gathering of actors.
*"[The coordinator] made contact with the RDW, the provinces, the ministry and insurance companies*" (Interviewee #1, municipal level)
*"Although we were involved in a later stage, when almost everything was already arranged. I do not have the illusion we had to influence the project in an earlier stage, actually I do not think at all, that something indicated things should have been arranged differently*" (Interviewee #9, provincial level).

In the pilot, most contact took place between EasyMile, the RDW and the municipality, which were cooperative:
"*The RDW has made a great effort in the project and was very cooperative*" (Interviewee #1, municipal level).
"*In the very beginning I called the municipality and we have discussed the objective. However, actually quite fast the other provinces were also enthusiastic and involved. We were convinced that, as a unity, we stand strong with respect to Europe. Besides, the development [of autonomous cars] needed a bigger catchment area [...]. They are very cooperative, but also the Ministry, they considering a law to experiment without a steward, and we were allowed to provide them with input*" (Interviewee #9, provincial level).

All the provinces and the municipality agreed relative quickly on the intentions and goals of the letter of intent. A shared perspective was reached within this intention:
"*If you look at the underlying thoughts of the letter of intent, We all say that automated mobility is promising in depopulated areas [...] it was natural that these ambitions are pursued as a unity*" (interviewee #6, provincial level).

Besides, the RDW is a key player in involving stakeholders and a very pro-active actor. The RDW wants to be involved as early as possible, like happened in the pilot:

"*The RDW tries to infiltrate as soon as possible in the process, we can prevent known mistakes are made over again* [...] *we can make sure the right actors are present and we create the right scope for everyone*" (Interviewee #10, national level)

In the appendix of the signed letter of intent, the provinces indicate they are willing to cooperate with diverse actors. However, the actors that have really signed the intention, were limited to governmental actors. The diversity of stakeholders from different policy fields, was thus limited (Gemeente Ooststellingwerf, 2016). The interviewed consultancy was actually surprised:
"*A letter of intent is nice, but it doesn't mean anything. Not all stakeholders are involved in the intention. The industry is one of those stakeholders!*" (Interviewee #12, market)

Either way, the provinces are still struggling with forming a team of key actors. It seems that they are aware that market parties have to join them. The provinces mention that in this phase they are initiating pilots, but it is done with the underlying idea that in the end, market parties can take over the development:
"*We are still considering how to form a team of key actors, if we do it ourselves, or do we hire someone externally*" (Interviewee #3, provincial level)
"*We are considering what kind of actors we would like in our team of actors. For example, we are talking with the Automotive in Helmond" (Interviewee* #9, provincial level)
"*As a governmental institution, we have to make the first step in such a way, that market parties can join in our slipstream. Eventually, they have to take over the development."* (Interviewee #7, provincial level).

The province of Friesland sees possibilities for a public transport company to play a key role in the intention, like Arriva (currently permitted to exploit the transport concession in the province of Friesland) or EasyMile (supplier of the Pod):
"*I approach automated mobility as something that will be there anyway, just because it is cheaper [than current public transport], for example we can tender a part of our transport concession to be automated only. A company like EasyMile can program routes for the vehicles [...] it will be a crucial development because the current rural busses will vanish anyway due to high costs*" (Interviewee #4, provincial level).

*Final comments*
In Chapter 6 the discussion takes place which argues to what extent empery matches the theoretical framework. However, the previous analysis did not include any recommendations or opportunities for the region to exploit. A tool of analysis is needed that leads to these operational recommendations.

## 5.4 Tool for operational recommendations

In the introduction of this thesis (Section 1.1.1), COM (2011) and Beiker (2012) both pleat for operational recommendations towards sustainable (COM, 2011) and automated mobility (Beiker, 2012). Therefore, additional to the case-study, a tool is needed to come up with those operational recommendations.

The benefits and limitations of two tools of analysis are shown in table 5.2: a SBCA and a SWOT analysis. A Social Cost-Benefit Analysis is a tool to asses the added social value of certain alternatives compared to their investments. It can be used to test what types of automated mobility are promising compared to the current mobility system. A SWOT- analysis is a "strategic planning tool, used to evaluate the Strengths, Weakness, Opportunities and Threats involved in a project" (Hay & Castilla, 2006, p.4).

| Tools: | SCBA | SWOT |
|---|---|---|
| Benefits | - Very practical outcome for policy makers<br>- Clear cost-benefit overview<br>- Objective method to value arguments and investments<br>- Tool for project improvement in non-feasible measures<br>- High transparency and traceability | - Easy to understand due to its simplicity and publicity<br>- Makes complex issues clear and easy to grasp<br>- Clear overview of opportunities for investment and strategy<br>- Tool for reflection on institutions |
| Limitations | - (High) Uncertainty is inevitable (future-oriented)<br>- Social impact is hard to express in money, and therefore has a weaker position in SCBA<br>- Complex (financial) SCBA-system for usage | - Possible limited objectivity (room for interpretation for author)<br>- Tends to generalize or oversimplify an issue<br>- Limited depth and critical presentation<br>- Equal weight of issues |

*Table 5.2: Benefits and limitations of SCBA & a SWOT-analysis (Hay & Castilla, 2006; Mouter, 2012)*

On the basis of the table 5.2, it is concluded that a SWOT-analysis is more suitable for this research. A SCBA will results in more practical outcomes for policy makers, but due to the high uncertainty of the transition to automated mobility, the results will be even more uncertain. Also the limitations to express the social impact of an automated mobility system in money (due to the involved uncertainty), makes a SWOT-Analysis more applicable. The limitations of a SWOT-analysis can be reduced by using only data from the interviews. Hereby, objectivity is increased and oversimplification is reduced.

A SWOT analysis is an analysis that identifies the Strengths, Weakness, Opportunities and Threats of a project, visualized in a SWOT-matrix (see table 5.3). The underlying principle of a SWOT-analysis is that the matrix is used as "input to creative generation of possible strategies" (Hay & Castilla, 2006, p.4) to make **use** of the strengths of the region, **reduce** the weaknesses, **exploit** present opportunities and **defend** against possible threats. A SWOT-analysis makes a distinction between internal and external factors, which suits the governance-focus of this thesis. The internal strengths and weaknesses of the actors at the regime level can be identified, which helps to come up with a governance recommendations to facilitate the transition to automated mobility.

| | Helpful<br>**To achieving the objective** | Harmful<br>**To achieving the objective** |
|---|---|---|
| **Internal origin**<br>(Attributes of the organization) | ***Strengths*** | ***Weaknesses*** |
| **External origin**<br>(Attributes of the environment) | ***Opportunities*** | ***Threats*** |

*Table 5.3: SWOT-matrix, adopted from Hay & Castilla (2006)*

*Data collection of SWOT-matrix*

During interviews, respondents are asked what opportunities and threats may be present now and in the future (see appendix 3). The strengths and weaknesses are compiled from the context from the interviews. In appendix 4, an overview of the results of data collection for the SWOT-matrix is presented.

## 5.5 Results of SWOT-analysis

In table 5.4 the SWOT-Matrix for the northern region is filled with the most common items, based on the data in appendix 4. Although it is based on the northern region, a lot of general items are mentioned.

| | Helpful<br>**(To achieving the objective)** | Harmful<br>**(To achieving the objective)** |
|---|---|---|
| **Internal origin** | ***Strengths***<br>*1. Institutional willingness and open-mind for innovation*<br>*2. Letter of Intent*<br>*3. Feedback system in exemption system of RDW and cooperative attitude.*<br>***4.*** *Authorized to grant transportation permit* | ***Weaknesses***<br>*1. Double role in pilot projects and initiatives*<br>*2. Profiling and branding of the region is weak.*<br>*3. No industry and market included in intention.*<br>***4.*** *Money-oriented institutions* |
| **External origin** | ***Opportunities***<br>*1. Automation of Last Mile*<br>*2. Mobility as a service, flexible, on demand and shared vehicles,*<br>*3. Feasibility of Pod system*<br>*4. Combination Pod with services*<br>*5. Smart tendering of transportation permit*<br>*6. Resonate with focus of Ministry & Declaration of Amsterdam* | ***Threats***<br>*1. Social attitude and visions (reputation damage)*<br>*2. Misinformation of media*<br>*3. Potpourri of systems*<br>*4. Non-consecutive learning processes*<br>***5.*** *Socio- economic consequences* |

*Table 5.4: SWOT-matrix for northern region (based on appendix 4).*

### 5.5.1 Business case

A remarkable item returned over again in the interviews: the influence of money. When asking for threats and opportunities, the term 'business case' was inevitable.

"*[Due to subsidy] it has cost us relatively little money, but we have had a nice project with a lot of publicity*" (Interviewee #1, municipal level)

"*[…] because the Pod is backed by a really good business case. There is no public transport in rural areas, thus you have to offer an alternative. Calculations have already revealed that driving little busses is more expensive than such a Pod […] the business case of the Pod is way more realistic, that why it is so promising*" (Interviewee #10, national level).

"*The autonomous vehicles are appropriate for a good business case, if combined with additional services*" (Interviewee #9, provincial level)

Apparently making money, even in this phase of a transition, is important. Although the current pilots are not profiting, the underlying idea for the Pod system is promising to be feasible within a short time in comparison with e.g. cooperative and connecting mobility.

### 5.5.2 Strengths

*Institutional conditions*

The most important strength of the stakeholders in the northern region is the will to look for new innovations and in doing so, they are willing to join forces and to invest resources:

"*Along with the letter of intent, [the ministry] has provided us with a declaration of support. They have indicated that they are willing to support us. However, the improvement of the current public transport system remains our responsibility*" (Interviewee #9, provincial level).

*"If you look at the underlying thoughts of the letter of intent, we all say that depopulated areas are promising for automated mobility"* (Interviewee #6, provincial level).

"*The RDW has made a great effort in the project and was very cooperative*" (Interviewee #1, municipal level).

Backed by a willing Ministry and a cooperative RDW, the administrative and political willingness is positive towards automation of mobility. With the right mindset and resources, the institutional conditions in the region seem to be promising for a future transition.

*Cooperative RDW*

One of the additional strengths of The Netherlands, which is relevant for the region, is the RDW. This institution is open and cooperative to new vehicles. For example, they are one of few national services that is approving, within the legal framework, the automated models of Tesla. In doing so, a learning-by-doing approach is adopted in their 'exemption-system'. A feedback cycle with the manufacturer of the car, makes the system unique in Europe. The feedback is used as input for the ministry to adapt laws.

"*We are the only country that is positive with regard to permit the models of Tesla [...] It is the strength of The Netherlands, our exemption-system includes a feedback-cycle. We evaluate experiences and knowledge. [...] all our output is shared. In comparison, Sweden only "approves" projects, and that's it! No feedback is given. And that is the strength of The Netherlands [...] we have to keep the stimulation and execution of projects going, that is the way to keep the development going"* (Interviewee #10, national level)

*Powerful position*

Furthermore, provinces have a powerful position in the transportation system. They are responsible for public transport system, by tendering the transportation concession for the region. Where the province of Friesland has an own transport concession, the provinces of Groningen and Drenthe already have one permit for two provinces, for dealing with the supra-provincial Daily Urban System of the city of Groningen:

"*We are tendering the public transport concession. We thus have a large responsibility, but also it is a nice opportunity for development. The public transport companies listen pretty well to us*" (Interviewee #4, provincial level)

"*Together with the province of Drenthe we are tendering the transport concession*" (Interviewee #9, provincial level)

### 5.5.3 Weaknesses

*Double role*

The provinces are the road-authorities of the regional infrastructure. They have a duty to ensure safety on these roads. Additional, it is argued that provinces are expected to come up with initiatives and are willing to do so. This double role can lead to struggles:

"*It will lead to a bifurcation, the province, as a project manager and as initiator, is willing to do anything. However, as a road authority he has to decide if it is safe. [...] It can lead to struggles, as a road-authority you need space to act value-free, but it is difficult to reject a project you like, even when it is not safe. In this way, the provinces mark their own papers*" (Interviewee #10, national level)

*Initiatives*

The stimulation of bottom-up initiatives for automation has not really took off: only one initiative of a local school popped up. Perhaps it is too early in the transition, but it could also be due to the weak profile of the region. One of the weaknesses of the northern region is the branding:

*"You tell me why the industry is willing to test in Appelscha, on a bicycle lane! What market perspective is offered for the supplier of the vehicle?"* (Interviewee #12, market)

Remarkably, the province is convinced the northern region has an added value to test here, but at the same time they are not convinced of their own profile:

"*I think the manufactures of the autonomous vehicles are pretty choosy where they want to test. It has to be a trendy. Their profile needs to be raised, in London are somewhere, for the world to see it. Testing in the Friesland doesn't mean anything*" (Interviewee #3, provincial level).

*Key-team*

Next, communication amongst stakeholders included in the letter of intent is not yet institutionalized and the key-team is not yet completed. This can result in unclear responsibilities and possibly in a waste of resources

"*We are still considering how to form a team of key actors. Or we do it ourselves, or we hire someone externally*" (Interviewee #3, provincial level)

"*Yet, we meet on a monthly basis to share experiences, but to be honest, it doesn't run as it should, it is not formalized*"(Interviewee #6, provincial level)

As Beiker (2012) argues, automated mobility requires attention from a wide arrange of policy fields to be successfully implemented. Currently, this diversity is limited as explained in Section 5.2.2 (Gemeente Oosstellingwerf, 2016), and thus can be considered a weakness.

*Superficial ideas*

Finally, from the interviews show that, as a strength, the governmental actors are aligned. Automated mobility is seen as a promising solution to issues in depopulated rural areas:

"*If you look at the underlying thoughts [...] We all say that automated mobility is promising in depopulated areas [...] in the letter of intent certain ambitions are written down, it is natural that these ambitions are pursued as a unity [...] and as a unity you want to approach your network and the market*" (interviewee #6, provincial level).

However, approached as a weakness, the visions are superficial and neatly. Beside the Pod system, stakeholders do not really see more opportunities (see next Section): an increased accessibility. That is as far as it goes. Hardly any out-of-the-box thinking, or the opposite, a thought-through vision how to move on is present.

### 5.5.4 Opportunities

Stakeholders seem to agree about the same opportunities. First, the opportunity for dealing with the first and last mile (PBL, 2014) in the rural areas in the region is widely mentioned. An autonomous Pod system is seen as feasible and realistic to transfer people from specific nodes towards a destination (see Section 5.5.1):
"*The Pod is backed by a really good business case.*" (Interviewee #10, national level).

*Mobility as a service*
Relatively, a lot of elderly live in 'contracting areas': "Municipalities that are expected to deal with aging, are mainly found in the outlying rural areas and in areas that are facing depopulation, like [...] the Eemsdelta (province of Groningen)"(PBL, 2017). For these people accessibility to amenities can increase if a Pod can be summoned on command and stops before their doorstep. The pod could bring them directly to their destination or a specific node. Stakeholders see the Pod as 'Mobility as a service', as is defined in the scenarios of KIM (KIM, 2015; Section 3.2.4):
*"We aim at a shared economy for depopulated areas, we think it is one of the main advantages of automated mobility [...] In depopulated areas you need a flexible, demand driven, public transport system, which is available whenever you need it"* (Interviewee #9, provincial level).

Besides the mentioned increase in accessibility, the stakeholders in the letter of intent do not see any more possibilities: *"Actually no, I do not see any more opportunities, it is just a new mode of transport*" (Interviewee #4, provincial level)

However, in the Pod system, interesting combinations are possible with an extra service of a steward:
"*When a steward is present, additional services can be offered. You can combine it with healthcare, package delivery, school, groceries services and so on*" (Interviewee #9, provincial level).

As widely mentioned throughout this Chapter, the Pod system is seen as a feasible and realistic system for rural areas. To foster the development of that system, the RDW pleas for the manufacturing of a Pod "made by the Dutch":
"*Why not build a Pod in The Netherlands of our own, develop a universal Pod. We have enough knowledge: car-manufactures, universities, knowledge institutes. We need to bundle all that knowledge to create a boost for placing The Netherlands on the world map*" (Interviewee #10, national level).

Testing can possibly take place in the rural north, due to the unique circumstances. For example, the possibilities to test with demands and wishes of an aging society, which are not present in the rest of The Netherlands.

*Transportation concession*

There are opportunities for the provinces to facilitate a Pod system. The province is tendering the transportation concession for public transport, which usually applies on a complete provinces. However, the province of Friesland indicate it can be separated:

"*We are tendering the public transport concession. [...] a specific concession can be tendered wherein partly autonomous vehicles are demanded, for example, on the 'Wadden' islands [a small group of island in the north of the region],*" (Interviewee #4, provincial level).

For transportation companies, this would be a unique opportunity for implementing innovations. Within a certain amount of time, the routes and obstacles could be programmed for the system to run.

*Talking traffic*

An opportunity that not yet has been explored by the northern region is testing with automated, connected and cooperative mobility. Until now, the region is only focused on an autonomous Pod:

"*In principal, we are inviting to connected traffic, platooning and everything. However, for us it is less attractive if we have to adapt infrastructure, it makes it less interesting for us. The long-term idea is to invest less and to focus on smart vehicles"* (Interviewee #9, provincial level).

However, with a focus on automated mobility, they align with the focus of the Ministry and the EU. It can result in more publicity and support from the Ministry, but more important, from international market parties. In the end, there are not a lot of locations where automated mobility can be tested. Especially now, when the Dutch ministry is adopting a law which permits legal experiments in 2018 without drivers (Ad.nl, 201&). In the end, the question remains if they are willing to invest in infrastructure.

*Profile*

As explained in the Weaknesses, the region is not convinced of their own profile. For strengthening the profile of the region several opportunities are present. One of the possibilities is to align with the Declaration of Amsterdam, for international publicity. As is acknowledged in this document, and thus by all EU member states: "recognizing also the long-term potential for social inclusion and increased mobility in remote areas, as well as the link with other developments such as the shared economy" (EU, 2016, p.3). Exactly this statement is the focus of the northern region. In this declaration, the industry is also engaged (see in declaration: chapter V Actions by Industry). An alignment with the declaration can possibly attract attention of willing manufactures and international publicity is more likely to occur. The initiative of "TopDutch" could be taken as an example (Nu.nl, 2017). In this initiative, Tesla is invited to start a car factory in the northern region and the region is branded as thé perfect region for Tesla, for reasons like: available space, focus on sustainability and good logistics with the world and EU (TopDutch, 2017). Arguments as a unique location with legal possibilities to test a Pod system can be used.

### 5.5.5 Threat

*Transparency*

The first threat is concerned with the attitude of society. Currently society is unknown with the system and rather skeptical. When executing pilots, accidents may happen or results are disappointing. In the end it is a pilot. It may lead to a damaged reputation of automated mobility:

"*Media can come up with anything. You need to communicate very well, what are your goals, what is the phase, we are in the beginning of an innovation. Things can go wrong, so be it, it is part of the game*" (Interviewee #8, provincial level)

*"People don't know it, it is new and they just have to experience it [...] the people who are most skeptical, forget within 2 seconds no driver is present [...] it is a pilot and we have to learn from it. Naturally things go wrong*" (Interviewee #9, provincial level)

Transparency is thus important, otherwise people may classify projects as a waste of resources, as illustrated by the municipality in Section 5.3.5.

*Social consequences*

An automated mobility system will make (a part of) the bus-drivers redundant. A driver is simply not required when the vehicle steers itself. As the province of Friesland mentions, and experienced with similar projects, firing almost 600 employees has an impact on society:

"*It is a sensitive subject, you cannot simply get rid of 600 jobs. Such issues can slow down the process*"(Interviewee #3, provincial level)

However, the provinces of Drenthe and Groningen acknowledge it is an issue, but see it differently:

"*They will appear anyway, they are just not feasible [...] it is more like a drop in the ocean [...] it will create some discussion, but with the help of a social plan and arrangements, it will be solved*"(Interviewee #6, provincial level)

*"It is an additional consequence for keeping the rural area livable*"(Interviewee #9, provincial level)

Nevertheless, social and economic consequences of implementing a new system have to be taken into account.

*Consecutive learning processes*

In the current phase of the transition, learning is crucial. It has to be avoided that pilots with the same results being executed over again. The need for consecutive learning processes has to be coordinated, to reduce a waste of resources:

"*If we want to execute pilots for the coming years, we have to ensure that every pilot succeeds the preceding pilot. In every step you have to learn. This will exceed the local level and cross municipal borders"*(Interviewee #9, provincial level)

"*We have to avoid that it will be a chaos, that different systems appear, The RDW has a key role in coordination*" (Interviewee #5, provincial level)

"*A role is foreseen on a national scale, you have to avoid a potpourri of initiatives that are unaligned, a coordinating function is needed"*(Interviewee #11, national level).

Thus a crucial role for the provinces in the region and the RDW on a national scale is foreseen for coordination of consecutive learning processes.

*Stable institutional structure*

Finally, the RDW and the ministry stress the importance of a stable institutional structure. Currently, the ministerial interest in the transition is positive towards automated mobility (Morsink et al., 2016). However new elections take place this year, and priorities may change. The region intends to keep a focus on automated mobility the coming years (Gemeente Ooststellingwerf, 2016).

"*Minister Schultz is willing to change laws, like the law to experiment legally with autonomous cars. With this law we can keep executing experiments in the future, regardless the political priorities. You have to create stability. And it is all about securing that stability*!"
(Interviewee #10, national level)

*"It also depends on society, what they vote. They chose specific political parties. The policy goals can change, which influences the role of automation*"
(Interviewee #11, national level).

It is thus important, regardless the elections, that conditions are present to continue the quest for automated mobility. The question is however, to what extent this can be influenced.

## 5.6 Recap of findings

In short, the results have shown that:

- **The transition phase** is in the pre-development phase or take-off phase. A breakthrough has not occurred and society has not been involved on a large scale;
- **The general focus** of the ministry is on automated vehicles, where the provinces mainly focus on autonomous vehicles. The northern region targeted rural depopulated areas for shared autonomous vehicles, a so-called Pod, as a new mode in trip-chaining, to connect the hinterland to the main public transport network. A Pod system is seen as more feasible than to maintain the current public transport in depopulated areas.
- **The regime level**: a key role is foreseen for the provinces. The provinces have to support municipalities in facilitation of pilots and projects, but also to increase the stimulation of niches in the area. Provinces take responsibility for designing a broader vision for the role of automated mobility in the region. Besides, coordination is required from a provincial level to guarantee a consecutive learning process to develop a comprehensive automated system in the region, The Netherlands and Europe. The ministry foresees a crucial role for the region to increase experiences with automated mobility. Via the northern region and the RDW, the ministry is provided with crucial input for adapting national and European policies and laws.
- **Niches** are monitored by all actors and mostly stimulated with the help of money. Niches can approached from three different layers. The outcome layer is of most interest where the possible added value of the niche on society is determined.
- With regard to **barriers towards implementation**, the provinces and municipalities are dedicated to collaborate for increasing the involvement of society in projects, by keep investing and executing projects. Both institutional levels are not experiencing any struggles to deal with the complex topic of automated mobility, since expert knowledge is obtained externally and regional politics are willing to invest in it. The provinces can stimulate and involve a diversity of stakeholders via tendering a demand for automated-related objectives.
- A huge **opportunity** is the Pod system in the region which can be explored, and eventually exploited, with the powerful position of the provinces regarding public transport. Specific automated mobility related demands can be included when the transportation concession in the northern region is tendered.

# 6

# Discussion

In this Chapter, the results of the analysis are discussed. The emphasis in this discussion will be on the extent to which the empiric results match the theoretical framework and conceptual model developed in Chapter 3.

## 6.1 Transition phase

Theory indicates that the take-off phase of a transition is characterized by an increase in the speed of change (Rotmans et al., 2001), but, tangible indicators to objectify this are lacking. Therefore, it is hard to say if the pre-development phase has passed in this case (Section 5.2). In the context of transition management, in particular strategic activities are taken place. The ministry is developing a long-term vision with scenarios and actors are mobilized (KIM, 2015). Moreover, the ministry has a clear focus on automated mobility instead of autonomous mobility (EU, 2016; Rathenau Institute, 2017).

Initiatives take place where dedicated frontrunners are gathered and experiences and concerns are shared, like in the taskforce of the CROW (CROW, 2017). However, the large scale involvement of society is still lacking (Rathenau institute, 2017; Timmer et al., 2015). The earlier mentioned projects (NOS, 2016; AutomotiveNL, 2017; Ministerie van I&M, 2017) involve society but on such a small scale that trust and experience barely can be enhanced. As mentioned in Section 3.3, involving society is a serious difficulty. At this point, decentralized authorities can be helpful due to their proximity to society. In this case, provinces and municipalities are dedicated to collaborate:
"*We see involving society is a combined task of the municipality and the provinces*" (Interviewee #6, provincial level in Section 5.3.5).

To make a real difference, and a pace in the transition, society has to be involved on a larger scale (Timmer et al., 2015; Banister, 2008). When this is the case, trust and acceptance are expected to grow and niches may be adopted in factory-build cars. As mentioned by a car-manufacturer (via the RDW):
"*I am not sure my client is willing to pay for all those developments we are doing, they are interested and curious, but at the same time they are a bit anxious and afraid [...] It comes slowly, the moment that people are willing to pay will not be tomorrow, but it will come*" (Interviewee #10, national level in Section 5.3.1)

This shows that, the car industry are willing to implement more advance systems in factory-cars, as they experience an increase in societal trust and acceptance. A lack of trust and familiarity currently withholds customers to pay for those innovations. Based on the minimal described characteristics of the phases in literature (Loorbach, 2007), the scanning attitude of the car industry seems to be a characteristic of the pre-development phase. The car industry is testing with innovations that are a clear deviation of the current system. However, these innovations are not yet implemented, and exactly implementation is a characteristic of the take-off phase (Loorbach, 2007). Also, legislation is influencing implementation. First steps are taken with the Declaration of Amsterdam (promotion of legal consistency) and a law for legal experiments (EU, 2016; AD.nl, 2017) but it is not yet possible to drive a car without being able to intervene.

Resuming, on the basis of a general lack of trust, large-scale involvement of society and the lack of the implementation of advanced self-driving techniques, it can be concluded that the transition is currently still in the pre-development phase.

## 6.2 Modal shift versus automated mobility: general focus

In Section 3.1 a framework has been developed demonstrating that the concept of sustainable mobility is based on two pillars: establishing a modal shift and the quest for a new safer and cleaner mobility system. The empiric results of this study (Section 5.2.1) show that both two pillars are combined in practice. There is no specific focus on either a modal shift, or a replacement of the current system by completely automated mobility. Automated mobility is seen as an additional modality to public transport and not as a replacement of a system.

The interviewed stakeholders do not have specific policies for a new mobility system. Whether it is too early for that or not, automated mobility until now is seen by them as an addition to the current modalities. The northern region frames automated mobility as a promising solution to the problems related to depopulation. They specifically mention the 'first and last mile' where an automated vehicle can form the link between the main public transport network and the customer's house. As mentioned:
"*Our aim [for automated mobility] has always been a new link in trip-chaining [...] a self-driving vehicle is used for the last mile, thus a use of different modes of transport*" (Interviewee #5, provincial level, in section 5.3.1).

This new shared system, as described in the northern region, applies to the pillar of a new system in figure 3.1 in which innovations are adopted and new vehicles are implemented. However, it cannot be considered as a replacement of the complete mobility system. Moreover, it is only meant for a certain target area or population. With regard to the second pillar, this form of mobility, as currently framed, is only partly aimed at getting people out of the car and let them use other sustainable modes of transport (like in a modal shift, see Bonsall (2006)). It intends to replace a service that is currently not feasible and may disappear:
*"It will be a crucial development, the current rural busses will vanish anyway due to high costs and there are no volunteers" (Interviewee #4, provincial level, in Section 5.3.5)*

The proposed direction of the ministry - a focus on connected and cooperative driving (Rathenau Institute, 2017; EU, 2016) - seems to be more in line with the framework of figure 3.1, in such a way that it focuses on the pillar of a new system.

Either way, looking at the different perspectives underlying the framework (Banister, 2008; Nykvist & Whitmarsh, 2008; Goldman & Gorham, 2006), the proposed Pod system of the northern region matches mainly with the 'Livability-perspective' of Goldman & Gorham (2006). This perspective is focused on integrating society in the current transport system. The Pod system intends to increase the accessibility in depopulated areas and tries to integrate people in remote rural areas with the main public transport system, as is widely argued in Section 5.3.1. Besides, the Pod system matches with more or less all perspectives under the 'New Mobility System'-pillars, aimed at reducing the environmental footprint and more efficient traffic, but also overlaps with 'the use of more sustainable mode' (Nykvist & Whitmarsh, 2008) and 'transport policy measures' (Banister, 2008).

It seems that the perspectives distinghuised in the framework in figure 3.1, are acknowledged in practice. However, automation of transport can adopt several perspectives and is not solely focused on one pillar.

## 6.3 Regime level

Geels (2011) put forward, that the regime level is of prime interest to a transition. Therefore, sub-question 4 in the introduction is concerned with the kind of actors at this levels and the main-question with the role of the actors.

### 6.3.1 Actors

Section 3.4.2 describes the characteristics of a regime level actor: involved in tactical governance activities, interest driven, making mid-term projects, plans, institutions and regulations and additional concerned with optimization and exploitation rather than innovation and exploration of the current mobility system (Loorbach, 2010; Van den Brugge et al., 2005) of the current mobility system. Only niches that make the current system more efficient or profiting will be adopted on a large scale. Kemp (2012) argues that "without regime actors it will not work" (p.1), meaning a transition will not take place without the dedication of these actors.

The first question is whether or not the governmental actors can be considered regime-actors. All are monitoring innovations and niches (though not strategically), but not yet adopting them. However, to what extent are governments adopting niches at all? Governmental bodies are more occupied with stimulating and giving the opportunity to develop niches rather than adopting them. The tactical activities of the provinces do match the regime actor characteristics. As staed by the province of Groningen, the intention is to implement the Pod system on the mid-term (5-10 years; Section 5.3.1) which corresponds with the horizon suggested in transition management (Loorbach, 2010). The municipality however, cannot be seen as a regime-actor. As they indicated themselves, they have a

short term vision, aimed at single projects, and are too small to be decisive on a longer term:
"*As a municipality, certainly as a rural municipality, you are rather small. It is very interesting but to keep executing pilots and new initiatives we are just too small*" (Interviewee #1, municipal level in section 5.3.5)

Whether the ministry is a regime-actors or not is more difficult to determine. The ministry is active at the landscape level because of their involvement "with the overall development of the societal system" (Loorbach, 2010, p. 169). However, also some characteristics of regime-actors can be recognized at the ministry level, which confirms the assumption in Section 3.4.5 that actors can be active at multiple levels. The ministry is involved in mid-term concrete projects via the RDW and RWS and "is dealing on a daily basis with developing programs, (...) institutional regulations, organizing networks and represents certain interest" (Loorbach, 2010, p. 169). For example, the Taskforce Dutch Roads as a network (CROW, 2017), legislation like the experimental-law (Telegraaf.nl, 2017; Ad.nl, 2017; Section 5.3.5) and the interest in lower emissions and increased accessibility captured in their policy goals (section 5.3.1).

It can be argued that the car-industry is besides being a niche-level actor, also can be considered a regime-actor, due to their scanning attitude with regard to developing and implementing new techniques. As the RDW put forward, the point has been reached that car-manufacturers are actually looking at each other and do not really know how to move on, because all their development have to be feasible in the end.
*"In the end, it has to be paid. I do not know my client is willing to pay for my developments [...] currently it is not a feasible business case*" (Interviewee #10, national level in Section 5.3.1)

In the meanwhile they keep developing "*because others do the same*" (Interviewee #10, national level). This resonates with the characteristic of a regime-actor: they are explorative, looking for new innovation, developed niches, test with it, but in the end, their activities are aimed at exploiting the current system. As long as nobody is willing to pay for it, the (speed of) development will slowly but surely lessen over time.
"*The automobile industry is risk-avoiding, they are careful to implement their developed niches [...] they are working for a long time on new systems which are implemented very slowly, they need to generate money, but the current customer is not yet trusting it*" (Interviewee #12, market)

Transport companies like the Dutch Railways (in Dutch: Nederlandse Spoorwegen, NS) and Arriva (currently exploiting the northern transport concession) can also be considered a regime-actors in the field of automated mobility. Currently exploiting their current modes of transport, but once adopting niches that make their transport system more feasible or more efficient, the transition will take a leap. Examples of niches of the NS are the 'OV-fiets', as an extra service for biking the last mile (Kemp, 2012). Especially with the described opportunity to tender a specific part of the transportation concession as 'automated-only', the transportation companies may have a big influence on the regime.
*"A specific concession can be tendered wherein partly autonomous vehicles are demanded*"(Interviewee #4, provincial level, in Section 5.5.4).

### 6.3.2 Roles

Based on the transition phase, governments should currently have a facilitating and catalyzing role (Rotmans et al., 2001). In short, the current activities of the governmental bodies seem to resonate with these facilitating and catalyzing roles. For example, the municipality, the provinces as well as the ministry, are all involved in stimulating niches and facilitating projects over the country. Although the roles in the pilot seems to differ from theory, the described roles in the transition by the interviewees are closely related with the roles of Rotmans et al. (2001). However, the roles are applicable on governments in general and not specifically for the regional or local level. How are these role dispersed over the planning system and do the theoretical roles resonates with the roles the actors described?

In the case study, the main roles were limited to three actors. From the regime-actors, only the RDW had a straight role in the project. Either way, the roles in the pilot partly match with theory: the municipality has initiated and facilitated the project, but turned out not to be a regime level actor. The RDW does corresponds with the facilitating role they should have in the pre-development phase (Rotmans et al., 2001) e.g. cooperate as much as possible in dealing with vehicle exemptions. The provinces had a minor role in the case study, but theoretically seen, they should support the decentralized rural municipalities (as suggested in Section 3.3.1).
*"We were involved in a later stadium, when almost everything was already arranged"* (interviewee #9, provincial level, in Section 5.3.5)

Thus, the role the provinces really had in the pilot does not correspond with the supporting role they should have. This is probably due to their late involvement in the pilot, because the general role in the transition – as described by the provinces - corresponds with a facilitating and supporting role of Rotmans et al. (2001) and the supportive role in Section 3.3.1:
"*As resonates with the current phase of the transition, (...) we have a coordinative function and we are facilitating projects*" (Interviewee #6, provincial level, in Section 5.3.3).

The role of the municipality of Ooststellingwerf in the letter of intent (Gemeente Ooststellingwerf, 2016) is remarkable because their role in future projects will probably be minor. At first it seems natural because the pilot took place in their municipality. However, as indicated by the provinces, new pilots are intended to take place region wide. In these new pilots other municipalities will have an executing role and the role of Ooststellingwerf will be marginal. If a large scale involvement is desired, it is wise to disperse the new pilots over the region.

Another role for the municipality of Ooststellingwerf may possibly be, to share their experiences with the pilot with other municipalities, but as argued in Section 5.3.2, sharing experiences regarding automated mobility already takes place at the platform Taskforce Dutch Roads (CROW, 2017) amongst all road-authorities (including interested municipalities) and is the legal responsibility of the RDW (Section 5.3.3). Thus, the added value of the municipality of Ooststellingwerf – other than being the municipality where in the pilot took place - in the letter of intent remains unclear.

The question remains if do the provinces have the crucial role in the transition as described in Section and 3.3.1 & 3.4.5, constituting the link between the micro and macro level. Do they have the capabilities to support the rural authorities in dealing with automated mobility? With the National Spatial Strategy of 2006 (see Appendix 2) the province gained a more enacting role for stimulating and enabling municipalities in designing and implementing new policies (Nadin & Stead, 2008). Also with the implementation of the new Environmental Act in 2019, a more supporting (instead of directing) role of the provinces is foreseen (KING et al., 2015)

Based on the roles described in Section 5.2.3, it can be argued that the provinces are aware of the supporting and stimulating role they are expected to have and additional, are a crucial actor in the regional transition. The provinces stimulate municipalities to come with bottom-up initiatives and want to collaborate for e.g. involving society. More important, the provinces have a crucial coordinative role in the current transition at a region level. Coordination is needed to ensure a consecutive learning process in the region (see section 6.5). Regarding resources and knowledge, it turns out that human and financial resources are present:
*"Within the province, like provincial councils, everyone thinks it is promising and therefore, they are willing to make resources available*" (Interviewee #9 provincial level in Section 5.3.5)

Whether or not the provinces are responsible for transition remains debatable. Drenthe clearly thinks that mainly the ministry is responsible with their influence in legislation, where the ministry sees the industry as main-responsible. Anyway, the provinces all acknowledge that they certainly have responsibilities and thus feel their responsibility, especially in implementation of systems (which matches with the process of decentralization).

In short, it can thus be argued that the current activities of the governmental bodies correspond with the roles that are described in transition theory (Rotmans et al. 2001).

## 6.4 Niches

In Section 5.3.4 three levels within an innovation have been outlined (figure 6.1). The figure visualizes the three levels and shows the involved actors at these levels, based on the following discussion.

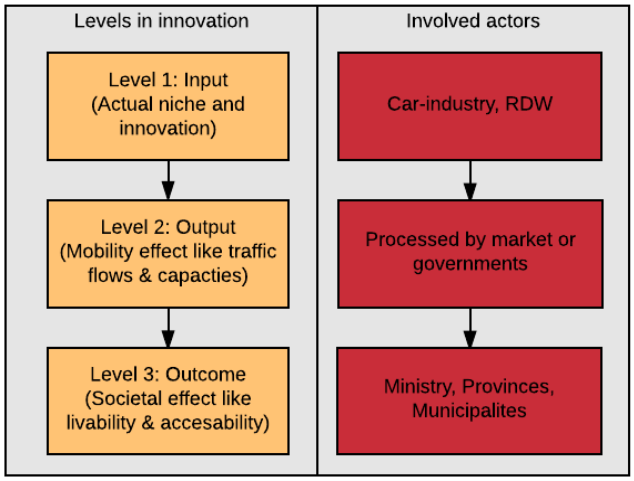



*Figure 6.1: Three analytical levels within an innovation (Interviewee #12, market)*

It can be argued that the first layer is mainly of interest to the RDW, because they need to know what is possible to stimulate and support other parties in pilots and projects. Also this technical knowledge may be required to adapt their exemption-system for new pilots and projects. Furthermore, the second layer is specifically of interest for market parties, which can be of great value by modeling variables of the niche. Also, governments may be interested and can choose to internally model the effects towards an outcome. The second level thus can be seen as a step in-between to translate the output to a tangible outcome for the last level. The third level is of most interest to governmental parties:
*"The outcome is of most interest for the regime."* (Interviewee #12, market, in section 5.3.4)
*"What does it mean for society? That is what I am monitoring."* (Interviewee #11, national level in section 5.3.4)

As described in the characteristics of a regime-actor, an actor is only willing to invest when the niche makes the current system e.g. more efficient and/or safe. For this consideration, the concrete outcomes have to be known to determine if it feasible to invest in the niche. This consideration matches with the exploitative attitude of the regime (Duit & Galaz, 2008; Section 3.4.3). However, as argued in Section 3.4.5 it is desired that regime-actors become more explorative. In practice it turns out, that only the governmental regime-actors (provinces and ministry) are explorative in creating a demand for niches, meaning an exchange between level 1 and 3. In the case-study for example, the societal effect of the Pod as an increase in accessibility has been noticed, which could possibly be useful in depopulated areas. In response, the market is approached.

This creation of demand is mentioned multiple times by the public national and provincial levels. It is seen as one of the crucial instruments to stimulate bottom-up initiatives, and resonates strongly with the theory of Kemp & Rotmans (2004). They argue that, apart from monitoring or promoting, creating an opportunity for niches to develop in a social context "is necessary for pushing the transition forward" (ibid., p. 158), due to the learning processes. A good example is given by the province of Friesland where bottom-up initiatives are adopted and executed in a social context:
"*It originates from the Dockinga College, on a consultation in the province, the director of the school came with the idea to transport students with an autonomous vehicle, which are struggling with commuting due to a lack of public transport. We adopted his idea and now we are collaborating to compete in a ministries-contest for extra subsidy [..] that is a typical example of a bottom-up initiative which we want to stimulate*" (Interviewee #5, provincial level)

Via the above mentioned project, the Pod-system in depopulated 'contracting-areas' can be developed further. This example indicates that the government, and not solely the ministry, is actively stimulating automated mobility. More important, they are aware that they have this role and are executing it properly.

## 6.5 Barriers

### 6.5.1 Decentralized rural authorities

Section 3.3.1 expected bottlenecks for automated mobility were explored. A lack of resources at the municipal level in contracting-areas may hamper the adoption of automated mobility in rural areas. In practice it turned out, that the process of decentralization may go along with a lack of knowledge and resources, but actually it is not perceived as a barrier in the transition.

*Decentralization as a process*
A decrease in resources and knowledge at the level of the local municipality in a contracting-area is recognized in practice. The expectation of the RDW and the Dutch ministry that projects have to be initiated bottom-up confirms decentralization as a process (see Section 5.3.3). The municipality acknowledges that they are too small to stay in charge of executing pilots on a regular basis, have not enough resources to fund it and that required knowledge has been obtained via external actors:
"*As a municipality, **certainly as a rural municipality**, you are rather small. It is very interesting but to keep executing pilots and new initiatives we are just too small*" (Interviewee #1, municipal level in section 5.3.5)
*"Do not overestimate the average momentum of a municipality [...] automated mobility is not a secondary activity, I experienced it almost as a full-time job*" (Interviewee #6, provincial level in section 5.3.3)

Additionally, the assumption in Section 3.5 that the provinces can support municipalities, human and financial-wise, can be underpinned by the data. As outlined in Chapter 5, sufficient monetary resources are currently available, and will be reserved, to invest in automation of transport the coming years. However, it has to be mentioned that currently, automated mobility is seen as a secondary activity, but in the future it possibly will become

a primary task. Finally, it has been mentioned that municipalities are too small to design a strategic vision to position loose pilots and projects in the greater mid-term development. This is caused by a lack of overview in the region, which is to be expected in a process of decentralization.

*Decentralization as a barrier*
Decentralization, however, is only partly considered a barrier in the Dutch transition. As mentioned frequently in the interviews, the provinces and the municipalities are convinced they do not need expert knowledge of automated vehicles to contribute to the transition. The basic knowledge of automation is present and in collaboration with market parties, manufacturers and the RDW, expert knowledge can be obtained if necessary.
"*I think substantive knowledge of autonomous vehicles is not needed to foster the transition, we need knowledge in other fields and that knowledge is available*" (Interviewee #6, provincial level in section 5.3.5).
"*We obtain knowledge from other parties, because a lot of parties are involved [with the topic of automated mobility], but the basic knowledge is present"* (Interviewee #9, provincial level in section 5.3.5).

This conviction of the provinces seems plausible, as provinces may be able to obtain such expert-knowledge internally with dedicated staff members. The staff should then require in-depth knowledge about a wide range of (automated) systems. However, external market parties are more likely to be up-to-date with new techniques and are involved in more projects. Besides, a contracted party is likely involved in only one or two system, which it probably knows best. Thus, as long as the provinces (and to a lesser extent municipalities) are aware of their responsibilities in the transition, as catalysts, and are able to execute their stimulating and facilitating role decentralized authorities are not perceived as a barrier in the transition.

Based on the difference in resources between the municipal and provincial level, and the externally obtained expert knowledge, it may be clear that the barrier of decentralization as described in Section 3.3 does not fully apply in practice. Rural municipalities are present with limited resources but to date are not perceived as a barrier.

### 6.5.2 Involvement of society

The barrier of involving society has been confirmed multiple times by the provinces and the municipality involved. It has been acknowledged that on a large scale people are not yet familiar with the concept and are rather skeptical, as Hengstler et al. (2016) argued. However, actors only partly know how to overcome this obstacle.

As regime actors, the provinces would be in the position to engage with society. Indeed, as the empirical results show, the provinces would like to take that role in collaboration with the municipality.
"*It is very clear: we want to be as close as possible to the people* [...] *Involving society is a combined task of the municipality and the provinces*"(Interviewee #6 provincial level in Section 5.3.5)

The proximity to society is one of the advantages of a decentralized authority. A collaboration between the municipality and the provinces is needed to overcome this barrier. Appropriate to the decentralization, the ministry is mainly involved in activities on a larger scale and on the long term (e.g. adapting laws, see Section 5.3.3) and actually only facilitating small-scale activities in the sense of possible subsidy. For example, the pilot in Appelscha is mainly funded by ministerial subsidy, but the actual role of the ministry remained limited.

Waldrop (2015) argued that experience is one of the main answers to many questions in the transition towards automated mobility. In Section 5.3.5 it is shown, that neither the government, nor the industry can convince society of the safety of the vehicles, but it has to be experienced by the people. Therefore, the provinces are convinced they only can create possibilities for society to experience automated mobility by continue to execute pilots and projects with automation. Remarkably, the provinces indicate that society's attitude towards automation shifts rather fast, as illustrated by the examples given in Section 5.3.5.

Besides an increase in experience, Banister (2008) argues that trust and acceptance has to be enhanced. This not always comes along with experience. As Loorbach (2010) argues, media (and internet) play an important role in reflexive activities of transition management, by "influencing public opinions and judging the effectiveness of policies" (Ibid., p. 170). However, in Section 5.5.5 is illustrated that media can turn facts inside out. Transparent communication therefore is crucial to prevent damage of trust and reputation of automated mobility.

With a focus on the enthusiastic people, the province think with keeps executing projects with automation in the region, and expects the willing-part of society to grow slowly. Thus in short, the barrier is confirmed, but not seen as insuperable.

### 6.5.3 Stakeholder cooperation

In the case-study, cooperation between stakeholders has not been experienced as a obstacle. However, this form of stakeholder involvement is not identical as mentioned in Chapter 3: a shared perspective, necessary diversity, legal framework and a stable institutional design. First of all, a shared perspective might have been reached with the letter of intent; in the case study only four actors were involved. Results show that the ministry and provinces are not on the same line. Where the ministry mainly focuses on connected and cooperative mobility, the provinces (and municipality) focus on collective autonomous mobility in the form of the Pod. It is thus debatable to what extent a shared perspective is reached. To some point this may be the case. With a shared perspective is meant: a common frame of reference (what does automated mobility mean for the region) and agreement towards an interest for e.g. investments. In the northern region, a common frame of reference is reached: automated mobility is seen to increase accessibility in depopulated rural areas. And there is an agreement that automated mobility should be approached as 'Mobility as a service': a flexible demand driven, collective autonomous Pod-system. From this point of view, a shared perspective ís reached in the northern region.

The struggle of the region to form a team of key-actors for future projects is perhaps a fortunate event, it is not too late to include a diversity of actors from different policy fields. As Bos & Temme (2014) argue, different disciplines have to be represented, due to the interdependencies amongst them. It may be wise to include e.g. EasyMile (based on e.g. a tender-procedure) in the intention and a representative(s) of society (e.g. village-association). However, data reveal that there are different conceptions of how to involve those parties, and especially how to involve the industry. Where the RDW and province of Groningen are aware of their pro-active task to approach the market itself, the province of Friesland is actually surprised the market is not approaching them:
"*A conversation with the market would be nice, that they organize something to show what is possible. It is unclear for us who can supply what*" (Interviewee #3, provincial level).

To successfully execute large scale projects (which is needed as is argued in the Section above), it is of interest that not every time new contacts have to be made and that little time is wasted with creating a common frame of reference over and over again. As put forward before, it is important to create enough diversity from different disciplines. However, it looks as though the provinces themselves cannot reach a consensus on how to approach other parties, it may be too early to involve other parties.

Regarding the legal barrier, the RDW is responsible for feedback to the ministry, which uses this feedback as input for legislation. Other stakeholders hardly are involved in legislation, apart from the need for legal space to test with new mobility. Thus, the legal barrier under the title of cooperation of stakeholders is actually misplaced, since it only involves few stakeholders (RDW and the Ministry). However, to create feedback for legislation it is needed to keep executing pilots and projects with automated mobility. From this point of view, this obstacle (legal issues) is indeed present (since we have seen diverse disciplines were needed in a pilot).

# 7

# Conclusion

In this Chapter the (sub) questions formulated in the introduction are addressed. Additionally, policy recommendations are given for facilitating the transition in the northern region.

## 7.1 Main conclusion

In conclusion, the regime level of the transition towards an automated mobility in the northern region of The Netherlands can facilitated by:

- an explorative, stimulating and facilitating key-actor: the province;
- continuing with the execution of pilots, which involve society on a large scale, to enhance trust and acceptance of a new system;
- intensive collaboration and interaction between actors from diverse policy fields;
- pro-active creation of a demand for automated-related niches;
- coordination from the RDW (national scale), and provinces (regional scale), to ensure consecutive learning processes and the development of a universal automated system.

In the remainder of this Chapter the main conclusion is underpinned by revisiting the conceptual model and addressing the sub-question and main-question of this research.

## 7.2 Revisiting the conceptual model

The conceptual model that has been developed in Chapter 3 (figure 7.1), only partly holds up against the empirical data.

As stated Section 6.2 the transition towards automated mobility, is not per definition a shift from a current focus on a modal shift, towards a focus on automated mobility. It can be concluded that the conceptual model produced in figure 3.1 does not hold up with regard to a focus on either the modal shift in the current system, or automated mobility in a new system. The distinction between two pillars are more diffuse than suggested in figure 3.1.

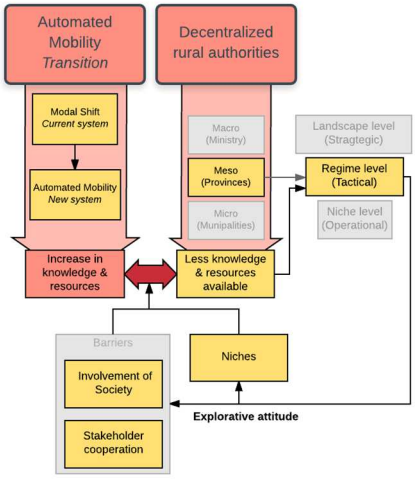



*Figure 7.1: Repetition of conceptual model (Chapter 3)*

The ministry has its focus on a replacement of the current system, where the provinces mainly focus on automation as part of public transport. Next, the decentralized rural authorities are not experienced as a barrier. The potential conflict between less resources and a resource requiring transition is only partly present: knowledge is externally obtained if necessary and resources are available at the provinces for supporting municipalities or projects themselves. The analysis of the (adopting and stimulation of) crucial niches for the transition (Rotmans et al., 2001) has pointed out that regime actors are differently interested in niches, which is visualized with three analytical levels in figure 5.4. Where the market is mainly involved in the first engineering levels (Input), the governmental bodies are mainly concerned with the outcome of that engineering.

At the regime level, it turns out that the government is seen as the more explorative actor and that the actors of the market at the regime level are considered to be more exploitative (see Section 7.2.3). Finally, it can be concluded that at the regime level, the provinces are of crucial interest, and the involvement of society & stakeholder cooperation is still an obstacle to overcome (see Sections 7.2.2 & 7.2.3).

## 7.3 Sub questions

### 7.3.1 What is the current phase in the Dutch transition?

In a transition several phases are recognized starting with the pre-development phase and in the next step the take-off phase. From this research it can be concluded, that the transition towards automated mobility is still in the pre-development phase. Most important aspects hampering a further development are the involvement of and trust by society.

*Explanation*

Rotmans et al. (2001) described the roles of governmental bodies in the pre-development phase: mainly catalyze and facilitate niches. On the basis of the data (letter of intent, case-study, and the upcoming pilots) it can be concluded that this catalyzing and facilitating

roles are present in the current situation, which underpins the conclusion of the pre-development phase. However, actions are taken, consciously or not, to prepare for the take-off phase. In the take-off phase the provinces should acts as a mobilizer to create an accumulation of developments and frontrunners (Rotmans et al., 2001; Van der Brugge et al., 2005). This awareness seems present. Consistent with the letter of, a key-team is being developed in the region, in which besides governments, also frontrunners from other disciplines are considered to be included. This mobilizing of frontrunners matches with the role that Rotmans et al. (2001) prescribes in the take-off phase. If a broader perspective is adopted, the mobilizing role can also be recognized at a national-scale. With the Declaration of Amsterdam EU-ministers are mobilized for a common frame of reference and a broad legal framework. Although these countries are not per se frontrunners, in the declaration a part for the industry is reserved (EU, 2016) which are the frontrunners in the transition.

Still, society is not involved on a larger scale (Rathenau Insititute, 2015). First steps are taken to prepare for a larger involvement, in order to increase the needed experience (Waldrop, 2015). Also a law is processed to experiment with driverless cars (widely mentioned in the media; telegraaf.nl, 2017; Ad.nl, 2017). This can significantly contribute to the involvement of society, and additionally to other answers which increase the speed of the change in the transition. Nation-wide it can be concluded that the current pre-development phase has not yet been passed and that current governance activities resonate with this phase.

### 7.3.2 What are the main barriers towards implementation?

Currently, not (yet) enough **experience** has been accumulated to answer societal, economic and institutional questions. It leads to, amongst other things, a lack of **trust**, **acceptance** and **understanding** within society, which in turn leads to hesitating market actors at the regime-level. Besides, a stable **institutional design** is seen as a barrier that can only partly be influenced with a progressive adaption of the current laws. Still many uncertainties regarding automated mobility are present, the **legal framework** regarding automated mobility is one of the main barriers.

In short, the solution to these barriers: *With the help of interaction and collaboration between stakeholder from different disciplines, execute and implement a wide arrange of pilots and projects to accumulate experiences*.

*Explanation*

Decentralized rural authorities in the target area of the northern region cope with limited resources and knowledge. This was recognized as potential bottleneck. Indeed, in the pilot of Appelscha, resources were limited and expert knowledge about autonomous vehicles had to be obtained elsewhere. These shortcomings were, however, not experienced as a real bottleneck. Provinces appear to have enough willingness and resources to support municipalities, monetary wise, but also in coordinating, steering and guidance for new pilots to focus on. Consecutive learning processes turned out to be important; these processes can be coordinated by the provinces. Expert-knowledge is not required by the gov-

ernmental actors in the transition, since they are mainly involved in coordinating and stimulating projects, and not in the technical aspects the vehicle itself. If necessary, knowledge will be obtained externally.

Involvement of society is confirmed as a barrier, related to accumulation of experience and trust. Provinces acknowledge that large-scale involvement is difficult to achieve. Trust, understanding and acceptance is not (yet) present, characterizing the pre-development phase. This leads also to a delay of large-scale investment of automated techniques in 'production vehicles' by the market. This hurdle is not in the least insuperable, society's attitude towards the subject is prone to shift rather fast.

In line with Waldrop (2015), the necessity of is experience is a main hurdle. The northern region has only one answer to enhance experience: continue with executing pilots in public. This approach corresponds with the argument of Kemp & Rotmans (2004) that the only way forward in the transition is a learning-by-doing approach. The message of safety and efficiency has to be experienced by society itself. The new law for experimenting (that probably will be introduced in 2018), will increase the possibilities for pilots. This law is also one of the answers towards the barrier of a stable 'institutional design'. Regardless the result of the elections in 2017 and changes in parliament, it is possible to keep executing pilots and introduce the next step: steward-less, driverless and steer-less vehicles. However, priorities within the ministry can shift which can reassign budgets.

With regard to the last main barrier, the cooperation of stakeholders, it can be concluded that this has not been a problem in the studied situation. The case-study showed that actors are mostly willing to cooperate and are aware of their interdependencies. Diversity of involved disciplines is still limited to governmental parties in the region, but seem not to be experienced as a barrier. The same applies to differences in perspective between the ministry and provinces.

Finally, collaboration is a prerequisite in the transition and thus the necessary stakeholder cooperation can be confirmed. Multiple times the need for collaboration is mentioned in the interviews at all institutional levels. As comprehensively illustrated by the Dutch ministry, it is the **interaction** between society, market and government that is needed for the transition. Besides, it can be concluded that literature is comprehensive towards the mentioned barriers. The study reveals that no other barriers have been experienced than mentioned in the theoretical framework (Section 3.3).

### 7.3.3 Which actors are involved at the regime level?

It has been outlined in Section 6.3.1 that, with regard to governmental parties, the provinces and the ministry are regime level actors. They are responsible for the tactical activities, such as described in the transition management cycle (Loorbach, 2010).

Also the car-industry can be regarded as a regime level actor, along with transportation companies. Especially their focus on feasibility and their partly hesitant attitude resonate with the exploitative character of regime actors (Duit & Galaz, 2006). Once implementing their development on a large scale, the regime is prone to shift. The assumption that actors

are active at multiple levels has been confirmed: the ministry is active at the landscape level as well as the regime level and the industry is involved at the niche and regime level.

Hence, at the regime level governmental as well as market parties are involved. At the regime level, the government is seen as the more explorative actor by facilitating and stimulating others. The actors of the market at the regime level are considered to be more exploitative.

### 7.3.4 How can the regime level be influenced and changed?

In Section 3.5 is argued that the regime level changes by top-down pressure from the landscape and by an explorative attitude so that niches from bottom-up gain momentum. Due to the multi-level involvement of different actors, in practice it turns out that niches are introduced at the regime level via the car-industry but also via the facilitating and stimulating role of the provinces. Although top-down pressure from the ministry or EU is not witnessed in the case-study, implicit pressure is exerted via stimulating and pressure via the long-term vision of the EU. This is apparent in the Declaration of Amsterdam, where "Connected, cooperative and automated driving developments should come together to harvest societal benefits" (EU, 2016, p. 2). This societal benefit is foreseen on a time-scale of 20 years, which is typically a long-term landscape focus. By signing this document, the Dutch ministry forces itself (again: multi-level involvement), as well as the provinces to execute projects regarding automated mobility.

Regarding the explorative and exploitative distinction between governmental actors and the market a clear picture emerges. The provinces are seen as less exploitative and less profit driven fitting their stimulating role. The provinces are convinced of the promising future of the autonomous Pod system, to such an extent that within the provincial council a broad support is found to invest in this opportunity, regardless the uncertainty that come with it. This stimulating and inviting role of the provinces forms the necessary link from the regime towards the niche-level. The province, as governmental regime-actor, show an explorative attitude that is needed for the exploitative market-actors. Via this process niches receive a stage to gain momentum. Once adopted by the exploitative industry, the regime level can be influenced and shift towards a new regime.

In transition management, Loorbach (2010) argued that reflexive activities are crucial to influence the regime level: learning processes are necessary to prevent a lock-in situation, and also foster the exploration of niches. In practice, the RDW and the province are the main actors responsible for these reflexive activities. The RDW is responsible for the technical evaluation and learning of the pilots, needed for legislation and engineering. The provinces are responsible, in collaboration with the municipality, to increase learning within society by publicity via media, including consecutive learning from near-future projects.

In short, it can be concluded that the regime-level can be changed by top-down pressure from the landscape and from bottom-up niches that gain momentum. At the regime level, the explorative provinces and the RDW are key actors for learning processes and facilitation of niches that eventually may be adopted by exploitative market actors.

### 7.3.5 Which strengths and opportunities are present to foster the transition?

A SWOT-analysis has been executed in Chapter 5. It can be concluded that regional willingness (and on the background a cooperating RDW and a front-running ministry), open-minded and the powerful position with regard to public transport are the best strengths of the region. However, these strong items are not returning in the weak profile of the region, as confirmed by the provinces.

The most mentioned opportunity is a mobility system with a shared and flexible autonomous vehicle, the Pod. The Pod system is assumed become feasible within a short time, and therefore realistic to implement. The Pod increases accessibility in the rural depopulated areas by providing an opportunity to travel the 'first and last mile', providing a flexible and on-demand mobility system.

The Pod system offers several other opportunities in the rural areas like combined delivery services. The provinces have a powerful position to attract automated mobility in the region, for example by tendering (for a designated region) an (partly) automated-only concession. This is a great opportunity, although in this stage the Pod system still needs further development.

For the Pod system to become reality and to attract (inter)national publicity, the weak profile of the northern region needs revisiting. Branding of the northern region may be possible through alignment with the Declaration of Amsterdam, for example to focus on social inclusion as the next step in the joint agenda. This may enhance, international publicity (the region already attracted international attention through the pilot in Appelscha). Whether this is realistic for the northern region is questionable, since the region has no influence in this international arena. Support from the ministry by 'selling' the northern region within the EU. More opportunities for branding are: a unique place where people's independencies in rural areas are supported, a place where the ministerial policy goal of keeping people home as long as possible is met, and a place where isolation is reduced in depopulated rural areas.

## 7.4 Facilitating the northern regime

The main-question for this thesis was (Chapter 1): *How can the transition towards an automated mobility system be facilitated at the regime level in the northern provinces of The Netherlands?* To answer this question the conceptual model has been improved (figure 7.2). It shows how the transition towards automated mobility can be facilitated. Additionally, operational recommendations are given for the three provinces in the northern region.

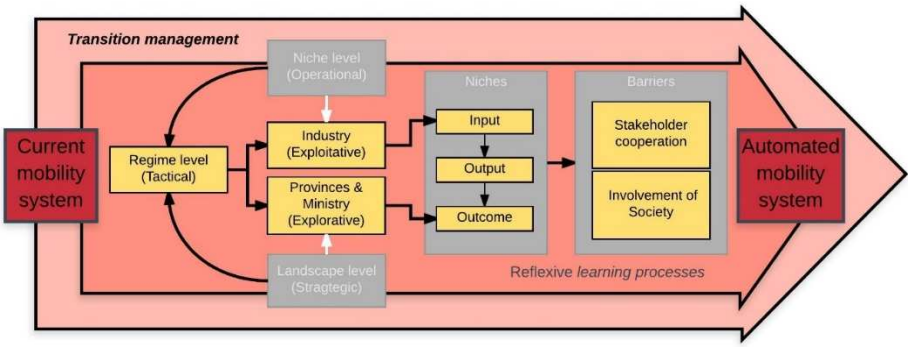



*Figure 7.2: Improved model for facilitating the transition at the regime level.*

In line with the transition management cycle, tactical activities present at the regime level, meaning a mid-term focus is adopted (Loorbach, 2010). A point of departure has been determined: the current pre-development phase in The Netherlands suits a stimulating and facilitating role to be pursued by the northern region (Rotmans et al., 2001). The regime level is influenced top-down by the long-term vision and polices of the Dutch ministry and EU, and bottom-up via the industry by presenting several niches for stimulation.

Since niches are the seeds of a transition (Elzen et al., 2005), niches deserve priority in the region with the right attention and space for development. The three explorative provinces Friesland, Groningen and Drenthe have to act as an inviting and stimulating actor to forms the link towards the niche-level. With their long-term focus, captured in the Declaration of Amsterdam, the ministry forms the link with the landscape-level.

At the regime level, the multi-level involvement of the industry (at the niche and regime level) reflects a double role: first the industry is actively involved in the engineering of vehicles, the first layer of within niches. Second, these niches will only be adopted by the regime-industry when society trusts it and is willing to pay for it (exploitative attitude). Therefore, the focus of the provinces and ministry on the outcome (third level of niches), is crucial: the creation of a demand for the market (explorative attitude). This creation keeps the development of niches going, but also makes sure the market gets opportunities for presenting their possibilities and innovations. When eventually an opportunity is present, it has to be facilitated in this phase by the governmental actors to create acceptance and trust in society. As turns out, decentralized authorities at the rural target area are capable of dealing with the complex objective of automated mobility when supported by the provinces. Therefore, collaboration between the local and provincial level is recommended to continue to execute consecutive pilots and turn them into concrete projects within ca. 5 years, which can eventually results in a large scale adoption within 10 years.

For involving society in these projects, the proximity to the people of the municipality can be of great help.

Knowing that the transition phase is prone to reach the take-off phase, the region has to think of how to mobilize a decent network of actors. This mobilization of actors is needed to get rid of the show-case image of the pilots and to form a concrete vision. For this reason, external knowledge may be obtained from different disciplines when necessary (Bos & Temme, 2014; Rotmans et al., 2001). This applies to technical knowledge as well as knowledge from engineering and consultancy parties. Advice may be needed to optimize the projects with regard to goal formulation, exploit learning processes and collect useful data.

In this vision it is recommended to include all the projects for the years to come. Pilots and projects need to be coordinated by provinces to keep the learning processes consecutive and to avoid a development of different systems. At a national scale this role is foreseen for the ministry with the help of the RDW.

Collaboration and interaction within the network of actors is crucial for fostering the transition. The actors within the network need each other to overcome the barriers observed:

- A legal framework on the national level has to be developed, via the RDW, with feedback produced by regional and local projects.
- Recognition of the same goals and mutual interest will help regime-market-actors adopt niches which are needed for a regime-shift;
- Lobbying of the provinces at the national level for these mutual interest of the market can contribute to a stable institutional structure, for aligning priorities between different political levels, mainly the provincial and national level.

Eventually, when society is accepting a new mobility system, collaboration between actors is acknowledged, an automated mobility system will embed in society: the current regime will shift irreversible and the transition has been completed.

### 7.4.1 Policy recommendations

A point of departure (pre-development phase) and the main barriers towards implementation are determined. Within this context, the following policy actions are recommend for adoption, in order to facilitate an automated transition at the regime level:

*Flexible, demand-driven, collective autonomous Pod system*

As widely mentioned throughout this thesis and accepted by the different actors, a Pod system is seen as a feasible transport solution for the Last mile-issues in the depopulated areas. Therefore, as long no better innovation pop up, the Pod is a realistic development to be adopted within the regime time-scale. Given the feasibility, and compared to the costly and heavily subsidized current public transport system, regime transportation actors are prone to adopt such a system.

Nevertheless, to implement a Pod system, hurdles can be expected. Who is going to pay for it and will the legal framework regarding autonomous vehicles will be comprehensive within the mid-term focus? It is recommended to adopt a phased. The first phases, which may encompass a relative small area, may possibly be governmentally subsidized with the resources currently used for non-effective public transport in rural areas. With more areas to implement, and a growing feasibility and exploitability of the system, the government can retreat slowly but surely. In the end, the market will take over. Additionally, a phased implementation will make use of consecutive learning and create increasingly useful input for legislation. For this legislation, the RDW needs to be intensively involved to create useful input for the ministry.

For such a phased implementation, a serious opportunity lies in tendering a partly automated transportation concession for a specific suitable rural area. Even when the system is not completely trouble free, this can be seen as a means to involve society on a large scale. To some extent, society will be forced to make use of the new system, as the current public transport system will then be replaced by the Pod system. For those who do not trust and are not willing to use the Pod system, a collaboration with a taxi service may be needed. However, this option should not be too attractive to reduce misusage.

*Profiling & branding*

For international and national publicity, the region has to be branded as a unique and meaningful location for investment. Especially in this early phase, it is useful to brand the region for international attention and thus increase possibilities to attract diverse stakeholders (see next item). For this branding several possibilities are present, but few are aligned with the EU and the ministry.

First of all, the region can be positioned as the location where the policy goals of the ministry are met with regard to independent living. With the automated mobility system in the rural areas, accessibility for elderly will increase, possibilities will increase and therefore livability will increase (Geurs & Van Wee, 2004). One of the policy goals of the ministry is the wish to keep people as long as reasonably possible at home, with the pod system, this time can be increased. Next, align with the Declaration of Amsterdam, as outlined in Section 5.5.4. The policy goals of de declaration resonate strongly with the foreseen goals in the northern region (EU, 2016). With a focus of social inclusion in remote areas and

shared perspective towards a shared economy are exactly in line with the wishes of the letter of intent. Also a turn of focus, compared to the ministry (autonomous vs. automated) into a unique strength of the region, in which the autonomous vehicle has a goal to issues empower 'contracting areas'.

As an example, TopDutch (TopDutch, 2017) can be used. Create a website or a platform where the region is promoted. Organize innovation-platforms (like the province of Groningen already is doing) as the northern region and promote the region-based strengths: An open-minded, willing region, backed by a willing ministry and an inviting National Service for Road Traffic with a unique feedback system for building the needed legal framework.

In the end, an increased attractive profile of the northern region should be aimed at attracting international industry and market parties to invest and experiment in the northern region, but mostly attract regime-actors. When an alignment with the Declaration of Amsterdam can be reached, market actors at the regime can use this alignment, when actively involved in the northern region, as a means to increase the value of their own brand. This unique branding may convince regime-actors that the northern region is a place where they can test their development before all customers are willing to pay for it. This may activate the regime-actors to become more explorative instead of being exploitative

*Diversity*
With the help of this unique profile a diversity of actors may be interested to invest and experiment in the northern region. As has been argued, from different disciplines knowledge is needed to overcome barrier towards implementation. With the help from mobility, societal and financial sectors suitable conditions for a project can be designed, resulting in an attractive and safe environment wherein the pilot takes place. Such an environment may produce useful data but more important, it may involve society in such a way that it feels comfortable in a new vehicle (with the help of the right societal actors). Also to obtain a reduction of the waste of resources (revisiting perspectives over again), one should include knowledge from the market or industry actors, and include them in the key team of actors that is currently being mobilized between the three provinces. This resonates with the foreseen activities in the take-off phase, a team of frontrunners need to be mobilized (Rotmans et al., 2001). In short, a stable institution is then formed as a point of departure in the take-off phase.

Additional to the transportation concession, it is an opportunity to include a transportation company (or multiple) into the team of key-actors. With including such a company it is more likely that the exploitative regime-companies are adopting an automated system. The shared mutual interest can be the driving force behind the adoption processes.

Either way, it is recommended that the provincial level stays in charge of the projects in the region for coordination. Consecutive learning processes have turned out to be crucial, and regional overview is therefore needed that crosses municipal and maybe provincial borders.

*Publicity*

Since Loorbach (2010) argued that media play a crucial role in the reflexive activities in a transition, it is recommended to actively promote a new mobility system for a broad support. Transparency and goal-communication is recommended. When a pilot is executed to test with a new innovation, it is natural that some things go wrong. Communicate with the unknowing society what is envisaged to go wrong and what steps are taken to mitigate this. This is recommended to guard the image and reputation of automated mobility amongst society.

Not only media play a role in promotion. Also education at (primary) schools can be useful to create an understanding amongst different generations. Create an understanding for a shared economy instead of the current individual use of mobility. A transition is a long-term process, thus eventually children at the current primary school will be the main consumers of the system. Besides promotion, the advice is to keep executing pilots in different municipalities. A broader view than currently captured in the letter of intent may be needed to involve society on a larger scale. Thus not only the municipality of Ooststellingwerf should be the playground.

Not only external publicity is needed towards society and the market. Also internal (governmental) publicity towards the subject is needed. The ministry, via the RDW or via the platform Taskforce Dutchroads of the CROW (2017), has to stress that the provinces are not the crucial link that will probably block the transition, but perhaps can be the link to set the transition in motion. This important position is not to be underestimated. Next, provinces need to be aware that they are expected to come up with niches, meaning keep creating a demand for the market to respond to. And last, despite the double role of initiator and road-authority, keep safety in mind at all cost. If a situation or project is doubtful, obtain external expertise from leading consultancies.

*Out-of-the-Box*

Finally, adopting a different perspective could be interesting. Even when a shared perspective is reached towards the position of the Pod system in a new mobility system, niches remain crucial for a transition. Niches can e.g. in a later stadium make the Pod system more efficient or provide it with extra services (besides e.g. delivery services). Instead of approaching automated mobility as a solution towards a problem, approach it as a possibility towards opportunities. Dare to think out of the box, organize innovation-platforms where specifically opportunities are discussed. External knowledge can broaden the view of governmental actors.

# 8

# Reflection

Starting with the successes in this research, I have experienced a good start of my thesis. First, the fascination of the subject has motivated my throughout this thesis. It is interesting to see and read how the world is preparing for a new mobility system. Second, developing a theoretical framework is not experienced as a struggle. Mainly due to courses I took in my master program, it was relatively easy to find useful literature and critically reflect on them. Also connecting with experts and governmental actors in the field of automated mobility has been a smooth process. The interviewees were very helpful and inviting. However, as with every research, there was a downside.

The framing of the problem has changed over time, due to the confusion between the terms regional, meso and regime level. Especially the link between the provincial activities and the regime-actors was not clear. A lesson learned is that before developing any context or theory, the problem description has to be defined more clearly. A second lesson learned is concerned with the time-schedule. In the initial planning no time was scheduled for processing received feedback from supervisors and experts. It has resulted in a delay of finishing my theoretical framework and methodology, which cascaded through the rest of the planning.

## 8.1 Findings

With regard to the findings of my research, it was a disappointment more or less all the respondents only had neat and in-the-box ideas about automated mobility in the northern region. All interviewees were on the same line regarding the position of automated mobility in the northern region. No possibilities for automated mobility have been encountered in this research, other than the general increase in accessibility in depopulated areas. Possibly this is due to the position of the provinces in the planning system: were automation is framed as a solution towards a problem, rather than an opportunity towards possibilities. Also the early phase of the transition and unfamiliarity with regard to the subject may have hampered the development of a wide range of possibilities.

## 8.2 Method

The development of a suitable research method has resulted in a period of struggles and consequently led to the loss of some time and efficiency. The initial research method (loose interviewees) could hardly lead to an academically accountable answer on the research question.

However, the eventually used case-study in this research turned out to be a useful unit of analysis. It revealed a lot of information about the current Dutch transition. The interviewees provided many insights regarding their roles and positions in the transition. What also contributed to the value of this research, is that the pilot in the case study is finished last year. Therefore, all the stakeholders already evaluated the pilot and could share lessons learned (like involving the RDW as soon as possible in an automated-related project).

## 8.3 Suggestions for further research

The theoretical framework that has been developed in chapter 3 and has been discussed in chapter 6, turned out to be comprehensive with regard to the influences on the regime-level. However, what may be lacking in this theoretical framework is a more in-depth analysis of specific elements of the conceptual model. For example, the theory of strategic niche management (SNM) is a theory that could be helpful to analyze how exactly an innovation can be stimulated or managed. The articles of Kemp et al. (1998), Caniëls & Romijn (2008) and Schot & Geels (2008) may be of interest. SNM is an approach that seems to use the same basic elements like the transition theory and the multi-level perspective that have been used in this thesis. However, SNM seems to offer a more in-depth analysis of how niches can infiltrate the regime-level.

Additionally, a more in-depth analysis for involving society can be useful. I would recommend to approach this involvement from a psychological perspective, rather than a governance or transition perspective. A social psychological perspective can offer perhaps insights in peoples framing of trust and understanding of radical changes and the use of a collective fleet of vehicles. This can be helpful for the provinces in the northern region to involve society to a greater extent.

Finally, this research would benefit from an economic backing with regard to the Pod system. Although calculations have been made, as indicated by the interviewees, a broader financial underpinning of the feasibility of a Pod system can be useful to convince regime actors to invest in a Pod system.

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# Appendix 1

# List of figures and tables

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# Appendix 2

# Transport and infrastructure planning

In The Netherlands is a clear distinction between the national, regional and local level. The national level corresponds with the Ministry of Infrastructure and Environment, responsible for transport and infrastructure planning, and can be seen as the macro-level in the system. The ministries dictum is to decentralize policies as much as possible and centralize only if necessary (Nadin & Stead, 2008). Therefore, the ministry designs infrastructure plans via national zoning plans to ensure national interest at the local level (Tan et al., 2014).

The executing body of the ministry is Rijkswaterstaat (RWS), which executes projects like national highways improvements and is the road-authority of the highways (Dutch: wegbeheerder, Rijkswaterstaat, 2016). When executing automated mobility experiments on national highways, RWS (WerkenvoorNederland, 2016; Rijksoverheid, 2016e) and the National Service for Road traffic (Dutch: Rijksdienst Wegverkeer, RDW) have to be involved. The RDW grants permits for testing on the public roads (Rijksoverheid, 2016f).

The local level corresponds with the municipalities, at the micro-level, as most decentralized institution. However, defining the regional level is not as clear as the local level, due to the scope of the provincial level (Needham, 2005). Janssen-Jansen & Woltjer (2010) and Needham (2005) argue that the regional level is located between the provincial and municipal level. In practice, it turns out that regional initiatives and projects are coordinated at the provincial level (Nadin & Stead, 2008) and that there is no will to create an extra body for the regional level (Needham, 2005).

With regard to transport planning, the ministry designs long-term transport policies. In these policies the direction for the coming years is captured like “advance economic growth through improving accessibility” (Tan et al., 2014, p. 643). Tan et al. (2014) argue that the aim of national transport policies have changed significantly over the last forty years, which hindered the development of long-term strategies (Needham, 2005). However, a stable institutional design is needed in the transition towards automated mobility, fluctuations are undesired.

Looking at transport planning at the lower levels, the province is responsible for mobility policies and public transport at regional and local level. The provinces come up with policies

to e.g. increase public transport with new lines. The municipality only executes these policies and makes sure bus-lines will be constructed. (Fryslan, 2016a). Provision of local public transport, occurs through granting a concession by the provinces. This concession applies on a regional scale and funding occurs through a national transportation budget. This budget is beyond the jurisdiction of the municipalities (Tan et al., 2014).

Concerning land-use planning, the municipalities deal with the legally binding land-use plans and local matters (Janssen-Jansen & Woltjer, 2010). Livability issues and urban renewal projects are often part of the municipal spatial agenda. In essence, the municipality only perform projects that are of direct concern of their inhabitants. (Rijksoverheid, 2016a). However, with the new Spatial Planning Act of 2008 (Dutch: Wet Ruimtelijke Ordening 2008), the provinces have gained more power to overrule municipalities when regional or national interests are at stake. When desired, the province can ensure regional interest with the regional strategic vison (Dutch: Structuurvisie) and regional zoning plan (Dutch: inpassingsplan). In this vision the province can set out a clear (mostly 10 year-) vision on spatial design and policies. In the land-use plan it can overrule municipal interests. The ministry does not audit the regional plan anymore with the new planning act (Janssen-Jansen & Woltjer, 2010).

With the new National Spatial Strategy 2006 (Dutch: Nota Ruimte 2006), the province gained a more enacting role for stimulating and enabling municipalities in designing and implementing new policies (Nadin & Stead, 2008). Also with the upcoming Environmental Act (Dutch: Omgevingswet) in 2019, a supportive role will be stressed and expected from the provincial level (KING et al., 2015). This is of particular interest for the role of the provinces in the transition towards automated mobility. The provinces have an inspiring and mobilizing role in the transition, whereby it has to stimulate the municipality in thinking in new ways and enabling development of niches (Rotmans et al., 2001). With the new strategy, the provincial layer is no longer auditing and correcting the municipality: trust in local authorities is the basis for this new strategy (Rijksoverheid, 2016c).

# Appendix 3

# Interview guidelines

In the following matrix the interview questions are given. The questions are shown in English and Dutch with their link to the relevant sub-question and the elements of the conceptual model. The interviews are held in the Dutch language, due to the native Dutch language of the respondents. Before every interview, I have introduced myself (e.g. study program & internship) and the research is explained. All interviewees gave permission to record the interview and to mention them by name in the research.

| | Question | Translation | Link to conceptual model | Sub-question | Remarks |
|---|---|---|---|---|---|
| Provinces of Friesland, Groningen and Drenthe | Wat is uw functie binnen de provincie en wat zijn uw verantwoordelijkheden? | What is your function within the organization and what are your responsibilities? | | | Introduction |
| | Wat is het huidige beleid op het gebied van Duurzame mobiliteit en zijn er barrières waar de provincie tegen aan loopt? | What is the current policy on Sustainable Mobility and what barriers do you face implementing these policies/niches? | Modal Shift or Automated mobility focus | 1, 2 | |
| | Hoe houdt de provincie de innovaties op het gebied van zelfrijdende-auto's in de gaten en zijn er bepaalde instrumenten of afdelingen die daar voor verantwoordelijk zijn? | How are niches been monitored in your organization? | Niches | 3 | Explorative Exploitative |
| | Welke instrumenten zijn er beschikbaar bij de provincie om innovaties te adopteren of te stimuleren? | What tools are available for the province to stimulate and adopt niches? | Niches | 3 | Explorative Exploitative |
| | Denkt u dat er bij de provincie voldoende kennis en middelen beschikbaar zijn om de verantwoordelijkheid van de transitie op zich te nemen of ziet u deze rol meer weggelegd voor nationale overheid? | Do you think your organization has sufficient knowledge and resources to be responsible for the transition of do you think this is the role of the national government? | Decrease in knowledge & Resources | 4 | Decentralization |
| | *Case-related questions* | | | | |
| | Hoe is het pilot project in Appelscha geïnitieerd en welke partijen waren in eerste instantie hierbij betrokken? | How is the project of Appelscha initiated and what actors are involved? | Meso & Regime level, Stakeholders cooperation, Decentralization | 1, 4 | |
| | Hoe is de samenwerkingen tussen deze partijen geregeld? Wie is verantwoordelijk voor het contact met de markt en de maatschappij (Gemeente/Provincie)? En hoe wordt er nu binnen de intentieverklaring samengewerkt? | How do the stakeholders collaborate in this project? Who is responsible for involving the market and society? How is the collaboration currently in the letter of Intent? | Stakeholder cooperation, Involvement of society | 4 | |

| | | | | | |
|---|---|---|---|---|---|
| | Wat is de rol van uw provincie in het project en hoe verschilt dit t.o.v. de andere provincies? | What is the role of the province within this project? | Meso & Regime level | 3, 4 | Decentralization |
| | Wat is het vervolg op het project in Appelscha en hoe worden de resultaten van deze proef meegenomen in toekomstige projecten? | What is the sequel of the project and how are the results incorporated in the next projects? | Meso & Regime level | 5 | Learning processes |
| | *Final questions* | | | | |
| | Hoe zorgen jullie dat de maatschappij bekend wordt met zelfrijdende voertuigen en dat er acceptatie en vertrouwen wordt gekweekt met deze voertuigen? | How do you ensure that acceptance and trust with automation of mobility is created amongst society? | Decentralization, Involvement of Society | 2, 4 | |
| | Wat voor kansen voorziet u voor autonome mobiliteit in het Noorden? | What opportunities you think are present for the region for automated mobility? | | 5 | SWOT |
| | Waar denkt u dat de provincies voor moeten waken in het kader van testen van autonome mobiliteit? | What threats you think are present for the region for automated mobility? | | 5 | SWOT |
| | Hoe denkt u dat de provincie de transitie naar autonome mobiliteit kan versnellen of beïnvloeden? | How do you think the province can foster the transition to automated mobility? | | 2, 5 | SWOT |
| | Wat zouden jullie graag anders zien zodat de provincie meer invloed heeft op de transitie? | What would you like to change so that the province has more influence in the transition? | | 2, 5 | SWOT |
| | **Question** | **Translation** | **Link to conceptual model** | **Sub-question** | **Remarks** |
| **Municipality of Ooststellingwerf** | Wat is uw functie binnen de gemeente en wat zijn uw verantwoordelijkheden? | What is your function within the organization and what are your responsibilities? | | | Introduction |
| | Wat is het huidige beleid op het gebied van Duurzame mobiliteit en zijn er barrières waar de gemeente tegen aan loopt? | What s the current policy on Sustainable Mobility and what barriers do you face implementing these policies/niches? | Modal Shift or Automated mobility focus | 1, 2 | |
| | Hoe houdt de gemeente de innovaties op het gebied van zelfrijdende-auto's in de gaten en zijn er bepaalde instrumenten of afdelingen die daar voor verantwoordelijk zijn? | How are niches been monitored in your organization? | Niches | 3 | Explorative Exploitative |
| | Welke instrumenten zijn er beschikbaar bij de gemeente om innovaties te adopteren of te stimuleren? | What tools are available for the municipality to guide niches? | Niches | 3 | Explorative Exploitative |
| | Denkt u dat er bij de gemeente voldoende kennis en middelen beschikbaar zijn om de verantwoordelijkheid van de transitie op zich te nemen of ziet u deze rol meer weggelegd voor de provincie of nationale overheid? | Do you think your organization has sufficient knowledge and resources to be responsible for the transition of do you think this is the role of the national government? | Decrease in knowledge & Resources | 4 | Decentralization |
| | *Case-related questions* | | | | |
| | Hoe is het pilot project in Appelscha geïnitieerd en welke partijen waren in eerste instantie hierbij betrokken? | How is the project of Appelscha initiated and what actors are involved? | Meso & Regime level, Stakeholders cooperation, Decentralization | 1, 4 | |
| | Hoe is de samenwerking tussen deze partijen geregeld? Wie is verantwoordelijk voor het contact met de markt en de maatschappij (Gemeente/Provincie)? | How do the stakeholders collaborate in this project? Who is responsible for involving the market and society? | Stakeholder cooperation, Involvement of society | 4 | |
| | Wat is de rol van uw gemeente in het project en hoe verschilt dit t.o.v. de provincies? | What is the role of the municipality within this project? | Meso & Regime level | 3, 4 | Decentralization |
| | Wat is het vervolg op het project in Appelscha en hoe worden de resultaten van deze proef meegenomen in toekomstige projecten? | What is the sequel of the project and how are the results incorporated in the next projects? | Meso & Regime level | 5 | Learning processes |
| | *Final questions* | | | | |
| | Hoe denkt u dat de gemeente de transitie naar autonome mobiliteit kan versnellen of beïnvloeden? | How do you think the municipality can foster the transition to automated mobility? | | 2, 5 | SWOT |

| | | | | | |
|---|---|---|---|---|---|
| | Wat zouden jullie graag anders zien zodat de gemeente meer invloed heeft op de transitie? | What would you like to change so that the municipality has more influence in the transition? | | 2, 5 | SWOT |
| | **Question** | **Translation** | **Link to conceptual model** | **Sub-question** | **Remarks** |
| National Service for Road Traffic (RDW) | Wat is uw functie binnen de RDW en wat zijn uw verantwoordelijkheden? | What is your function within the organization and what are your responsibilities? | | | Introduction |
| | Wat is het huidige beleid op het gebied van Duurzame mobiliteit en zijn er barrières waar de RDW tegen aan loopt? | What is the current policy on Sustainable Mobility and what barriers do you face implementing these policies/niches? | Modal Shift or Automated mobility focus | 1,2 | |
| | Wat is de rol van de RDW in de transitie naar autonome mobiliteit en hoe ziet ut de rol van de provincies en de gemeente in deze transitie? | What is the role of the RDW in the transition to automated mobility and how do you see the role of the lower authorities? | Stakeholder cooperation, Meso & Regime level, Decentralization | 3, 4 | |
| | Hoe houdt de RDW de innovaties op het gebied van zelfrijdende-auto's in de gaten? Welke instrumenten zijn er beschikbaar bij de RDW om innovaties te adopteren, stimuleren en vervolgens (te laten) implementeren? | How are niches been monitored in your organization? What tools are available for the RDW to guide niches? | Niches | 3 | Explorative Exploitative |
| | Hoe werkt de RDW samen met andere partijen, zoals marktpartijen (Google), om de transitie te versnellen? | How does the RDW collaborate with other market parties to foster the transition? | Stakeholder cooperation, Meso & Regime level | 3, 4 | |
| | Zijn er projecten elders in Nederland die niet zijn goedgekeurd of zijn er concrete projecten die bezig zijn met autonome voertuigen? | Are there any other projects in The Netherlands which have been rejected or other projects which involve automated mobility? | Meso & Regime level | 3 | Learning processes |
| | *Case-related questions* | | | | |
| | Hoe is het pilot project in Appelscha geïnitieerd en welke partijen waren in eerste instantie hierbij betrokken? | How is the project of Appelscha initiated and what actors are involved? | Meso & Regime level, Stakeholders cooperation, Decentralization | 1, 4 | |
| | Hoe is de samenwerkingen tussen deze partijen geregeld? Wie is verantwoordelijk voor het contact met de markt en de maatschappij? | How do the stakeholders collaborate in this project? Who is responsible for involving the market and society? | Stakeholder cooperation, Involvement of society | 4 | |
| | Wat is de rol van de RDW in het project geweest? | What is the role of the RDW within this project? | Meso & Regime level | 3, 4 | |
| | Wat is het vervolg op het project in Appelscha en hoe worden de resultaten van deze proef meegenomen in toekomstige projecten? | What is the sequel of the project and how are the results incorporated in the next projects? | Meso & Regime level | 5 | Learning processes |
| | *Final questions* | | | | |
| | Hoe denkt u dat de RDW de transitie naar autonome mobiliteit kan versnellen of beïnvloeden? | How do you think the RDW can foster the transition to automated mobility? | | 2, 5 | SWOT |
| | Wat zouden jullie graag anders zien zodat de RDW meer invloed heeft op de transitie? | What would you like to change so that the RDW has more influence in the transition? | | 2, 5 | SWOT |
| | **Question** | **Translation** | **Link to conceptual model** | **Sub-question** | **Remarks** |
| GoudAppel - Coffeng, Mobility Consultancy | Wat is uw functie binnen de Goudappel en wat zijn uw verantwoordelijkheden? | What is your function within the organization and what are your responsibilities? | | | Introduction |
| | Wat is de rol van adviesbureaus in de transitie? | What is the role of consultancies is the transition towards automated mobility? | Meso & Regime level | 3 | |
| | Hoe denk u dat de adviesbureas zich moeten opstellen om de transitie te bevorderen? | How do you think consultancies have to intervene in the transition? | Meso & Regime level | 3 | |
| | Hoe ziet u de rol van lagere overheden als de gemeente en de provincie in de transitie? | How do you see the role of lower authorities in the transition? | Decrease in knowledge & Resources, Stakeholder cooperation | 2, 3 | Decentralization |
| | Hoe worden innovaties en ontwikkelingen door jullie in de gaten gehouden en wat wordt daar vervolgens mee gedaan? | How does your organization monitor niches? And what is consequently done with these niches? | Niches | 3 | Explorative Exploitative |

| | | | | | |
|---|---|---|---|---|---|
| | Denkt u dat er voldoende kennis en middelen zitten bij de provincies en gemeente om verantwoordelijk te zijn voor de transitie? En hoe kunt u als adviesbureau daarin ondersteunen? | Do you think lower authorities have sufficient knowledge and resources to be responsible for the transition? And how can you support them? | Decrease in knowledge & Resources | 3, 4 | Decentralization |
| | Hoe wordt er door de adviesbureaus samengewerkt met overheden, dan wel andere marktpartijen? | How is being collaborated between consultancies and governments and other parties? | Stakeholder Cooperation, Meso & Regime level | 2, 3 | |
| | Hoe zouden jullie of een andere markt partij kunnen bijdragen om meer draagvlak te creeren bij de maatschappij? | How could you contribute to create more support and acceptance amongst society for automated mobility? | Involving society | 2 | |
| | *Final questions* | | | | |
| | Wat voor kansen voorziet u voor autonome mobiliteit in het Noorden? Waar zet de markt op in, cooperatief or autonomous? | What opportunities you think are present for the region for automated mobility? Is the market focusing on automated or autonomous mobility? | | 1, 5 | SWOT |
| | Waar denkt u dat de regio voor moeten waken in het kader van testen van autonome mobiliteit? | What threats you think are present for the region for automated mobility? | | 5 | SWOT |
| | Wat zouden jullie graag anders zien zodat de marktpartijen meer invloed krijgen op de transitie? | What would you like to change so that the market parties have more influence on the transition? | | 2 | |
| | **Question** | **Translation** | **Link to conceptual model** | **Sub-question** | **Remarks** |
| **Ministry of Infrastructure & Environment** | Wat is uw functie binnen het KIM en wat zijn uw verantwoordelijkheden? | What is your function within the organization and what are your responsibilities? | | | Introduction |
| | Wat is het huidige beleid op het gebied van autonome mobiliteit binnen het ministerie en wat is het beleid voor de regionale overheden in de transitie? En zijn er barrières waar het ministerie tegen aan loopt? | What is the current policy on automated mobility and what is the policy for regional and local authorities? What barriers are faced when implementing these policies? | Modal Shift or Automated mobility focus | 1, 2 | |
| | Wat is de rol van het Ministerie in de transitie en hoe ziet u de rol van de provincie en de gemeente? | What is the role of the ministry in the transition and how do you see the role of lower authorities in the transition? | Meso & Regime level | 3, 4 | |
| | Hoe worden innovaties en ontwikkelingen door het ministie in de gaten gehouden en welke instrumenten zijn er beschikbaar om innovaties te adopten, stimuleren en te laten implementeren? | How are niches been monitored in your organization? What tools are available for the Ministry to guide niches? | Niches | 3 | |
| | Hoe werkt het Ministerie samen met andere partijen, zoals marktpartijen (Google), om de transitie te versnellen? | How is being collaborated between with market parties to foster the transition? | Stakeholder cooperation, Regime level | 4 | |
| | Wie acht u verantwoordelijk voor de transitie in Nederland? | Who do you think is responsible for the transition in The Netherlands? | Decrease in knowledge & Resources, Stakeholder cooperation, Involvement of Society | 3 | Decentralization |
| | *Final questions* | | | | |
| | Wat voor kansen voorziet u voor autonome mobiliteit in het Noorden? | What opportunities you think are present for the region for automated mobility? | | 5 | SWOT |
| | Waar denkt u dat de regio voor moeten waken in het kader van testen van autonome mobiliteit? | What threats you think are present for the region for automated mobility? | | 2, 5 | SWOT |
| | Hoe denkt u dat er moet worden samengewerkt in de noordelijke provincies om de transitie te beinvloeden? Of zal dit top-down moeten worden gestuurd? | How do you think collaboration needs to take place in the northern region to influence the transition? Top-down? | | 3 | Decentralization |
| | Hoe worden lagere overheden aangestuurd door het ministerie op het gebied van autonome mobiliteit? Of is het juist dat die bottem-up moeten worden georganiseerd? | How are lower authorities directed by the ministry in the field of automated mobility? Bottom -up? | Decrease in knowledge & Resources, Stakeholder cooperation, Involvement of Society | 3 | Decentralization |
| | Zouden scenario's van het KIM ook leidend kunnen zijn voor het beleid? Dat we ontwikkelingen herkennen en naar een bepaald scenario sturen? | Could the scenarios of KIM be leading for a policy? And that a process of back-casting can take place? | | 1 | Scenario-planning |

# Appendix 4

# Data SWOT-Matrix

*Data collection for SWOT-Matrix:* This SWOT-matrix is compiled with data from the conducted interviews. During interviews, respondents are asked what opportunities and threats may be present in the future. The strengths and weaknesses are compiled from the context form the interviews. The SWOT-matrix in this appendix is a general matrix applicable to the northern region of The Netherlands, per interviewed institutions. The submitted items are generally applicable on the region and the stakeholders and are thus not limited to the institutions that mentioned them. For example: The province of Friesland mentioned the following strength: "Cooperative attitude with regard to innovation. Open to all kinds of development", meaning that not only the province of Friesland is cooperative to all kinds of innovation, but that also the other provinces, municipality are willing to cooperate with new innovations. In the northern region one is open to test with more innovation than only the Pod system.

| SWOT-Matrix | *Strength* | *Opportunity* | *Weaknesses* | *Threat* |
|---|---|---|---|---|
| *Municipality of Oost-stellingerwerf* | 1. Municipality is approachable due to proximity with society and therefore crucial in pilot-phase. | | 1. Lack of vison on sustainable mobility and automated mobility<br>2. Communication and responsibilities have not been documented which is risky for a 'small' institution.<br>3. Struggling with approaching the right institutions and providing the right expertise<br>4. Small budget at Municipality for longer pilots | |
| *RDW* | 1. Responsibilities are shared and willingness is present at (most) stakeholders.<br>2. The Netherlands is an inviting country for approval for testing. RDW is cooperative.<br>3. Unique feedback cycles in "exemption system" of RDW<br>4. Right awareness: Transparent institution, aware of the importance of "the truth" (in contrast with media). Pilots are followed by international media. Be open over reasoning, Communication to society is key! | 1. "A huge market for the Pod is present in the North, with the fact of the Last Mile. The Pod will be bigger than autonomous driving".<br>2. Business case of Pod can be more feasible. Especially when forces are combined in The Netherlands Combine forces: National collaboration with universities and market, create a national Pod for NL.<br>3. Efficiency is reached with automated driving. Connecting and cooperative driving. Region can resonate with interest and vision of Ministry | 1. Double role Provincial government: **A)** Initiator and enthusiastic about pilot vs. **B)** Road-Authority: As safe as possible, has to decide initiative takes place<br>2. Still in showcase phase | 1. Double role can results in: "Provinces mark their own paper".<br>2. Political pressure and changes amongst society.<br>3. Consumer is not willing to adopt new functions e.g. keep lane system.<br>4. Miscommunication through Media which results in e.g. image- and reputation damage.<br>5. Threat that market is not willing to take over development of projects, results in waste of public resources<br>6. RDW is too late involved in process and risk of making the same mistakes and run into the same barriers that already have been over won. |

| SWOT-Matrix | *Strength* | *Opportunity* | *Weaknesses* | *Threat* |
|---|---|---|---|---|
| *Ministry of Infrastructure and Environment* | 1. Provinces are authorized to grant transportation permit.<br>2. We live in a share-society, young "people do not want a car per se, that has changed in the past years" | 1. Sharing society, mobility as a service, demand driven mobility<br>2. Automation for Last-mile in rural areas<br>3. Business case of Pod can be more feasible<br>4. Automated and cooperative driving for policy goals<br>5. Sharing system as an accelerator of automation | 1. Business case in rural area is of less interest than urban area.<br>2. Dare to make negative conclusion: Is it better to wait? It has cost us money, but results are marginal. Industry is not far enough<br>3. How is it framed? As a showcase? Fine! As a future-oriented system? Think better about the goal of a pilot.<br>4. Difficult to monitor speed of development. | 7. Currently on top of the "hype loop", critique is starting to come. Make sure it stabilizes, be creating e.g. a stable institutional structure.<br>8. Designing policy too early, can stop innovation and exploring of opportunities<br>1. Potpourri of systems, avoid non-consecutive pilots and project, learning is key.<br>2. Changes in institutional structure, change of policy goals<br>3. Unclear if pilots contribute to development of technology, where to invest?<br>4. Opportunities for improvements within current framework which are not automated related.<br>5. Attracting extra mobility when capacity increases, results are nullified.<br>6. Converted to hours/year people drive, compared to fail-frequency of software, would mean the vehicle may fail once in a 100 years. Is that feasible? |
| *Province of Drenthe* | 1. Young and "fresh" team of professionals available for new issues like automation. (Pro-active towards market) at Provinces.<br>2. Combined forces as northern Region; good for communication towards Ministry and society, more and wider publicity for project and pilots<br>3. Automated mobility approached as a solution | 1. Automation for Last-mile in rural areas, increase in feasibility of amenities.<br>2. Sharing vehicles and market- or state-owned system. If financial aspect of car ownership will decrease in a market- or state-owned system, automation will attract lots of people (car ownership is expensive in Drenthe).<br>3. (Bus-) Drivers/Stewards can take over other tasks, combination with delivery and other services.<br>4. Increase in employment: opportunities for low-skilled people as stewards/services. | 1. In the end, every policy officer is responsible for its own province and is accountable to his board of officers.<br>2. Communication within letter of Intent is not great yet. Also it is not institutionalized.<br>3. Lack in offer of automated vehicle manufactures. In the end there are only a few providers of automated vehicles<br>4. Lack of available time (resources) within province of Drenthe (only 2 available employees)<br>5. Lack of alignment between vision and ideas between provinces. | 1. Generally, the market is more interested in investing in urban area than in rural area´s due to a higher demand in urban areas. It is unclear if the market is willing to invest in rural areas.<br>2. Risk of wasting public resources, if no market party is willing to take over the development of certain projects/pilots. In time, back-up of the market is needed.<br>3. If sharing vehicles becomes popular, can results in loss of tax income, e.g. less road tax will be paid which is one of the main sources of income for provinces.<br>4. Avoid non-consecutive pilots and project, learning is key. |
| *Province of Friesland* | 1. Transport companies are willing to listen to the demand of the provinces in general.<br>2. Provinces are authorized to grant transportation permit.<br>3. Cooperative attitude with regard to innovation. Open to all kinds of development.<br>4. Combined forces as northern Region; good for overview and communication<br>5. Learning-by-doing approach | 1. 'northern is different than rest of the country, added value to test in rural area.'<br>2. Last mile, 'chain mobility', increase in feasibility of amenities<br>3. Tendering a specified automated Public transport permit for a designated area. Opportunities for market to show possibilities and to push market for development.<br>4. Pod is seen as a fully additional modality.<br>5. Commuting between northern Region and 'Randstad' can become more attractive due to autonomous driving scenarios. Living in the north may therefore become more attractive. | 1. Reserved attitude towards market parties: "If innovation keeps going, we do not have to act that much".<br>2. Digitization in region is not yet completely finished or up to date: important condition for an efficient (test with an) automated mobility system.<br>3. Due to a lot of uncertainties, it is hard to decide where investments should take place e.g. invest infrastructure: what do we have to take into account?<br>4. Certain entrepreneurs only continue development when subsidized. | 1. Avoid potpourri of systems, avoid non-consecutive pilots and project, learning is key.<br>2. Social consequence of automated system, risk of unemployment: demission of hundreds of (bus or taxi) drivers. Sensitive topic amongst politicians and society, results in risk for support and willingness in society. |
| *Province of Groningen* | 1. Combined forces as northern Region; good for overview and communication with EU and NL (e.g. subsidy)<br>2. External coordinator of the letter of Intent (Mr. Hamstra) and communication team. One central point for internal and external access. | 1. Automation of train system, expected to be less of a struggle: is already a closed system. Machinist already has a minor role.<br>2. Automation for Last-mile in rural areas, increase in feasibility of amenities.<br>3. Sharing vehicles and market- or state-owned system. | 1. Lack of stable regulation on a short term to make Pod system reality. (Innovation is per definition ahead of legislation) Experimental legislation is first step in right direction.<br>2. Bureaucracy regarding setting up a pilot.<br>3. Skeptical attitude of society | 1. Avoid non-consecutive pilots and project, learning is key.<br>2. Behavior of cyclist is unpredictable: cycling culture in urban Groningen will slow down autonomous Pod or vehicle, a lot of obstacles.<br>3. Social consequence: demission of hundreds of (bus) drivers, taxis. Sensitive topic amongst politicians and society. Risk for support amongst society. |

| SWOT-Matrix | *Strength* | *Opportunity* | *Weaknesses* | *Threat* |
|---|---|---|---|---|
| *GoudAppel Coffeng – Mobility Consultancy* | 3. Province of Groningen has a clear vision of goals regarding automated mobility. Ambitious and realistic goals (within 10 years).<br>4. Open to all kinds of test, not only focused on livability issues/tests/pilots. | 4. Combine the pilot of 5G in Loppersum, combine with automated mobility, connecting and cooperative.<br>5. Road Safety, reducing human-fail frequency: meaning e.g. reduce alternate strips, guiding via traffic center, speed limit control.<br>6. Alternative land-use due in urban area due to decrease in footprint of mobility (e.g. parking)<br>7. Target and transportation ("WMO-vervoer")<br>8. (Bus-) Drivers/Stewards can take over other tasks, combination with delivery and other services. "Helping old people, delivering medicine" | | |
| | 1. Resonating with the intention of the ministry: wants to be frontrunners. | 1. Resonate with the Declaration of Amsterdam: aim at joint agenda e.g. aim at connected and automated driving. International allure, publicity, market interest.<br>2. Specified automated driving lanes are a possibility in the north due to availability of space.<br>3. Design policy goal: Network-broad optimization, only permit automated cars that contribute to optimization. Collective traffic flow dominates individual car.<br>4. Accessibility of small towns with low density. Automation for Last-mile in rural areas, increase in feasibility of amenities.<br>5. Choose interesting perspective towards automation for profiling towards rest of the country and world: link with ministries policy goals, wish to keep people at home for as long as possible. Automation can contribute to personal independencies, reduce isolation in rural areas.<br>6. Design a regulated system like is done with airplanes. Only permit vehicles that contribute to traffic flows. Permit a slot on infrastructure. Freedom will be reduced. | 1. Profile of northern Region is weak! Why should one like to test in a rural area unknown area? What is your added value in comparison with all the other possibilities?<br>2. Unclear goal formulation, learning is key! Creation of right setting for achieving those goals is not good enough. For example digitization of conditions is not yet finished to profit in an optimal way.<br>3. Not enough diversity is in cooperated in the letter of intent. Only governmental parties have signed the letter. | 1. Be aware of social critique during and after pilots. Media play a huge role in this. Society is prone to classify pilots as silly and waste of money. But support is needed. |

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