THESIS

Smart Mobility in the Netherlands

Road authorities' perspectives on obstacles and opportunities in the 2018-2023 time frame

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Smart Mobility in the Netherlands: Road authorities' perspectives on obstacles and opportunities in the 2018-2023 time frame

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Preface

This thesis is the concluding work of my study Management of Technology at Delft University of Technology. After graduating as mechanical engineer for The Hague University of Applied Sciences I sought new perspectives on technology and innovations in the everyday world. The past half year was a true challenge which forced me to reach beyond my skill set and has taught me many new insights.

It goes without saying that this thesis was not possible without the help and expertise of all involved. First, I would like to thank Royal HaskoningDHV for providing an inspirational and warm learning environment. I have had contact with lots of co-interns and colleagues at the Amersfoort office.

On a personal note I would like to thank Pieter Prins, daily supervisor at Royal HaskoningDHV, for his extensive knowledge of transport and planning and efforts to help my cause. With his sharp remarks and critics on my deliverables he trimmed away loose ends and ambiguous formulations. As a true project manager and strategic advisor Pieter steered my efforts towards this thesis which I am proud of. Also I would like to thank Jan Anne Annema, first supervisor at Delft University of Technology, for his guidance and belief in my subject. His amiable personality provided me confidence in conducting research according to appropriate scientific research methods. My gratitude also goes out to Bert van Wee, chair of the graduation committee, and to Laurens Rook, second supervisor, for their critical remarks and comments on my deliverables during the past six months.

Within the Smart Mobility team I would also like to thank Evert Klem and Peter Morsink, strategic advisors Smart Mobility at Royal HaskoningDHV for their involvement with my thesis. Finally I am thanking my girlfriend Therese for her unconditional trust and help with the graphical parts of my thesis.

Marlon Spaans

Delft, September 2018
Summary
There is a need for a more efficient use of existing infrastructure to improve the accessibility, liveability and safety of Dutch cities, metropolitan areas and provinces. A projected solution to growing mobility issues is Smart Mobility. The Ministry of Infrastructure and Water Management stated that the Netherlands aims to become world leader in Smart Mobility, but the transition from a vision to a detailed strategy on the implementation of Smart Mobility is still lacking. Engineering consultancy firm Royal HaskoningDHV has looked into this and concluded that there is still no centrally defined implementation strategy for Smart Mobility in the Netherlands. At this time, governmental institutes allocate their own resources in projects they believe are worth investing in, resulting in a patchwork of initiatives and no guarantee for success is given in any circumstance. From a scientific perspective, research has only been performed on the possible effects of Smart Mobility technologies. Yet, not much literature exists on the success and failure criteria for the implementation of Smart Mobility. This scientific knowledge gap is the main scientific driver of this thesis.

The main objective of this research is to gain knowledge on obstacles and opportunities for implementing Smart Mobility in the Netherlands in order to fill the knowledge gap for road authorities and science. The social and scientific relevance of the thesis project have been taken into account while constructing the research questions. The main research question is:

What are the obstacles and opportunities for implementing Smart Mobility in the Netherlands in the 2018-2023 time frame from road authorities’ perspectives?

Figure 1 shows this thesis’ research strategy. Relevant semi-structured interview topics and questions on Smart Mobility were constructed based on expert opinions, preliminary desk research and the literature review. Fourteen road authorities divided in three scale levels of government were interviewed. Two interviews were held with national road authorities, six interviews with regional road authorities, and six interviews with municipal road authorities. The interviews were transcribed as clean-read transcripts. The transcripts were coded with word-based and scrutiny-based coding techniques.

During the content analysis, seven themes and 27 underlying categories were constructed. The national and regional road authorities are clustered as frequency group 1, while frequency group 2 consists solely of municipal road authorities. The four obstacle themes and eighteen underlying obstacle categories are posed in Table 1. The three opportunity themes and nine opportunity categories are posed in Table 2. The reliability of the results was checked with an intercoder reliability check (κ = 0.528 , p < 0.001) and the validity of the research is checked by a validation workshop with experts. Figure 2 shows a frequency chart of addressed obstacle categories per frequency group and Figure 3 shows a frequency chart of addressed opportunity categories per frequency group.

Six themes were observed in total during the analysis of the coded interview transcripts. After that, eighteen obstacle and nine opportunity categories were constructed. Three obstacle categories, one obstacle theme, one opportunity category and one opportunity theme for implementing Smart Mobility in the Netherlands were found to be crucial factors for implementing Smart Mobility in the Netherlands. The obstacle categories are (1) organisational inertia, (2) the changing role of governments, (3) cooperation with other governmental institutions and market parties and (4) the theme obstacles related to execution. The opportunity category is (1) (social) benefits and the theme is (2) cooperation and knowledge sharing.
Figure 1 - Research Strategy
Obstacle categories | Theme code | Frequency group 1: National and Regional RAs (8 total) | Frequency group 2: Municipal RAs (6 total) | Total Frequency (14 total)
---|---|---|---|---
**Theme 1: Obstacles related to cooperation and knowledge sharing**
Cooperation within the organisation | C1 | 5 | 4 | 9
Cooperation between governmental institutions | C2 | 1 | 6 | 7
Cooperation with market parties | C3 | 2 | 6 | 8
Learning by doing | C4 | 6 | 2 | 8
**Theme 2: Obstacles related to inertia**
Organisational Inertia | I1 | 7 | 6 | 13
Social Inertia | I2 | 6 | 5 | 11
Political Inertia | I3 | 4 | 3 | 7
Economic Inertia | I4 | 6 | 4 | 10
**Theme 3: Obstacles related to governance**
Changing role of governments | G1 | 4 | 0 | 4
Uncertainties | G2 | 6 | 3 | 9
Policy and regulations | G3 | 5 | 4 | 10
Privacy | G4 | 3 | 3 | 6
(Digital) Security | G5 | 3 | 1 | 4
Safety | G6 | 4 | 1 | 5
**Theme 4: Obstacles related to execution**
Practical obstacles | E1 | 5 | 6 | 11
Governance obstacles | E2 | 6 | 6 | 12
Implementation obstacles | E3 | 6 | 5 | 11
Obstacles due to scale | E4 | 5 | 5 | 10

Table 1 - Absolute frequencies of addressed obstacle categories per frequency group

Figure 2 - Frequency chart of addressed obstacle categories per frequency group
### Opportunity categories

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<th>Theme code</th>
<th>Frequency group 1: National and Regional RAs (8 total)</th>
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<th>Total Frequency (14 total)</th>
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<tr>
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<td>Research, innovating and knowledge sharing</td>
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<tr>
<td>Environmental benefits</td>
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<td>1</td>
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<tr>
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Table 2 - Absolute frequencies of addressed opportunity categories per frequency group

The most frequently addressed opportunity category was social benefits. Interviewees stressed that Smart Mobility is a mean, not a goal. Social benefits were named in all sorts and shapes: social benefits for the liveability of cities, quality of life, sustainability, sense of safety, and social prosperity. Also better emergency response, parking administration and reduced pressure on the existing infrastructure are considered to be social benefits by the interviewed road authorities. The majority of the municipal road authorities claimed that Smart Mobility could enhance the inclusivity of mobility. New technologies and innovations could alter human behaviour; Smart Mobility is also letting citizens re-evaluate their travel behaviour or driving style.
Despite the various potential benefits of Smart Mobility, all road authorities named more obstacles than opportunities during their interviews. The most frequently addressed obstacle category was organisational inertia. On top of that, many interviewees had doubts whether people will accept Smart Mobility innovations and technologies in their daily lives. Concerns were shared whether Smart Mobility innovations and technologies would be fully accepted by the Dutch people in general, bearing in mind that people could have a tendency of being reluctant to change.

Data (management) was the most frequently named theme when interviewees were asked which Smart Mobility themes were within the scope of their organisation. Data (management) is viewed as the cornerstone of Smart Mobility. In other words, if the data is not properly managed, then Smart Mobility cannot be implemented with full safety and security. Organisational inertia and data management are potentially hampering factors that should be taken into account when implementing Smart Mobility in the Netherlands.

Opportunities were mentioned less than obstacles. Obstacles were more 'top of mind' for the interviewees than opportunities. Policy-makers and civil servants are more used to dealing with inert organisations and are subconsciously more aware of negative factors than positive factors. The opportunities could be limited due to the scope and resources of many road authorities, while obstacles could subsurface and be hard to detect. In the end, 'show-stoppers' are more easily recognisable than 'no-regret' measures and activities. As one interviewee said: ‘There are a thousand reasons not to do something. But only one reason is needed to start something.’

The scientific literature on Smart Mobility is far from conclusive. This thesis research is a thin cross-section of Smart Mobility efforts of road authorities in the Netherlands. However, it does give a rich image of the efforts and heuristics on Smart Mobility in the Netherlands. To provide structure for future development, there is a clear need for a broadly supported and robust “Smart Mobility Roadmap” that defines transitional aspects and provides an adaptive strategic skeleton for weighing and structuring current and future initiatives, thereby reducing the number of uncertainties for decision makers at different levels.

One of the needs for future research is the evaluation of market penetrations of the most frequent Smart Mobility innovations. Thereby, more research should be done into (dynamic) adaptive policy planning regarding break-through technologies and innovations. For instance, research on dynamic policy pathways has been done on fairly static and long-term infrastructure projects such as water management and bridges. Deep uncertainties related to the effects on policy planning of Smart Mobility have not yet been researched.

Data and privacy ownership is also topic gaining importance. In a swiftly digitalising world, legislation and protocols do not evolve as fast as the subjected technologies. Research is required in order to provide a standardised framework for safe and secure (digital) systems. Research on Smart Mobility contingency planning is suggested in order to cope with external events that hamper the data management infrastructure. A standardised contingency framework could be helpful for governmental institutions and private firms in order to provide a robust and resilient Smart Mobility system.

Implementing new Smart Mobility technologies might lead to a point of no return. In that scenario, certain path dependent trajectories have been created which steer the future scenarios of Smart Mobility. Combining the theory of (deep) uncertainties, dynamic adaptive policy planning and a Delphi study on the future scenarios of Smart Mobility in different countries could lead to a better understanding of factors for successful implementation, show-stoppers and no-regret measures in a wider context.
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1 Introduction

The accessibility of Dutch cities is declining at a fast pace (Van Dijk, 2017). The growing demand for mobility puts stress on the infrastructure (NOS, 2017a). Extra asphalt is merely replacing bottle necks of traffic jams to other intersections (NOS, 2017b). There is a need for a more efficient use of existing infrastructure to improve the accessibility, liveability and safety of Dutch cities, metropolitan areas and provinces (Ministerie van Infrastructuur en Milieu, 2017a, pp. 9-13).

The Dutch Ministry of Infrastructure and Water Management (2017b) stated that in the 2014-2016 period the amount of traffic jams increased by forty percent. If no actions are undertaken, the amount of traffic jams in the 2014-2021 period is estimated to increase by sixty-eight percent. Around 1.2 million people in the Netherlands commute daily by train and this number grows by 2.5 percent per year. In the Randstad the annual growth in population is 5 percent. Worldwide mobility is expected to grow from 23 billion kilometres per year today to 105 billion kilometres in 2050 (Schafer & Victor, 2000). In the Netherlands, car ownership is growing and in all scenarios car use and traffic increase from now until 2030 (CE Delft, 2018). The growing of mobility is due to cheaper travel, more travel options, growing population and globalisation. The finite fossil fuel reserves will lead to increasing costs of transport (Wegener, 2013). There is a direct need for attractive technical and societal transport solutions in order to maintain the affordability of transport.

A projected solution to the growing mobility issues is Smart Mobility. The phenomenon Smart Mobility is relatively new. Smart mobility is a cyber physical system that allows vehicles to be operated autonomously (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). Smart Mobility allows people to move while all movements, in the most abstract way, are calculated, tuned and adjusted for the sub optimal level of travel for all users involved. The implementation of Smart Mobility is comparable to the implementation of other vast ICT projects in the past, such as television and internet. These technologies did not have pre-determined development and implementation trajectories, resulting in opportunity- and demand driven early stages of evolution towards their more strategically current state. The same is true for the development and implementation of Smart Mobility; only when Smart Mobility is actively implemented into society and multiple systems become dependent on the underlying architecture, then the future trajectory could be managed even more strategically.

1.1 Research problem

The Ministry of Infrastructure and Water Management stated that the Netherlands wants to become world leader in Smart Mobility (NOS, 2017c; Ministerie van Infrastructuur en Milieu, 2016), but the transition from a vision to a detailed strategy on the implementation of Smart Mobility is lacking. Several collaboration initiatives have been conducted or concluded. In order for the Netherlands to become a worldwide authority on Smart Mobility, all tangible and intangible development must be coordinated and guided by the same framework or roadmap. Among all layers of government, from Ministries to road authorities, provinces, and large cities, the ambition to create a sustainable and valuable infrastructure is pressing. All these governmental institutions are in different stages of strategy development on Smart Mobility. Due to this lack of coordination among the different governmental institutions different implementation routes with different realisation effectivity are being chosen.

A characteristic of ground-breaking technological innovations, such as Smart Mobility, is that there are many (scientific) uncertainties (Marchau, Walker, & Van Wee, 2009). Engineering consultancy firm Royal HaskoningDHV has researched and experienced that there is no centrally defined implementation strategy for Smart Mobility in the Netherlands (Prins, 2017). At this time, governmental institutes allocate their own resources in projects they believe are worth investing in. Yet, no guarantee for success is given in any circumstance. From road authorities’ perspectives, Smart Mobility is an umbrella term; all kinds of connected
and communicating mobility applications are included. Royal HaskoningDHV has experienced an increasing demand for guidance and governance of Smart Mobility by road authorities (Ammerlaan & Lieshout, 2018).

From a scientific perspective, only research has been performed on the possible effects of Smart Mobility technologies (Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014; Fagnant & Kockelman, 2015; Grossi & Pianezzi, 2017). Yet, not much literature exists on the success and failure criteria for the implementation of Smart Mobility (Jeekel, 2016). This scientific knowledge gap is the main scientific driver of this thesis research.

1.2 Research objective and research scope

In order to better understand what Smart Mobility can contribute, socially and economically, to the Netherlands, Royal HaskoningDHV has proposed a research into the activities and possibilities for road authorities in the Netherlands. The main objective of this thesis project is to close the knowledge gap on the success and failure criteria (respectively named obstacles and opportunities in this research) and status quo of Smart Mobility in the Netherlands.

A research strategy has been developed in order to research the phenomenon of Smart mobility in the Netherlands. Firstly, data and information is collected from several road authorities on different scales: National, Regional and Municipal. The data and information in combination with scientific literature on innovative and adaptive policy-making can be used to compare the different road authorities within the Netherlands. Following this comparison similarities, differences and discrepancies between the subjected road authorities can be depicted. Simultaneously, the obstacles and opportunities of Smart Mobility according to the subjected road authorities are researched.

The scope of the thesis project is constructed within the domain and interest of Royal HaskoningDHV, while maintaining scientific focus to close the scientific knowledge gap. The focus is on past, current and future perceived obstacles and opportunities of road authorities in the Netherlands. Only the perspectives of road authorities in the Netherlands on three scale levels (national, regional and municipal) have been measured.

1.3 Research questions

The main objective of this research is to gain knowledge on obstacles and opportunities for implementing Smart Mobility in the Netherlands in order to fill the knowledge gap for road authorities and science. The social and scientific relevance of the thesis project have been taken into account while constructing the research questions. The main research question is:

What are the obstacles and opportunities for implementing Smart Mobility in the Netherlands in the 2018-2023 time frame from road authorities’ perspectives?

The sub research questions are divided into two categories: The first two questions are on the ‘what’ of Smart Mobility. The last three are on the ‘how’ of Smart Mobility:

1. What do the subjected road authorities consider to be ‘Smart Mobility’?
2. What do the subjected road authorities foresee as potential obstacles and opportunities for implementing Smart Mobility in the Netherlands?
3. How do the subjected road authorities govern their investing in researching, developing and implementing of Smart Mobility in the Netherlands in order to overcome obstacles and exploit opportunities?
4. How do the subjected road authorities interact with each other and with other institutions in order to overcome obstacles and exploit opportunities?
5. How are Smart Mobility-related developments organised in both the public and the private domain in order to overcome obstacles and exploit opportunities?

1.4 Relevance to the MOT programme

The Management of Technology (MOT) programme teaches students to explore and understand how firms and institutions develop, implement and use complex technologies. MOT provides students with scientific knowledge on how to cope with technological innovations in a corporate setting. At the base of the programme is learning to analyse technologies and their impact on firms and society. A typical MOT thesis should contain a scientific study in a technological context: Smart Mobility is such a technological innovation. Smart Mobility is a novel set of technologies and innovations of which the impact on society is not yet determined. The study also relates Smart Mobility as both a new artefact for all people to use as well as a corporate resource for firms, research institutes and governmental organisations to explore and exploit. Engineering and consultancy firm Royal HaskoningDHV wants to gain knowledge on the obstacles and opportunities of road authorities to better facilitate their Transport & Planning services. The thesis demonstrates how scientific methods and techniques to analyse a problem are used, as put forward in the MOT curriculum. The research into the implementation of Smart Mobility in the Netherlands is pure qualitative study based on interviews, expert opinions, policy documents and (scientific) literature.

1.5 Thesis outline

Chapter 2 provides a literature review on Smart Mobility definitions, adaptive policy planning, decision making under (deep) uncertainty. Chapter 3 poses the research strategy of this thesis: scientific methods are explained, limitations are named and the research steps are elaborated upon. The results and main findings are presented in chapter 4. Chapter 5 gives interpretations of the main findings. The conclusion of this thesis complemented by a discussion on interpretations, limitations, relevance and recommendations on future research are presented in chapter 6.
2 Literature review

The literature review is used in the beginning of the thesis to construct an inductive research design. It frames the problems and challenges of road authorities regarding the implementation of Smart Mobility in the Netherlands as well as around the world. The literature is a context-building exercise. By researching scientific literature and investigating available policy documentation, main themes are depicted. These main themes are used as input for the interviews, as they describe technological artefacts with large subjectivity. The scientific literature was snowballed, which means that adjacent scientific articles were found and researched based on prior searched articles. Scopus and Google Scholar are the two primary used scientific search engines.

Additional (scientific) information and knowledge is required in order to answer the research questions of this thesis. This chapter establishes the multidimensional context of implementing novel innovations on a large scale by governmental institutions. Four main topics are researched. First, the apparent knowledge gap is elaborated upon. Secondly, the definitions of Smart Mobility are discussed. Thirdly, obstacle and opportunity criteria are researched based on the case of implementing self-driving cars on public roads. After that, theories on policy- and decision-making under (deep) uncertainty are researched. The literature review is concluded by a brief elaboration on adaptive policy planning.

2.1 Knowledge gap

The world’s largest non-profit organisation on unmanned systems and robotics, The Association for Unmanned Vehicle Systems International (AUSVI), has formulated several sub areas of Smart Mobility that require further scientific research (Fagnant & Kockelman, 2015; Transportation Board AUVSI, 2014), of which two are closely related to the research objectives of this thesis: Roadway management and operations and near-term deployment opportunities. In this thesis these two subjects are closely researched. A preliminary analysis based upon available documents and policy statements on Smart Mobility offered by governmental institutes in the Netherlands showed that different definitions and premises are used (Jeekel, 2016). Thereby, the term Smart Mobility is often used inconsistently within sources. This is due to the relatively novel and innovative characteristics of Smart Mobility. The current definitions and potentials of Smart Mobility are largely based upon wishful premises and futuristic outlooks. The Dutch ministry of Infrastructure and Water Management aims to take the lead in the developments of self-driving vehicles internationally (Government of the Netherlands, 2018). Despite this ambition, the transition path from vision to strategy and implementation has not been formulated; a detailed roadmap or implementation strategy is not available on governmental websites. Moreover, the scientific literature describes governmental efforts in general, but the specific efforts by road authorities on multiple scale levels are not discussed.

2.2 Definitions of Smart Mobility

This paragraph describes the definitions and scope of Smart Mobility from multiple angles. This first research into Smart Mobility is to provide a better grasp of which innovations, technologies and efforts are considered to be Smart Mobility. A working definition of Smart Mobility is needed in order to establish a common understanding of the topic for the further thesis.

Smart Mobility is one of six components of a Smart City. There are many different definitions of a Smart City (Caragliu, Del Bo, & Nijkamp, 2009; Nam & Pardo, 2011; Albino, Berardi, & Dangelico, 2015; Benevolo, Dameri, & D’Auria, 2016). The label Smart City is fuzzy and often used inconsistently (Nam & Pardo, 2011). The concept is fairly well known, yet the discrepancy between the used terminology and taxonomy stays (Benevolo, Dameri, & D’Auria, 2016). Hollands (2008) acknowledges a lack of definitional precision. The article poses smart city as an “urban labelling” phenomenon, especially to reveal as well as hide certain aspects of a city.
From a marketing perspective the word smart indicates a smartness of a product or service from a user’s perspective (Klein & Kaefer, 2008). This is comparable to the use of smart in smartphone, where the smartphone offers a better user experience while fulfilling the same function as a conventional cellular phone, namely wireless telecommunication. Also from a marketing and societal acceptance perspective, the word smart is more prudent than the word intelligent (Nam & Pardo, 2011). A smart product comes across more user-friendly than an intelligent product. A Smart City would therefore be a city that can adapt to the desires and need of users and could provide a different customised interface per user (Marsa-Maestre, Lopez-Carmona, Velasco, & Navarro, 2008).

There are three fundamental components which make a city smart. The three categories of core factors of a Smart City are technology factors, institutional factors and human factors (Nam & Pardo, 2011). Technology factors entail infrastructures of hardware and software, institutional factors entail governance and policy and human factors entail creativity, diversity and education of people. (Caragliu, Del Bo, & Nijkamp, 2009).

Initially, a Smart City is based on four components: industry, education, participation and technical infrastructure (Giffinger, et al., 2007). For instance, industry has changed from manual manufacturing in the Industrial Revolution to Industry 4.0. Automated communicating cyber-physical systems transform conventional industries into more flexible, decentralised and resource efficient industries that can deliver more individualised products and services on demand (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). The application of automated and autonomous cyber-physical systems in industry create Smart Factories (Lucke, Constantinescu, & Westkämper, 2008). These concepts of combining physical assets with the ability to communicate creates Industry 4.0 applications (Jazdi, 2014).

After the first definition of Smart City, components, Giffinger & Gudrun (2011) researched the different and more detailed components and constructed a framework of six main components of a Smart City: Smart Economy, Smart People, Smart Governance, Smart Environment, Smart Living and Smart Mobility. The latter is related to the logistics and infrastructural aspects of urban life (Lombardi, Giordano, Farouh, & Yousef, 2012).

The term Smart Mobility is often called an ‘umbrella’ term for various digitalised transport applications (Fagnant & Kockelman, 2015; Transportation Board AUVSI, 2014). Furthermore, Jeekel (2017) states that Smart Mobility is a concept that is not yet completely researched in the academic world. Jeekel found that Smart Mobility is the more active concept that has rapidly replaced the former concept Sustainable Mobility. Smart mobility is a cyber physical system that allows vehicles to be operated autonomously (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014). Establishing a definition for Smart Mobility allows for better use of public resources and an increased quality of services provided by the government to citizens while reducing the operational cost of public administration (Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014). Based on web research of fourteen web sites on Smart Mobility, Jeekel appoints four main themes: data, vehicle technology, intelligent traffic systems (ITS) and new multimodal travel platforms. Appendix D summarises the mission statements and definitions of Smart Mobility used by the interviewed road authorities. Not one definition exists, but multiple definitions coexist. This this also researches the scope of road authorities.
2.3 Obstacles and opportunities

The main research question is on the obstacles and opportunities for Smart Mobility in the Netherlands in the near future. It is important to research the pitfalls and lessons learnt in order to better understand the difficulties around Smart Mobility. The scientific literature on Smart Mobility in this chapter is not contained to the Netherlands only. Valuable information and insights can be distilled from research on governments and road authorities around the world.

Fagnant and Kockelman (2015) provide an important article on success factors for implementing one Smart Mobility technology, namely self-driving cars. Potential success factors are described in overview; factors such as personal safety, traffic flow, travel and parking behaviour, freight transportation, vehicle ownership, mobility accessibility, cost of transport and less insurance claims. Obstacles for the implementation of self-driving cars are described; liability issues, risk perception and acceptance, security of systems. Overakkerr (2017) researched that a hypothetical fatal accident caused by an Autonomous vehicle’s (AV) technical error is regarded as at least four and a half times more severe than one caused by human error. In the case of intentional abuse, like a fatal accident due to a hacked car, this is a factor of six. This shows that the social acceptance for AVs is low and that the fear for AVs is relative high, despite that AVs are rationally more safe than human driven cars.

Some factors are both a potential success factor and a potential obstacle. Table 1 shows various factors that are positively and/or negatively influenced by the introduction of AVs on public roads. For instance: travel behaviour (better traffic flow (Anderson, et al., 2014) versus more vehicle use and traffic congestions due to a ‘rebound effect’ (Litman, 2017)) and cost of transportation (reduced cost due to less accidents (Walker Smith, 2013) versus use of expensive novel technologies in AVs (Asadi Bagloee, Tavana, Asadi, & Oliver, 2016)). Table 1 shows that almost all factors are researched as both potential success factors or as potential failure factors of autonomous vehicles. This table shows that there is no scientific consensus on this topic. Following this line of thought, other Smart Mobility topics might deal with the same lack of agreement on the potential success and failure criteria. This thesis research into the obstacles and opportunities of Smart Mobility as a whole could give new insights into the ambivalent factors of implementing Smart Mobility technologies and innovations.

Besides tangible and relatively easy measurable factors there are also less obvious obstacles to self-driving cars. Liability, risk perception and social acceptance are mentioned often as potential obstacles or even show-stoppers (Colonna, 2012; Pudane, et al., 2016). McCarthy (2009) describes the social, legal and ethical obstacles of autonomous systems. Firstly, there is the threat of social exclusion (can people drive conventional cars on roads design for AVs?). Secondly, liability, insurance and accident management are black boxes at the moment. Lastly, privacy is a main issue that requires attention. One framework for that is Privacy by Design. Privacy by Design is developed by Information and Privacy Commissioner of Ontario, the Authoriteit Persoonsgegevens and TNO (Van Hes & Borking, 2000; Hustinx, 2010). Privacy by Design means that during the development of products and services, such as information technology systems, privacy aspects are accounted for. During the development process extra (safety) measures could be undertaken to build a protection layer for protecting personal data. These measures are called Privacy Enhancing Technologies (PET). All Smart Mobility related technologies, innovations and developments should require intense monitoring on potential social, legal and ethical issues in order to create a solid base for the implementation of Smart Mobility products and services on a large-scale.
### 2.4 Governance and uncertainties

Many difficulties of implementing Smart Mobility are associated with (scientific) uncertainties (Marchau, Walker, & Van Wee, 2009). This chapter is about identifying uncertainties, coping with uncertainties and policy-making in an uncertain world. Preliminary research showed that governmental institutions in the Netherlands are looking for a more dynamic approach to long-term investments in infrastructure. Therefore the main focus of this chapter is adaptive policy-making.

#### Models on innovations, market adaption and large scale diffusion

Successfully implementing new technologies is dependent on various external factors. In order to understand why some technologies and innovations do or do not take off, it is useful to look at several technology and innovation implementation frameworks. These frameworks explain the underlying factors and concepts for policy-making with regard to (scientific) uncertainties. Defining uncertainties, innovation
models and market adaption models help understanding the mechanisms why some technologies and innovations flourish while other prospected innovations never see the light.

There are many models for characterising technological innovations and market adaption. The four-stage technology cycle (Tushman & Anderson, 1986) provides an oversight in four phases of a technology: technological discontinuity, era of ferment, dominant design and era of incremental change (Figure 1). Abernathy and Utterback (1978) discuss the difference between product innovations and process innovations over three phases: fluid phase, transitional phase and specific phase (Figure 2). Another well-spread model is the technology S-curve for technology adaptation and market penetration. The S-shaped curve (Figure 3) shows the cumulative sales of a specific product summed by all sales over all companies involved (Ortt, Zegveld, & Shah, 2007). Ort and Schoormans (2004) show large-scale diffusion patterns in three different phases: Innovation phase, adaption phase and market stabilization phase (Figure 4).

Concludingly, the market penetration of technologies and innovations is suggested as an S-curve in the market stabilisation phase with the classical depictions of certain adopter group: innovators, early adopters, early majority, late majority and laggards (Schilling, 2013).

These models help understanding the different phases of technology implementation, yet underlying factors are not given. In the next paragraph the concept of uncertainty is explained and related to policy planning.
(Deep) uncertainty

Uncertainties are the underlying principle that makes investing, product placement, decision-making and governing non-routine and with risk. Understanding the characteristics of uncertainties is essential for policy makers in order to make reliable long-term urban and spatial plans.

Walker, Marchau and Swanson (2010) adopted a definition on deep uncertainty, also known a scientific uncertainty: “the condition in which analysts do not know or the parties to a decision cannot agree upon (1) the appropriate models to describe interactions among a system’s variables, (2) the probability distributions to represent uncertainty about key parameters in the models, and/or (3) how to value the desirability of alternative outcomes”. Table 2 provides an overview of different levels of uncertainty. It shows that including variations of future scenarios on an increasing scale of uncertainty. The Smart Mobility market could provide technologies and innovations to road authorities in line with various future scenarios, depending on the course set by policy-makers and politics. The mission values and goals of the interviewed road authorities are included in appendix D. Private firms could play part in the innovation process by extracting the need formulated in those mission values and goals.

Popper et al. (2009) states that traditional decision-making methods, in all domains, are “founded on the same shoals: an inability to grapple with the long-term’s multiplicity of plausible futures.”

<table>
<thead>
<tr>
<th>Uncertainty</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>Clear future scenario with small deviation</td>
<td>Alternative future scenarios with assigned probabilities</td>
<td>Alternative future scenarios (ranked)</td>
<td>Variation of future scenarios (unranked)</td>
<td>Unknown future</td>
</tr>
<tr>
<td>Execution</td>
<td>Simple model, multiple sources of information available</td>
<td>Simple model, multiple scenario’s with assigned probabilities and reliability intervals</td>
<td>Ranked model based on multi-criteria analyses</td>
<td>Model based on policy-makers’ expertise. No consensus due to lack of knowledge and/or agreement</td>
<td>No model available</td>
</tr>
</tbody>
</table>

Table 2 - Levels of uncertainty (adapted from (Walker, Lempert, & Kwakkel, 2013))

Acknowledging uncertainties and the effort to map those are a step towards informed decision-making and policy-making processes. The next chapter elaborates on (dynamic) adaptive policy planning and the impact of uncertainties on policy-making.
2.5 Adaptive policy planning

Planning large infrastructural projects can be complex due to size, budget and interdependencies. Besides practical obstacles there can be many social, environmental and organisational obstacles while conducting large infrastructure projects. Projects in the Netherlands have difficulties with steering Smart Mobility technologies and innovations (SmartwayZ.NL, 2016). Maier et al. (2016) suggest adaptive strategies are increasing in importance and are used more commonly by static organisations. There is a call for a more adaptive approach for implementing break-through innovations and technologies (Armitage, et al., 2009; Núñez Velasco, 2016).

Adaptive Policies

In order to understand the possible difficulties that road authorities could experience and how planning policies could help to overcome those, some adaptive policy frameworks and strategies are reviewed.

Firstly, Walker, Adnan Rahman and Cave (2001) pose that policies should be adaptive, devised not to be optimal for a best estimate future, but robust across a range of plausible futures. Adaptive policies grasp near term goals and actions. These actions are time urgent, important commitments to shape the future and are needed to preserve the needed flexibility for the future. Walker, Adnan Rahman and Cave propose an approach to policy formulation and implementation that explicitly confronts the pragmatic reality that policies are adjusted as the world changes and as new information becomes available.

Kwakkel, Walker and Marchau (2010) developed a process diagram of adaptive policy-making that is often adopted in scientific literature (Figure 6). This process diagram is used by researcher to build adaptive policy-making frameworks (Kwakkel & Van der Pas, 2011; Haasnoot, Kwakkel, Walker, & Ter Maat, 2013; Hamarat, Kwakkel, & Pryt, 2013; Pas, Walker, Marchau, Wee, & Kwakkel, 2013; Saritas, Dranev, & Chulok, 2017).

Secondly, following the adaptive policy approach is Dynamic Adaptive Policy Planning (DAPP) (Haasnoot, Kwakkel, Walker, & Ter Maat, 2013). Based on the adaptive policy-making steps in Figure 6, a DAPP approach is constructed (Figure 5). It is a combination of the Adaption Pathways approach and the Adaptive Policymaking approach (Walker, Haasnoot, & Kwakkel, 2013). DAPP presents a variety of scenarios with relevant uncertainties over time. In a workshop pathways
can be assembled and managed from a set of promising pathways into a set of preferable pathways (Figure 7).

Finally, to understand why technologies are or are not adopted, it is important to pay attention to the established literature on diffusion of innovations and the adaption of new technologies. Another framework for implementing technologies, while dealing with (deep) uncertainties, is STREAM (Popper, et al., 2013). STREAM stands for Systematic Technology Reconnaissance, Evaluation and Adaption Method. It poses a five step framework for implementing technologies under special conditions, such as deep uncertainties, non-financial benefits and large investment costs. The five steps are: frame, identify, characterize, compare, and decide. By framing the problem, goals can be specified. These goals can be achieved by a technology, in this case by Smart Mobility technologies. In case of transportation goals such as traffic flow, accessibility and liveability, multiple Smart Mobility concepts and technologies can be depicted as useful. This is the identification phase. The third phase is to characterize the alternative technology applications. This can be done in multiple ways, but most common are effects on mission/goals, barriers for successful implementation and costs. After reviewing these comparison components, the different technology applications can be mapped against each other in a matrix. It is in that matrix that trade-offs and alternatives become apparent. STREAM is a potentially valuable framework for implementing Smart Mobility related technologies into public life.

Interview questions are developed based on the scientific literature on (dynamic) adaptive policy making in order to answer the third sub research question. Concluding this literature review is a short summation of public-private partnerships and its gaining importance in Dutch endeavours in urban and spatial planning. STREAM was presented during validation workshop to validate the use of technology reconnaissance and implementation frameworks.

Public-Private Partnerships
The previous sections have shown that limitations due to governmental traditional characteristics could be overcome by implementing new strategies for products and services. A suggested could be approach is Public-Private Partnerships (PPP). Public Private Partnership (PPP) is a form of governmental procurement where public and private parties collude on projects. This form of collaboration often comes in a DBFM(O) (Design, Build, Finance, Maintain, and Operate) contract. PPP is not a new concept and not a fully integrated one either. Wolting, Bregman, and Pool (2012) describe multiple key characteristics of PPP such as a mutual
(financial) responsibility and liability, societal and commercial benefits, and preservation of the respective identities while also creating a shared identity. With respect to Smart Mobility projects this approach creates a more balanced synergy between the governmental institutions, road authorities and technology firms.

The scientific literature has shown that there are many knowledge gaps around policy-making in a fast-paced and changing world. This literature review forms the base for the construction of the semi-structured interviews with road authorities in the Netherlands. The next chapter discusses the research methods and strategy in order to come to a rich understanding of what the potential obstacles and opportunities for Smart Mobility in the Netherlands are from road authorities’ perspectives within the 2018-2023 time frame.
3 Methodology

This chapter presents the research methodology needed in order to answer the main research question. The chosen strategy consists of a literature review, cross-case study and semi-structured interviews. The cases studied are efforts for research, testing and implementing Smart Mobility in the Netherlands by various road authorities.

3.1 Research strategy

Sekeran and Bougie (2013) argue that there are three categories of studies: exploratory, descriptive and causal. On one side, exploratory studies are performed on subjects where no information is present. This category of study requires extensive preliminary work to understand the phenomenon studied. On the other hand, causal studies are performed on subjects where a variable is tested whether or not it causes another variable to change. This category of study requires an established set of dependent and independent variables. The last category, the descriptive study, meets in the middle of exploratory and causal case studies.

This thesis is a descriptive study. A descriptive study is designed to describe characteristics of situations, persons or events. Descriptive studies help understanding the characteristics of groups in certain situations. In this thesis, the characteristics of Dutch road authorities are researched for the situation of implementing Smart Mobility in the 2018-2023 time frame. Moreover, this thesis systematically creates an understanding of the situations by depicting the obstacles and opportunities for the implementation of Smart Mobility. In the end, results and the conclusion are shared and recommendations for future research are made.

Multiple research strategies were considered in order to answer the main research question “What are the obstacles and opportunities for implementing Smart Mobility in the Netherlands in the 2018-2023 time frame from road authorities’ perspectives?” Initially, among the strategies were focus groups, Q-methodology and a Delphi study. Due to the novelty of the subject and the deep uncertainties that come with implementing Smart Mobility, the Delphi study would not have given a conclusive consensus without reasonable doubt. The Q-methodology and focus group set-up were considered due to its practical set-up and insightful statistical analysis based exploratory factor analysis. Time is the main limitation of these research methods. Due to the short period of this thesis, Q-methodology and focus groups were not chosen. Instead, an in-depth semi-structured interview approach was chosen to identify current obstacles and opportunities of Smart Mobility in the Netherlands, as seen by the interviewees.

Figure 8 shows a graphical representation of the research strategy framework. The research is divided into four main phases complemented by verification steps throughout the research. In the set-up phase the initial thesis scope is established and redefined in several rounds. The interview questions were made after finalising the scope and research question. Relevant interview topics and questions on Smart Mobility were constructed based on expert opinions, preliminary desk research and a literature review. The second phase is the data collection phase. After potential interviewees agreed on an interview, a date is scheduled on the interviewee’s preferred location. The interview is conducted after a short personal introduction between interviewer and interviewee. Before the interview starts, the interviewee is asked if the interview can be audio taped in order to transcribe the interview based on audio data. Audio taping allows the interviewer to better focus on the interview topics and questions, being able to ask sharper and more in-depth questions. Of all conducted interviews only one interviewee had not given permission to audio tape the interview. A transcript was made directly after conducting the interview.

Qualitative research can be organized in multiple ways. For this thesis a literature review (of scientific literature and policy documents) and semi-structured interviews were chosen.
Interviews generate valuable data and insights. By codifying tacit knowledge of stakeholders involved a complex network of actors, efforts, attitudes and motives can be observed. By posing the right questions new insights can be derived from the information given. The answers to the interview questions can be generalized and used to answer the research question in order to solve the problem statement.

Qualitative research is not only about posing the right questions and follow-up questions, the more important part is to test several hypotheses during the interview. Tentative categories are created through a cyclical process of depicting, comparing and reflecting on the data. The tentative categories form constructs and variables that closely decompose the empirical research data. Qualitative research is a partly unpredictable creative process where procedures help guide the whole. Success is not guaranteed, yet the replicability and continuation of the research is promoted.

![Figure 8 - Research strategy](image-url)
3.2 Qualitative research

This thesis is a qualitative research into the obstacles and opportunities of implementing Smart Mobility in the Netherlands. According to Evers (2015) six characteristics can be named as common denominators for qualitative research:

1. Direct observation in ordinary/natural situation
2. The researcher is explicitly present in the data collection
3. The inductive approach prevails (in most cases)
4. The respondents' perspectives are central
5. Holistic and contextual approach
6. Research results usually in a narrative form

All six criteria are upheld in this thesis: (1) the interviews are conducted in a non-experimental setting. There is direct contact between the researcher and the interviewees. (2) By collecting the data first hand, the researcher is explicitly present during the data collection. (3) The results are inductively derived by a process of generalisation of empirical data. (4) The interview transcripts form the most important source of empirical data. (5) The research is on a high abstraction level: processes, negotiations and decisions are the main focus of the interview. (6) The research results are transcribed before being codified into a narrative.

Van Zwieten and Willems (2004) argue that the role of the researcher in quantitative research is minimized in order to minimize subjective results, interpretations and conclusions, while in qualitative research this minimization of the researcher’s interpretations is not desirable. Qualitative research relies highly on the expertise, diligence, and contribution of the researcher. The almost inevitable subjectivity of the researcher is not expected to be eradicated. Instead, the distorted picture of the results is countered by reporting the researcher’s role as transparently as possible. Creswell (1997) poses five instances in which qualitative research is most valuable:

1. Situations where little research has been conducted
2. Situations which have yielded much research (results), but divergent/opposite conclusions which need to be tested or explained
3. (Highly) complex or dynamic situations
4. When quantitative research for practical or ethical reasons is undesirable
5. Meaning making to humans and/or their behaviour

The strategies of inquiry are phenomenology, grounded theory, ethnography, case study and narratives. In this thesis research in-depth semi-structured interviews are conducted. The practices which are used in this research are: Collection of participant (interviewee) statements, focus on a single concept or phenomenon (Smart Mobility), studying the context/setting of the participants (road authorities), interpretations of the data and validation of the accuracy of findings.

3.3 Interview methodology

Dutch road authorities are the unit of analysis for this thesis project. Road authorities are governmental institutes that have the responsibility to develop, construct and/or maintain public roads. This unit of analysis is top-down subdivided into three main scale levels: national (Ministry of Infrastructure and Water Management, Rijkswaterstaat), regional (provinces and metropolitan areas), and municipalities.
Fourteen interviews are conducted in total in order to obtain insights into the status quo of Smart Mobility related efforts and achievements. The interviewees have been selected to represent a sample according to the composition of road authorities in the Netherlands. Table 3 gives an overview of the respondents across three scale levels of government. The respondents are strategic advisors and/or project managers that represent a broad set of skills and experience in the field of urban planning, technological innovations and (next-generation) infrastructures. All subject road authorities had formulated, in the widest sense, a strategy on Smart Mobility. This included a wide variety in topics, such as AVs, Internet of Things (IoT), Mobility as Service (MaaS) and Connected and Intelligent traffic systems (C-ITS).

### Table 3 - Number of interviews per government level

<table>
<thead>
<tr>
<th>Type of government</th>
<th>Number of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>National (Ministry of Infrastructure and Water Management and Rijkswaterstaat)</td>
<td>2 (1 + 1)</td>
</tr>
<tr>
<td>Regional (Provinces and Metropolitan regions)</td>
<td>6 (4 + 2)</td>
</tr>
<tr>
<td>Municipalities</td>
<td>6</td>
</tr>
</tbody>
</table>

Based on policy documents and expert opinions within Royal HaskoningDHV and TU Delft, a shortlist of Dutch road authorities has been constructed. Every road authority has different priorities, resources and strategies. The road authorities that have profiled their own institute as a prominent stakeholder in implementing Smart Mobility in the Netherlands fall within the research scope of this thesis.

#### 3.3.1 Types of interviews

Generally there are three types of interviews: unstructured interviews, structured interviews and semi-structured interviews. Unstructured interviews are interviews without a predetermined set and sequence of interview questions. This type of interviews would be useful as preliminary research for a broad problem area. Structured are interviews with pre-determined set and sequence of interview questions. This type of interviews would be useful if a specific research has to be conducted. Structured interviews are more commonly used in quantitative or mixed-methods research settings.

The format chosen for the interviews in this thesis research is semi-structured, which provides a clear casket and structure for all interviews while leaving space to also focus on surprising topics and visions. The qualitative research requires a smaller population than quantitative research. As a subjectivist, I believe that there is more than one truth and that there is not but one way to go with Smart Mobility. An interview allows me, as a researcher, to discover perceptions, visions and beliefs of different road authorities.

The semi-structured interviews are conducted on locations chosen by the respective road authorities. This was done to make the obstacles for complying with the interview as low as practicable. The research area of Smart Mobility is complex and it requires opinions, philosophies, interpretations and experiences. In this phase of the thesis project what concepts and results are most important was not yet determined. The framework of Smart Mobility is more important than the artefacts within it. The interviews are recorded, transcribed and coded. In this phase it was also not yet determined what exact technique and prerequisites for the data would be applicable. Certain trends and patterns are discovered during the content analysis from the interview transcripts. These patterns form the basis for the coding and analysis of the data. The interviews are summarised and fed back to the interviewees. It is a maximum two page summary in which the key points, opinions and statements of the interviewee are listed. The interviewees can approve and/or complement the summary if needed.
3.3.2 Interview process

The construction of interviews can be an iterative and time-consuming task. The questions have to be formulated unambiguously in order to gather reliable data. Validity is important in order to make conclusive statements and interpretations. In other words, can the answers given by the interviewees contribute to answering the sub questions of the research? The process of constructing, conducting and analysing interviews is shown in Figure 9:

1. The required information for the research was determined.
2. Questions were prepared based on the findings of the literature review, desk research and expert opinions of Royal HaskoningDHV senior (policy) advisors.
3. Using the large network of Royal HaskoningDHV and searching for contact information on large knowledge platforms, such as Talking Traffic, Better Benutten and Connekt, candidates were contacted for an interview. For each road authority an interview invitation was sent to the managing personnel. These were responsible managers agreed upon by experts within Royal HaskoningDHV and in consultation with the subjected road authorities.
4. Respondents that agreed upon an interview were interviewed over the course of three months. Thirteen out of fourteen interviews have been audio-recorded. Recording interviews allows the researcher to focus more on the interview and less on writing down of answers and memorising replies on specific questions.
5. Interviews were conducted at the interviewee’s location of choice.
6. Transcripts were made of the interviews directly after the interviews were conducted. The transcripts were sent to the interviewees in order to verify and approve the transcript. In some cases follow-up questions were asked if some topics had not been asked, discussed or elaborated on during the interview.
7. The analysis phase was started after all the data is collected. During the analysis phase the transcripts are coded and the results are processed. Results in this thesis research are merely the frequencies of certain codes, categories and themes that were found during the analysis. During the conclusion phase the findings and the conclusions are presented.
8. After coding the interview transcripts certain themes and categories emerged from the results. The results are presented in chapter 4. Seven main findings from chapter 4 are discussed in chapter 5.
3.3.3 Sampling interviewees

Glaser and Strauss (1967) argue that regarding theoretical sampling 20 expert interviewees are sufficient for obtaining the maximum variation of a phenomenon. In other words, a sample larger than 20 respondents should lead to little new data, concepts and themes (Sandberg, 2000). The road authorities in this research have all been selected based on their leadership and/or expertise in the area of Smart Mobility.

The population of road authorities in the Netherlands is such a specific unit of analysis that the variation in possible answers is smaller than a broader unit of analysis. For instance, the unit of analysis ‘potential autonomous car buyers in the Netherlands’ is a less specific research group and could therefore lead to a greater variation in statements, answers and behaviour. In case of the implementation of Smart Mobility in the Netherlands the population is significantly smaller. Only governmental institutions have diffusion power on the actual implementation. The sample in this thesis research was drawn from a population of 388 municipalities, 12 provinces and 2 nationwide governmental institutions.

The participants are selected based on their efforts on Smart Mobility. In light of Roger’s (2010) classic Diffusion of Innovations, first edition in 1962, and Moore’s (1991) marketing classic Crossing the Chasm, the ideal participants are regarded as ‘innovators’ or ‘early-adopters’ on Smart Mobility from a governmental perspective. These two categories can be considered as first movers, providing deep insights in Smart Mobility in spatial planning situations.

Fourteen interviews were conducted in total, resulting in 30,000 words of transcript. The interviews were coded to anonymise the interviewees and specific organisations. The number of the respondent’s ID reflects the scale level (1 for national, 2 for regional and 3 for municipal). The letter of the respondent’s ID stands for the interviewee within a scale level. The order of interviewees within a scale level is randomised.

3.3.4 Theoretical saturation

In a proper qualitative interview the questions are short and the answers are long. While conducting interviews there is a point where no new information is obtained from the interviews. This phenomenon is called theoretical saturation. Based on empirical statements, theoretical saturation in phenomenographic studies is often reached at a number of 20 interviews (Lamb, Sandberg, & Liesch, 2011; Teeter & Sandberg, 2017). For the research on the implementation of Smart Mobility in the Netherlands a theoretical saturation was expected between 12 and 20 interviews. The results of theoretical saturation are discussed in chapter 5.4.1.

The interviews are transcribed after conduct. Transcribing is a technique for writing oral interviews as a transcript. Conducted interviews in this thesis are codified by transcribing. Bucholtz (2000) argues that there are two types of transcribing: naturalised or denaturalised. Naturalised transcripts are verbatim transcripts. In this type of transcript the oral presentation is fully captured. All words are transcribed literally, so that grammatical errors, repetition and unfinished sentences are written down. Details (apart from spoken words) such as coughing, saying ‘hmm’ or a change of tone, are also captured in a verbatim transcript. A true verbatim transcript is hard to read and does not often capture a coherent story.

Denaturalised interviews can either be clean-read transcripts or summarising transcripts. Summarising transcripts are not scientifically valid due to the lack of details and depth. On the other hand, clean-read transcripts, also known as reader-friendly transcripts, can capture the fundamental meaning of interviewee’s answers. Grammatical errors, repetitions and unfinished thoughts that diverge from the line of answering are not transcribed in a clean-read transcript. Some statements are paraphrased by the transcriber in order
to convey the statement as meant by the interviewee. A limitation of denaturalised transcripts is unintended interpretation by the researcher.

For the research on the implementation of Smart Mobility in the Netherlands from road authorities’ perspectives it was vital to capture the essence of the interviews. The chosen system of clean-read transcripts on the one hand is the suboptimal way of transcribing the interviews; but on the other hand the sentences contain no noise and the transcripts are easily readable and codable for analysis. The limitation of unintended interpretation by the researcher was countered as much as possible by closely transcribing according to the audio data.

The semi-structured interviews were conducted in a rather ‘organic’ manner, to aid a free flow of exchange of thoughts within the structure of the interview. This means that not all topics were discussed in exactly the same order. Furthermore, some topics were discussed in more depth or intensively while other topics were just touched upon due to lack of interest, expertise or willingness to discuss on the part of the interviewee. The transcripts are based on the notes made during the interview and the audio data. For the quality of the transcripts it was very important that interviews were transcribed directly after conducting the interview.

### 3.3.5 Coding the interviews

Sekaran and Bougie (2013) propose an extensive coding sequence for validating interview findings. The interviews are coded in three steps: firstly, the interviews are open coded, and labels are appointed to interview statements and remarks. Multiple labels can be appointed to one statement. After that, axial coding helps to compare fragments of similar content (labels) for differences and similarities. The final phase, selective coding, is performed in a trimmed-down version due to limited time. The coherence of the coded interviews is researched. Concepts are depicted, relationships between statements are named and extremes are analysed.

Curry (2015) presented a tutorial on the data analysis in a series of video lectures on the fundamentals of qualitative research methods. In order to perform a structured, reliable and valid qualitative analysis of interview data it is important to work schematically through multiple phases of the analysis. First all transcripts are read. It is important to create a global understanding of the data at hand. After that, all relevant words, phrases, sentences and sections are labelled. This is to conceptualize underlying categories, concepts and themes. The units coded are not restricted to paragraphs. Sentences and sections of text can also give meaningful segments of code. Certain themes arise when things are repeated, are surprising, link to other literature or establish new theories and concepts. It is important to explain all steps and the ‘why’ under the methods section. The researcher must stay as unbiased as possible and as close as possible to the data. Some codes appear to be more important than others. After that, decisions have to be made about which codes are most important and which code can be clustered in categories. The most relevant categories must also be decided upon. It is important to depict how they are...
connected to each other. Categories and connections between categories are the main result of the analysis of interview data. It provides new insights and new knowledge. By connecting several categories of codes, a formulation of a theme or concept can be achieved. This should be done in neutral formulation with no interpretation of the results. In the end of the results and findings chapter the interpretations are written down and the results are discussed.

To better understand the implementation of innovations, it is important to understand the different types and categories of innovations. Categories make themes and themes represent the outcome of coding (Saldaña, 2009), see Figure 10. Rallis and Rosman (2003) explain the differences between codes and themes: “think of a code as a word or phrase describing some segment of your data that is explicit, whereas a theme is a phrase or sentence describing more subtle and tacit processes”.

3.4 Theme identification and content analysis

One of the most fundamental tasks in qualitative research is theme identification. Ryan and Bernard (2003) pose that discovering themes is at the very heart of qualitative data analysis. Themes are characterized by Ryan and Bernard as abstract constructs which are identified by researchers before, during and after data collection.

Ryan and Bernard (2003) describe four main categories of theme identification techniques, but for this thesis research only word-based and scrutiny-based techniques are used. The other two categories, intentional analysis of linguistic features and physical manipulation of texts, are too exhaustive and time-consuming. Moreover, these last two categories of theme identification techniques require more extensive transcripts, such as verbatim transcripts and word-for-word transcripts, to be useful.

The simplest techniques are word-based techniques. Word-based techniques are efficient and fast ways to research large quantities of transcripts. By observing what words are used by the interviewees the most pressing topics and opinions can be observed. In the set-up phase the word-based techniques are useful to denominate themes and to set the stage for further analysis. Word-based techniques can be sub-divided into three categories:

1. Word repetitions
   Words that occur often can be seen as top-of-mind knowledge and opinions. Anyone who has listened to monologues of people, whether they are friends, family, co-workers or unknown people, knows that people circle though an established network of ideas. Word repetitions can be analysed in a formal and an informal way. Informally, the text is read and key words plus synonyms are depicted. The idea is that recurring words are more important for the respondent. More formally, the frequency of word occurrence can be counted. It generates a list of most used words which can be used to find the most important themes.

2. Indigenous categories
   As a contrast to “analyst-constructed typologies” Patton (1990) poses “indigenous categories”. It means that the themes and words used by the respondents are so unique, specialized or meaningful that these can be used as themes. Work area related vocabulary or jargon can indicate a common understanding of the challenges that lie ahead and it shares a common ground built on previous experiences.

   For example, a phrase that is used a lot by interviewees is ‘learning by doing’. This phrase shows a common understanding of the importance to actually perform value-adding (physical) improvements. The underlying thought is that a lot of governmental institutions are conventional,
large and inert. Therefore it is harder to cross the chasm between making reports and doing actual projects.

3. Key-words-in-context (KWIC)
One of the easiest tell-tales for an observer is key-words-in-context (KWIC). KWIC is based on the principle of how certain concepts are used in a specific context. KWIC are closely related to indigenous categories. Themes can be identified by sorting similar key words accompanied by the contexts. In this manner the meaning of KWIC can be deconstructed.

A careful scrutiny of the transcripts is performed to find themes that are less codified and more tacit. These themes are not per se denominated in the text, but follow from subtle remarks and use of words. Scrutiny-based techniques are about reading larger blocks of texts intensively. Therefore it is more time-consuming than word-based techniques and requires more attention to nuances and details. Scrutiny-based techniques can be divided into three categories:

4. Compare and contrast
The compare and contrast technique helps finding the differences and similarities in different transcripts. This technique is closely related to ethnographic interviewing. The researcher compares transcripts by asking questions such as: “How is this remark different from similar remarks in other transcripts?” and “Why is this topic addressed so many times in multiple transcripts?” As a researcher it is important to compare the answers to these questions in light of all the interviewees’ expertise.

5. Social science queries
In order to answer a lot of “why” questions, it is important to be receptive to social context of the context. The perspectives of interviewees are largely constructed on personality, education, job description, hierarchical level in the organisation and relationships with other actors. Querying the transcripts in light of social sciences can provide deep-cutting insights in highly debatable topics.

6. Searching for missing information
A reverse way to identify themes is searching for missing information. A researcher searches missing themes in the text, rather than found themes. As Ryan and Bernard (2003) say: “Much can be learned from a text by what is not mentioned.” Missing themes can indicate themes that are avoided on purpose by the interviewees. There can be unwillingness to discuss certain topics due to political, social or organisational controversy. Searching missing information is the most difficult scrutiny-based technique; the reasons interviewees do not respond well to topics are various and can be opaque. Trust, pending sensitive negotiations, introversion and unfamiliarity with the subject can be reasons for not discussing topics.

3.5 Reliability and validity of the research
Reliability and validity are two indispensable criteria in order to judge the objectivity of research (Morse, Barrett, Mayan, Olson, & Spiers, 2002; Van Zwieten & Willems, 2004). The concepts of reliability and validation are widely described in numerous qualitative studies (Golafshani, 2003). Reliability is posed as a measure of the absence of coincidental distortions and validity is posed as a measure of the absence of systematic distortions on the researched topic (Maso & Smaling, 1998). In simpler terms: reliability is a measure of how several measurements give the same outcome while validity is a measure whether you measured what was intended to be measured. Reliability is necessary for conclusive data, but not a condition for validity. In other words, you can measure a construct rather precisely, but that does not mean this construct is a valid measure of another construct. Research and experiments can be reliable without being valid, but research can never be valid without being reliable (Sekaran & Bougie, 2013). Qualitative
researchers should implement verification strategies during the whole process in order to claim responsibility for reliability and validity of the research (Morse, Barrett, Mayan, Olson, & Spiers, 2002).

3.5.1 **Intercoder reliability check**

Morse, Barrett, Mayan, Olson, and Spiers (2002) suggest five verification strategies in the Reliability by Design framework:

1. **Methodological coherence**
   The congruence between the research questions and the proposed research methods must be ensured. The research methods must generate data and analytic procedures that matches the research questions.

2. **Appropriate sampling**
   A selection of participants must be selected that have in-depth knowledge or expertise of the research topic. This selective sample ensures data quality and effective saturation of categories. Seeking for less obvious expert opinions is essential to ensure the validity of the data set as a whole.

3. **Collecting and analysing data concurrently**
   Simultaneously gathering and analysing data creates an understanding of what is known and needs to be known. This iterative process is a crucial step for obtaining reliable and valid results and conclusions.

4. **Thinking theoretically**
   New insights and theories built from existing data form new data. This new data must be retroactively verified with existing and collected data. Theoretical thinking is a process of little progress without making cognitive leaps or shortcuts. By checking data constantly, a solid foundation for new theories can be built.

5. **Developing theories**
   By moving back-and-forth between the micro-perspective (data) and the macro-perspective (theories) a theory is formed conscientiously and deliberately.

According to Mouter and Vonk Noordgraaf (2012) it is uncommon to explicitly discuss the reliability of the analysis of interviews and literature review, especially in the field of transport. In order to review the reliability of coded interviews an intercoder reliability check is suggested. An intercoder reliability check, also known in scientific literature as an inter-rater reliability check, assesses the reliability of a coded interview. Intercoder reliability is the degree of agreement among coders. The intercoder reliability coefficient provides a score on the homogeneity of the rates provided by the coders.

Mouter and Vonk Noordgraaf (2012) discuss the main practical steps of the intercoder reliability check. Firstly the scope of the intercoder reliability check has to be determined. Secondly the protocol is drafted. The intercoder reliability check protocol describes the rules and definitions by which the researcher has determined codes and (sub) categories. The second coder uses this protocol to interpret the empirical data and to replicate the study. All coders using the protocol must be trained and familiarised with the definitions in order to carry out a reliable test. Thirdly, the sample size that has to be tested must be determined. Testing all data would be inefficient and time-consuming. A sample around 10% of the total empirical data should be sufficient (Lombard, Snyder-Duch, & Bracken, 2010). Using this rule of thumb, testing two interviews is sufficient in case of the fourteen interviews in this thesis. Fourthly, the test must be executed, the reliability coefficient selected and the actual coefficient calculated. The shadow coding of the second coder is compared to the coding of the researcher. Since there is no consensus on the best coefficient (Lombard, Snyder-Duch, & Bracken, 2010), different coefficients co-exist in practice. Most dominant are Holstí’s
method, percentage agreement, Cohen’s kappa, Scott’s pi and Krippendorff’s alpha. In other contexts than measuring reliability in content analysis Pearson’s R and Cronbach’s alpha are used. Yet, these indices measure covariation and not inter-rate agreement. In this thesis Cohen’s kappa is used due to the availability of computing software tools and easy manipulation techniques. The calculation of Cohen’s kappa values are provided in appendix C. SPSS is used to calculate the intercoder reliability coefficients for nominal data. Although consensus on reliability standards in scientific literature is lacking, Lombard, Snyder-Duch and Bracken (2010) suggest that coefficients of .40 and greater are sufficient in most cases. Altman (1991) suggests that the kappa value can be interpreted as follows:

<table>
<thead>
<tr>
<th>Value of kappa</th>
<th>Strength of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.20</td>
<td>Poor</td>
</tr>
<tr>
<td>0.21 – 0.40</td>
<td>Fair</td>
</tr>
<tr>
<td>0.41 – 0.60</td>
<td>Moderate</td>
</tr>
<tr>
<td>0.61 – 0.80</td>
<td>Good</td>
</tr>
<tr>
<td>0.81 – 1.00</td>
<td>Very good</td>
</tr>
</tbody>
</table>

*Figure 11 - Interpretation table of Cohen’s kappa values (MedCalc, 2018)*

The results and implications of the intercoder reliability check on the research results and interpretations are discussed in chapter 5.4.2.

### 3.5.2 Validation workshop

Verification of results and findings is important for the validity of a research (Wageningen University & Research, 2016). A validation workshop has been conducted to validate the preliminary results and conclusions. The goal of the workshop was to validate results and conclusions drawn from scientific literature, policy documents and the analysed empirical data from conducted semi-structured interviews. Important stakeholders were invited for the workshop. Among those stakeholders are senior staff members of road authorities across scale levels, experts on Smart Mobility and interested employees of Rijkswaterstaat.

The validation workshop has been held at Rijkswaterstaats’ Verkeerscentrale Nederland (VCNL) on the 21th of June 2018. This validation is an extra contribution to the value and validity of the thesis project’s findings, results and conclusions. In total 25 experts were present. Among the attendees were Rijkswaterstaat personnel, the Netherlands vehicle authority (RDW), experts from the Ministry of Infrastructure and Water Management and three interviewees from road authorities across the Netherlands. All interviewees and several experts from governmental transport organisations were invited for an interactive workshop where the findings, results and preliminary conclusions are presented. The comments and feedback of the attendees was integrated with the data, information, findings and results from the literature review, desk research, conducted interviews and analyses. The invitation to the workshop is included in appendix E. A summarising report of this workshop is included in appendix F. The workshop presentation slides are included in appendix G and the thank mail to all attendees is included in appendix H.

The results and implications of the validation workshop on the research results and interpretations are discussed in chapters 5.4.3 and 6.2.2.
4 Results

In this chapter the results are presented based on the content analysis of the interviews. Since the interviewees freely spoke about personal, organisational and external difficulties it was chosen not to publish the interviewees by name. Instead the interviewed road authorities are depicted and given an interview code (Figure 12 and Table 4).

The obstacles and opportunities for implementing Smart Mobility in the Netherlands are identified by clustering codes given to statements in the interviews with a variety of road authority experts in the Netherlands.

A simple presentation of empirical data does not make a narrative. The presentation of the results is a clean read summarised narrative that closely follows the data. As described in chapters 3.3.5 and 3.4 the coded transcripts provided a basis where categories and themes can be identified. Themes capture the overall tacit and codified heuristics in comprehensive concepts. The themes are inductively derived from the collected empirical data of the semi-structured interviews, according to the frameworks as presented in Figure 10 in chapter 3.3.5 and chapter 3.4. The data analysed from the governmental policy documents have a complementary role to the empirical interview data.

Fourteen interviews were conducted in total (Figure 12), resulting in over 30,000 words of transcript. Quotations are translated from Dutch to English with diligence. However, it is possible that nuances and interpretations differ from the original statement. In the next chapter (4.1) the seven themes are discussed (four obstacle themes and three opportunity themes) and the rules for coding are given in chapters 4.2 and 4.3. After that, the results are discussed by hand of frequency tables and charts in chapters 4.4 to 4.6.
4.1 Themes and categories of obstacles and opportunities

During the interviews certain themes and categories arose. All interview transcripts are included in appendix I. In Table 5 and Table 6 all constructed themes and categories are depicted for respectively obstacles and opportunities for Smart Mobility. The scheme provides an overview of the identified obstacle and opportunity in categories.

With regard to obstacles, four themes are distinguished: The cooperation and knowledge sharing theme (C), and within that theme, four obstacle categories can be distinguished. Four obstacle categories can also be related to inert processes in the inertia theme (I). Six typical obstacle categories are distinguished in the governance theme (G) and four obstacle categories are related to the execution theme (E). The obstacle themes and according categories are shown in Table 5.

<table>
<thead>
<tr>
<th>Obstacle categories</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme 1: Obstacles related to cooperation and knowledge sharing</td>
<td></td>
</tr>
<tr>
<td>Obstacles related to cooperation within the organisation</td>
<td>C1</td>
</tr>
<tr>
<td>Obstacles related to cooperation between governmental institutions</td>
<td>C2</td>
</tr>
<tr>
<td>Obstacles related to cooperation with external parties</td>
<td>C3</td>
</tr>
<tr>
<td>Obstacles related to the learning by doing approach</td>
<td>C4</td>
</tr>
<tr>
<td>Theme 2: Obstacles related to inertia</td>
<td></td>
</tr>
<tr>
<td>Obstacles due to organisational inertia</td>
<td>I1</td>
</tr>
<tr>
<td>Obstacles due to social inertia</td>
<td>I2</td>
</tr>
<tr>
<td>Obstacles due to political inertia</td>
<td>I3</td>
</tr>
<tr>
<td>Obstacles due to economic inertia</td>
<td>I4</td>
</tr>
<tr>
<td>Theme 3: Obstacles related to governance</td>
<td></td>
</tr>
<tr>
<td>Obstacles due to the changing role of governments</td>
<td>G1</td>
</tr>
<tr>
<td>Obstacles due to uncertainties</td>
<td>G2</td>
</tr>
<tr>
<td>Obstacles related to policy and regulations</td>
<td>G3</td>
</tr>
<tr>
<td>Obstacles related to privacy</td>
<td>G4</td>
</tr>
<tr>
<td>Obstacles related to (digital) security</td>
<td>G5</td>
</tr>
<tr>
<td>Obstacles related to safety</td>
<td>G6</td>
</tr>
<tr>
<td>Theme 4: Obstacles related to execution</td>
<td></td>
</tr>
<tr>
<td>Practical obstacles</td>
<td>E1</td>
</tr>
<tr>
<td>Governance obstacles</td>
<td>E2</td>
</tr>
<tr>
<td>Implementation obstacles</td>
<td>E3</td>
</tr>
<tr>
<td>Obstacles due to scale</td>
<td>E4</td>
</tr>
</tbody>
</table>

Table 5 - Encoding scheme for obstacles
With regard to opportunities, three themes are distinguished: For the cooperation and knowledge sharing theme (K), three opportunity categories can be distinguished. Three opportunity categories are related to the benefits theme (I) and three opportunity categories are related to the policy, governance and execution theme (P). The opportunity themes and according categories are shown in Table 6.

<table>
<thead>
<tr>
<th>Opportunity categories</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research, innovating and knowledge sharing</td>
<td>K1</td>
</tr>
<tr>
<td>Cooperation between governmental institutions</td>
<td>K2</td>
</tr>
<tr>
<td>Cooperation with external parties</td>
<td>K3</td>
</tr>
<tr>
<td>Theme 2: Opportunities related to benefits</td>
<td></td>
</tr>
<tr>
<td>Social benefits</td>
<td>B1</td>
</tr>
<tr>
<td>Economic benefits</td>
<td>B2</td>
</tr>
<tr>
<td>Environmental benefits</td>
<td>B3</td>
</tr>
<tr>
<td>Theme 3: Opportunities related to policy, governance and execution</td>
<td></td>
</tr>
<tr>
<td>Political and managerial opportunities</td>
<td>P1</td>
</tr>
<tr>
<td>Implementation opportunities</td>
<td>P2</td>
</tr>
<tr>
<td>Managing expectations</td>
<td>P3</td>
</tr>
</tbody>
</table>

Table 6 - Encoding scheme for opportunities

4.2 Coding scheme for obstacles

In this chapter the four themes (C, I, G and E) are subsequently discussed. Eighteen obstacle categories in total are examined in the following three steps: firstly, a quote from the interviews is provided to set a tacit example of a typical phrase that could be considered under that specific obstacle category. Secondly, the coding rules for the obstacle category are given. Often the coding rules consist of explicitly mentioned words that directly indicate a certain obstacle category. Also heuristics, sayings and more scrutinised phrasings can be depicted in order to provide more wholesome coding rules. Lastly, a concise explanation based on the interview data is given for the obstacle category in order to create an unambiguous understanding of the category. This coding scheme is used to transparently codify the process of coding transcripts in this thesis research. Thereby, it is used as a coding protocol for the intercoder reliability check. The results of this check are discussed in chapter 5.4.2.

4.2.1 Obstacles related to cooperation and knowledge (C)

All obstacles related to cooperation and knowledge sharing are assigned to the theme ‘obstacles related to cooperation and knowledge sharing (C)’. Four obstacle categories are distinguished: obstacles related to cooperation within the organisation (C1), obstacles related to cooperation between governmental institutions (C2), obstacles related to cooperation with external parties (C3) and obstacles related to the learning by doing approach (C4).

Cooperation for governmental institutions can be divided into three categories (Leydesdorff & Etzkowitz, 1996). The first three obstacle categories (C1, C2 and C3) are based on the division:

1. Cooperation within an organisation;
2. Cooperation with other (governmental) organisation;
3. Cooperation with private parties.

The last obstacle category, obstacles related to the learning by doing approach (C4), is constructed due to often heard critiques about this more practical approach to implementing innovative technologies in public.

Obstacles related to cooperation within the organisation (C1)

“Not all results are tacit. If results are not recognised, then it is difficult to explain the added value. There are always conservative sounds from within the organisation. It will cost extra effort to get everybody on board.” – Interviewee 2C

Coding rules for C1: Obstacles are assigned to C1 if organisational and internal cooperation and collaboration between layers within the organisation are mentioned.

Obstacles related to cooperation between governmental institutions (C2)

“Regional collaborations are the key element for the development of tomorrow’s mobility. It’s not about leadership in a domain. It is more about constructing a better liveable Netherlands together. Municipalities and provinces need each other. Together synergy can be reached in order to further develop the region.” – Interviewee 2A

“By yourself you go faster, yet together you come further.” – Interviewee 2D

Coding rules for C2: Obstacles are assigned to C2 if the collaboration between governmental institutions is explicitly mentioned. This can be collaborations within a scale (local road authorities among each other) as well as multi-level collaborations (regional road authorities collaborating with Rijkswaterstaat or local road authorities).

Obstacles related to cooperation with external parties (C3)

“Collaborating with private parties is quite difficult. A large part of the private firms does not show their cards because of the threat of other firms stealing their ideas. Thereby, private firms want that governments precisely formulate their needs, while governments only have visions or mission statements. Due to this the government will fall back on traditional patterns.” – Interviewee 2A

Coding rules for C3: Obstacles are assigned to C3 if the interviewees refer to difficulties with collaborating with market parties. Difficulties such as private parties do not show their hand, private parties have a hidden agenda are assigned to C3.

Obstacles related to the learning by doing approach (C4)

“Practical doing, that’s learning. Sometimes things fail, but you will always gain knowledge.” – Interviewee 3E

“Sometimes you just got to try things if it comes to innovations. Just to see what works and what not. If innovations are not allowed to fail, then you will only undertake certainties. You can manage the expectation by communicating the efforts and risks transparently in advance.” – Interviewee 3F

Coding rules for C4: Obstacles are assigned to C4 if the phrase ‘learning by doing’ is used. This phrase or sort-like phrases indicate an urge for a more practical approach to the development and implementation of Smart Mobility. This obstacle category contains arguments such as an urge for more practical efforts, fewer studies and more pilots or implementation efforts.
4.2.2 Obstacles related to inertia (I)

All obstacles related to inertia of processes are assigned to the theme ‘obstacles related to inertia (I)’. Four obstacle categories are distinguished: obstacles due to organisational inertia (I1), obstacles due to social inertia (I2), obstacles due to political inertia (I3) and obstacles due to economic inertia (I4).

Obstacles due to organisational inertia (I1)

“A lot of road authorities are only concerned about today’s task. Many governmental organisations are too much focussed on internal matters. There is too much thinking in problems instead of solutions.” – Interviewee 2E

“Smart Mobility is innovative; traditional organisations have a hard time coping with that. We are now in an unknown phase. This phase calls for initiative, guts and financial resources in order to reach the next level.” – Interviewee 3B

Coding rules for I1: Obstacles are assigned to I1 if interviewees address organisational aspects that hamper the implementation of Smart Mobility. This obstacle contains arguments such as a hierarchical organisational structure or the lack of resources, capacity or knowledge.

Obstacles due to social inertia (I2)

“Opinions within society and politics are various. There is resistance against new solutions and technologies for transport and mobility.” – Interviewee 3B

Coding rules for I2: Obstacles are assigned to I2 if interviewees specifically address social and societal obstacles to Smart Mobility related efforts. Key words such as anxiety and fear for new technologies, social resistance and obstruction of implementation indicate category I2 obstacles. References to emotional arguments against new technologies and obstructions efforts could be assigned I2.

Obstacles due to political inertia (I3)

“It is a great opportunity to put money on developments that appeal to politicians. Politicians can use novel developments to profile the organisation to the outer world.” – Interviewee 3F

Coding rules for I3: Obstacles are assigned to I3 if interviewees discuss political aspects of spatial planning and governing. Politics also entail strategic positioning of civil servants due to diffusive interests and opaqueness of decision making.

Obstacles due to economic inertia (I4)

“Smart Mobility users might experience financial obstacles when they start using new mobility solutions.” – Interviewee 1A

“During financially hard times, innovations are budgeted first” – Interviewee 3B

Coding rules for I4: Obstacles are assigned to I4 if interviewees state that financial and economic difficulties hamper the successful implementation of Smart Mobility initiatives. Specifically remarks in line with the lack of financial resources are labelled with code I4.

4.2.3 Obstacles related to governance (G)

All obstacles related to governance of Smart Mobility are assigned to the theme ‘obstacles related to governance (G)’. Four obstacle categories are distinguished: obstacles due to the changing role of governments (G1), obstacles due to uncertainties (G2), obstacles related to policy and regulations (G3),
obstacles related to privacy (G4), obstacles related to (digital) security (G5) and obstacles related to safety (G6).

**Obstacles due to the changing role of governments (G1)**

“Should we regulate, facilitate or obstruct? Our new role is a discussion that is gaining momentum within and outside our organisation.” – Interviewee 1B

**Coding rules for G1:** Obstacles are assigned to G1 if interviewees specifically mention the changing role of the organisation. Remarks on the societal role of the organisation, organisational changes and shifting needs are labelled with code G1.

**Obstacles due to uncertainties (G2)**

“The future is very uncertain. The program we developed has open ends because we just do not know what comes. There are many uncertainties and we have many dependencies on other parties. We see a shift from government to market. That is an obstacle as well as an opportunity.” – Interviewee 2B

**Coding rules for G2:** Obstacles are assigned to G2 if interviewees specifically address uncertainties. Remarks on uncertainties of technology, society and spatial planning are labelled with code G2.

**Obstacles related to policy and regulations (G3)**

“You never know if Smart Mobility is the answer to certain problems, until you implement it. It's an ongoing chicken or egg issue. Effects are hard to predict, especially when innovations are involved. This calls for a more adaptive approach.” – Interviewee 2D

**Coding rules for G3:** Obstacles are assigned to G3 if interviewees address obstacles involving policy strategies, decision-making and spatial planning. Concepts such as Adaptive policy planning, robust planning and multi-year program plans are assigned code G3.

**Obstacles related to privacy (G4)**

“Privacy and cyber-security are our key topics. We set-up a digital office because we believe that we (the local government, local education institutions and private firms) can excel in this domain. We do not focus on physical road tests with AVs. Instead, we focus more on the subjects that are directly involved with AVs.” – Interviewee 3B

“The privacy regulations are very fluctuating at the moment. In May the new EU privacy regulations are launched. There are many questions underneath privacy: what do we consider to be privacy? How do we cope with privacy? What do we do? And what not? We try to make processes as water tight as possible by actively searching for bottle necks and by thinking ahead about potential problems.” – Interviewee 3F

**Coding rules for G4:** Obstacles are assigned to G4 if interviewees specifically mention privacy as an issue. Remarks such as ‘privacy remains an issue’, ‘privacy regulation is necessary’ and ‘public opinions on privacy shifted’ are assigned code G4.

**Obstacles related to (digital) security (G5)**

“There is quite some internal resistance to outsourcing data activities to third parties. This is due to fear of losing quality, privacy and cyber-security” – Interview 2B

**Coding rules for G5:** Obstacles are assigned to G5 if interviewees discuss physical or digital security concerns and issues. Digital security is closely related to privacy, yet there is a distinct difference when harmful actions are discussed.
Obstacles related to safety (G6)

"Traffic safety is prominently addressed when new developments are implemented. We notice that there are Achilles’ heels to Smart Mobility regarding traffic safety. An example of that are in-car apps."
– Interviewee 1B

Coding rules for G6: Obstacles are assigned to G6 if interviewees mention (physical) safety issues are mentioned. Hacking and obstructing physical and digital safety obstacles are labelled with code G6.

4.2.4 Obstacles related to execution (E)

All obstacles related to execution of Smart Mobility are assigned to the theme ‘obstacles related to execution (E)’. Four obstacle categories are distinguished: practical obstacles (E1), governance obstacles (E2), implementation obstacles (E3) and obstacles due to scale (E4).

Practical obstacles (E1)

"It is difficult to combine multiple streams of data" – Interviewee 2C

"You cannot start out of nowhere." – Interviewee 2B

"Many processes are still based on visual information” – Interviewee 2D

Coding rules for E1: Obstacles are assigned to E1 if interviewees discuss practical obstacles in everyday situations. Practical obstacles can be all sorts of practical issues that need to be sorted in order to start the successful implementation of Smart Mobility, according to the interviewees.

Governance obstacles (E2)

"Many people I spoke within and outside my organisation are talking about adaptive programming, but very little know how the properly execute it.” – Interviewee 2B

"Adaptive programming can lead to swaying, but you have to keep track while doing so.” – Interviewee 2C

Coding rules for E2: Obstacles are assigned to E2 if interviewees address obstacles that involve the process of governing. Governance obstacles can be lack of resources (capacity, knowledge or funds), organisational immaturity for conducting a dynamic adaptive planning approach or aspects involving law, norms and power positions of governmental institutions.

Implementation obstacles (E3)

"Innovation should be higher on the agenda of private firms. Public money is easily spent, yet the step from research to implementation could have been better if private firm had invested more energy into it.” – Interviewee 3E

Coding rules for E3: Obstacles are assigned to E3 if interviewees discuss the aspects of implementation which have been or are negative for the successful implementation of Smart Mobility. Difficulties of handling innovations and structuring implementation efforts are therefore labelled with code E3.

Obstacles due to scale (E4)

"You need scale in order to get others along, yet you only get scale if others cooperate” – Interview 3F

"The idea is to develop standards and travel information national of global, not local. This forces the organisation to seek collaboration with other parties in order to gain a sufficient scale.” – Interviewee 2C
Coding rules for E4: Obstacles are assigned to E4 if interviewees address the lack of scale as an obstacle for the implementation of Smart Mobility. Remarks such as ‘scale is not large enough’ and ‘many studies and pilots, but no large-scale implementation’ are labelled with code E4.

4.3 Coding scheme for opportunities

In this chapter, the three themes (K, B and P) are subsequently discussed. Nine opportunity categories are examined in total in the following three steps: firstly, a quote from the interviews is provided to a tacit example of a typical phrase that could be considered under that specific opportunity category. Secondly, the coding rules for the opportunity category are given. Often the coding rules consist of explicitly mentioned words that directly indicate a certain opportunity category. Also, heuristics, sayings and more scrutinised phrasings can be depicted in order to provide more wholesome coding rules. Lastly, a concise explanation based on the interview data is given for the opportunity category in order to create an unambiguous understanding of the category.

4.3.1 Opportunities related to knowledge sharing and cooperation (K)

All opportunities related to knowledge sharing and cooperation are assigned to the theme ‘opportunities related to knowledge sharing and cooperation (K)’. Within this theme, three opportunity categories are distinguished: opportunities related to research, innovating and knowledge sharing (K1), opportunities related to cooperation between governmental institutions (K2) and opportunities related to cooperation with external parties (K3).

Research, innovating and knowledge sharing (K1)

Sharing knowledge is a huge opportunity, but at this moment in time it is still an obstacle. We find it hard to admit flaws and failures, especially when this is shared widely.” – Interviewee 2D

Coding rules for K1: Opportunities are assigned to K1 if interviewees addressed the importance of performing research, sharing knowledge and creating innovations. Collaboration opportunities and efforts for creating knowledge platforms are also accounted for in this category.

Cooperation between governmental institutions (K2)

“Many developments are done in collaboration with the five biggest cities in the province. This collaboration stands for cooperating in the region. Sharing knowledge and teaming up on new innovative technologies are central to this collaboration.” – Interviewee 2C

Coding rules for K2: Opportunities are assigned to K2 if interviewees mention the positive effect of cooperation with other road authorities and governmental institutions.

Cooperation with external parties (K3)

“We work with knowledge institutes, private firms and governments in according to the Triple Helix model” – Interviewee 3D

“I notice that more products and services are being outsourced to private parties. We do not want to produce the traditional Statement of Requirements. Instead, we put the whole service outside the organisation. This form of tendering is quite new. The ministry follows the process closely. It is an opportunity for the market, whereas new risks and business models arise.” – Interviewee 2C
Coding rules for K3: Opportunities are assigned to K2 if interviewees mention the positive effect of cooperation with private firms. Alliances, collaboration models and cooperative actions in the public domain are accounted for in this category.

4.3.2 Opportunities related to benefits (B)

All opportunities related to the benefits of Smart Mobility are assigned to the theme ‘opportunities related to benefits (B)’. Three opportunity categories are distinguished: social benefits (B1), economic benefits (B2) and environmental benefits (B3).

Social benefits (B1)

“Especially user-centred technologies have our undivided attention. MaaS contributes to the sharing economy. It is about user-centred services where governments have to facilitate and not dictate. In other words: Enable! One main focus is target transport.” – Interviewee 3A

“Economic drivers must not become the main goals for implementing Smart Mobility. There is more need for social benefits than financial benefits.” – Interviewee 1A

Coding rules for B1: Opportunities are assigned to B1 if interviewees name social benefits and advantage, such as liveability of cities, sense of safety, social prosperity, and other social well-being factors.

Economic benefits (B2)

“Everything we do within the region is with economic drivers in the back of our heads. All efforts should end up creating jobs in the region.” – Interviewee 2E

“Many benefits are on the economic side. Is there, besides projects and spatial planning, room for innovations, renewals and discoveries? Organisations must overcome certain program-related thresholds to cope with these questions on a more integral municipal approach. It makes the execution complex.” – Interviewee 3E

Coding rules for B2: Opportunities are assigned to B2 if interviewees name economic and financial benefits and advantages, such as financial incentives for governmental institutions and private firms, cost reduction, business opportunities, and other beneficial economic factors.

Environmental benefits (B3)

“By coupling the efforts to enhance the traffic flow and to better use the existing infrastructure the sustainability is raised.” – Interviewee 2F

“Besides the fact that the Dutch want to arrive in time, there is also a need for more sustainability. We realise that we cannot emit emissions without boundaries. People want to live healthy lives. You can kill two birds with one stone by coupling Smart Mobility concepts to sustainability goals.” – Interviewee 2B

Coding rules for B3: Opportunities are assigned to B3 if interviewees name environmental advantages, such as sustainability, quality of life, the environment, and the reduction of emissions.

4.3.3 Opportunities related to policy, governance and execution (P)

All opportunities related to the planning and implementation of Smart Mobility are assigned to the theme ‘opportunities related to policy, governance and execution (P)’. Within this theme, three opportunity categories are distinguished: political and managerial opportunities (P1), implementation opportunities (P2) managing expectations (P3).
Political and managerial opportunities (P1)

"It is an opportunity to focus on multiple developments that are doing well in politics. High placed civil servants are likely to grab new technologies and innovations to promote their cause." – Interviewee 3E

Coding rules for P1: Opportunities are assigned to P1 if interviewees address Smart Mobility as an opportunity for politicians and civil servants to profile their party/organisation in a positive way. Decisions can be made with a strategic agenda in mind.

Implementation opportunities (P2)

"The organisation can respond adequately to developments outside of the organisation by being adaptive." – Interviewee 1B

Coding rules for P2: Opportunities are assigned to P2 if interviewees comment on strategies for a better chance on implementing Smart Mobility.

Managing expectations (P3)

"If innovations are not allowed to fail, then only non-regret efforts will be undertaken. Expectations can be managed up front by communicating risk and efforts. Do not promise that your innovation is going to change the world. Instead, emphasise the added value for people’s everyday lives." – Interviewee 3F

Coding rules for P3: Opportunities are assigned to P2 if interviewees specifically mention managing expectations in a public, governing or societal context.
4.4 Scope and themes

The scopes of road authorities’ Smart Mobility efforts differ. Table 7 demonstrates the different subjects and main focus areas per road authority. These main focus areas are compared to the findings of Jeekel (2017) and are used to answer research question 1.

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<th>Data (management)</th>
<th>Digital infrastructure / ITS</th>
<th>MaaS</th>
<th>Automotive technology</th>
<th>Traffic management</th>
<th>Physical infrastructure</th>
<th>Car sharing</th>
<th>Mobility management</th>
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Table 7 - Scope and themes per road authority
Table 8 - Absolute frequencies of addressed scope focus per frequency group

<table>
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<tr>
<th>Scope</th>
<th>Frequency group 1: National and Regional RAs (8 total)</th>
<th>Frequency group 2: Municipal RAs (6 total)</th>
<th>Total Frequency (14 total)</th>
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Following from Table 7 and Table 8, Figure 13 shows that the most frequently named topics are Data (management), ITS, MaaS and automotive technology. This finding is in line with the four main themes of Smart Mobility as researched by Jeekel (2017). Chapter 5.3.1 answers the first sub research question of this thesis regarding scope and definitions of Smart Mobility from road authorities’ perspectives, based on the results of this chapter.
4.5 **Frequencies per category**

In this chapter the frequencies per category are provided. The national and regional interviewees are clustered into one frequency group (FG1). This is due to the similar characteristics of national and regional road authorities; both are occupied with ‘stroomwegen’ (relative high-intensity roads with average speeds of 100 km/h (regional) and 130 km/h (national). Thereby, budgets are relatively high compared to municipal road authorities. The municipal road authorities are clustered as the second frequency group FG2.

Chapter 4.5.1 provides tables on obstacle categories per frequency group (Table 9) and per road authority (Table 10). After that, the results from Table 10 are visualised in a frequency chart (Figure 14). Chapter 4.5.1 is concluded by four main findings on obstacles for implementing Smart Mobility in the Netherlands.

Chapter 4.5.2 provides tables on opportunity categories per frequency group (Table 11) and per road authority (Table 12). After that, the results from Table 12 are visualised in a frequency chart (Figure 15). Chapter 4.5.2 is concluded by four main findings on opportunities for implementing Smart Mobility in the Netherlands.
4.5.1 Frequencies per obstacle category

This chapter provides two tables and a chart on obstacle categories. Firstly, a table of absolute and relative frequencies per obstacle category per frequency group is provided in Table 9. Secondly, a table of scored obstacle categories per road authority is provided in Table 10. After that, the results from Table 10 are visualised in a frequency chart (Figure 14). Concluding this chapter, four main findings on obstacles for implementing Smart Mobility in the Netherlands are given.

<table>
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<th>Obstacle categories</th>
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<th>Frequency group 1: National and Regional RAs (8 total)</th>
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Table 9 - Absolute frequencies of addressed obstacle categories per frequency group
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Table 10 – Number of addressed obstacles per obstacle category per road authority
Four main findings on obstacles for implementing Smart Mobility in the Netherlands are presented below. These main findings are further examined and discussed in chapter 5.4.2.

Organisational Inertia
Organisational inertia obstacles were named most often: in total thirteen out of fourteen interviewees addressed inertia related to organisational processes. 48 times an organisational obstacle was mentioned during the interviews (29 times by FG1 and 19 times by FG2). This obstacle category was most mentioned in FG1 and FG2 as well as FG1 and FG2 combined.

Changing role of governments
Obstacle category G1 (Changing role of governments) is an obstacle that is typically addressed by national and regional road authorities. No municipal road authority mentioned obstacles related to the changing role of their organisation.

Obstacles related to execution
The four obstacle categories of theme 4: obstacles related to execution (E) were named by almost every municipal road authority (E1 and E2: 100%, E3 and E4: 83%). Municipal road authorities experience more practical obstacles than national and regional road authorities.

Cooperation with other governmental institutions and market parties
Obstacle categories C2 (Cooperation between governmental institutions) and C3 (Cooperation with market parties) were addressed more by municipal road authorities than by national and regional road authorities: C2 was addressed by one road authority from FG1 while C2 was addressed by all road authorities from FG2. C3 was addressed by two road authority from FG1 while C3 was addressed by all road authorities from FG2. Obstacle categories C2, C3 and E3 were the only obstacle categories addressed more often by FG1 during interviews than FG2 in all other categories FG1 mentioned more obstacles per category.
4.5.2 Frequencies per opportunity category

This chapter provides two tables and a chart on opportunity categories. Firstly, a table of absolute and relative frequencies per opportunity category per frequency group is provided in Table 11. Secondly, a table of scored opportunity categories per road authority is provided in Table 12. After that, the results are visualised in a frequency chart (Figure 15). Concluding this chapter, two main findings on opportunities for implementing Smart Mobility in the Netherlands and one overall finding on the research are given.

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<th>Frequency group 2: Municipal RAs (6 total)</th>
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Table 11 – Absolute frequencies of addressed opportunity categories per frequency group
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Table 12 – Number of addressed opportunities per opportunity category per road authority
Two main findings on opportunities for implementing Smart Mobility in the Netherlands are presented below. One main finding on the overall amount of mentioned obstacles and opportunities is given as well. These three main findings are further examined and discussed in chapters 5.1.1 and 0.

**Social benefits**
Social benefit opportunities (B1) were named most often: Thirteen interviewees in total addressed social benefits as an underlying opportunity for implementing Smart Mobility in the Netherlands. 35 Times, an opportunity related to social benefits was mentioned during the interviews (24 times by FG1 and 11 times by FG2). This opportunity category was most mentioned by FG1 and by FG1 and FG2 combined. The most frequently mentioned opportunity category by FG2 was K1 (Research, innovating and knowledge sharing).

**Cooperation and knowledge sharing**
The theme opportunities related to cooperation and knowledge sharing (K) was addressed most often (84 times). Differences between the frequency groups were smaller than the other two opportunity themes (opportunities related to benefits and opportunities related to policy, governance and execution), namely 49 to 33 times (K) (33% difference between FG1 and FG2) opposed to 49 to 20 times (B) (59% difference between FG1 and FG2) and 35 to 17 times (P) (51% difference between FG1 and FG2).

**Opportunities mentioned less than obstacles**
In total 334 obstacles were addressed (C: 61, I: 109 G: 66, E: 98, Total: 334), while in total 205 opportunities (K: 84, B: 69 P: 52, Total: 205); a division of 61.3% obstacles to 38.7% opportunities. Overall, opportunities were mentioned less than obstacles by the interviewees. All opportunity categories are addressed more frequently by FG1 than FG2.
5 Discussion

This chapter discusses results and conduct of this thesis. This thesis research gives insight into current and future technological, economic and social factors of Smart Mobility from both governmental as firm perspectives. By analysing the obstacles and opportunities for the implementation of Smart Mobility in the Netherlands, a first step into identifying challenges, show-stoppers and opportunities has been set.

First, the results and seven main findings of chapter 4 are discussed in chapter 5.1. The typical obstacles and barriers per scale level are discussed in chapter 5.2 Chapter 5.3 provides answers to the sub research questions. This chapter is concluded by chapter 5.4 which evaluates the research methods and the conducted research. First, the adequacy of the interviewee sample size is discussed by the theory of theoretical saturation. Secondly, the reliability of the research results is discussed based on the results of the intercoder reliability check. Thirdly, the validity of the research’ main findings is discussed based on the validity workshop at Rijkswaterstaat.

5.1 Interpretations of results

In total seven main findings were posed in chapter 4. One finding on obstacles compared to opportunities, four findings on obstacles and two findings on opportunities.

5.1.1 Obstacles compared to opportunities

One main finding, posed as last in chapter 4.5.2, is that opportunities were mentioned less than obstacles. Overall, opportunities were mentioned less than obstacles by the interviewees.

“There are a thousand reasons not to do something.” – Interviewee 1A

Obstacles were addressed more frequently than opportunities. This is due to a number of reasons. First, the obstacles are more ‘top of mind’ than opportunities. Policy makers and civil servants are more used to dealing with inert organisations and are subconsciously more aware of negative factors than positive factors. Second, the opportunities are limited due to the scope and resources of many road authorities. Concluding, ‘show-stoppers’ are more easily recognisable than ‘no-regret’ measures and activities.

5.1.2 Obstacles: four main findings

Four main findings on obstacles were briefly discussed in chapter 4.5.1.4.5.2. These are organisational inertia, the changing role of governments, obstacles related to execution and cooperation with other governmental institutions and market parties.

1: (Organisational) Inertia

Organisational inertia obstacles were named most often. Many interviewees had doubts whether people will accept Smart Mobility innovations and technologies in their daily lives. Important factors for successful implementation of Smart Mobility technologies and innovations are intuitiveness and scale-ability. Factors that often have been assigned to inertia are acceptance and, its reciprocal, resistance.

Not only citizens can obstruct new technologies and innovations to diffuse on a large scale. Also organisational resistance and reluctance to change can play parts:

“There is resistance to new solutions and technologies within traffic and mobility. This will only be countered by just starting new projects … I have worked two years without budget. The biggest benefit of not spending/having budget is that you are not accountable for failures, but you are praised for success … Innovations should be organised outside the regular organisation. If not, you will only encounter resistance. Everybody has his or her own projects and knowledge domain. These people lose sight of the greater goal.” – Interviewee 3D
Contracts with private firms are more complex and more intense than in the past. Road authorities do not ask for a product, a service is more in line with their needs. This transition is not easy for many traditional road authorities:

“Private firms will facilitate data collection, processing and sharing in the near future. This is a tough transition for governmental institutions. There is much reluctance to outsource data activities due to quality level, privacy and cyber-security.” – Interviewee 2D

It is important to keep close quality control when outsourcing sensitive activities. In a PPP the interdependencies and agreements are made explicit. This explicitness should ensure no party acts ‘strategically’.

Besides organisational inertia, social and political inertia were also named often (respectively 25 and 12 times). On social inertia: at this moment there is not much social resistance against new solutions for existing mobility problems. Users’ acceptation is key to successfully implementing Smart Mobility. Issues such as perceived safety, privacy and willingness to pay need to be properly addressed to overcome biases and heuristics. On the other hand, nowadays a lot of daily-life situations are digitalised. Transport is one of the more conservative areas regarding digitalisation. This is due to the severity and the rate dangerous and life-threatening situations occur. The importance of a users’ community is stressed by one of the interviewees; by involving potential users in the development process many unforeseen social effects can be discovered in an early stage.

On political inertia: a many heard remark is that politicians are quite fond of Smart Mobility. The need for measures to cope with the growing demand for transport is evident. Smart Mobility as solution, in contrast to extra asphalt, is an embedded vibe, regardless of political colour. It is also important how politicians and citizens want to profile their region or city:

“It is a great opportunity to put money on developments that appeal to politicians. Politicians can use novel developments to profile the organisation to the outer world.” – Interviewee 3F

Moreover, the change of politicians and administrators in governments can hamper the development of Smart Mobility and the implementation. Luckily, many progressive political sounds were reported during the interviews. Newly installed politicians are likely to maintain course or even intensify the development of Smart Mobility technologies and innovations.

2: Changing role of governments
Obstacle category G1 (Changing role of governments) is an obstacle that is typically addressed by national and regional road authorities. No municipal road authority mentioned obstacles related to the changing role of their organisation.

The role of governments is changing. The classic image of governmental institutions does not do justice to the efforts and achievements of civil servants in the past years. Whereas in the past governments produced all products and services in-house, nowadays more efforts are outsourced to the market. Smart Mobility is one of the concepts that facilitated a market pull instead of a technology push. Private parties develop more technologies and innovations than are known to road authorities. If the collaboration between governmental institutions and private firms are not formally described, no common goal is created.

A cumbersome and inert organisation is not how governments function anymore. However, some processes remain traditional: the organisational structure of governmental institutions is mechanistic. Features like a
The accessibility of Dutch cities is a responsibility of both the national government (main rail road network and highways) and regional governments (local busses, trams, metro). Dependent on the specific accessibility tasks governmental institutions can handle out of different roles. Kennisinstituut voor Mobiliteitsbeleid (2018) depicted four basic roles: regulator, facilitator, realisator and communicator.

- **Regulator**: in the role of regulator a governmental institution steers by encouraging, discouraging, stimulating, prohibiting or financially incentivising activities and efforts. Steering can be done in the domain of MaaS, OV-bicycles and car sharing.

- **Facilitator**: in the role of facilitator a governmental institution creates boundaries to stimulate travelers’, tourists’ and commuters’ behaviour. This can be done by financially incentivising certain behaviour, instigating negotiations with parties (governmental, knowledge institutes and/or private) or facilitating knowledge sharing platforms. By creating more transparent collaborations, involved parties can make better informed decisions.

- **Realisator**: in the role of realisator a governmental institution can undertake action to conduct a product or service initiation by itself. The production of the product or service can be done in-house or by a contracted private party. This can be organised by a tender or procurement procedure.

- **Communicator**: in the role of communicator a governmental institution has the task to inform. Examples of informing are educating, providing information, delivering products or services and rewarding initiatives and performances. By clearly communicating policies a governmental institution can set the stage for a whole society.

These four basic roles provide a framework for road authority policy-makers to choose their strategic position in changing times. An adaptive role approach can be suggested for road authorities to strategically manoeuvre through various stages of Smart Mobility development:

"If a new app becomes a hit tomorrow, then the users have the power to start using the app or not. The government remains on the side line. That is a position you must hold; the government is regulating and guiding." – Interviewee 3D

"Car sharing and bicycle sharing were not topics of debate until quite recently. This niche exploded due to new entrants to the market. The role of the government changes due to this effect. As a government, one must hold sight on initiatives and projects that evolve within a municipality. The question is whether to stimulate, facilitate or obstruct. On one side you do not want private firms beginning a brawl. On the other side you do not want to interrupt the market." – Interviewee 3B
3: Obstacles related to execution
The four obstacle categories of theme 4 obstacles related to execution (E) were named by almost every municipal road authority. Municipal road authorities experience more practical obstacles to overcome than national and regional road authorities.

Coping with uncertainties of technological innovations is a prominent topic. Traditional conservative governments seek for effective planning methodologies for large long-term infrastructure projects. Unfortunately, the economic life cycle of large infrastructure assets decline in faster pace each day:

"Infrastructure assets obsolesce faster by the day. We can go for various options: replace, renew, delay, change cycle time. These investment questions are very complex and come with a high burden of spending large amounts of public money." – Interviewee 1A

A phrase that has been cited a lot was ‘we must not re-invent the wheel’. The underlying message is that a lot of studies and pilot projects are conducted, but that there is a great overlap. This overlap could be seen as a waste of resources. Many factors can lead to performing double work: will the technology be accepted by the users? Is privacy secured enough? What are the life cycles of the technologies? What are the costs and benefits? Which private firms are able to deliver the job? When is ‘enough’ enough? What technologies are not yet known but almost launched? Uncertainties about the future are not new. Uncertainties make decision-making and policy-making a tough exercise. Not all decisions based on rational facts and figures are the best; people tend to make decisions based on emotions, biases and heuristics. In order to better understand why it is difficult to not re-invent the wheel and why people tend to fall back to known patterns instead of embarking on new routes, it is important to look into the following three constructs: bounded rationality, decision-making in networks and incrementalism.

Bounded rationality
Herbert A. Simon (1997) developed a theory on bounded rationality. Bounded rationality is about human rationality regarding limited available information, lack of cognitive comprehension and narrow timeframes to make decisions. Bounded rationality could give an insight into the underlying mechanisms that could make decision-making a difficult and exhaustive exercise. Simon posed seven axioms in order to describe decision-making theory:

1. Humans cannot know all alternatives to a decision;
2. The alternatives known to one, are not simultaneously comparable. One goes through a sequential searching process, where alternatives are considered one after another.
3. Following the first two axioms, one will not be able to choose the optimal alternative. One will go for the first satisfying alternative.
4. Humans have a set of routine actions, which are called into play if a recognizable problem occurs.
5. The routine actions are independent of each other.
6. Every problem is regarded in context of the existing goal and existing resources.
7. Due to axioms four and five, the sequential searching process (axiom two) will only take place if routine actions are not found sufficient.

Simon’s theory on bounded rationality describes the problematic aspects of coping with uncertainties that many road authorities experience:

"The future is very uncertain. The program we developed has open ends because we just do not know what comes. There are many uncertainties and we have many dependencies on other parties. We see a shift from government to market. That is an obstacle as well as an opportunity." – Interviewee 2B
Decision-making in networks
A construct closely related to bounded rationality is decision-making in networks. Hans de Bruijn and Ernst ten Heuvelhof (2008) pose that many decisions are made in networks. Networks can be defined by four characteristics. A network has a number of actors (1) with different goals and interests (2) and different resources (3), who depend on each other for the realization of their goals (4). A network is the reciprocal of hierarchy. Networks have a variety of actors, which makes steering decisions harder. The span of control is smaller in networks of many actors than of few actors. Regarding the implementation of Smart Mobility in the Netherlands, many actors are unknown or not on the table yet. Actors can have production power, blocking power or a diffuse power position. Production power means that actors have a positive contribution to the realization of a common goal. Blocking power means that actors can block steps and decisions in the process of realizing a common goal. A diffuse power position means that it is not clear what power the actor has on the process. The position of actors with diffuse power is probable to change during the process due to changes in resources, timing and relationships.

Many actors (and unknown actors) involved with the implementation of Smart Mobility in the Netherlands have diffuse power positions. Many road authorities have clear goals and mission values, while politicians and private parties might be less transparent with their strategies and positions. Overcoming obstacles related to execution could mainly be done if Smart Mobility would be more ‘a way of life’ than radical innovations being implemented overnight.

Incremental innovations are innovations that slowly adapt to their environment. In order to better understand how incremental innovations could help Smart Mobility related technologies and innovations to become a success, a break-down of incrementalism is posed in the next section.

Incrementalism
Charles E. Lindblom (1959) wrote an article on incrementalism: The science of muddling through. Lindblom argues that humans are limited in rationality. A lot of social and spatial planning projects are an exercise that is very much influenced by emotional arguments. Incrementalism is the concept of policy-making and decision-making in small steps. A good decision is acceptable to all actors involved and provides a decision that is better than other decisions. The benefit of an incrementalistic approach is not having to completely agree on fundamental values in order to come to good decisions. This decision model is criticised for being too conservative.

Regarding the implementation of Smart Mobility in the Netherlands a prudent and slightly conservative approach could be a potential benefit. Incrementalism is more in sync with daily governmental operations than more radical decision models. Another benefit of incrementalism is that the method is not deterministic. In other words, no predefined solution by certain actors to the problems is steered towards. When taking small steps, all actors can evaluate their response and follow-up actions. Incremental innovations are often at the base of large-scale diffusion.

Large-scale diffusion
Incremental innovations are not always tangible or visible. Ort, Zegveld and Shah (2007) show that there are three different scenarios of duration for breakthrough innovations and technologies (Figure 16). Scenario 1 describes a long innovation phase where it takes a long period before a new technology product is successfully introduced in a market. Scenario 2 describes a product introduction quickly after invention. However, the market adaption phase is long. In other words, it large-scale diffusion holds for quite some time. Scenario 3 describes a new technology product that directly after invention diffuses on a large scale in the market. The adaption phase is skipped.
Scenario 1: Long innovation phase after invention

Scenario 2: Long market adaption phase after invention

Scenario 3: Large-scale diffusion directly after invention

Figure 16 – Three scenarios with different lengths of innovation phase, market adaption phase and large-scale diffusion (Ortt, Zegveld, & Shah, 2007)

These models are based on research on breakthrough technologies such as radar technology (scenario 1: 30 years innovation phase, yet five years market adaption phase), contraceptive pill (scenario 2: one year innovation phase, yet 34 years market adaption phase) and dynamite or X-ray (both scenario 3: one year innovation phase and direct large-scale diffusion). Despite that these scenarios are based on products in mass market, parallels can be found to innovative products and services in the public domain. Large-scale diffusion of Smart Mobility technologies and innovations is the next step after the study phase and the pilot phase:

“We are in a phase where scale and diffusion of new technologies and services are not sufficient. There are many uncertainties. It is hard to predict what really happens with traffic flow and with new technologies, vehicles and new kinds of traffic information.” – Interviewee 1B

“The actual diffusion of systems on large scale happens marginally. We want to find out which obstacles face us while doing that.” – Interviewee 2E

J. Roland Ortt, Marc Zegveld and Chintan M. Shah (2007) argue that actors in innovation and new technology adaption environments can be distinguished into four groups. First are the pioneers. Second are the followers that copy the pioneers’ strategies. Third are the smart followers that create a different strategy based on the pioneers’ strategies in order to reach large-scale diffusion. Fourth are the late entrants that copy the smart followers’ strategy. Which strategy works is dependent on time. Three strategies are proposed: the mass market strategy, the niche market strategy and the wait-and-see strategy.

In their research, the case of the photocopier, among others, is used to explain the positions and strategies: Xerox (pioneer) developed expensive high-end products for business only (niche strategy), with high levels of service, maintenance and complementary products. Canon (smart follower) developed cheap low-end
products for the mass market (mass market strategy) based on the ‘razor and razor blade’ model (low price on the photocopier, high recurring costs for cartridges).

A parallel can be found in the case of Smart Mobility in the Netherlands. At this moment, no large-scale diffusion has happened. One could signal developments follow a niche strategy. The interviewees were univocal on that a wait-and-see strategy would not be a viable option. In their opinion: problems with traffic and mobility will only escalate further if no actions are undertaken. Proper working implementations of Smart Mobility technologies and innovations have to be demonstrated in the Netherlands in order to nudge private firms to copy the pioneers’ strategies on Smart Mobility. After that, more firms could copy the strategies of the pioneers and the smart followers can emerge with different strategies on the same principle. This should elevate Smart Mobility in the Netherlands to the next level. When theories on bounded rationality, decision-making in networks and large-scale diffusion patterns are combined, a direction for a new planning approach emerges. A planning approach is needed that takes uncertainties into account and that tries to describe alternative futures. Such a methodology was already suggested in chapter 2.5 of the literature review: adaptive policy planning.

Adaptive policy planning
Adaptive policy planning (‘Adaptief programmeren’ in Dutch) has been named in many interviews as the solution to coping with uncertainties in planning. The adaptive approach is characterised by short time spans in planning. In the past, planning large infrastructure projects were planned in terms of thirty years. Nowadays, product life cycles are shortened drastically.

"The matter involved does not allow it to be pinned down. Most projects and efforts are long term. The process is absolutely adaptive. Before I came working here adaptiveness was not something I encountered daily, but with all volatile developments such as Smart Mobility it is important to switch at any time." – Interviewee 2A

"Adaptive planning is something you just have to do. As an organisation, one can use a dot on the horizon and set milestones towards that horizon … You have to look for projects with shared ambition. The motto ’Discovering, learning and doing’ is most important. Adaptive planning is an explanation of the playing field where innovations take place.” – Interviewee 3D

"We participated in European projects. We wrote a roadmap in that regard. A roadmap creates a final image, your ambitions and your vision. After that, interviews were held with experts that give their prognosis on the future between now and 2050. Projects are chosen based on those expert interviews. In essence, this is adaptive planning; what route do you take and what milestones have you depicted." – Interviewee 3E

Road maps, dynamic planning, dynamic budgets and diverse knowledge teams are named as success factors for working with adaptive planning. ‘Adaptive’ is embedded in the process by formulating ambitions, vision and milestones rather than formulating concrete infrastructure projects. Development, investments and maintenance become processes instead of projects. The conservative product-based developments and tenders transform into progressive service-based co-creation and collaborations. Better understanding and use of adaptive policy planning methods could increase the success rate of Smart Mobility initiatives around the Netherlands. This approach could provide a solid basis for implementing Smart Mobility innovations whereas it transparently communicates future scenarios, decision milestones, budgets, risks and risk mitigation strategies.

4: Cooperation with other governmental institutions and market parties
Obstacle categories C2 (Cooperation between governmental institutions) and C3 (Cooperation with market parties) were addressed more by municipal road authorities than by national and regional road authorities: C2 was addressed by 1 (13%) road authority from FG1 while C2 was addressed by 6 (100%) road authorities from FG2. C3 was addressed by 2 (25%) road authority from FG1 while C3 was addressed by 6 (100%) road authorities from FG2. Obstacle categories C2, C3 and E3 were the only obstacle categories addressed
more often by FG1 during interviews than FG2, all other categories FG1 mentioned more obstacles per category.

“Cooperation is very important. However, it is still alternating between ‘getting everybody aboard’ and ‘making big steps’. Therefore you should be working on different paces.” – Interviewee 2D

Cooperation is more than an obstacle; it is a perquisite for successful implementing Smart Mobility in the Netherlands. Cooperation is hard to organise. The wish of many interviewees is to collaborate more often and more intense. Reasons for this are given due to mismatch of top-down and bottom-up approach of governments on different scale levels. Obtaining budget from a higher level government is hard if the approach does not congregate. Moreover, partnerships between public and private parties are also not always matches made in heaven.

5.1.3 Opportunities: main findings

Two main findings on opportunities were briefly discussed in chapter 4.5.2. These were (social) benefits and cooperation and knowledge sharing.

1: (Social) benefits

Social benefit opportunities were named most often: in total thirteen interviewees (93%) addressed social benefits as underlying opportunity for implementing Smart Mobility in the Netherlands. 34 Times an opportunity related to social benefits was mentioned during the interviews (23 times by FG1 and 11 times by FG2). This opportunity category was most mentioned by FG1 and by FG1 and FG2 combined. The most frequently mentioned opportunity category by FG2 was K1 (Research, innovating and knowledge sharing). The benefits of Smart Mobility are numerous. The benefits discussed below are from multiple perspectives. First, social benefits for people and society as a whole are presented. Second, the economic benefits are addressed. Concluding this section, the environmental benefits are presented.

Social benefits

Smart Mobility has the potential to create tailor-made target transport. Targeted transport (‘doelgroepenvervoer’ in Dutch) is transport for those who are not able to use regular modes of transport such as car, bus or train. These target groups can be children, handicapped people, sick people or elderly people.

“Especially user-centred technologies have our undivided attention. MaaS contributes to the sharing economy. It is about user-centred services where governments have to facilitate and not dictate. In other words: Enable! One main focus is target transport.” – Interviewee 3A

“Economic drivers must not become the main goals for implementing Smart Mobility. There is more need for social benefits than financial benefits.” – Interviewee 1A

New technologies and innovations can alter human (decision) behaviour. Smart mobility is also letting citizens re-evaluate their travel behaviour or driving style. Social benefits come in all sorts and shapes. Often addressed were quality of life, sustainability, inclusivity and ease of transport. But also better emergency response, parking administration and reduced pressure the existing infrastructure are social benefits.

Economic benefits

An often heard phrase was that Smart Mobility must positively contribute to ‘the Netherlands Ltd.’ (“de BV Nederland”). In other words, there should be a lasting economic benefit for Dutch companies. Thereby, there was a special division between SMEs and large firms. SMEs are thought to be the backbone of the Dutch economy, while large incumbent firms can provide cost-efficient services due to economies-of-scale. Firms can contribute by developing business cases for Dutch Smart Mobility implementation efforts.
One of the partnerships between road authorities and private firms in the Netherlands is Talking Traffic. Talking Traffic promotes the development, production and use of ITS in the Netherlands. Many N-road and local traffic intersections could benefit from better traffic flow. This saves lost time for transport firms and commuters, which results in less costs due to lack of productivity.

“Many benefits are on the economic side. Is there, besides projects and spatial planning, room for innovations, renewals and discoveries? Organisations must overcome certain program-related thresholds to cope with these questions on a more integral municipal approach. It makes the execution complex.” – Interviewee 3E

Private firms do not always seize the opportunity to develop business cases around governmental transport goals. At this moment the governmental institutions have to push the ideas to the private firms, while the innovation potential should lie with those firms.

Environmental benefits

TNO (2016) summarised many benefits of Truck Platooning. Most of the benefits have multiple sides. Less fuel consumption is a financial benefit for the transport companies, an environmental benefit due to fewer emissions and therefore a social benefit due to healthier living environments as well. The developed business case for Truck Platooning in Europe is well constructed. The technology is ready, the member states stand unanimously behind the concept and side issues are marginal.

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Sustainability is a concept closely related to Smart Mobility. Smart Mobility is not per se more sustainable, but the success lies in actively combining Smart Mobility to sustainability goals:

“By coupling the efforts to enhance the traffic flow and to better use the existing infrastructure the sustainability is raised.” – Interviewee 2F

“Besides the fact that the Dutch want to arrive in time, there is also a need for more sustainability. We realise that we cannot emit emissions without boundaries. People want to live healthy lives. You can kill two birds with one stone by coupling Smart Mobility concepts to sustainability goals.” – Interviewee 2B

By broadening the agenda, more policy-makers, administrators and businesses join the stream of innovations. Sustainability is a factor that can hardly be explained in a bad sense. Safer, carbon neutral and more efficient transport are all forms of sustainable transport.

2: Cooperation and knowledge sharing

Opportunities related to cooperation and knowledge sharing were addressed most often (79 times). Differences between the frequency groups were not as great as in the other two opportunity themes (B and P).

A theme that quickly arose during the data analysis phase was the importance of cooperation between road authorities and knowledge sharing. All interviewees have stated that cooperation and knowledge sharing are very important for the success rate of Smart Mobility initiatives.

‘Learning by doing’ is a common spread phrase across the interviews. It is viewed as the Dutch approach:

“Sometime you just got to try things if it comes to innovations. Just to see what works and what not. If innovations are not allowed to fail, then you will only undertake certainties. You can manage the expectation by communicating the efforts and risks transparently in advance.” – Interviewee 3F

Multiple initiatives and platforms for knowledge sharing are named during the interviews. Most frequently named were ITS Nederland, Beter Benutten, Connekt, LMVB (Landelijk Verkeersmanagement Beraad),

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Talking Traffic, Connecting Mobility and Socrates. A side note to these initiatives and platforms is the temporality of the collaborations and partnerships:

“Practical doing, that’s learning. Sometimes things fail, but you will always gain knowledge. An often forgotten part is: ‘What to do after the project is completed? What can we do with the conducted project?’ In the current situation a pilot is started, a report is delivered and, after that, the consortium falls apart. You should almost oblige people to make an ‘after-project’ strategy. Depending on the successfullness of a project, large scale diffusion could take place. If you think about follow-up steps in the last month of a project, then you are too late.” – Interviewee 3E

A combination between cooperating with other (governmental) organisation and private parties is often described as the Triple Helix innovation model. As discussed in chapter 4.2.1, Leydesdorff and Etzkowitz (1996) theorised the triple helix model as a framework for the rise of new institutions such as science centres, technology hubs, brain ports and innovation parks.

“Regional collaborations are the key element for the development of tomorrow’s mobility. It’s not about leadership in a domain. It is more about constructing a better liveable Netherlands together. Municipalities and provinces need each other. Together synergy can be reached in order to further develop the region.” – Interviewee 2A

“By yourself you go faster, yet together you come further.” – Interviewee 2D

5.2 Typical obstacles and opportunities per scale level

In this section the obstacles and opportunities that are typical for certain organisation scale levels are discussed. This overview provides the key focus areas of road authorities per scale level. The obstacles and opportunities in this chapter are not unique per scale level, but they provide an insight in the main pressing topics and heuristics. This chapter is concluded by shedding light on conflicting paradigms.

5.2.1 National

National governmental institutions are characterised by periodic change, politics, legitimacy and nationwide reach. National road authorities are charged with the build, operation and maintenance of public infrastructure. Law making, enforcing and regulating also belongs to the tasks of national road authorities. In the paragraphs below the typical obstacles and opportunities for national road authorities are discussed.

Typical national obstacles

National governments struggle with their role in Smart Mobility. They struggle with their position in changing times. National governmental organisations have a directing role. Smaller road authorities look at the national road authority for guidance. Should the government incentivise, facilitate or regulate? It is posed that the answer to the transitional role depends on the specific situation. Some measures call for guidance while other initiatives are resolved in the private domain with light regulating.

Mixed fleet is one of many challenges of the transition phase for road authorities in charge of highways. Self-driving cars are, theoretically and practically, able to drive autonomously today. The technology for systems to drive autonomously is available, yet regulations prohibit self-driving cars in the Netherlands at this moment in time. Moreover, for policy makers meaningful human control remains a construct to uphold. The intervention of a driver in case of an emergency is regarded as necessary until systems are fully integrated and without children’s deceases. The innovations of tomorrow have to be taken into account when designing new roads and updating existing roads. This turns out to be a tough exercise. This is due to the uncertainty of technological capacity and reliability of new innovative automotive technologies, but also due to the unpredictability of large scale diffusion of self-driving cars in general.

In a group where there is debate on topics, groupthink can occur. Group think is the psychological phenomenon of a group coming to consensus without being able to criticise decisions and alternatives
(Janis, 1991). There is a harmonious feeling, yet new insights and overcoming of false beliefs do not emerge. This false form of conformity within the group may lead to irrational decision-making. By avoiding raising controversial topics and issues, the true core of problems are not addressed. In relation to national road authorities influences from outside the organisation might be overlooked or suppressed.

Disruptive innovations are too radical for large conservative organisations such as national road authorities. As discussed in chapter Fout! Verwijzingsbron niet gevonden., incrementalism provides a more prudent approach for implementing new technologies and innovations. When researching Smart Mobility many obstructions for implementation and large scale diffusion arise:

“There are more than a thousand reasons not to be involved with Smart Mobility” – Interviewee 1B

Smart Mobility is regarded as a learning process, yet the organisational structure and business-as-usual is project-based. Smart Mobility also means new ways of managing assets. National road authorities are becoming less project executors and more process managers. The design, build, finance, maintenance and operation of infrastructure are outsourced to contractors. This step is from product to services. In this approach, road authorities do not ‘buy’ a road with certain specifications and dimensions. Instead a service is delivered in form of an operational and well-maintained road.

**Typical national opportunities**

National governments are the top level of governing a nation. Ministries of Transport and nationwide road authorities are the incumbent governmental organisations for steering, organising, planning and regulating large road infrastructures.

The biggest and most important opportunity, derived from the thesis results, for national road authorities is to set the agenda and shape the context. By creating and spreading a well-defined context, shared understanding and mission goals other road authorities and private firms can catch up to speed and contribute more to the process.

The Netherlands want to present a profile of being a nation of technological innovative leaders of the world. A few of these areas are infrastructure, health care and IT. Smart Mobility is a chance to combine multiple missions and create synergy between sustainable concepts.

Smart Mobility requires not only effort, but also smarter processes. Smarter organisations are organisations that are transformed from functional organisation with fixed budgets to efficient matrix organisations with flexible budgets.

### 5.2.2 Regional

Regional road authorities are the managing governmental institution that govern regional roads, water corridors and that appoints public transport concessions. In the paragraphs below the typical obstacles and opportunities for regional road authorities are discussed.

**Typical regional obstacles**

National road authorities are context setters on a nationwide scale. Regional road authorities are sandwiched between national and municipal layers. This can cause friction and it needs extra attention to maintain a clear focus:

“We work in many layers. Those are networks without juridical status. It is without obligation. That can make cooperating opaque and complex. You have to organise extra meetings and sessions to clarify made agreements and to propagate the same story to the public.” – Interviewee 2C
"As governments you need to have one voice to the outer-world" – Interviewee 2D

By working in different forums, which have PPPs across all layers, larger projects can be conducted with a higher possibility for successful large scale diffusion. Learning by doing is an proposed philosophy to start innovative projects without knowing all factors and uncertainties. By starting projects with an open-mind, civil servants could generate unpredicted knowledge and expertise. By reporting, and thus codifying, the efforts and obstacles, lessons learned can accelerate new projects in the future.

Knowledge sharing is a key opportunity, yet it remains an obstacle at the moment. Admitting flaws and failures in projects can be difficult and the lessons learned do not always end up at the right persons. It is a culture shift to share more information and, especially, issues and failures. This obstacle could be overcome if a more open-minded setting for Smart Mobility innovation efforts is created.

Budgets are quite difficult to plan. Provinces in the Netherlands are concessioner for public transport in the region. This means that regional governments must plan and divide funds for public transportation providers. Moreover, funds for new infrastructure investments come out of different budget than maintenance costs. This division was appropriate in the past, but with new financing and service-buying operation it becomes a greater obstacle. For instance, software updates are not funded from the new infrastructure budget, but also not from the maintenance budget.

Typical regional opportunities
Smart Mobility innovations and technologies can be developed regionally. This gives local and regional start-ups and technology firms an opportunity to sell their products and services at close range. The strength of weak ties within a region is important for successful implementation of Smart Mobility in the Netherlands. A facilitated fertile ground for the cooperation with SMEs and large transport organisations (such as NS, Arriva and Connexxion) could lead to new innovations and job creation within the region.

Regional public transport is important for the fast flow of traffic and appealing public transport. Regional road authorities can upscale their efforts for multimodal transport. The great streams of commuters could more efficiently be routed if multimodal transport hubs in larger cities. Alternatives to car use by offering multimodal travel options can be a huge opportunity for the region. Daily commuters spend thousands of hours in traffic jams. Multimodal transport is a smarter way of commuting. If provided in one application (plan, book, and pay in one app) by the MaaS concept, the pressure on roads can decrease.

Implementation of Smart Mobility innovations will probably only have a long term lasting effect is those innovations can be used throughout the Netherlands. Projects have more chance of succeeding if a large networks of municipalities and provinces have the same goal. Multidisciplinary project teams are needed to connect the larger road authorities that can ‘tow’ smaller ones. Civil servants with legal, communication, entrepreneurial, political and engineering expertise can form innovative teams that paving the way for large-scale diffusion of Smart Mobility technologies.

5.2.3 Municipal

In the paragraphs below the typical obstacles and opportunities for municipal road authorities are discussed.

Typical municipal obstacles
Effective cooperation with other municipalities remains a challenge. In order to streamline the difficulties of collaborating with other organisation the LMVB is installed. Collaborations are formed on four themes (Data, ITS, CAD, MaaS), where regions and municipalities are linked per theme.
“Many developments, projects and effort are not really concrete. To outsiders it might seem that we do little, but that is not just to the case; the pre-work is extremely important. If you do not take care of the pre-work, the rest will not matter anyway.” – Interviewee 3D

In many case funds for conducting pilots and diffusion are not sufficient:

“It is not always clear what has to be paid from which fund. This is a huge obstacle we constantly come across. I think every organisation has this problem, it is an old problem which we seems untackable for us.” – Interviewee 3F

“Within the municipality a lot of people were already busy with Smart Mobility. The ‘Smart’ part is often debated. The costs are high and the pay-off is not always clear or even financial. In traditional organisations it is difficult to communicate this message. Sequentially, it is difficult to get enough funds.” – Interviewee 3B

On the other hand, being creative in finding resources might pay off:

“We have funds available for Smart Mobility, but we try to generate as much funds as possible via European projects. We are quite successful in that remark: some projects are fully funded by the EU … Not all costs are covered by those funds, all pre-work is funded out of our own resources.” – Interviewee 3E

“We see all kinds of possibilities to get funds our way. For example, with the Beter Benutten programm” – Interview 3C

Internal expertise is named to be very specific and detailed, yet scarce. This scarcity is often due to the small size of the section that works on Smart Mobility. In the interviews anything from one to five FTEs is named. Following the low number of manhours on Smart Mobility is the low penetration grade of the efforts made by municipal road authorities. The larger part of the budget is allocated to obligatory governmental tasks. All investments and efforts on Smart Mobility might be regarded as ‘bycatch’

**Typical municipal opportunities**

Local politicians want to profile themselves and their political party. This topic arose during to the elections for local councils in March 2018. Many interviewees from municipalities noticed the newly installed councils. Despite a new course, Smart Mobility is not a development that has been scrapped in all cases. On the contrary, the need for and the benefits of Smart Mobility are widely recognised by the local councils. Despite the overall approval, politicians in general have a tendency to profile themselves with pilots and experiments in the area. If played right, this initial obstacle could be transformed into an opportunity.

Interviewees on a municipal level were more reluctant to make bold and concise statements on the definition of Smart Mobility. The overall conception was that definition of Smart Mobility is fluid at this moment in time. Municipalities are more followers than scene-setters.

In the interviews, collaborating and co-creating is called to be an opportunity. During the validation workshop cooperation was called a perquisite and a necessity for successful implementation of Smart Mobility in the Netherlands. Also knowledge sharing with other municipalities is highly valued and viewed upon as one of the biggest opportunities.

**5.2.4 Conflicting paradigms**

After discussing seven main findings and depicting obstacles and opportunities typical to certain levels of road authorities it is important to also evaluate multiple paradigms to Smart Mobility related topics. In this section a few of these topics are discussed from different viewpoints. First, Smart Mobility is viewed and discussed as being a wicked problem. Second, the infringement of private firms in the Smart Mobility arena is discussed. Third, problematic issues regarding innovation strategies are discussed. Fourth, the rate of social acceptance or reluctance is distinguished. Concluding this section, the ambivalent projected use of mobility is differentiated.
Smart Mobility as ‘wicked problem’

Horst W.J. Rittel and Melvin M. Webber (1973) developed ‘wicked problem’ in their article Dilemmas in a general theory of planning. A ‘wicked’ problem is defined as the failure of the search for scientific bases for confronting problems of social policy, due to the nature of these problems. Implementing Smart Mobility in the Netherlands is a wicked problem due to multiple aspects: The lack of predetermined trajectories cause inaccurate definitions of the problem. Therefore, accurate forecasting of Smart Mobility’s path and impact is not possible. There is a plurality of politics involved; many actors have their own strategies, values and resources regarding issues such as need to innovate, capacity, liability, security and privacy. Efforts made by policy-makers towards the implementation of Smart Mobility are subjective. In other words, there is no perfect solution to the problems at stake. No solution will be likely to satisfy all actors involved, directly or indirectly. In the end, decision-makers are pushed to make decision based on personal judgement due to endless possibilities and consequences, rather than make decisions based on pre-determined and weighted criteria.

Since implementing Smart Mobility in the Netherlands can be viewed upon as a wicked problem, many conflicting paradigms can co-exist. Depending on time and place, the weight can be shifted towards other ends of different spectra. A few conflicting paradigms are:

**Allowing private parties to take over**

Should private parties be incorporated in the daily cycle of road authorities or be held at a certain distance from operations. New smart contracts suggest that road authorities could ask less for products and more for services. Looking from a service providing perspective, long term uncertainties can be diverted to private parties instead of keeping uncertainties within the governmental institution.

**Managing innovations**

Innovations are investments in new knowledge creation. These investments in innovations come with uncertainties and are no guarantee for success or pay-off. Decision-makers and policy-makers are not always aware that innovations can fail. The responsibility of innovation developments is also not clearly defined. Should persons or organisations be held responsible for failed innovation efforts or is it a ‘business risk’ of developing new knowledge? How should decision-makers be held accountable for spending public money?

**Social acceptance**

People do not always use technology as designed and developed. The practice can be quite the opposite: if technologies are not user-centred developed, the nudge to use these technologies will be low (Peek, et al., 2014). Intuitive design is very important for letting users automatically behave as was designed. Thereby, it must be researched if Smart Mobility technologies increase inclusivity and if Smart Mobility cause more digitalised and information-intense processes.

**Use of mobility**

Studies have shown that the use of AVs could potentially increase the use of cars (Gruel & Stanford, 2015; Bonnefon, Shariff, & Rahwan, 2015; Isaac, 2016). The intensified traffic could turn out to be more problematic than problem-solving, despite many positive influences and potential relief for less mobile people (children, handicapped, elderly). More ease of transport could less traffic flow and more pressure on the road system.

Chapters 5.1 and 5.2, respectively provide the interpretations of the research results and the typical obstacles and opportunities per scale level accompanied by conflicting paradigms on Smart Mobility
implementation. These chapters and the results chapter of this thesis provide a sufficient amount of data, results and findings in order to adequately answer the research questions as posed in chapter 1.3.

5.3 Answering the sub research questions

After elaborating on the seven main findings in chapter 5.1 and reviewing the typical obstacles and opportunities per scale level in chapter 5.2, the five sub research questions are answered based on the analysis of the research results, policy documents and interpretations.

5.3.1 RQ 1: Definition and scope of Smart Mobility

The first sub research question What do the subjected road authorities consider to be ‘Smart Mobility’? is about the scope and focus of the road authorities. All interviews were opened with questions about the Smart Mobility landscape. In order to gain an understanding why road authorities do certain efforts, it is important to ask about their definition and scope of Smart Mobility. As described in chapter 2.1 of this thesis, Smart Mobility is an umbrella term. Not all aspects of Smart Mobility can be pursued due to limited resources, knowledge and practicability.

Definitions

Many different answers were given to the question what the definition of Smart Mobility would be according to the interviewee. Some of the quotes were:

“Smart Mobility is the digitalisation of mobility” – Interviewee 1B

“Smart Mobility is coping with mobility and traffic management in a smarter way” – Interviewee 2B

“Smart Mobility is all innovations applicable to traffic and transport” – Interviewee 2C

“Smart Mobility is creating better flow, safety and liveability” – Interviewee 2F

“Smart Mobility is the integration of traffic management and mobility management” – Interviewee 3D

“Smart Mobility is a system where information technology is central to solutions” – Interviewee 3E

The interviewees’ wide interpretation of the definition of Smart Mobility follows the scientific literature. The common denominator of the given definitions is the top-down viewpoint on Smart Mobility. A holistic view on systems, technologies, digitalisation and innovations form the base of many heuristics.

Due to Smart Mobility’s ambiguous and novel characteristics, some interviewees were more reluctant to provide a definition:

“The definition of Smart Mobility does not exist. That is immediately the problematic part Smart Mobility.” – Interviewee 3C

“A definition of Smart Mobility is something we don’t try to name anymore.” – Interviewee 3F

Many definitions co-exist and not one definition is sufficient enough to grasp the full complexity of the concept of Smart Mobility. Innovation is also sharing things that are not finished or incomplete. As the many definitions suggest, Smart Mobility is broader and more extensive than one can describe. All efforts towards a more sustainable, liveable and accessible environment contribute to the definition of Smart Mobility.

Scope

As discussed in chapter 2.1, Jeekel (2017) posed four main areas of Smart Mobility that construct the scope of Smart Mobility. According to Jeekel, Smart Mobility is about vehicle technology, ITS, data and new
mobility services. Table 7 in chapter 34.4 shows the scope components the interviewed road authorities have provided during the interview. The most frequently answered questions on topics about the road authorities’ scope and efforts are in line with Jeekel’s suggested topics. Data (management), ITS, MaaS and Automotive Technology (often named Connected/Cooperative Automated Driving (CAD) by the interviewees). The scope of Smart Mobility is visualised in Figure 17. Only MaaS is not named as a scope component by the national road authorities’ interviewees. However, the Dutch ministry does name new flexible mobility concepts such as MaaS to be one of the many focusses of Smart Mobility in the Netherlands (Ministerie van Infrastructuur en Milieu, 2016, p. 9). Rijkswaterstaat focusses on nationwide highways and waterways, car travel and logistics. MaaS is a theme that Rijkswaterstaat follows closely, but not actively researches or invests in.

Traffic management and physical infrastructure, both related to physical assets, are the backbone of roads and road systems. All road authorities have to deal with the physical infrastructure assets. Developments, operations and maintenance of physical infrastructure often belong to other parts of road authorities’ organisations than Smart Mobility. Therefore, these components are often placed outside the scope of Smart Mobility.

The last four scope components (car sharing, mobility management, sustainability and Smart Logistics) are more tailored focus areas of certain road authorities. Some areas in the Netherlands have more automotive industry, while other areas cope with large amounts of freight traffic. Smart Mobility provides an innovation base for governments on all scale levels to experiment and implement solutions to their specific problems and wishes.

Figure 17 - Smart Mobility scope (adapted from BEREIK!, 2017)
5.3.2 RQ 2: Obstacles and opportunities

The second sub research question “What do the subjected road authorities foresee as potential obstacles and opportunities for implementing Smart Mobility in the Netherlands?” is about the explanation of why road authorities act or do not act on certain trends and developments of Smart Mobility. The second sub research question is the basis of the research.

Obstacles

Chapter 5.1.1 to 5.1.3 discussed the seven main findings from the interviews. The section below discusses some other obstacles and opportunities, which were validated during the validation workshop. Five obstacles provided to be common denominators for road authorities on all three scale levels and were extensively discussed in the validation workshop. The summary of the validation workshop is included in Appendix F.

Do not reinvent the wheel

The most prominent topic was a figure of speech, ‘Do not reinvent the wheel’. It addresses the urgency not to spend resources on efforts that are already done or in progress somewhere else. One of the factors leading to this figure of speech is the fear of not spending resources on the right efforts.

“Sharing knowledge is a huge opportunity, but at this moment it seems to be an obstacle. We find it hard to admit flaws and failures, especially when those are shared broadly … It is not in our culture to share a lot about this” – Interviewee 2C

Cooperation and collaboration are evident for successfully implementing Smart Mobility. These topics were explicitly debated and agreed upon during the validation workshop. Cooperation and collaboration, within and outside of the organisation, are prerequisites for success. If there is no cooperation or collaboration, Smart Mobility will probably not take off.

Knowledge is often available to specific individuals or organisations. Thereby, knowledge is often available in the region. Especially municipalities stressed the importance of knowledge creation and sharing within the region:

“If regional private firms have the knowledge and resources available, we rather chose those firms over global parties. It is about stimulating each other and grant each other opportunities.” – Interviewee 3C

There are many platforms on Smart Mobility. As discussed in chapter 5.1, many of these platforms contribute to codifying knowledge by organising knowledge sharing sessions and distributing reports.

Large scale diffusion does not take place

The gap between pioneering, studying and doing pilots to large-scale diffusion and implementation of Smart Mobility technologies and innovations is too large. The scale for implementing Smart Mobility is not great enough. The success factor can be increased by broadening the applicability of Smart Mobility developments. Prices should go down and more investment will probably be made, which should cause a suction effect. This principle of economies-of-scale is well applicable to Smart Mobility.

“All experts in one region can be counted on one hand. It is important to look outside the boundaries of the region to other parts of the Netherlands to create scale in order to further develop technologies.” – Interviewee 3D

Pilots are useful for testing whether premises are significant or not. In a real-life experimental design, new technologies and innovations can be tested. Phases of coming from inventions and ideas to implementation on a large scale are often addressed as study, pilot, implementation:
“There are many pilots and novelties, yet the diffusion to practical life remains difficult. We must build further upon successes and failures of previous projects. The lessons learnt cause new challenges and can be used not do perform double work.” – Interviewee 2A

“Writing reports and doing pilots are national hobby no. 1 in the Netherlands. TU Eindhoven’s professor Hans Jeekel stated that only the province of Noord-Brabant alone had 500 pilots. That is not manageable. It is the challenge to come from pilots to operational traffic systems. That step requires extra power, knowledge and effort without any guaranteed pay-off in return.” – Interviewee 2F

The interviewees described that many pilots are undertaken without a clear goal in mind. A pilot is only useful when the outcomes of that pilot contribute to other efforts:

“When executing Smart Mobility in the Netherlands it is important not to start just somewhere. One of the main lessons learnt is that starting pilots and projects out of the blue is a waste of time and money” – Interviewee 2D

As discussed in chapter Fout! Verwijzingsbron niet gevonden., the economic feasible life cycle of physical and digital infrastructure assets is decreasing steadily. This calls for new contract and finance methods. Not only infrastructure and traffic must become smarter, also organisations, budgets and staff have to become smarter.

The role of governments is changing
This obstacle is discussed in chapter 5.1.2. The changing role of governments were discussed thoroughly during the validation workshop and agreed upon by many attendees. It was noted that new forms of contracts are the first step towards a more lean government. Instead of asking for products, such as a three-lane highway, the shift is going towards asking for a service, such as highway that can facilitate a traffic flow of 10,000 cars per hour. During the validation workshop, remarks were made that the Netherlands was more in the phase of ‘searching governments’. This indicates that the government is looking for more efficient, practical and effective ways to serve the people, whilst maintaining its current level of service.

There are many uncertainties
As discussed in chapters Fout! Verwijzingsbron niet gevonden. and Fout! Verwijzingsbron niet gevonden., uncertainties are the main obstacle for decision-making on policy level. The underlying factor for many obstacles is (deep) uncertainty. Uncertainties can be about all sorts of constructs. Many named uncertainty-related issues are acceptation, privacy, safety and life cycles.

Uncertainties are considered to be one of the main underlying factors why it is so hard to govern Smart mobility. The digitalisation of transport comes with many socio-technical questions. The shift from product-based procurement of transport and mobility to a more service-based procurement strategy comes with new governance difficulties. The digitalisation of transport also has an impact on asset management. More sensors and other hardware are needed to facilitate (C)-ITS. Directly following are the increasing costs of infrastructure. In the near future, the economic life cycle of products might not keep up with the physical life cycle, due to software updates and technological obsolescence.

Privacy remains a concern
Privacy and (digital) security are two highly debatable topics in the Smart Mobility domain:

“Privacy and cyber-security are our key topics. We set-up a digital office because we believe that we (the local government, local education institutions and private firms) can excel in this domain. We do not focus on physical road tests with AVs. Instead, we focus more on the subjects that are directly involved with AVs.” – Interviewee 3B

A theme that arose from the interviews was privacy. On May 25th 2018 new privacy regulations were effective in the EU. Many road authorities feel the need to do something with privacy, yet concrete actions.
were not mentioned often. In most cases, there was an appointed person within the organisation who was in charge of checking and implementing privacy measures.

Privacy is a hot topic at this moment in time. With Cambridge Analytica, multiple data breaches and online hacks, digital privacy and data security have been set the world stage. The acceptance of privacy infringing measures is low, while the terms of agreement for smartphone applications and computer software are rarely read before accepting. Based on interview responses, people show two-faced behaviour when it comes to privacy. Many users of digital applications measure privacy with double standards.

Many interviewees were aware of privacy-related issues. Privacy control on municipal scale is less stringent than on the national scale. Larger road authorities process more data a wider variety of data. Privacy is getting more important due to the more regulating and directing role of larger road authorities.

The perception of possible privacy infringements was scored to be low, yet the feeling was expressed that privacy will become more important in the near feature. Overall the privacy regulations are received as a necessary construct in times of data breaches and hacking.

“There is quite some internal resistance to outsourcing data activities to third parties. This is due to fear of losing quality, privacy and cyber-security” – Interview 2B

“The privacy regulations are very fluctuating at the moment. In May the new EU privacy regulations are launched. There are many questions underneath privacy: what do we consider to be privacy? How do we cope with privacy? What do we do? And what not? We try to make processes as water tight as possible by actively searching for bottle necks and by thinking ahead about potential problems.” – Interviewee 3F

Including private parties in the development and use phase of privacy-related operations remains difficult. With recent privacy scandals such as the NSA violations, the Cambridge Analytica scandal and Google’s various privacy controversies, it is hard to positively influence public acceptation of data collection methods and processing. Users are more aware of the implications of sharing private data when downloading newly launched applications for Smart Mobility in the Netherlands.

Privacy is an issue when it is an issue, self-evident as that is. In other words, in normal circumstances privacy is mostly not an issue, privacy is only an issue when private data is misused, leaked, hacked or breached otherwise. Privacy mitigating actions have to be implemented if there is reasonable doubt whether a system is watertight or not. Efforts around privacy protection are like vehicle maintenance: parts are checked, changed or repaired in order to maintain the standard function. A vehicle will most likely not ride better after standard maintenance, just like processes with private data will probably not spontaneously improve after updates. However, it is important to service and maintain components in order to uphold a robust and resilient system.

For road authorities, the following framework could be useful when implementing new processes and services while taking privacy into account. Figure 18 shows an eight-step privacy design strategy developed by Jaap-Henk Hoepman (2012) This framework is based on the ISO-29100 Privacy Framework (Hoepman, 2017). This ISO standard focusses on Personally Identifiable Individuals. The eight strategies can be divided into two categories: the first four strategies are data oriented strategies, the second four strategies are process oriented:
Opportunities

Obstacles for the implementation of Smart Mobility in the Netherlands were discussed twice as much during the interviews than opportunities, as stated in chapter 4.5.2. This indicates that obstacles are top-of-mind and potential show stoppers. There were common opportunities, despite the more risk-averse vision of interviewees. Two main findings on opportunities were discussed in chapter 5.1.3. These were (social) benefits, cooperation and knowledge sharing.

5.3.3 RQ 3: Governance

The third sub research question “How do the subjected road authorities govern their investing in researching, developing and implementing of Smart Mobility in the Netherlands in order to overcome obstacles and exploit opportunities?” is about the governance of Smart Mobility.

Governing Smart Mobility innovations and technologies is a process of continuous adaption to the complex environment of transport planning. The internal organisation of road authorities are likely to have certain hierarchal organisational structures. Civil servants switch between daily tasks and efforts on innovation, where daily tasks consume the largest amount of working hours. Thereby, resistance to new innovations, technologies and processes is a common change aversity. It demands dedicated innovation leaders to help overcome organisational inertia factors in order to create a socio-technical environment ready for new innovation technologies. A small but steady transition can be put in motion by starting with incremental innovations. Private firms develop next generation technologies simultaneous to these incremental innovations in public organisations.

Figure 18 - Process flow visualisation of eight privacy design strategies (Hoepman, Privacy Design Strategies, 2012)
Stimulating innovations and pilot projects could be key to increasing the scale for Smart Mobility. Expectation management could be used to explain failures as lessons learned. An inspirational environment has to be created in order to create an incubator effect for novel Smart Mobility projects. Governmental organisations are changing on various grounds: the infrastructure is more digitised, processes are globalised and services are more individualised. This causes road authorities to search for new purpose in changing times. New contract forms, procurement and services ask for innovative and intelligent civil servants. Road authorities should be switching between the four basic roles (regulator, facilitator, realisator and communicator) as defined by Kennisinstituut voor Mobiliteitsbeleid (2018).

Road authorities should map out mission statements, efforts and uncertainties, when executing Smart Mobility pilots and projects. By closely monitoring trajectories and future scenarios, road authorities could steer Smart Mobility projects during the implementation. Involving multidisciplinary teams of both the public domain and market parties could lead to knowledge spillovers and contextual innovations. Multi-disciplinary teams widen the bounded rationality of individuals and organisations. A network-based approach team could increase efficiency by effectively attracting actors with production power. Large-scale diffusion of Smart Mobility innovations and technology into the market is possible if incremental innovations are combined and the market parties provide novel technologies at the right time. Creating awareness on Smart Mobility among the Dutch people and civil servants is necessary to create a fertile environment for socially accepted transport solutions.

5.3.4 RQ 4: Interaction with other governmental institutions

The fourth sub research question “How do the subjected road authorities interact with each other and with other institutions in order to overcome obstacles and exploit opportunities?” is about the interaction between road authorities and other governmental institutions.

Chapter 5.1.2 discussed the main findings which are related to the interaction of governmental institutions.

Often named collaborations are VNG (Vereniging Nederlandse Gemeenten), IPO (Interprovinciaal Overleg) and LMVB (Landelijk Verkeersmanagementberaad). The following platforms and initiatives were also named during multiple interviews: Beter Benutten, Connecting Mobility, Talsking Traffic, SmartWayZ.NL, Polis, Eurocities, Smart Societies, and Socrates.

5.3.5 RQ 5: Public-Private Partnerships

The fifth sub research question “How are Smart Mobility-related developments organised in both the public and the private domain in order to overcome obstacles and exploit opportunities?” is about the interaction between road authorities and private parties.

A many heard phrase is that governmental institutions get cramped when private firms enter the stage:

"Collaborating with private parties is quite difficult. A large part of the private firms does not show their cards because of the threat of other firms stealing their ideas. Thereby, private firms want that governments precisely formulate their needs, while governments only have visions or mission statements. Due to this the government will fall back on traditional patterns." – Interviewee 2A

As the quote above states, private firms wait for governmental tenders before showing their ‘cards’. This is where the problematic part lies: how do governmental organisations know what to ask for if the private firms do not show what is available. PPP can be a solution to this impasse in cooperation. By collaborating in research, creating a shared lexicon and establishing long-term dependencies, PPP can provide new insights and technology for large-scale diffusion. Issues regarding large-scale diffusion were often named as hampering factors for implementing Smart Mobility: the scale is too small and the playfield of Smart Mobility in the public domain is too complex.

The Triple Helix model is a good framework for creating successful innovations and technologies. As discussed in chapter 5.1, Triple Helix provides a basis for multi-perspective collaborations between governmental institutions, universities and knowledge institutions, and private firms. Knowledge is an export
product for governments, knowledge institutions and private firms. When co-creating new innovations and technologies, it is important to share visions on the future of these developments on a national level:

“Private firms have a need for a uni-vocal government. All noses must be pointed in the same direction and there must be a shared understanding on the goals and executions. Private firms can invest, develop and deliver products and services on long-term only if the vision of Dutch governmental institutions are stable and unambiguous.” – Interviewee 2D

By involving private firms, a self-fulfilling prophecy is created: Private firms develop business cases, they find financial securities, they see opportunities for contracts and services, and they synchronise developments of Smart Mobility according to governmental developments.

Over the past ten years, due to the financial crisis and lower economic growth, business-as-usual was more important than investing in innovations. This has turned around slowly in the last three years. Private firms make more business cases for Smart Mobility, they find more financial securities and there are more opportunities for long-term collaborations.

### 5.4 Reliability and validity of the research

The reliability and validity of the research are discussed in this chapter. First, the adequacy of the interviewee sample size is discussed by the theory of theoretical saturation. Subsequently, the reliability of the research results is discussed based on the results of the intercoder reliability check. Concludingly, the validity of the research’ main findings is discussed based on the validity workshop at Rijkswaterstaat.

#### 5.4.1 Theoretical saturation

Chapter 3.3.4 discussed the prerequisites of theoretical saturation. Figure 19 shows the cumulative addressed topics during the interview sequence. Figure 20 presents the frequency of new topics

![Graph showing cumulative addressed topics](image)

**Figure 19** - Cumulative addressed topics during fourteen semi-structured interviews (categories of codes) per interview and the trend line of new topics over time. No full theoretical saturation appeared. The main pressing themes and grand topics were discussed by the first six interviewees. Not many new insights and topics were discussed from that point onwards.
The sampling was stopped due to the scope of the research, whereas finding obstacles and opportunities for successful implementation of Smart Mobility in the Netherlands in the 2018-2023 time frame is unlimited in answering. Qualitative research has no central definition of the measure of significance, which makes determining an adequate sample size difficult. O'Reilly and Parker (2013) argue that theoretical saturation is a concept that follows from grounded theory research and is not directly applicable to other qualitative research. Theoretical saturation by itself is not per se a good indicator for the quality of qualitative research. Data can best be seen in terms of rich and thick opposed to sample size (Burmeister & Aitken, 2012). Rich data means a lot in quality, thick data means a lot in quantity (Fusch & Ness, 2015). Rich data is detailed, well-constructed, nuanced and layered, while thick data is just a lot in numbers. The data used in this thesis is believed to be more rich than thick, yet the semi-structured interviews have led to 30,000 words of transcript.

5.4.2 Intercoder reliability check

As discussed in chapter 3.5.1, the reliability of the interview coding is done by an intercoder reliability check. Dr. Jan Anne Annema, first supervisor of this thesis, coded a sample of two interviews as intercoder. The calculation of the intercoder reliability coefficients were performed with SPSS. The coefficient used is Cohen’s kappa. Full cross tables and calculations are included in appendix C.

The kappa value of the agreement based on category scores is $\kappa = 0.460$, $p < 0.001$. The kappa value of the agreement based on themes scores is $\kappa = 0.528$, $p < 0.001$. Both values indicate moderate agreement between the coders, based on Altman’s (1991) interpretation of kappa values. These values can be interpreted as that the transcripts are coded with appropriate diligence and reliability.

Not achieving a greater score on the agreement between coders could be explained due to various underlying factors: First, no training, instruction or help during the coding was offered to the second coder other than a coding protocol. Secondly, the coding protocol was a direct copy of chapters 4.2 and 4.3 of the second coder with a short introduction with no further explanation or extensive practice examples. Thirdly, segments were underlined in the transcripts provided with the amount of codes used per segment. Fourthly,
both the codes as the coded segments are. Many categories have overlapping codes. In other words, some segments of text could fall in more than one category. This makes the process of coding more subjective to multiple interpretations. The codes could also be interpreted in multiple ways, due to different background knowledge and experience of the coders.

5.4.3 Validation workshop

Chapter 3.5.2 discussed the added value of a workshop to check the validity of research results and interpretations. This validation is an extra contribution to the value and validity of the thesis project’s findings, results and conclusions. Not much time was spent on the methodological aspects of the thesis during the workshop. Rather than that, the overarching results and conclusions were focussed on. It was assessed whether the findings were correct and to what extent they were correct. Nuances were given, debates were held and sharpening of the research statements happened during the workshop:

The four most important themes, Data management, Connected and Automated Driving, (C)-ITS and MaaS, were agreed upon by the group. The definition of Smart Mobility, or better to say the lack of a definition, was widely discussed. This challenge could also be used as an innovation canvas to explore all possible innovative technologies related to transport and mobility. It underlines the interpretation of the first research question.

After that, these five obstacles were presented as the biggest common denominators:

1. Don’t reinvent the wheel.
2. Implementation does not take place sufficiently at this moment in time.
3. Privacy remains a difficult issue.
4. The role of the government is changing.
5. There are many uncertainties.

Most statements were agreed upon and resulted in fruitful discussion. Only the fourth obstacle category gave light to multiple interpretations and paradigms. Arguably the most the debated statement in that obstacle category was that governmental institutions are too traditional. Traditional characteristics were posed as fixed budgets, limited scope, inert organisational structures and the lack of entrepreneurial spirit. Rijkswaterstaat is largest (water) road authority of the Netherlands and puts a lot of effort into being efficient and effective. Therefore, this statement did not resonate accordingly with the majority of the group. The organisational structure allows Rijkswaterstaat’s civil servants to work on innovations and novel technologies besides their ‘normal’ workload. Interviewees at smaller governmental organisations experienced much more reluctance to change and innovations. Also the term ‘changing government’ was argued deeply. A suggestion that resonated with the group was to use the term ‘searching government’ instead. This indicates that the government is looking for more efficient, practical and effective ways to serve the people, whilst maintaining its current level of service.

The workshop was finalised by a concluding part where the lessons learned were briefly recuperated and the attendees had a chance to network and exchange knowledge. New collaboration opportunities among the road authorities were discussed (and formed), both within and outside the scale levels.
6 Conclusion, reflections and recommendations

The previous chapter discussed the main findings (chapter 5.1), typical obstacles and opportunities per scale level (chapter 5.2) and the sub research questions of this thesis were answered (chapter 5.3). The overarching conclusion, implications and relevance are discussed in this concluding chapter. First, the main research question is answered in chapter 6.1. Secondly, a reflection on the thesis research is discussed in chapter 6.2 with the research’ limitations and relevance. This thesis research is concluded by practical recommendations and recommendations for future research in chapter 6.3.

6.1 Conclusion

This thesis has researched the obstacles and opportunities for implementing Smart Mobility in the Netherlands in the next five years from road authorities’ perspectives. Scientific literature and governmental policy documents were reviewed in order to construct semi-structured interviews. The set-up of the semi-structured interviews allowed the interviewed civil servants to speak freely about their everyday efforts, predictions on the future of Smart Mobility and scenarios for their own organisation. The semi-structured interviews were held with two national, six regional and six municipal road authorities. Based on this analysis the main research question of this thesis, What are the obstacles and opportunities for implementing Smart Mobility in the Netherlands in the 2018-2023 time frame from road authorities’ perspectives?, can be answered:

Six themes were observed in total during the analysis of the coded interview transcripts. After that, eighteen obstacle and nine opportunity categories were constructed. Three obstacle categories, one obstacle theme, one opportunity category and one opportunity theme for implementing Smart Mobility in the Netherlands were found to be crucial factors for implementing Smart Mobility in the Netherlands. The obstacle categories are (1) organisational inertia, (2) the changing role of governments, (3) cooperation with other governmental institutions and market parties and (4) the theme obstacles related to execution. The opportunity category is (1) (social) benefits and the theme is (2) cooperation and knowledge sharing.

The most frequently addressed opportunity category was social benefits. Interviewees stressed that Smart Mobility is a mean, not a goal. Social benefits were named in all sorts and shapes: social benefits for the liveability of cities, quality of life, sustainability, sense of safety, and social prosperity. Also better emergency response, parking administration and reduced pressure on the existing infrastructure are considered to be social benefits by the interviewed road authorities. The majority of the municipal road authorities claimed that Smart Mobility could enhance the inclusivity of mobility. New technologies and innovations could alter human behaviour; Smart Mobility is also letting citizens re-evaluate their travel behaviour or driving style.

Despite the various potential benefits of Smart Mobility, all road authorities named more obstacles than opportunities during their interviews. The most frequently addressed obstacle category was organisational inertia. On top of that, many interviewees had doubts whether people will accept Smart Mobility innovations and technologies in their daily lives. Concerns were shared whether Smart Mobility innovations and technologies would be fully accepted by the Dutch people in general, bearing in mind that people could have a tendency of being reluctant to change. Two important factors for successful implementation of Smart Mobility technologies and innovations that were named by the interviewees were intuitiveness of Smart Mobility innovations and technologies and their scale-ability. That intuitiveness could be a big factor in helping people accept Smart Mobility technologies and innovations into their daily lives. The other often recurring factor was scale-ability. A chasm was depicted by many interviewees between studies and pilot on the one hand and large-scale diffusion on the other hand. This chasm should be bridged in order to come from small Smart Mobility initiatives to, preferably, a nationwide Smart Mobility innovation available to all citizens of the Netherlands.
Data (management) was the most frequently named theme when interviewees were asked which Smart Mobility themes were within the scope of their organisation. Data (management) is viewed as the cornerstone of Smart Mobility. In other words, if the data is not properly managed, then Smart Mobility cannot be implemented with full safety and security. One of the most pressing issues discussed by the interviewees regarding data (management), was the scenario that data would not be available due to a disruption of the data network or a data breach. To cope with such an external failure, a contingency system has to be created in order to provide a robust and resilient data management infrastructure. Organisational inertia and data management are potentially hampering factors that should be taken into account when implementing Smart Mobility in the Netherlands.

As a closing remark, opportunities were mentioned less than obstacles. Obstacles were more 'top of mind' for the interviewees than opportunities. Policy-makers and civil servants are more used to dealing with inert organisations and are subconsciously more aware of negative factors than positive factors. The opportunities could be limited due to the scope and resources of many road authorities, while obstacles could subsurface and be hard to detect. In the end, 'show-stoppers' are more easily recognisable than 'no-regret' measures and activities. As one interviewee said: 'There are a thousand reasons not to do something. But only one reason is needed to start something.'

6.2 Reflection

This chapter discusses the conduct of the research. First, a reflection on the conclusion is provided. Secondly, the relevance of the research reviewed from four perspectives. Finally, the limitations of the research are discussed.

6.2.1 Reflection on the conclusion

The conclusions of the thesis research questions provide an in-depth insight in the way road authorities in the Netherlands cope with growing transport and mobility problems in an innovative and sustainable manner. Chapter 5 provides a discussion and interpretations on the results of the research. The section below entails some final remarks by the researcher on less tangible results and heuristics.

The ambitions of road authorities in the Netherlands differ per region and even per city. Yet, the goal to maintain or increase the accessibility, liveability and safety of cities in the Netherlands is widely shared (appendix D). Smart Mobility has been opted as the solution to many policy issues regarding transport and mobility. Moreover, a lot of effort is being made to get digital mobility solutions to the next level: from studies to pilots and from pilots to implementation on a large scale.

The jump to large-scale diffusion of Smart Mobility technologies and innovations however, turns out to be too big a step according to the majority of the interviewees. Initiatives fail, not due to technological or financial obstacles, but, according to the interviewees, they mainly fail due to organisational obstacles. These organisational obstacles could be reinforced by the changing role of governments due to globalisation, digitalisation and rapid technological innovations.

Small road authorities struggle with capturing knowledge and expertise when budgets are often not sufficient. Bigger road authorities are cumbersome and subjected to high standards of failure-free performing. Many uncertainties are underlying factors that slow down the process of implementing Smart Mobility in the Netherlands. Uncertainties are various and comprehensive, maybe even inexhaustible.

Understanding what potential obstacles and opportunities are for implanting Smart Mobility in the Netherlands in the 2018-2023 time frame calls for a process-based and network-oriented viewpoint. The wickedness of a problem such as solving traffic and mobility issues is easily explainable. The plurality of
actors, uncertainties and possible solutions create an opaque and unpredictable picture of the future of Smart Mobility in the Netherlands.

Opportunities lie inside and outside of the road authorities’ organisations. It is important to have the right timing with the right expertise, vigour and perseverance. Heuristics and biases on Smart Mobility can be altered by incrementally introducing innovations and processes into the organisation. Scoping Smart Mobility on a short term, 2018-2023 or shorter, causes tangible mile stones. Setting mission values and creating a dynamic approach to implementing Smart Mobility, raises the possibility of successful implementation.

6.2.2 Relevance

The following paragraphs discuss the relevance of the research from multiple perspectives. First, the scientific relevance of this thesis’ results and conclusions are elaborated upon. Subsequently, the relevance for society is discussed. After that, the corporate relevance is explained for engineering and consultancy professionals in transport, manufacturing and the built environment and the managerial relevance is put forward for policy-makers and politicians that cope with implementing large innovative infrastructure projects. Concluding, the relevance of the thesis research from a Management of Technology perspective is discussed.

Scientific relevance

The scientific literature on Smart Mobility is far from conclusive. This thesis research is a thin cross-section of Smart Mobility efforts of road authorities in the Netherlands. However, it does give a rich image of the efforts and heuristics on Smart Mobility in the Netherlands. Among the interviewees were key players in the Smart Mobility ecosystem of the Netherlands.

New applications and innovations on sustainability, mobility, digitalisation and globalisation keep the concept of Smart Mobility ambiguous and complex. More effort on researching Smart Mobility will lead to more uncertainties and more complexity. Answering one question will raise more questions. It is more interesting for scientific research to take a Smart Mobility innovation or technology, such as AVs, and explore those in-depth.

Societal relevance

This thesis has shown that there are many benefits to people when Smart Mobility technologies are embedded in their everyday life. The benefits for society reach far beyond mere financial and economic benefits. Intangible benefits such as safety, comfort and availability of transport are easily explainable to citizens. However, user acceptance of Smart Mobility technologies and innovation is far from optimal at this stage. Applications must be made too intuitive to fail for people to use it on a large-scale.

Corporate and governmental-managerial relevance

Smart Mobility is viewed as a development for next generation mobility and transport. New paradigms can be created by businesses. A theme that arose from the interviews was the struggle of governments with their role. Many times, it was suggested that private parties should enter the stage and develop Smart Mobility oriented solutions for governments, either in cooperation or as tenders.

To provide structure for future development, there is a clear need for a broadly supported and robust “Smart Mobility Roadmap” that defines transitional aspects and provides an adaptive strategic skeleton for weighing and structuring current and future initiatives, thereby reducing the number of uncertainties for decision makers at different levels.
During the validation workshop it was claimed that governments and road authorities should also explore new ways of cooperation and partnerships with market parties. This is needed to catch up with quickly developing and newly emerging technologies that have a big potential to reach policy goals, but also tend to change traditional roles and responsibilities. Governing dynamic organisations in a time of rapid changing environments, technologies and innovations can be a complex task. Smart Mobility is a multi-actor, multi-disciplinary concept which calls for expertise, visions, goals and achievements. Applying network-oriented and process-based decision-makers and policy-makers in the network could form a basis for fruitful PPPs.

6.2.3 Limitations

In this section the limitations of this thesis research are discussed. First, the theoretical saturation of the data is discussed. After that, the reliability of the coding is argued.

Theoretical saturation

This research was limited to road authorities in the Netherlands. The applicability for the Netherlands is evident: a proper sample has been researched to generalise the analysed data and results. Chapter 5.4.1 showed that the interview data was not completely saturated. Therefore more interviews should be conducted. Due to the scope of this thesis, fourteen interviews were considered sufficient, by the thesis’ first supervisor, to create a rich understanding of the obstacles and opportunities for implementing Smart Mobility.

An often heard phrase while doing interviews was “When you have interviewed one person of an organisation, you have interviewed just one person of that organisation”. In other words, multiple paradigms exist within organisations. The answers to interview data strongly depend on the person interviewed. The same research can be duplicated within one road authority scale, to get a more detailed and rich understanding of the obstacles and opportunities of implementing Smart Mobility in the Netherlands from one road authority’s perspective.

This thesis only describes road authorities in the Netherlands from the perspectives of fourteen interviewees. Even though there are cultural differences within the Netherlands, different answers, results and conclusions would have been found when researching a more global set of road authorities. However, it does show the main heuristics on Smart Mobility in the Netherlands.

Reliability

The kappa value of the agreement based on category scores is $\kappa = 0.460$, $p < 0.001$. The kappa value of the agreement based on themes scores is $\kappa = 0.528$, $p < 0.001$. These values demonstrate that the reliability of the coding was found to be moderate. A higher score could have been achieved if the intercoder was trained instead of handed the coding protocol without instruction.

6.2.4 Recommendations for future research

As discussed in section 5.2.3, the scientific literature on Smart Mobility is far from conclusive. This concluding section poses the recommendations for future research and for practitioners working with Smart Mobility innovations and technologies.

Recommendations for future research

One of the needs for future research is the evaluation of market penetrations of the most frequent Smart Mobility innovations. The four main themes of Smart Mobility in the Netherlands (Data management, ITS, MaaS and automotive technologies) come with certain products and services which probably will be implemented in the coming decade. The market penetration and large-scale diffusion of these various innovations and technologies require thorough research, interpretation and discussion.
More research should be done into (dynamic) adaptive policy planning regarding break-through technologies and innovations. For instance, research on dynamic policy pathways has been done on fairly static and long-term infrastructure projects such as water management and bridges. Deep uncertainties related to the effects on policy planning of Smart Mobility have not yet been researched.

Data and privacy ownership is a topic gaining importance. In a swiftly digitalising world, legislation and protocols do not evolve as fast as the subjected technologies. Research is required in order to provide a standardised framework for safe and secure (digital) systems. A disruption of the data network could lead to a fallout of data dependent Smart Mobility technologies. Research on Smart Mobility contingency planning is suggested in order to cope with external events that hamper the data management infrastructure. A standardised contingency framework could be helpful for governmental institutions and private firms in order to provide a robust and resilient Smart Mobility system.

Implementing new Smart Mobility technologies might lead to a point of no return. In that scenario, certain path dependent trajectories have been created which steer the future scenarios of Smart Mobility. Combining the theory of (deep) uncertainties, dynamic adaptive policy planning and a Delphi study on the future scenarios of Smart Mobility in different countries could lead to a better understanding of factors for successful implementation, show-stoppers and no-regret measures in a wider context.

Recommendations for practitioners

All interviewees involved in this research were aware of the importance of finding new solutions to make the Netherlands an accessible, liveable and safe country. The improving economy and economic growth put extra pressure on road authorities and personnel. Private parties can jump into the gap that has opened due to large governments’ inertia to move along with the economic growth and pressure on the roads.

Engineering consultancy firms, such as Royal HaskoningDHV, could provide services around the planning, implementation and life-cycle of Smart Mobility initiatives. IT firms and car manufacturers could collaborate in an alliance model, supported by subsidies from the EU, in order to develop new Smart Mobility technologies, innovations and applications.

The validation workshop at Rijkswaterstaat revealed that the biggest Dutch road authority is struggling very much with adaptive planning. Their long term strategies have been shorted greatly in the last years due to technological obsolesce and digitalisation. Jointly investigating (dynamic) adaptive planning and incorporating that philosophy in the processes of large road authorities is a great opportunity to create a suction effect for new technologies, resources and skilled knowledge workers.
References


Ammerlaan, D., & Lieshout, S. v. (2018, February 5). Interview on Experiences with Road Authorities on the subject of Smart Mobility. (M. Spaans, Interviewer)


Prins, P. (2017, October 25). E-mail conversation with Pieter Prins (Royal HaskoningDHV). (M. Spaans, Interviewer)


Appendix A: Interview Guide

RQ1: Scope
“What do the subjected road authorities consider to be ‘Smart Mobility’?”

- What do you consider to be Smart Mobility?
- What scope does your organization use?
- Why do you have chosen for these particular subjects?
- Do you act on:
  - C-ITS;
  - Self-driving cars;
  - Data management;
  - MaaS?
- Are there any current projects?
- Can you describe in one or a few sentences why Smart Mobility is important for your organization?
- What subjects are left outside of your organization’s scope?

RQ2: Obstacles and opportunities
“What do the subjected road authorities foresee as potential obstacles and opportunities for implementing Smart Mobility in the Netherlands?”

- What are the current problems/opportunities for your organization on the area of mobility and transport?
- In the past, what actions did you undertake to counter (these) problems?
- How do you cope with potential obstacles of Smart Mobility? For instance:
  - Privacy;
  - Safety;
  - Regulation, legislation and liability;
  - Other obstacles?
- How do you act on potential opportunities of Smart Mobility? For instance:
  - Accessibility (for citizens/commuters/tourists);
  - Parking;
  - Travel behaviour?
  - Other opportunities?

RQ3: Governance: Adaptive Planning
“How do the subjected road authorities govern their investing in researching, developing and implementing of Smart Mobility in the Netherlands in order to overcome obstacles and exploit opportunities?”

- What is your organization’s budget for Smart Mobility in 2018-2023?
- What activities do you perform ‘in-house’?
- What activities are out-sourced?
- Adaptive policy planning:
  - Are you familiar with Adaptive Policy Planning?
  - How do you use Adaptive Policy Planning?
  - How do you use Robust Decision Making (RDM)?
- What is your organization’s structure?
- What implementation actions/activities does your organization undertake in the near future?
RQ4: Interaction with other road authorities / governmental institutions
“How do the subjected road authorities interact with each other and with other institutions in order to overcome obstacles and exploit opportunities?”

- Which institutions do you work with? Why and how?
- Which knowledge platform(s) do you participate?
- What value does your organization add to Smart Mobility in the Netherlands?

RQ5: Public-private Partnerships
“How are Smart Mobility-related developments organised in both the public as the private domain in order to overcome obstacles and exploit opportunities?”

- Which private parties do you work with? Why and how?
- How does the collaboration with private parties unfold?
  - What services/products/knowledge do you obtain?
  - Do you co-create services/products/knowledge?
- What projects are planned for the coming years?
Appendix B: Interview invitation

Beste heer/mevoruw […],

Afstudeeronderzoek
Dit jaar ben ik begonnen als afstudeerder MSc Mangement of Technology van de TU Delft (faculteit Techniek Bestuur & management) bij Royal HaskoningDHV op het gebied van Smart Mobility. Ik onderzoek hoe verschillende wegbeheerders de implementatie van maatregelen op het gebied van Smart Mobility organiseren in de periode 2018-2023.

Ik ga een selecte groep van wegbeheerders in Nederland met een grote ambitie op het gebied van Smart Mobility onderling met elkaar vergelijken. Onderwerpen die daarbij aan de orde komen zijn zelfrijdende auto’s, intelligente verkeerssystemen en governance. Ook de ervaringen met adaptief programmeren, robuust plannen en implementatieestrategieën worden in mijn onderzoek meegenomen.

Medewerking gemeente/provincie […]
Ik nodig u, namens de gemeente/provincie […], graag uit om deel te nemen aan het onderzoek. [persoonlijke tekst] In mijn interview ga ik in op vragen over de totstandkoming van deze acties en ambities met onderwerpen als besliscriteria, publiek-private samenwerking en visies over de toekomst van Smart Mobility in Nederland.

Uw bijdrage bestaat uit een interview op uw locatie. Dit interview duurt ongeveer een uur en zal bijdragen aan inzichten in de barrières en kansen van Smart Mobility in Nederland vanuit wegbeheerders’ perspectieven. Aan de hand van het interview kunnen nog documenten nagezonden worden die bijdragen aan de besproken onderwerpen. […] […] en […] gingen u al voor. Na vergelijkend onderzoek wordt u (in mei 2018) uitgenodigd voor een werksessie waarbij de conceptresultaten en -conclusies als eerste met de deelnemende wegbeheerders wordt gedeeld. Uiteraard krijgt u een exemplaar van het definitieve eindrapport.

Lijkt u het leuk en bent u bereid tot medewerking aan dit onderzoek? Ik hoor het graag!

Met vriendelijke groet,
Marlon Spaans

Afstudeerder Smart Mobility bij Royal HaskoningDHV
Appendix C: Calculating intercoder reliability (Cohen’s Kappa)

Crosstable of coder 1 (MS) and coder 2 (JAA)

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a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstable of coder 1 (MS) and coder 2 (JAA) on obstacle and opportunity themes

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Systematic Measures of the agreement on coding in themes

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## Appendix D: Mission statements Smart Mobility (Dutch)

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<td>Rijkswaterstaat</td>
<td>Om mensen en goederen <em>vlot en veilig</em> hun bestemming te laten bereiken, werkt Rijkswaterstaat dagelijks aan weg en water. Dat doen we in een dichtbevolkt land waar de ruimte beperkt is. Om Nederland ook in de toekomst <em>bereikbaar</em> en <em>leefbaar</em> te houden, willen we de kansen benutten die nieuwe informatie- en communicatietechnologie ons biedt. Deze inzet van ICT-oplossingen noemen we <em>Smart Mobility.</em></td>
<td><a href="https://www.rijkswaterstaat.nl/over-ons/nieuws/archief/2018/02/smart-mobility-wij-moeten-af-van-het-autodominante-denken.aspx">https://www.rijkswaterstaat.nl/over-ons/nieuws/archief/2018/02/smart-mobility-wij-moeten-af-van-het-autodominante-denken.aspx</a></td>
</tr>
<tr>
<td>Regional</td>
<td>Province of Flevoland</td>
<td>Onze wereld staat voor <em>grote maatschappelijke uitdagingen</em> die voortkomen uit de <em>groeïrende vraag naar mobiliteit</em> en de impact daarvan <em>op onze leefomgeving</em> en de <em>economische ontwikkeling.</em> Het verkeersnetwerk zit regelmatig vol: een kleine verstoring leidt al snel tot <em>lange files.</em> In Nederland zijn jaarlijks ruim 600 verkeersdoden te betreuren. Ons vervoer heeft door de <em>vervulende uitstoot</em> zeer negatieve gevolgen voor het <em>leefklimaat</em> en voor de opwarming van de aarde. Allemaal verschijnselen die de maatschappij <em>veel geld kosten.</em> Om de <em>bereikbaarheid, veiligheid</em> en <em>leefbaarheid</em> in Nederland te versterken willen we de kansen benutten die nieuwe informatie- en communicatietechnologie ons bieden. Deze inzet van innovatieve ICT-oplossingen noemen we <em>Smart Mobility.</em> Het is van belang dat we de kansen en mogelijkheden die zich voordoen op dit vlak, ook in Flevoland benutten. <em>Smart Mobility draagt niet alleen bij aan bereikbaarheid, maar ook aan economische ontwikkelingen.</em></td>
<td><a href="https://www.flevoland.nl/wat-doen-we/wegen-/vaarwegen-/openbaar-vervoer/smart-mobility">https://www.flevoland.nl/wat-doen-we/wegen-/vaarwegen-/openbaar-vervoer/smart-mobility</a></td>
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</table>
verkeersveiligheid op weg en water. Technieken die zorgen voor een betere bereikbaarheid van de regio en een leefbaarder omgeving. Ze bieden mogelijkheden het reizen veiliger, gemakkelijker en prettiger te maken voor de gebruiker. Dit soort vernieuwingen in de mobiliteit zowel voor auto als voor fiets, vrachtauto, bus en schip, heten Smart Mobility.

Province of Noord-Brabant
Het gaat goed met de Zuid-Nederlandse economie. Good nieuws, maar die groei heeft ook impact op de mobiliteit. De druk op ons wegennet neemt steeds verder toe. Om onze regio bereikbaar en aantrekkelijk te houden werken we nu aan de mobiliteit van morgen. Onze ambitie is om het slimste wegennet van Europa te realiseren, want de oplossing ligt niet alleen in extra asfalt of klassiek openbaar vervoer.

Metropolitan area Amsterdam
Het aantal inwoners, banen en toeristen in de Metropoolregio Amsterdam blijft naar verwachting in de komende jaren stijgen. Bovendien wordt er flink gebouwd aan zowel nieuwe infrastructuur, als aan woningen en bedrijfspanden. Dit alles leidt tot een stevige opgave ten aanzien van de bereikbaarheid van de stad én de regio.

De gemeente Amsterdam én de samenwerkende overheden in de Metropoolregio Amsterdam (MRA) zien kansen om met Smart Mobility oplossingen de bereikbaarheidsopgaven in de stad en de regio aan te pakken. Om deze reden is het actieprogramma Smart Mobility MRA 2018-2022 ontwikkeld. Het doel van dit programma is het aanjagen en verbreden van toepassingen die bijdragen aan de leefbaarheid, duurzaamheid en veiligheid van de stad en de regio.

Floor Vermeulen, gedeputeerde Mobiliteit, Regiogids van de Zuidelijke Randstad, verplichte lezer: “Uit verschillende studies blijkt dat het verkeer muurvast loopt als we geen maatregelen nemen.”.

Bereikbaarheid is geen doel op zich, maar een middel om een reeks grotere ambities te halen, namelijk: versterken van de economie, zorgen voor een aantrekkelijke leefomgeving, vergroten van kansen voor mensen en het vergroten van de aantrekkelijkheid van het vervoersysteem.

Het verkeer in de Zuidelijke Randstad loopt vast als er geen maatregelen worden genomen om de bereikbaarheid te verbeteren. Het Rijk erkent de grote opgaven waar de Zuidelijke Randstad de komende jaren voor staat: meer hoogwaardig OV en een betere verkeersdoortretong in samenhang met de regionale woningbouwopgave van 230.000 woningen, de economische ontwikkeling en het verduurzamen van de mobiliteit. Met het programma Duurzame Bereikbaarheid pakken Rijk en regio deze uitdagingen aan. De focus van het programma sluit goed aan op de prioriteiten uit het regeerakkoord, zoals het aanpakken van de knelpunten die in de NMCA naar voren komen (A4, A16/A15 Brienenoordcorridor, OV), betere aansluitingen van de regionale wegen op de snelwegen, hoogwaardiger regionaal openbaar vervoer in relatie tot de verstedelijking, verduurzamen van mobiliteit en aanjagen van de woningbouw. Het aantal inwoners, banen en toeristen in de Metropoolregio Amsterdam blijft naar verwachting in de komende jaren stijgen. Bovendien wordt er flink gebouwd aan zowel nieuwe infrastructuur, als aan woningen en bedrijfspanden. Dit alles leidt tot een stevige opgave ten aanzien van de bereikbaarheid van de stad én de regio.

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De komende jaren groeit het aantal inwoners, werknemers en bezoekers van de Vervoerregio Amsterdam fors. Daarnaast is de regio in transitie naar een meer duurzame en schone economie. Dit leidt tot stevige bereikbaarheids-, leefbaarheids- en duurzaamheidsopgaven. We zien kansen voor Smart Mobility: een bijdrage te leveren aan deze opgaven, want door de digitalisering van mobiliteit kunnen we slimmer reizen. Maar we zien ook uitdagingen: nieuwe technologieën beïnvloeden de manier waarop wij onszelf en onze goederen verplaatsen drastisch en hebben een grote impact op hoe de wereld van mobiliteit is georganiseerd.

Met de opkomst van allerlei slimme technologieën rees in Enschede de vraag hoe een binnenstad daar gebruik van kan maken om aantrekkelijker te worden. Een aantrekkelijke en innovatieve binnenstad draagt direct bij aan de lokale economie. Een binnenstad die aantrekkelijk is, bereikbaar en gastvrij. Voor bezoekers, bewoners en mensen die er werken. Voor gezinnen met kinderen, maar ook voor ouderen. We willen een leukere, mooiere en gezondere binnenstad voor iedereen. Vooral de voetganger krijgt daarbij meer ruimte dan nu.

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| Municipality of Helmond | Vandaag de dag willen we mobiel zijn. Zonder files, parkeerproblemen, ongelukken en onnodig oponthoud. De oplossing kun je alleen in nieuwe wegen zoeken. Maar dat loopt nogal in de kosten en het is zo zonde van het groen om ons heen. Wat nodig is zijn slimme oplossingen die slim, snel, veilig en schoon zijn. In Helmond hebben we de drive om die te vinden. Tientallen bedrijven, kennisinstellingen en overheidsorganisaties werken in Helmond samen om de mobiliteit van morgen weer te geven. | https://www.helmond.nl/1/duurzaamheid/Smart-mobility-Driven! |
Appendix E: Invitation Workshop Rijkswaterstaat (Dutch)

Beste collega’s,

Barrières en kansen voor Smart Mobility - *Adaptief Programmeren*” beschouwd vanuit wegbeheerdersperspectief.

De hele wereld praat er over en de *kansen voor Smart Mobility* lijken voor het oprapen te liggen. Smart Mobility is dé toekomst! Toch...?

Voordat we bij die toekomst zijn hebben we nog een flinke weg te gaan; Welke actie moeten we nu doen? En welke activiteit morgen? En welk besluit moeten we overmorgen nemen? Moeten we eerst gaan ontdekken? Gaan leren? Of vooral beginnen met doen!?

Innovatie, ontwikkeling en implementatie kent grote uitdagingen op alle thema’s die we scharen onder Smart Mobility. Of het nu gaat om voertuigtechnologie, data, infrastructuur of mobiliteitsconcepten. *Marlon Spaans (Royal HaskoningDHV)* heeft onderzoek gedaan naar *de barrières en kansen voor Smart Mobility in Nederland* en heeft zich verdiept in één van de antwoorden op deze onzekerheden: “*Adaptief Programmeren*”. Beschouwd vanuit wegbeheerdersperspectief neemt Marlon Spaans ons mee in wat er achter al die onzekerheden in Smart Mobility zit. Met een doorsnede aan barrières en kansen opgehaald vanuit nationaal, regionaal en stedelijk perspectief geeft dit meer dan genoeg voer om gezamenlijk te kijken hoe we grip kunnen krijgen op deze onzekerheden en wat we hiervan kunnen leren richting onze huidige aanpak van Smart Mobility en de ambitie op verkeersmanagement.

Bij deze sessie zijn ook regionale en stedelijk wegbeheerders van harte welkom.

Groet
Appendix F: Summary Workshop

Approved by Peter Morsink via mail (September 3rd 2018)

This is a summary of the validation workshop “Barrières en kansen voor Smart Mobility” at Rijkswaterstaat, Utrecht on June 21st 2018. Goal of the workshop is to validate the research results, interpretations and preliminary results. Peter Morsink, Leading Professional Smart Mobility at Royal HaskoningDHV, accompanied me during the workshop. The workshop was attended by 34 attendees, of which 3 were interviewed during the research. Most attendees were Rijkswaterstaat employees.

Not much time was spent on the methodological aspects of the thesis during the workshop. Rather than that, the overarching results and conclusions are focussed on. It was assessed whether the findings were correct and to what extent. Nuances were given, debates were held and sharpening of the research statements happened during the workshop. The first half was one hour, introducing the workshop, presenting the results and preliminary conclusions and the start of a group discussion on the results and preliminary conclusions. After a break the workshop continued for the second hour with an in-depth interactive part on several Smart Mobility topics applicable for the attendees, recommendations by the attendees on future work and research. Visions and information can be exchanged during the interactive part of the workshop.

The four most important themes, Data management, Connected and Automated Driving, (C)-ITS and MaaS, were agreed upon by the group. Also Jeekel’s desk research was cited by an attendee in this regard. The definition of Smart Mobility, or better to say the lack of a definition, was widely discussed. This challenge could also be used as an innovation canvas to explorer all possible innovative technologies related to transport and mobility.

Five obstacles were presented as the biggest common denominators.

1. Don’t reinvent the wheel,
2. Implementation does not take place sufficiently,
3. Privacy remains a difficult issue,
4. The role of the government is changing,
5. There are many uncertainties.

1. Not reinventing the wheel was a statement that resonated well with the attendees. It was discussed how processes could better be integrated into daily work life to codify knowledge of single persons and experts. It is not a task of being first somewhere, it is much more important to create knowledge together and to share that knowledge among others.

2. There was a wide consensus that there is a great discrepancy between scale and pilots. The actual scale is not enough to completely convince people to all step over to a new technology. The step from pilot to large scale implementation is often too big. It was suggested to pool efforts and resources of multiple road authorities in order to successfully implement technologies with a broad reach.

3. Privacy was not regarded as a very urgent matter, other than that processes should be constructed with diligence regarding privacy. Rijkswaterstaat employees stated that they have colleagues working specifically on the GDPR-related tasks.

4. Arguably the most the debated statement was that governmental institutions are too traditional. Traditional characteristics are fixed budgets, limited scope, inert organisational structures and the lack of entrepreneurial spirit. This bold statement did not land very well. In hindsight it was understandable that
this statement flew in the face of many Rijkswaterstaat attendees: in the interview Rijkswaterstaat code 11, Organisational inertia, was not used at all. Rijkswaterstaat is largest (water) road authority of the Netherlands and makes a lot of effort to be efficient and effective. The organisational structure allows Rijkswaterstaat's civil servant to work on innovations and novel technologies besides their 'normal' workload. Interviewees at smaller governmental organisations experienced much more reluctance to change and innovations. In general it was also claimed that governments and road authorities should also explore new ways of cooperation and partnerships with market parties. This is needed to catch up with quickly developing and newly emerging technologies that have a big potential to reach policy goals, but also tend to change traditional roles and responsibilities.

The term ‘changing government’ was argued deeply. A suggestion that resonated with the group was to use the term ‘searching government’ instead. This indicates that the government is looking for more efficient, practical and effective ways to serve the people, whilst maintaining its current level of service.

5. Uncertainties are considered to be the underlying factor why it is so hard to govern Smart mobility. The digitalisation of transport comes with many socio-technical questions. There is a shift from product-based procurement of transport and mobility to a more service-based procurement strategy. The digitalisation of transport also has an impact on asset management. More sensors and other hardware are needed to facilitate the (C)-ITS. Directly following are the increasing costs of infrastructure. In the near future, the economic life cycle of products might not keep up with the physical life cycle. Due to software updates and technological obsolescence.

A nice closing remark was made by an attendee who mentioned that regional road authorities have stopped claiming to be the ‘koploper’, instead ‘voorloper’ is used. This is the subtle difference between being the innovator and being a first mover. It eradicates the negative connotation of a competition element on innovating Smart Mobility technologies.

The workshop was finalised by a concluding part where the lessons learned are briefly recuperated and the attendees have a chance to network and exchange knowledge. New collaboration opportunities among the road authorities were discussed (and formed), both within and outside the scale levels.
Workshop 21 juni 2018

- Opening / welkom
- Resultaten en bevindingen
- Discussiemomenten
- Vragen / reacties mogen altijd

Doel van vandaag:
- Verdieping van expertise,
- Het opdoen van nieuwe ideeën,
- Het delen van kennis ahv praktijksituaties

Workshop | 21 juni 2018
Wie zijn wij?

Marlon Spaans

Peter Morsink

- HTS Werktuigbouwkunde
- MSc Management of Technology

Onderzoek

Aanleiding
- Smart Mobility om bereikbaarheid en leefbaarheid te behouden
- Worsteling met activiteiten, innovaties en onzekerheden

Doelstellingen
- Inzicht creëren in hoe Smart Mobility kan bijdragen aan sociaal, maatschappelijk en economisch gewin
- Vergelijking op meerdere niveaus: Nationaal, regionaal en stedelijk
- Bepalen van kansen en barrières voor succesvolle implementatie

Onderzoeksopzet
- Literatuuronderzoek en desk research
- Interviews met experts en verantwoordelijken
- Content analysis

Resultaten
- Validatie: Workshop

Conclusies en aanbevelingen

Royal HaskoningDHV
Opvallende zaken

- 14 interviews
- 30.000 woorden transcript
- 70 Beleidsdocumenten
- 166 Barrières en 72 kansen

Noodzaak voor Smart Mobility is duidelijk:
- Bereikbaarheid
- Veiligheid
- Leefbaarheid
Belangrijkste thema's

Data management
Digitale en fysieke infrastructuur (ITS)

Voertuigtechnologie (CAD)
Mobility as a Service (MaaS)

Definities en Scope

Enkele citaten:

*Smart Mobility is:
  - de digitalisering van mobiliteit.*
  - slimmer omgaan met mobiliteit en verkeersmanagement.*
  - alle innovatie die je in verkeer en vervoer kan brengen.*
  - slimme toepassingen voor verkeer en mobiliteit.*
  - het komen tot betere doorstroming, veiligheid en leefbaarheid.*
  - verkeersmanagement en mobiliteitsmanagement in één doorgedraaid.*
  - het systeem waarin informatietechnologie centraal gesteld worden om tot oplossingen te komen.*

Maar ook:
  - "De definitie van Smart Mobility bestaat niet. Daarin ligt ook meteen de problematiek."*
  - "Een definitie voor Smart Mobility wagen wij ons niet aan.*

Scope Smart Mobility (BEREIKI, 2017)
Barrières: Grote gemene delers (I)

Niet steeds het wiel opnieuw uitvinden
- Kennisdelen binnen en buiten de organisatie is niet makkelijk.
- Kennis is vaak belegd bij individuen.
- Veel platforms, maar hoe voorkom je dubbel werk?

Implementatie blijft uit
- Schaalgrootte ontbreekt (financieel, planning, FTE’s)
- Studies en pilots lukken, maar opschalen is moeilijk.
- Economische levensduur van fysieke en digitale infrastructuur wordt steeds korter

Barrières: Grote gemene delers (II)

- Privacy blijft een lastig punt
  - Ontwerpeisen niet duidelijk
  - Marktpartijen betrekken
  - Publieke opinie en acceptatie

- De rol van overheden verandert
  - Overheden zijn te conservatief
  - Moeten overheden faciliteren, sturen, handhaven, verbieden?

- Er zijn veel onzekerheden
  - Acceptatie?
  - Privacy?
  - Veiligheid?
  - Levensduur?
  - Kosten en baten?
  - Marktpartijen?
Kansen: Grote gemene delers

- Samenwerken tussen
  - overheden
  - overheid en kennisinstituten
  - overheid en marktpartijen
- Van studie en pilot naar implementatie
- Verwachtingsmanagement
  - Politiek
  - Bestuur
  - Maatschappij
- Integraal data delen
- Doelgroepenvervoer
- Het nieuwe denken
  - Deeleconomie
  - Gedragsverandering
- Slimmere organisatie
- Slimmere financiering
- Slimmere uitvoering

1° Niveau: Nationaal

Barrières

- Overgangsperiode naar verkeer van de toekomst
- Wishful thinking / Groupthink.
- Overal valkuilen: “duizend redenen om niet met Smart Mobility bezig te zijn”
- Te grote organisatie om in te springen op disruptieve innovaties.
- Niet onvoorwaardelijk gaan voor “Learning by doing”

Kansen

- Context- en agendazetter
- Internationaal profileren van Nederlandse kennis economie, innovaties en infrastructuur
- Slimmere organisaties, slimmere budgetten en slimmere ambtenaren
2e Niveau: Regionaal

**Barrières**
- Je moet één verhaal hebben als overheid.
- Digitaliseren gaat moeizaam.
- Niet duidelijk welke opgaven worden belegd onder welke afdelingen.

**Kansen**
- Betere doorstroming voor logistiek door de regio
- Creëren van banen binnen meerdere sectoren.
- Alternatieven voor autogewijs door alternatieve vervoersconcepten

---

3e Niveau: Gemeentelijk

**Barrières**
- Samenwerken
- Politici willen zich profileren.
- Verantwoordelijken willen zekerheden en/of quick wins.
- Budgetten zijn niet altijd toereikend.
- (Interne) expertise is schaars.
- Weinig slagkracht.
- Niet lokaal ontwikkelen maar nationaal.
- Organisatiecultuur moet wel rijp zijn voor Smart Mobility.

**Kansen**
- Directe baten bij bewoners
- Kennisdelen met andere gemeenten en steden.
- Samenoptrekken op verschillende projecten in consortia.
- Marktpartijen uit de regio betrekken en stimuleren.
- Focus op één of twee thema's voor meer daadkracht
Meerdere zienswijzen

- **Marktpartijen**: op afstand houden of juist toelaten?
- **Politiek**: profileren of gewoon doen?
- **Bestuurlijk**: verantwoordelijk voor falen innovaties of is dat een "bedrijfsrisico"?
- Hoe verantwoord om te gaan met *publiek geld*?
- Is/Komt er *sociale acceptatie* of weerstand
- Verhoogt Smart Mobility *inclusiviteit* of juist niet?
- Verhoogt of verlaagt Smart Mobility het gebruik van *mobiliteit*?

---

**Governance**

- Overheden zijn vaak klassiek ingericht als een functionele organisatie.

- Budgetten vanuit plannen of plannen vanuit budgetten?

- Verantwoordelijk voor de bereikbaarheid van grote gebieden.

- "Learning by doing" is geen vrijbrief om zo maar te beginnen met een project.

---

Adaptief programmeren

- Van visie en ambities naar uitvoering

- Niet één juiste manier:
Voorbeeld adaptief programmeren Overijssel

Samenwerking met andere wegbeheerders

- Veel kennisplatforms
  - LMVB
  - ITS Nederland
  - Connecting-Mobility
  - Connekt
  - BEREIK!
  - Beter Benutten

- Veel programma’s
  - Aanhaken bij de ontwikkelingen van andere wegbeheerders.

- Maak één verhaal, bespreek:
  - organisatorische barrières,
  - politieke barrières,
  - sociale barrières,
  - technologische barrières.

- Innovaties mogen mislukken, niet alle investeringen betalen zich terug.

- Veel baten liggen niet bij de wegbeheerders.
Publiek-private samenwerking

- Samenwerking volgens het Triple-Helix model is belangrijk
- Kennis is exportproduct voor zowel overheden als marktpartijen en kennisinstituten.
- Overheden schieten vaak in een traditionele krap wanneer marktpartijen betrokken raken.
- Door marktpartijen te betrekken ontstaat een zelf vervullende voorspelling:
  - Marktpartijen zien de business case.
  - Marktpartijen vinden financiële zekerheden.
  - Marktpartijen zien kansen voor contracten van hun diensten.
  - Ontwikkelingen van marktpartijen lopen synchroon met overheidsontwikkelingen.
- Op dit moment zijn contracten te ingewikkeld, is de schaalgrootte te klein en is het speelveld te complex.
- Door co-creatie kom je tot innovatieve oplossingen op beleidsdoelstellingen.

Conclusie

Bedenk, in groepen van 4 of 5, wat jullie vandaag meenemen als lesson learnt / take-away.

Wat kan je in jouw directe omgeving (meer) doen aan Smart Mobility?
Hoe gaat Smart Mobility jouw werk beïnvloeden?
Deep uncertainties
Theoretisch kader en implicaties voor ontwerp

Toekomstmodellering
Drie complementaire zienswijze

a) Anticiperen op beschikbare kennis
b) Kwantificeren van onzekerheden
c) Onderzoek naar meerdere toekomstscenario's
d) Combinatie van drie paradigma's om meerdere bronnen van onzekerheden te beschouwen.
**Niveaus van onzekerheid**

<table>
<thead>
<tr>
<th>Onzekerheid</th>
<th>Niveau 1</th>
<th>Niveau 2</th>
<th>Niveau 3</th>
<th>Niveau 4</th>
<th>Niveau 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>Duidelijke toekomstscenario met kleine spreiding</td>
<td>Alternatieve toekomstscenario's (met waarschijnlijkheids)</td>
<td>Alternatieve toekomstscenario's (gerangschikt)</td>
<td>Een variatie aan toekomstscenario's (niet gerangschikt)</td>
<td>Onbekende toekomst</td>
</tr>
<tr>
<td>Utvoering</td>
<td>Eenvoudig model, veel informatie beschikbaar</td>
<td>Eenvoudig model, meerdere scenario's met een betrouwbaarheidsinterval</td>
<td>Model met rankschikking op basis van multicriteria-analyses</td>
<td>Model op basis van beleidsmakers' expertise. Geen consensus door gebrek aan kennis/overeenkomst</td>
<td>Geen model beschikbaar</td>
</tr>
<tr>
<td></td>
<td>[Diagram]</td>
<td>[Diagram]</td>
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<td>[Diagram]</td>
</tr>
</tbody>
</table>

**Strenght-of-Knowledge assessment**

Achtergrondkennis is **zwak** als één of meer van de volgende beweringen waar zijn:

- De gemaakte aannames zijn sterke simplificaties van de werkelijkheid.
- Data/informatie is niet aanwezig of hoogst onbetrouwbaar/irrelevant.
- Er is een sterk meningsverschil tussen experts.
- Het fenomeen wordt nog niet goed begrepen, modellen zijn er niet of geven slechte voorspellingen.

Achtergrondkennis is **sterk als al** de volgende beweringen waar zijn:

- De gemaakte aannames worden gezien als redelijke weergaven van de werkelijkheid.
- Er is veel betrouwbare en relevante data/informatie beschikbaar.
- Er is consensus tussen experts.
- Het fenomeen wordt goed begrepen en er zijn modellen die voorspellingen geven met de vereiste nauwkeurigheid.
Deep uncertainties

Omgaan met deep uncertainties

- **Weestand**: Plan voor het worst case scenario
- **Veerkracht**: Wat er ook gebeurt in de toekomst, het systeem moet zo snel mogelijk herstellen.
- **Statische robustheid**: Implementeer een basis beleid dat goed functioneert en in bijna alle gevallen geldt.
- **Adaptieve robustheid**: bereid je voor om het beleid te veranderen als dat nodig blijkt.

- Highly reliable organizations: organisations die catastrofes voorkomen in een ecosysteem waar normale ongelukken verwacht worden door risicofactoren en complexiteit (verkeer!)

1. Preoccupation with failure
2. Reluctance to simplify interpretations
3. Sensitivity to operations
4. Commitment to resilience
5. Deference to expertise

---

Adaptief programmeren

*Omgaan met onzekerheden in het publieke domein*
Adaptief programmeren

Nieuwe organisatiestructuren
- Functionele organisatie
- Lijnmanagement
- Vaste budgetten
- Specialisatie bij individuen

- Matrix organisatie
- Projectteams
- Dynamische budgetten
- Knowledge spillovers

Trends
- Digitalisering
- Globalisering
- Het nieuwe werken
- De wet van Moore
- Onzeker wereld

Adaptief programmeren
- Dé adaptieve aanpak bestaat niet
- Het is meer een filosofie dan een doel
- Verwachtingsmanagement is zeer belangrijk.
Adaptief programmeren in zes stappen

Blue Economy (2013)

- ambities en opgaven
  - top 3 ambities
  - onderscheidend tussen regio's
  - smart gemaakt
- opgaven
  - concreteering van ambities
  - basissen voor goede indicator
  - bandbreedtes per opgave
- kernzekerheden
  - kernzekerheden per opgave
  - zoek naar goede indicatoren
  - basissen voor betrouwbaarheid
- maatregelen en opties
  - fysieke en niet-fysieke maatregelen
  - afsluiting maken tussen maatregelen en opgaven
  - middellange en lange termijn omzet in beeld en behouden
- knikpunten
  - fysieke en niet-fysieke knikpunten
  - afspraken over monitoring knikpunten
- ontwikkelpad en adaptieve strategie
  - maatregelen gevisualiseerd en in tijd gezet
  - samenhang tussen opgaven in beeld
  - afspraken over inhoud en process

Adaptief programmeren

Dynamic Adaptive Policy Pathways →

Adaptief programmeren in Overijssel
Kennis, potentie en hype

- Niet het wiel opnieuw uitvinden
- Kennisdelen
  - Dunning-Kruger effect
  - Gartner hype cycle

UITROL OP GROTE SCHAAL

<table>
<thead>
<tr>
<th>Cases</th>
<th>Invention</th>
<th>Length - Innovation phase</th>
<th>Market introduction</th>
<th>Length - Market adoption phase</th>
<th>Diffusion takes off</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radar</td>
<td>1904</td>
<td>1934</td>
<td>5</td>
<td>1939</td>
</tr>
<tr>
<td>1</td>
<td>PVC</td>
<td>1836</td>
<td>1931</td>
<td>7</td>
<td>1938</td>
</tr>
<tr>
<td>2</td>
<td>Contraceptive pill</td>
<td>1927</td>
<td>1</td>
<td>1928</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>Dynamite</td>
<td>1895</td>
<td>1867</td>
<td>6</td>
<td>1867</td>
</tr>
<tr>
<td>3</td>
<td>X-ray</td>
<td>1895</td>
<td>1896</td>
<td>6</td>
<td>1896</td>
</tr>
</tbody>
</table>

Scenario 1: Lange innovatiefase na uitvinding

Scenario 2: Lange marktadopfase na uitvinding

Scenario 3: Uitrol op schaal groote direct na uitvinding
Privacy

Stappenplan tot zuivere communicatie

AVG 25 mei 2018

Algemene verordening gegevensbescherming AVG

- Hoeveel tijd kost het om een nieuwe gewoonte te leren?

Stappenplan AVG

1. Bewustwording
2. Rechten van Betrokkenen
3. Overzicht verwerkingen
4. Data protection impact assessment (DPIA)
5. Privacy by Design en Privacy by Default
6. Functionaris Gegevensbescherming (FG)
7. Meldplicht datalekken
8. Verwerkersovereenkomsten
9. Leidende toezichthouder
10. Toestemming
Wettelijke grondslagen

Wanneer mag je gegevens verzamelen?

Wettelijke grondslagen AVG
1. Toestemming persoon
2. Noodzakelijk voor uitvoering van een overeenkomst.
3. Noodzakelijk voor uitvoering wettelijke verplichting.
4. Noodzakelijk ter bescherming van de vitale belangen.
5. Noodzakelijk voor de vervulling van een taak van algemeen belang of uitoefening van openbaar gezag.
6. Noodzakelijk voor de behartiging van gerechtvaardigde belangen.
Appendix H: Workshop, thank mail after session (Dutch)

Beste aanwezigen en (aanmelders) bij de Serresessie,

Afgelopen donderdag heeft Marlon Spaans (TU Delft/RHDHV) jullie meegenomen in zijn onderzoek over Barrières en kansen voor Smart Mobility in Nederland. Wij kijken terug op een geslaagde serresessie en danken je voor je aanwezigheid en waardevolle inbreng bij de discussies. Bijgevoegd vind je de presentatie die Marlon heeft gegeven, met daarin ook de achtergrondinformatie die niet tijdens de sessie aan bod is gekomen. Als je hier vragen of opmerkingen over hebt dan hoort Marlon graag van je. Hij is te bereiken via ……….

Als je geïnteresseerd bent in de toegelichte ‘STREAM’-methodiek, dan graag ook even met Marlon contact opnemen. Hij kan je hier meer over vertellen en aan extra informatie helpen.

We hopen dat je het ook een geslaagde serresessie vond die zowel op inhoud als met vakgenoten onder elkaar nuttig was. De volgende WVM-serresessie staat gepland op 27 september.

Met vriendelijke groeten,
Mede namens ………. en Marlon Spaans,
Appendix I: Transcripts of all interviews