Policy and governance for transformative innovation

POLICY AND GOVERNANCE FOR TRANSFORMATIVE INNOVATION

Insights from the Dutch smart mobility policy

Edgar Salas Gironés

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Edgar

Karlsruhe, Germany. 2020.

Table of Contents

Abbreviations and acronyms

AVs	Automated vehicles	
BB	Better Utilization program	*Beter Benutten*
BGOW	Better Informed on the Road	*Beter Geïnformeerd op Weg*
I&M	Ministry of Infrastructure & Environment	*Infrastructuur en Milieu*
I&W	Ministry of Infrastructure & Water Management	*Infrastructuur en Waterstaat*
KiM	Dutch Mobility Policy Institute	*Kennisinstituut voor Mobiliteitsbeleid*
OECD	Org. for Economic Cooperation & Development	
RDW	Dutch Vehicle Authority	
RWS	Road Agency of the Netherlands	*Rijkswaterstaat*
SDC	Self-driving cars	
STI	Science, Technology & Innovation	

List of figures

List of tables

1. Introduction

In recent years, we are witnessing that long-standing societal demands related to sustainability, wellbeing, and quality of life, have reached the top of public agendas worldwide. Described as 'grand challenges' or 'sustainable development goals' in current policy debates, these demands are now driving policies on multiple governmental levels and in many policy domains.

Innovation plays a crucial role in addressing these demands. Think of innovations to reduce greenhouse gas emissions, favor societal inclusion, or minimize fatal road accidents. The link between innovation and societal challenges is particularly relevant for pressing issues such as climate change and poverty (see European Commission, 2019; OECD, 2018; Stanley et al., 2018). We see the trend of aligning innovations to societal demands in multiple ways: the UK's innovation foundation NESTA identified a growing (and explicit) recognition of societal benefits on innovation agendas (Stanley et al., 2018), the OECD (2018) found that research funding has been increasingly oriented to societal challenges since the 2000s, and the European Commission has positioned societal challenges as pillars in Horizon 2020 (and upcoming FP9).

The novel innovation policy orientation towards societal challenges is what Daimer, Hufnagl & Warnke (2012) labeled as its "normative turn". This turn has led to a policy rhetoric redefining the relationship between innovation and society (Uyarra et al., 2019; Weber & Truffer, 2017), new policy frameworks such as responsible research & innovation (Stilgoe et al., 2013), smart specialization (Foray, 2016), and social innovation (Kuhlmann & Rip, 2018). In one way or another, these all take societal demands into account.

This turn has raised questions regarding the design and governance of innovation policy. Traditional policies, based on innovation systems and neo-classical paradigms, were not conceived to address societal challenges, and seem to be a 'bad fit' for the normative turn. The reasons why this is so can be summarized as follows:

- Societal challenges are not straightforward problems to solve. Grand challenges are 'wicked' policy problems, with a high level of uncertainty and complexity (Schlaile et al., 2017). Therefore, these challenges are extremely difficult to address. A 'one-size-fits-all' approach is not adequate for various

reasons: each challenge is unique, prone to controversy and disputes, subject to interpretations by multiple actors, and there is no ultimate solution in sight (Head, 2008).

- Societal challenges are not bounded to administrative jurisdictions. For instance, challenges related to mobility cannot be addressed only by local authorities, as they demand the consideration of regional or national authorities. For this reason, innovation policy has been oriented towards functional areas such as energy, transport, or health (Weber & Rohracher, 2012). This issue-centered approach was lacking in traditional innovation policies.
- Traditional innovation policies do not consider the systemic and transition-oriented requirements for societal challenges. By systemic, I refer to a change in the entire system (e.g. personal mobility) rather than one specific element it (e.g. automobiles). For this reason, societal-challenge oriented policies consider a socio-technical system as their starting point, and the multiple elements within it (e.g. legislation and user practice) as it scope of action.
- Such systemic changes require a strategic orientation in order to define what type of change an innovation policy should enable. Traditional policies are considered to be directionless (Alkemade et al., 2011; Daimer et al., 2012; Mazzucato, 2018b).
- Finally, addressing societal challenges is a political quest, in sharp contrast with the technocratic practices and limited contestation of the systems of innovation approach. Consequently, legitimacy and political struggles are at the core of societal-challenge oriented innovation policies (see Pfotenhauer et al., 2019).

These limitations have shown how current policy frameworks are not adequate for this normative turn, and that public authorities lack competencies for it (Mazzucato, 2016; Steward, 2012). Academic debates are calling for a 're-think' of innovation policy in this era of grand challenges, as we can see in *Research Policy* (48:10, 48:4, 41:10), *Science and Public Policy* (45:6, 45:4), and *The Oxford Review of Economic Policy* (33:1). I refer to this generation of societal-challenge oriented policies as *transformative innovation policies*.

1.1. Transformative innovation policy

To better understand transformative innovation policy, we need to look into the theories that have inspired this approach. Transformative innovation has been fostered by two major strands of literature. The first is the so-called transformative change approach. First featuring in works by Steward (2012) and Weber & Rohracher (2012), this approach takes the socio-technical transitions for sustainability literature as starting point (see Geels & Schot, 2007, 2010; Smith et al., 2005). The suggestion is that innovation policy should strive for a radical shift in contemporary societies' production and consumption patterns (in other words, a "transition"). The approach takes the Multi-Level Perspective, based on a framework analyzing socio-technical transitions to sustainability (Geels, 2002), which indicates that innovations dealing with societal challenges should come from protected spaces (known as 'niches') where transformative technologies can emerge to enable their adoption in dominant socio-technical systems (so-called 'regimes') (also Schot & Steinmuller, 2018).

The second strand, the so-called 'new' mission orientation, championed primarily by authors such as Mazzucato (2018a) and Edler & Boon (2018), advocates the need for state-sponsored missions to deal with grand challenges. Its 'blueprint' is the type of classic missions that enabled the achievement of policy goals such as the moon landing or the green revolution in agriculture. State authorities serve as catalytic entities, taking risks and making institutional arrangements that allow changes to the entire innovation chain. Mission orientation has been shaped by works on institutional economics and seminal contributions by authors such as Polanyi. Missions place market creation as a key feature for policy intervention, suggesting that societal demands should be translated into demands that markets can address in the future (te Kulve et al., 2018). While mission orientation has been a blueprint for the European Union (e.g. Mazzucato, 2018a) and the OECD (2018), transformative change has attracted attention from national innovation agencies in Mexico, Norway, Colombia, and Sweden (TIPC, 2019).

This dissertation considers that both transformative change and new mission-orientation literature are part of this new generation of innovation policies, that we label here as transformative innovation. There is an ongoing discussion on how transformative both strands of literature actually are. However, as mentioned above, both are informing contemporary innovation policy designs. For this reason, we incorporate both approaches in this thesis. They have been used to inspire the

design of the next generation of innovation policies. In the section below, we present its governance challenges -which are at the core of this dissertation-.

1.1.1. Governance challenges in transformative innovation policies

Transformative approaches demand a radical change of innovation policy, similar to the one that Hall (1993) referred to in his influential historical-institutionalist account of the dismissal of Keynesianism in the 1970s. Such a shift involves a whole spectrum of changes, from the theories used to inform policy design, to the policy instruments and governance modes (Hall, 1993). It also implies the rise of new actors to policy circles, new modes of policy implementation, and a new policy jargon. This thesis is built on a major assumption that the adoption of the transformative innovation approach implies a radical change in innovation policymaking and governance. This assumption can be sustained by studies on institutional change such as Blyth (2001), Hall (1993), and Campbell (2004), who showed how the incorporation of new ideas can radically alter the decision-making and implementation of public policy.

For these reasons, this shift towards transformative innovation results in new governance challenges, that appear throughout the policymaking process. In particular, recent literature on innovation policy has increasingly focused in unraveling the consequences of transformative innovation in the policymaking process (e.g. Kern & Rogge, 2018). Policy processes are the ways and elements that influence how public policies are made, taking into account actors, institutional contexts, interests, and settings (see Weible et al., 2012). Even though in recent years studies form the perspective of policymaking on transformative innovation policies have increased subsantially (Edler & Boon, 2018; Edler & Borrás, 2014; Kern & Rogge, 2018; te Kulve et al., 2018), we are still in an early phase, in which just the first contributions have been published.

Certain research gaps can be identified and are intended to be addressed in this dissertation. First, limited insights have been produced on how, what, and by whom agendas are set (cf. Edler & James, 2015). This point, however, is crucial for transformative innovation because it broadens the scope of policy actors, and demands to incorporate societal demands in public policy that can increase legitimacy (Kuhlmann & Rip, 2018). Setting new agendas, however, will not necessarily make innovation policy deliver results in terms of grand challenges. For this reason, a second question is the *policy capacity* that transformation innovation

demands. Governments needs to improve their capacity to make informed and intelligent decisions regarding alternatives and directions (cf. Wu et al., 2015). In other words, it demands better competencies and capacity building in the public sector to meet societal challenges (Boon & Edler, 2018). Finally, the question of policy capacity is intrinsically related to new policy instruments. Transformative innovation broadens and deepens the scope of policy intervention, beyond the traditional areas of traditional innovation policies (Magro & Wilson, 2013). We see this in the (re-)emergence of demand and socio-technical policy instruments (Edler & Borrás, 2014), and an expanding 'instrument toolbox', with soft instruments steering innovation processes. Moreover, the above issues have been limitedly studied in an empirical way. So far, the issues aforementioned have been studied in an 'idealized' version, e.g. how agenda setting *should look like* rather agendas are being constructed. Thus, there is an urgency to understand how this shift towards transformative innovation will impact the practice of policymaking.

Presenting a dissertation covering all these aspects would be an impossible task. In contrast, I want to 'zoom in' on particular elements of innovation policy that remain underexplored. The empirical gaps that I aim to address in this dissertation are three areas that Weber & Rohracher (2012) suggested that innovation policy should embrace to make it suitable for societal challenges. I will explain them in detail in chapter two. First, the direction of innovation, which in policy studies can be studied through the lenses of agenda setting and policy formulation. Second, the need for better policy coordination, that resonates with policy theories for institutional collaboration. Finally, demand articulation -a question of how to create markets for transformative innovations-, is at the core of policy design and implementation theories. By focusing on how interventions can be orchestrated, they shine a light on how this market creation process unfolds.

I will address these three gaps in an empirical way. To do so, I look into a case study that: (1) informs us about the implications of adopting the transformative innovation paradigm; (2) applies policy theories to better understand how to adopt transformative innovation; (3) considers aspects such as agenda-setting, policy capacity, and policy broadening, and (4) in which I could explore the three areas of innovation policy indicated by Weber & Rohracher (2012).

1.2. Case study selection

The case study selected is the Dutch smart mobility policy. Smart mobility as a concept emerged in the 2000s, to reflect the increasing use of information technologies in the mobility system. These technologies were expected to optimize usage of the road network and offer new mobility alternatives. Examples of smart mobility innovations include self-driving cars, IT-enabled Mobility-as-a-Service, platooning, and Cooperative-Intelligent Transport Systems. Despite being a technologically-driven approach (Benevolo et al., 2016), smart mobility reflects the normative turn as it is expected to contribute to a cleaner, safer, and more equitable mobility system. However, these societal benefits are only expected to materialize if the development of smart mobility goes hand in hand with ways to capture its public value (Docherty, 2018).

Taking into account the societal and economic potential of smart mobility innovations, the Ministry of Infrastructure and Environment (I&W),[1] not long after it was established in the Netherlands, announced a smart mobility agenda in 2013. Under the action plan 'Better Informed on the Road' (BGOW), the smart mobility agenda involved a ten-year program aiming to: position the Netherlands at the top of this emerging technological field; enable its rapid diffusion; and align smart mobility innovations with pressing societal issues such as quality of life and sustainability. BGOW had a national scope, and although led by the I&W ministry, it permeated through diverse local and regional initiatives, a decentralized approach, and stakeholder involvement. An extensive description of the case study follows in chapter two.

Dutch smart mobility policy resonates with the transformative innovation approach for several reasons. It positions three societal goals as central elements for public action, namely quality of life, accessibility, and safety (de Mooij, 2013). Unlike previous innovation policies primarily led by the Dutch Ministry of Economic Affairs, smart mobility policy was led by I&W. This reflects the 'issue orientation' suggested in the transformative innovation literature (Weber & Rohracher, 2012). Thanks to this policy, new approaches to mobility have emerged that resemble a paradigmatic shift. A few years after the action plan was instigated, we already

[1] I frequently refer to the Ministry of Infrastructure and Environment (I&M). This ministry was the initiator and leading institution for Dutch smart mobility policy. It became the Ministry of Infrastructure and Water Management (I&W) in 2018. Thus these two acronyms (I&M and I&W) refer to the same entity, but in different time periods.

witnessed new policy approaches appearing throughout policy designs, ranging from policy instruments to new organizations and institutional arrangements. New actors, until recently not involved in the mobility field, gained prominence in the policy, while new private and public collaboration schemes emerged. The policy is also presented in primary documents as a transition. Indeed this policy reflects a radical shift from existing policy practices.

1.3. Goals and research questions

This dissertation has two main goals: First, it aims to study a real-life application of the transformative innovation approach. Second, it aims to contribute to the recent debates on transformative innovation from the perspective of policy processes and governance. This approach resonates with recent efforts to link political science sub-disciplines with (transformative) innovation policy studies (Bugge et al., 2019; Cunningham et al., 2016; Kroll, 2019). This path will certainly enrich our understanding of the policy processes of transformative innovation.

The general research question:

RQ) To what extent is the Dutch smart mobility policy an example of a transformative innovation policy?

Which is expected to be addressed by the following sub-questions:

RSQ1. What and how do novel ideas present in the Dutch smart mobility policy resonate with the transformative innovation approach?

RSQ2. What kind of new policy instruments have these novel transformative innovation ideas in the Dutch smart mobility policy led to, and how?

RSQ3. What novel ways of organization have been developed to translate transformative innovation ideas into action in the Dutch smart mobility policy?

RSQ4. How do the practice of the Dutch smart mobility policy and the theory on transformative innovation relate to each other, and what can we learn from them?

With these questions, this dissertation intends to clarify the similarities and differences between theory and practice, how the adoption of the transformative innovation approach is impacting the governance in practice, and to determine how transformative innovation is impacting innovation policymaking. These questions also intend to 'un-blackbox' transformative innovation policymaking.

Each sub-question contributes to the general research question (RQ). With RSQ1, I identify what and how ideas in the case study resonate with the transformative innovation approach. RSQ2 and RSQ3 explore how this link can inform innovation policy in terms of instruments and organization. In RSQ4, I consider whether this link provides avenues for future research and formulating policy recommendations. As theories in innovation policy either inform *ex-ante* or legitimize *ex-post* public intervention, I do not aim to unravel causality, but rather study the relationship between theory and practice.

I applied the following frameworks and theories from policy studies. To investigate if this study is an example of transformative innovation policy, I examined Dutch smart mobility through the concept of policy paradigms as coined by Hall (1993). In his seminal work, Hall explored how ideas gain acceptance and modify public policy, inducing radical policy change. To study an innovation policy paradigm shift, I developed a conceptual framework guided by a literature review of policy and innovation studies. To check whether the case study contained aspects of transformative innovation, I consulted the work by Weber & Rohracher (2012). According to these authors, four types of transformational system failures should be included relating to: directionality, demand articulation, coordination, and reflexivity.[2]

Later on, I applied four complementary approaches to reveal different aspects of smart mobility policy as a transformative innovation initiative. The first was examining how directions are set in transformative innovation using the Multiple Streams Framework (chapter 3). This framework highlights the role of policy entrepreneurs as central actors in determining policy routes via political strategies (Herweg et al., 2017; Kingdon, 1984). Secondly, I examined emerging governance arrangements for boundary-spanning policy problems, using the Policy Regimes perspective (Jochim & May, 2010). This perspective is applied where institutional structures are limited, thus requiring collaboration between various policy subsystems. Thirdly, to find out more about policy implementation and organization at the local level, I looked into policy implementation through the Social Construction of Target Populations (Ingram et al., 2007), and studied on organizing and designing policy intervention for sustainable accessibility by Curtis, 2008 and Papa & Ferreira, 2018. While the former study shows that deciding who

[2] Reflexivity is a process that takes a long time span to be empirically observed. For this reason, I decided to focus primarily on the first three failures.

benefits (or not) from public policy reinforces inequality and determines a policy's success, the latter studies consider policy interventions that foster public and private cooperation to generate public value.

1.4. Methodology and data collection

Studying the Dutch smart mobility policy as an example of transformative innovation poses two major challenges. First, the transformative innovation approach is a recent development, and only a limited number of studies could be identified when this PhD project began in 2015. Second, the Dutch smart mobility policy was an on-going development that initiated three years before this Ph.D. research project began. Consequently, the data collection was limited: quantitative data and evaluation documents were not publicly available, and undertaken policy initiatives were poorly documented.

Under the above-mentioned conditions, a one-case study design (document analysis and interviews) seemed appropriate. This type of case study is suitable for research aiming to explain the *how* and *why* of a particular phenomenon (Gray, 2004), as well as for exploratory research where limited data is available and for on-going developments (Yin, 2013). One-case study research, in comparison to other methodological approaches (e.g. variance-based research), is intended to understand how things played out in a particular case study, and it is very sensitive to contextual factors (Beach & Kaas, 2020). Thus, its main goal is not to generate findings that are fully replicable in other cases, but rather theory building. Moreover, one-case study approaches have been used in transformative innovation literature (Bugge et al., 2018; Coenen et al., 2017).

I define my research design as an 'embedded one-case study'− an overarching case study composed of multiple sub-cases. Sub-cases provide detailed investigative and insightful information about the study object (Yin, 2013). In this thesis, the Dutch smart mobility policy is the overarching case, and two representative sub-cases were selected: the Dutch vehicle automation initiative and the behavioral change program Beter Benutten (BB). The first is considered a breakthrough and potentially disruptive innovation (sometimes called the 'flagship' innovation of smart mobility technologies). It is expected to radically change modern mobility. The potential impact of introducing self-driving cars in society has even been compared to the introduction of motorized mobility in the twentieth century (Docherty, 2018; Marsden & Reardon, 2018). The second sub-case is the

smart mobility behavioral change program ‘Beter Benutten’ (BB), which can be translated as ‘Better Utilization’. Such programs have gained prominence in innovation processes because the introduction of technological innovations goes hand in hand with changes in user practices and personal habits. Business models that have emerged with smart mobility, such as Mobility-as-a-Service or car-sharing, assume that changes in user behavior are prerequisites for the rapid adoption of novel technologies.

Apart from the availability of data, the selection of subcases was based on the acknowledgement that automated vehicles and behavioral change are two innovations that differ dramatically in their characteristics. While vehicle automation represents a highly technical, breakthrough innovation, behavior change is focused rather on the non-technical aspects of innovation, e.g. regulations or user practices. These contrasting approaches provide insights of different types of innovation within the transformative innovation field.

The data for the case study was mainly collected via primary documents and interviews. Primary documents are useful for learning about events that are meaningful enough to be recorded by relevant actors. They are easily accessible and provide detailed information about a case study (Yin, 2013). The types of documents used in this research are: parliamentary documents, through which the Ministry of I&W communicated to the lower chamber (to which it is accountable) about smart mobility developments; reports from various government agencies like the Dutch Institute for Mobility Policy (KiM) or public research organizations like Rathenau Instituut; newspaper and journal articles; government brochures aimed at the general public; grey literature from non-governmental actors such as consultancy firms and companies; and websites of organizations involved in smart mobility policy.

Although primary documents enable us to retrieve relevant and detailed information on a case study, they are not suitable for obtaining participants' points of view, they may be biased, and do not consider ongoing developments where the information is not yet written down (Yin, 2013). For this reason, documents should be triangulated with other data sources. Thus, I carried out 41 semi-structured interviews with actors involved in innovation policy, allowing respondents to expand on their views about ongoing developments. Table 1-1 shows the interviewees’ background. These interviews, lasting on average 40 minutes, were

conducted in English. Participants were informed about the content of the interviews in advance. A snowball sampling method helped to gain access to interviewees. The interviews were recorded and transcribed for analysis using qualitative research software.

No.	Background	No.	Background
1	Director of smart mobility research area, university	22	Executive, mapping and location company
2	Policymaker, Intelligent Transport Systems, I&M	23	Executive, connected vehicle company
3	Policymaker, strategy and innovation, I&M	24	Business developer, mobility services
4	Researcher, transport institute	25	Executive, automotive embedded software start-up
5	Researcher, transport institute	26	Executive, automated freight transport company
6	Advisor, infrastructure, I&M	27	Advisor, mobility, RWS
7	Researcher, spatial/transport planning, I&M	28	Manager, behavioral change program
8	Project leader, automotive campus	29	Advisor, local mobility & behavioral change
9	Project leader, automotive campus	30	Advisor, infrastructure and waterways, I&M
10	Project leader, Triple-Helix platform	31	Advisor, public transport and mobility, I&M
11	Advisor, smart mobility platform	32	Consultant on mobility and environment
12	Public official, behavioral change program	33	Project leader, accessibility program
13	Public official, behavioral change program	34	Consultant on sustainable mobility
14	Executive, high-tech company	35	Consultant on accessibility and smart mobility
15	Executive, public transport company	36	Program manager, traffic management company
16	Project manager, I&M	37	Director, traffic management company
17	Executive, mapping and location company	38	Program manager, traffic management in municipality
18	Program manager, university	39	Consultant on user-centered architecture design
19	Business developer, infrastructure company	40	Program manager, public-private collaboration scheme
20	Consultant on mobility services	41	Researcher, public-private collaboration scheme
21	Consultant on mobility services		

TABLE 1-1: LIST OF INTERVIEWEES & THEIR BACKGROUND

Together with the semi-structured interviews, several informal conversations formed part of this research. These discussants helped to clarify certain policy aspects and served as gatekeepers for contacting other interviewees (see table 1-2).

No.	Background
A1	Advisor, smart mobility, Eindhoven municipality
A2	Manager, truck automated driving project
A3	Manager, national automated driving organization
A4	Advisor and strategist, Dutch Ministry of Infrastructure & Water Management
A5	Strategic advisor, road network authority
A6	Advisor, Intelligent Transport Systems
A7	Director, innovation platform

TABLE 1-2: LIST OF DISCUSSANTS

1.5. Outline of the thesis

The structure of this dissertation is as follows. In chapter two I start by investigating whether Dutch smart mobility policy is an example of transformative innovation (chapter 2). To do so, I used the concepts of policy paradigms and policy paradigm shifts (Daigneault, 2015; Hall, 1993; Kern et al., 2015). After a review of innovation policy literature using these concepts, I expanded a theoretical framework of the types of changes expected during a policy paradigm shift and applied this framework to assess Dutch smart mobility policy.

The following four chapters explore the paradigm shift towards transformative innovation in more detail. As shown in chapter three, I focused on the concept of agenda-setting and the directionality of smart mobility policy by examining the sub-case of vehicle automation. This involved researching not only policy entrepreneurs' role in steering policy towards their desired outcome, but also their impact on the overall course of developing smart mobility policy. Chapter four describes the emerging governance arrangements for a transformative innovation regime by studying the Dutch initiative on autonomous vehicles. This lens has been used to explore the governance of institutionally fragmented issues and when collaboration is required between different policy domains.

Chapters five and six discuss policy coordination and creating a market for transformative innovations in the Netherlands, looking at the behavioral change program 'Beter Benutten'. Both chapters focus on the implementation of new modes of public-private collaboration and new policy instruments developed for such initiatives. In chapter five, I explore the 'connected bicycle' project in two southern regions of the Netherlands, Eindhoven, and Maastricht, investigating how policymakers induced changes in mobility systems through incentives and by distributing the benefits and burdens between target populations. Chapter six examines a similar project, enhancing sustainable accessibility in the cities of

Amsterdam, Rotterdam, and Utrecht. I show how three approaches to demand articulation differed in their transformative potential and societal impact.

This dissertation ends with a discussion and conclusions, in which I answer the original research question and suggest avenues for future research.

1.6. Personal contribution to each in each of the chapters

This thesis (except this chapter and chapter seven) consists of academic articles submitted to journals and books, and is co-authored with fellow researchers on the same project. The following table presents the authors' personal contribution to each chapter.

Chapter	Role	Contribution to the chapter
1	Single author	Introduction, single author.
2	Main author	Developed approach and ideas, with comments from supervisor & promotors.
3	Main author	Developed approach and ideas, with comments from supervisor & promotors.
4	Main author	Developed approach and ideas, with comments from supervisor & promotors.
5	Co-author	Collected and analyzed data (50%), transcribed interviews (50%), developed the concept of sustainable accessibility, provided policy studies insights, empirical analysis (50%).
6	Co-author	Collect and analyze data (50%), transcribe interviews (50%), propose concept of sustainable accessibility, provide policy studies insights, empirical analysis (50%).
7	Main author	Conclusions, single author.

TABLE 1-3: AUTHOR'S CONTRIBUTION TO EACH CHAPTER

1.7. Research funding

This thesis is part of the Research Program "The Transition from Automobility to Smart Mobility", which ran from 2015 to 2019. The program was co-financed by Eindhoven University of Technology, Rijkswaterstaat, and the Dutch Ministry of Infrastructure and Water Management (I&W). The author would like to acknowledge and thank the parties involved for their support.

2. The Dutch smart mobility policy as an example of a transformative innovation policy[3]

Abstract

The recent orientation towards societal challenges in innovation policies has exposed the limitations of contemporary governance to deal with these endeavors. For this reason, it has been urged a shift towards the so-called 'transformative change' approach, drawn from socio-technical transitions literature. This research suggests that this approach can be considered an emerging policy paradigm and studies the implications of its adoption in innovation policy. For doing so, we developed a conceptual framework based on policy sciences and innovation studies literature and used it to study a policy resembling this societal-challenge orientation: The Dutch smart mobility policy. Our case study suggests that this approach can be considered a new paradigm in innovation policy, as novel theories, approaches, and mechanisms are being used to govern this policy. This research contributes to a better understanding of transformative approaches, by empirically looking at the changing role of governance in societal-challenge led innovation policies.

Keywords: innovation policy, transformative change, transformative innovation, societal challenges, policy paradigms, paradigm shift, smart mobility.

2.1. Introduction

Innovation is increasingly acknowledged for its potential contribution to addressing contemporary societal challenges, such as climate change and sustainability (OECD, 2015b). This acknowledgment has led to a strategic orientation towards societal challenges in innovation policies, e.g. the Horizon 2020 program (European Commission, 2016a), and in policy directives of various OECD member states (OECD, 2015b). This strategic shift also has fostered a debate on the governance of such novel type of innovation policies (c.f. the work of Edler & Boon on 'demand-side policy instruments', Mazzucato (2017) on 'mission orientation', and Schot &

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Steinmueller (2018) on 'transformative change'). It has been argued that contemporary innovation governance, largely influenced by the Neoclassical and Systems of Innovation (SI) theories (Chaminade & Edquist, 2010), may not be suitable for dealing with the complexity of such endeavors (Mazzucato, 2016; Schot & Steinmueller, 2018). This might be especially so, because contemporary governance primarily focuses on economic goals rather than societal desirable outcomes, limits state intervention to market failures and systemic problems, and neglects systemic changes at a societal level (Mazzucato, 2016; Schot & Steinmueller, 2018; Weber & Rohracher, 2012). Therefore, several scholars have urged for a paradigmatic shift in innovation (Mazzucato, 2016; Weber & Rohracher, 2012). This shift is expected to result in radical policy change, including new interpretative frameworks for innovation processes, policy objectives, intervention rationales, and policy instruments (Borrás & Edquist, 2013; cf. Flanagan et al., 2011).

To tackle the aforementioned deficiencies, one approach which has recently gained attention is the so-called "transformative change" (Schot & Steinmueller, 2018; Steward, 2012; Weber & Rohracher, 2012). It suggests that innovation governance must be tailored to suit its grand-challenge orientation by incorporating socio-technical transitions insights (Steward, 2012; Weber & Rohracher, 2012). These insights are expected to contribute to better governance for several reasons: they align economic and societal goals, broaden policy interventions from a firm and sectoral level to a societal level, and provide a normative orientation in innovation policies by mobilizing sustainability transitions theories (Weber & Rohracher, 2012). Recently, this approach has been deepened by theoretical developments delineating new policy objectives, intervention rationales and instruments (Daimer et al., 2012; Lindner et al., 2016; Weber & Rohracher, 2012).

Although the transformative change approach has gained prominence within the innovation community over the last years, previous studies have paid limited attention to actual policies that may aim for transformation. Thus, we still have a limited understanding of how the adoption of this approach will impact governance in practice. We fill this gap between theory and practice by analyzing a case study that we claim a transformative approach is present: the Dutch smart mobility policy. Established in 2013 to foster technological innovations in the fields of traffic management, travel information, and in-vehicle technologies, this policy

resonates with the transformative innovation approach for several reasons. First, it incorporates three societal challenges as policy goals (quality of life, accessibility, and safety), that are expected to be achieved by diffusing smart mobility technologies. Second, novel governance approaches have been carried out in this policy, broadening the scope of policy intervention beyond traditional innovation policies. Thirdly, it is literally framed as a transition policy, which is expected to transform step-by-step the current socio-technical regime into a new one (de Mooij, 2013).

In this research, we aim to answer the research question 'can the Dutch smart mobility policy be regarded as an innovation policy for transformative innovation?' and, if so, 'what governance mechanisms were used for providing this normative orientation?'. We answer these questions as follows. First, based on an extensive literature review of policy sciences and innovation policy literature, we develop a conceptual framework delineating the expected transformations of this novel paradigm. While the policy sciences literature provides a comprehensive understanding of paradigm shifts at a generic level, the innovation policy literature adds insights regarding the specificities of the innovation domain. There is sound evidence that intervention rationales should be broadened to justify transformative policies (see Weber & Rohracher, 2012; cf. Mazzucato, 2016; Schot & Steinmueller, 2018). Accordingly, our framework trace how novel understandings of innovation processes inform policy design and implementation, leading to new policy interventions and instruments. Finally, we apply this framework to our case study, to test whether the Dutch smart mobility policy can be considered a transformative innovation policy.

The structure of the chapter is as follows. In section 2.3. we present the theoretical background and the transformative change literature. The framework is developed in section 2.4. Section 2.5. entails the methods. We apply this framework to the Dutch smart mobility policy in section 2.6. This chapter finishes with discussion and conclusion sections.

2.2. Theoretical background

One approach to studying the governance of innovation policies is by looking into the theoretical perspectives informing policy choices, such as the Neoclassical and the Systems of Innovation (SI) theories (Bach & Matt, 2005; Chaminade & Edquist, 2010). These theories are central to innovation governance for at least two reasons.

First, they allow policymakers to mobilize theoretically sound arguments to 'make sense' of innovation processes (Laranja et al., 2008), e.g. linking problematic conditions requiring government intervention to 'market failures' or 'systemic problems' (Bach & Matt, 2005). Secondly, they legitimize policymakers' interventions, as they are considered scientifically sound knowledge sources (Weber & Rohracher, 2012, p. 1040). Although scholars have coined different terms for referring to these perspectives -Schot & Steinmuller (2018) talk of 'framings', Chaminade & Edquist (2010) refer to 'approaches', and Laranja, Uyarra & Flanagan (2008) discuss them as '(meta) rationales'-, they largely resemble to what in policy sciences are considered policy paradigms[4]: widely shared frameworks of ideas allowing policymakers to meaningfully understand a policy, provide guidance to their actions, and suggest possible responses to policy problems (see Hall, 1993; Hogan & Howlett, 2015).

The policy paradigm concept was developed in the late twentieth century to explain how ideas and theories influence policy change (Hall, 1993), and similar notions have been increasingly incorporated in innovation studies (cf. Chaminade & Edquist, 2010; Laranja et al., 2008; Schot & Steinmueller, 2018). This concept suggests that policymakers share dominant 'world views' which influence the governance of a policy. It allows us to conceptualize the relevant problems requiring governmental action, set policy ends and objectives, and suggest adequate activities and means for achieving these ends (Daigneault, 2014; Hall, 1993). Consequently, a paradigm also indicates certain aspects that are *not* considered relevant for policymaking. Because paradigms are widely shared, they induce stability, predictability, incrementalism, and consensus in policymaking (Béland & Cox, 2013).

Policy paradigms are stable over long time periods, but they occasionally change, especially when a paradigm's theoretical insights and policy realities become discrepant (Wilder & Howlett, 2015). This occurs when policy anomalies (e.g. cumulative policy failures) de-legitimize the existing paradigm and policymakers look into novel non-hegemonic paradigms a better way to cope with new policy realities (Capano, 2003). In these paradigm shifts multiple dimensions of policymaking encounter radical changes, ranging from the values, assumptions, and principles of policymakers, to the emergence of new problems that require

[4] In this paper, we refer to 'policy paradigms' for discussing the multiple concepts used to refer to the theoretical frameworks informing policy choices.

policy intervention and policy ends (Daigneault, 2014; Kern et al., 2015). Nevertheless, certain dimensions of the old paradigm will remain after the shift, due to policy legacy and the policymaking path-dependence.

2.2.1. The emergence of the transformative innovation approach

Two theoretical innovation policy frameworks would fit into what in policy sciences are considered dominant policy paradigms: The Neoclassical and the System of Innovation (SI) approaches (Bach & Matt, 2005; Chaminade & Edquist, 2010). The Neoclassical approach, rooted in mainstream economics, has been a major paradigm since the post-war era. In the 1980s, a shift occurred to overcome its deficiencies, resulting in the adoption of the SI paradigm.[5] To date, both paradigms remain largely influential and are considered suitable for governing innovation policies with a central economic focus (Laranja et al. 2008). Nevertheless, over the last years, the above two dominant paradigms have become contested by the emergence of grand societal challenges as central rationales for public policy. As a result, innovation policies have been strategically oriented towards addressing contemporary grand challenges and persistent negative societal conditions, such as unemployment and inequality (Schot & Kanger, 2016; Schot & Steinmueller, 2018). This orientation is considered as its 'strategic turn' (Weber, 2012) or 'normative turn' (Daimer et al., 2012).

This strategic or normative turn exposes the limitations of the two dominant paradigms to address societal challenges for several reasons (Daimer et al., 2012; Schlaile et al., 2017; Schot & Steinmueller, 2018; Steward, 2012). First of all, both dominant paradigms have a strong economic focus, and neglect any normative orientation, albeit normativity is a central issue in addressing societal challenges (Daimer et al., 2012). This is especially the case because these challenges are often considered 'wicked problems', for which market mechanisms or systemic approaches are not sufficient (Amanatidou et al., 2014). Secondly, these paradigms emphasize technological innovation, although other types of innovations are required, e.g. social innovation (Daimer et al., 2012). Thirdly, they reduce state intervention in administering, fixing, regulating, facilitating, or de-risking private sector activities (Mazzucato, 2016, p. 141). Fourthly, the dominant paradigms neglect policy interventions that grand challenges require, e.g. in the use, functionality, and values of technologies in society. Finally, the dominant

[5] For an extensive review on the differences between these paradigms, see: Chaminade & Edquist (2010), and Schot & Steinmuller (2018).

frameworks do not acknowledge the social desirability of innovations (Kuhlmann & Rip, 2014). It suggests that innovation may not necessarily be consistent with social and environmental values (Schot & Steinmueller, 2018).

For these reasons, several scholars have urged for a paradigm shift towards the 'transformative change' paradigm (Schot & Steinmueller, 2018; Steward, 2012; Weber & Rohracher, 2012). The origin of this paradigm can be traced back to earlier this decade. It suggests incorporating socio-technical transitions thinking to make innovation policy more suitable for addressing societal challenges (Steward, 2012; Weber & Rohracher, 2012; cf. Grin et al., 2010), allowing a better alignment between innovation policy and sustainability goals.

By now, it is possible to start mapping several innovation policies aligned with this transformative approach. For instance, the European Union fosters social innovation initiatives (by programs and supporting schemes) that are expected to contribute to societal demands (BEPA-EU, 2011); and several OECD countries have placed societal challenges as central elements in their directives (OECD, 2014b). What remains understudied is how we can better understand what this paradigm shift entails both conceptually and practically. As a first step, we a conceptual framework to study the shift towards transformative change.

2.2.2. Proposed framework to study an innovation policy paradigm shift

The previous section we showed the need for a paradigm shift for transformative change policies. To understand how this paradigm shift may look like, we develop a framework for such a shift. We think of 'conceptual framework' in a similar fashion to Ostrom (2011), referring to a tool for identifying the most important elements and their general relationships among them for studying particular phenomena (P. Sabatier, 2007).[6] Such frameworks are used as a starting point for research inquiries, allowing posterior refinements (Schlager, 2007).

Based on the literature review, we find that several elements (what we call here 'dimensions') are relevant in the study of innovation paradigms. We identified five dimensions that integrate our framework: ultimate policy goals, interpretative frameworks, intervention rationales, strategic tasks, and policy instruments. We

[6] The notion of 'framework' proposed by Ostrom -and used in throughout this dissertation- should not be confused by her own 'Institutional analysis and development' (IAD) framework. Ostrom distinguished between frameworks, theories, and models to indicate different analytical and conceptual levels of inquiry (Eleanor Ostrom, 2009).

present each of these dimensions in the following subsections, and we show how they are related to similar concepts present in innovation and policy sciences literature.

Author	Ultimate policy goals	Interpretative frameworks	Intervention rationales	Strategic tasks	Policy instruments
Daigneaut (2015)		Ideas about the nature of reality	Problems that require public intervention	Ideas about policy ends & objectives	Policy ends & objectives
Kern et al. (2015)		Interpretative frameworks, Governance institutions		Objectives of policy	Instruments
OECD (2010)	(Implicit)	Innovation model & actors	Rationales	Strategic tasks	Instruments
Schot & Steinmuller (2018)	(Implicit)	Consideration of technology & space, policymakers' role	Justification for policy intervention	Policy practices	Policy practices
Borrás & Edquist (2013)	Ultimate goals and objectives	Targets	Direct policy objectives	Key activities	Policy instruments
Laranja et al. (2008)	Policy goals & objectives	Main features	Public intervention rationale	Objectives and level of intervention	Policy instruments
Cunningham et al. (2016)	Ultimate policy goals	Interpretative frameworks			Instruments & implementation
Bach and Matt (2005)		Ideas about the nature of reality	Circumstances that do not work well	Principles of state intervention	
Chaminade & Edquist (2010)		Interpretative frameworks, Governance institutions	Main rationale, Government intervenes on	Focus	

TABLE 2-1: FRAMEWORK DIMENSIONS AND THEIR RELATIONSHIP WITH THE LITERATURE REVIEW

2.2.2.1. Ultimate policy goals

Innovation policies are rarely established for innovations *per se,* but they are rather oriented to major goals (Cunningham et al., 2016). For instance, for industrial development, competitiveness, economic growth or support strategic areas, such

as defense (Schot & Steinmueller, 2018). In a similar fashion, Hall (1993) indicated how major motivations, such as economic stagnation, have a direct impact on the paradigms adopted in economic policymaking. Following Borrás & Edquist (2013), we label these motivations and objectives as 'ultimate policy goals'. They also refer to how policymakers conceptualize the relationship between innovation policy and society (Kuhlmann & Rip, 2014). Generally, these goals are determined in political processes, beyond innovation communities (Borrás & Edquist, 2013).

Today, we are witnessing how novel ultimate objectives are defined in innovation policy, as it is acknowledged that innovation is essential for addressing grand societal challenges (Weber & Truffer, 2017). For instance, several OECD reports (2011, 2015b, 2018) acknowledge the emerging role of innovation in programs such as the Horizon 2020 program -focusing its activities on seven strategic societal challenges (European Commission, 2016a)-.

2.2.2.2. Interpretative frameworks

The adoption of ultimate policy goals has a clear impact on the theories that policymakers use to 'make sense' of policy. Hall (1993) suggested that in economic policymaking, a change of ultimate goals in the 1980s led to a shift from Keynesianism to neoliberalism. In the same period, innovation policy adopted a new systemic-evolutionary perspective to strengthen the competitiveness of national economic systems. If dominant paradigms no longer fit new policy realities, this creates space for new better suitable theories to become adopted. We call these theories 'interpretative frameworks'. They provide a scientific understanding of actual policymaking, by mobilizing theories, frameworks, models, and alike, e.g. to understand how knowledge is produced and diffused. However, they are seldom 'just' theories, as they also implicitly carry rather high-level philosophies, assumptions at the highest level of abstraction that are translated into policy design (cf. Laranja et al., 2008). For instance, they may suggest what is the appropriate role of the state *vis-à-vis* non-state actors (Chaminade & Edquist, 2010), or they indicate what are suitable forms for innovation governance (see Kern et al., 2015).

Nowadays, new interpretative frameworks are being proposed by innovation scholars to handle the 'normative turn' in innovation. Particularly, the transformative change approach has been nurtured from insights from socio-technical transitions literature (Steward, 2012), which aims to understand how

major transformations towards sustainability in contemporary societies can be achieved. Transitions literature suggests that technologies are embedded in socio-technical configurations that fulfill societal functions (e.g. mobility, health, and energy) (Grin et al., 2010), and major socio-technical change ('transition') can only occur if these configurations are also changed. For instance, the institutions, legal frameworks, and user practices come into play when thinking about transitions. Additionally, the transformative change approach also mobilizes insights of the Multi-Level Perspective (MLP). The MLP suggests that transitions are non-linear processes, resulting from the interactions of wider contexts ('landscape developments'), emerging innovations ('technological niches'), and unstable or weak dominant socio-technical configurations ('socio-technical regimes') (Geels & Kemp, 2012).

The transformative change approach has various advantages. First of all, it broadens the concept of innovation to new areas, e.g. frugal, low-tech, or social innovations (Daimer et al., 2012). Secondly, it has a stronger focus on the non-technical (e.g. social) components of innovation (Rogge et al., 2018). Thirdly, it raises questions of how to better align innovation processes with societal goals (Schot & Steinmueller, 2018). In addition, it suggests 'issue-centered policies', linking innovation with other sectors, e.g. transport or energy (Weber & Rohracher, 2012).

2.2.2.3. Intervention rationales

In innovation policy, the notion of 'intervention rationales' plays a key for legitimizing policy interventions (Laranja et al., 2008). They refer to the problematic conditions that are not expected to be solved on their own, thus becoming intervention rationales. Rationales relate conditions with their underlying theoretical causes (Edler et al., 2016a), and are the basis of policy actions.

Up till now, 'market failures' and 'systemic failures' (recently discussed as 'structural system failures' (OECD, 2015a)) were the two major rationales in innovation. While market failures legitimize public intervention in situations of poor allocation of resources by market parties (from a societal perspective) (Chaminade & Edquist, 2010; Mazzucato, 2016), systemic problems suggest interventions to target the conditions that "negatively influence the speed and direction of innovation processes" (Wieczorek & Hekkert 2012, p. 74). These interventions may not encompass all the policy interventions required for transformative change.

Weber and Rohracher (2012) argue that the aforementioned rationales should be complemented with new rationales derived from MLP and socio-technical transition thinking. They suggest four new 'transformational system' failures: directionality, demand articulation, policy coordination, and reflexivity.

The *directionality* failure indicates that the two dominant paradigms do not internalize a normative orientation function that transformative innovation policies require, in terms of "social, economic, and environmental sustainability" (Schot & Steinmueller, 2018). To date, directions of change are largely selected by market parties, but this is problematic as they are unable to internalize the high uncertainty and risks of transformative policies (Mazzucato, 2016). For this reason, it has been suggested that policymakers (along with societal stakeholders) should set a particular direction (Daimer et al., 2012; Mazzucato et al., 2015). This direction may be defined by selecting societal goals that innovation policies are expected to contribute to addressing (Weber & Rohracher, 2012). It should be noted that providing 'directions of change' in innovation policy is not entirely new, as exemplified in the Apollo and Manhattan projects. However, the direction in those projects was defined in terms of technical, instead of societal goals.

The *demand articulation* failure indicates that societally desirable innovations can fail due to a lack of user needs anticipation and learning, as well as a lack of "complementary social, organizational or institutional innovations" (Weber & Rohracher, 2012, p. 1043). This type of failure suggests that existing societal demands require to be articulated -and thus aggregated- by policy interventions (Boon & Edler, 2018). This articulation of demands resonates with the revisited role of the state by Mazzucato (2013), who identified that state authorities had a major role in fostering technologies with limited markets (as an 'entrepreneurial state'). Consequently, the author proposed that the state should embrace an active market-creating role (Mazzucato, 2016). State authorities create complementary assets for innovation processes, such as institutions and networks (Mazzucato & Semieniuk, 2017). This failure has been tackled by focusing on user-centered innovations from the very early stages of innovation, blurring the dominant dichotomy between producers and consumers (see Daimer et al., 2012).

Additionally, *policy coordination* refers to the necessity of coherence in policy implementation at national, regional, and sectoral levels (Weber & Rohracher, 2012). This coherence is needed as innovation is becoming a cross-

cutting domain that impacts and is impacted by other domains (Cunningham et al., 2016). Innovation policy has been widened to new actors (Kuhlmann & Rip 2014). As suggested by Lindner et al. (2016, p. 15) transformative innovation policies require "interactions across all types of pre-established boundaries, intra- and inter-organizational, intra- and inter-sectoral, intra- and international". According to Weber & Rohracher (2012), three different types of coordination are required: vertical coordination between different levels of governance, horizontal coordination between different actors on the same governance level, and of the timing of different policy interventions.

The last type of transformational failure is *reflexivity*. Reflexivity is "the ability of the [innovation] system to monitor, to anticipate and to involve actors in processes of self-governance" (Weber & Rohracher, 2012, p. 1044). Addressing societal challenges by innovation implies high levels of complexity and uncertainty, as there is no clearly defined pathway to achieve socially desirable outcomes (Schot & Steinmueller, 2018). Transformative policies require to internalize and reflect upon developments and, if necessary, their adaptation. Thus, innovation policy should be able to cope with uncertainty and unforeseen circumstances. Reflexivity failure can be addressed if policymakers are able to consider the values of innovation actors, align individual and collective goals, recognize conflict (and moderate it), anticipate uncertain outcomes, and experiment (Lindner et al., 2016).

2.2.2.4. Strategic tasks

Policymakers translate these rather abstract intervention rationales into "strategic tasks" (OECD, 2010). For example, the provision of knowledge and supporting services to innovation firms are strategic tasks for addressing systemic problems (Borrás & Edquist, 2013). In other words, they are the type of actions that public authorities can adopt (Bach & Matt, 2005), e.g. the delivery of infrastructure in innovation systems, and generation of basic knowledge. As suggested by the OECD (2010, p. 257), these tasks refer to a "broad direction of policy intent" in which timing, capabilities, and targets are considered.

Certain characteristics of these strategic tasks in transformative innovation policies can be outlined. The normative dimension of innovation policy requires processes of deliberation and negotiation among multiple societal actors. Transformative change scholars ask attention for new modes of participatory governance in innovation policies (Daimer et al., 2012; Weber & Rohracher, 2012).

Other scholars suggest incorporating societal actors throughout the complete policy process (Lindner et al., 2016), including policy evaluation (Amanatidou et al. 2014). Another strategic task seems to be experimentation (Lindner et al., 2016), which has a central role in transitions literature. According to Rogge et al. (2018), experimentation is needed to test the feasibility of projects and makes learning possible (also in terms of new socio-technical configurations).

2.2.2.5. Policy instruments

Finally, we refer to the concept of policy instruments. They are the tools or techniques developed by policymakers to govern innovation processes (see Edler & Fagerberg, 2017), e.g. fiscal incentives, credits, and public procurement schemes. Policy instruments do not have a direct impact on the ultimate policy goals (Borrás & Edquist, 2013), but rather on the strategic tasks and intervention rationales suggested by the policy paradigm. Theoretically speaking, policy instruments should match at least one intervention rationale and one strategic task (OECD, 2010). Innovation scholars have developed the concept of 'instrument mix' (Borrás & Edquist, 2013; Cunningham et al., 2016) to clarify that multiple policy instruments are used simultaneously in practice. The changes in policy instruments are important in a paradigm shift, particularly as they reflect how policymakers conceive the relationship between governing and governed parties (cf. Flanagan et al., 2011; Le Gales, 2011).

In transformative change literature, scholars have discussed the relevance of demand-side policy instruments (Edler & Boon, 2018) to complement existing largely supply-side policy instrumentation. Additionally, it has valued the role of soft-instruments (e.g. future-oriented exercises, including foresight and back-casting) as they enable negotiation and consensus building in policymaking (Lindner et al., 2016). Other instruments stimulating participation are required, as a broad network of actors is valuable for directing innovation policies. Finally, Kivimaa and Kern (2016) identified niche support instruments and regime destabilization instruments. While the former refers to the instruments accelerating and nurturing emerging technologies, the latter aims to apply pressure on existing socio-technical regimes to change.

2.2.2.6. Rounding up: Proposed framework to study transformative innovation

Figure 2-1 presents our framework for studying a paradigm shift in innovation policy. We identified that a paradigm shift occurs when the existing paradigm cannot cope with new societal (and political) questions, leading to cumulative policy failures (Rayner, 2015). As a result, new theoretical approaches are considered as alternatives to overcome these failures. The literature review suggests that societal challenges are a novel condition that cannot be addressed by existing paradigms and that several scholars have proposed the adoption of the transformative innovation paradigm (Schot & Steinmueller, 2018; Weber & Rohracher, 2012).

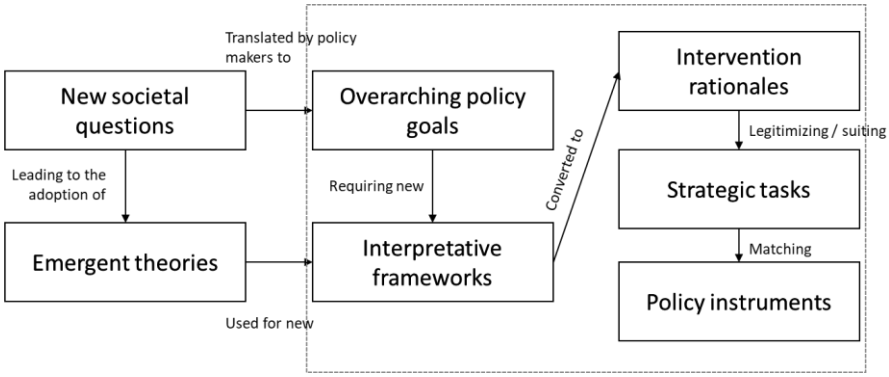

FIGURE 2-1: PROPOSED FRAMEWORK TO STUDY PARADIGM SHIFTS IN INNOVATION POLICY

Incorporating new theories in innovation policymaking implies changes in all the policy dimensions. We would expect that in a paradigm shift new societal questions are translated into ultimate policy goals. This change goes hand in hand with the adoption of new interpretative frameworks. In subsection 2.3.1. we showed that this may already be happening in the innovation domain. As suggested by Chaminade and Edquist (2010), there is an inherent link between theories and intervention rationales, the latter legitimizing policy interventions. The linkage between intervention rationales, strategic tasks, and policy instruments has been explicitly recognized by the OECD (2010), suggesting a nested relationship between these three dimensions: intervention rationales influence the strategic tasks, which subsequently impact the choice of policy instruments, and vice versa (OECD, 2010, pp. 256–257).

This framework has been developed based on the literature review. However, in actual policymaking, these dimensions may be present in a less

coherent manner, and their relationships may be fuzzy, non-mechanistic and non-rationalist. For instance, intervention rationales may serve either as *ex-ante* or *ex-post* justifications for policy interventions, and contingencies may influence policy implementation (see Flanagan et al., 2011). However, such a framework can be used as a starting point to 'make sense' of actual policymaking, by identifying the most relevant elements found in the literature review.

2.3. Methods

To answer our research question of 'can the Dutch smart mobility policy be regarded as an example of innovation policy for transformative innovation?', we performed two-stage qualitative research. First, we performed a literature review. In this phase, we identified how the 'policy paradigm' and 'paradigm shift' concepts are used in policy studies, to pinpoint how they could be applied to our field. Because these concepts suggest that a paradigm shift involves changes in multiple dimensions of policymaking, we proceeded by identifying which relevant dimensions are discussed in innovation policy literature. Through a systematic review of innovation policy and policy documents, we identified five dimensions in the domain that we incorporated in the framework, which was presented in the previous section. Table 2-1 summarizes the relationships between the five dimensions we identified and the innovation policy and policy paradigms bodies of literature.

During the second part of our research, we applied the framework to our case study. We relied on primary document analysis and fourteen interviews with policymakers. While the primary documents were used to retrieve reliable information about our case study, the interviews allowed us to explore how policymakers frame and interpret the policy. The policy documents were obtained via websites of organizations, programs, and projects of the smart mobility policy, and by means of the Dutch National Government search engine (overheid.nl). For this chapter, the interviews correspond to interviewees 1-14 (as indicated in table 1-1).

Interviewees were selected based on their knowledge about Dutch smart mobility initiatives. However, most of the interviewees are not directly involved in the smart mobility policy. For example, various interviewees work for research institutes, which are independent of the ministry. By interviewing a range of knowledgeable actors who are not directly involved in developing the smart

mobility policy, we expected to capture enough critical voices about the policy and avoid bias. At the same time, we are aware that, because of the early phase this policy, the circle of actors with knowledge of smart mobility policy is limited, and the same applies to the diversity of opinions. Triangulation techniques (e.g. with primary documents) were used to validate interviews.

The framework was applied as follows. After identifying the policy goals in our case study, we explored whether these goals required new policy approaches to achieve those goals, which in turn could indicate a potential paradigm shift. In other words, our aim was to identify new framings in policy that indicated a paradigm shift, to explore how that paradigm was operationalized in policymaking by means of policy instruments. Due to the early stages of this policy, it is out of our scope to study the effectiveness of this policy. To study how these novel framings are operationalized in policymaking, we mapped the instruments that policymakers use, and categorize them according to the intervention rationales suggested by Weber and Rohracher (2012). We linked them to various strategic tasks. For performing the analysis, we relied on a coding exercise that is being guided by the five dimensions of our framework and used a qualitative research software.

2.4. The smart mobility policy in the Netherlands: A transformative change approach?

In this section, we explore to what extent the Dutch smart mobility policy can be considered a transformative policy. Novel ultimate policy goals and interpretative frameworks encompass the first two sections. Afterward, we present the strategic tasks and policy instruments per intervention rationale. We present tasks and instruments in the same section, as they are largely interrelated.

2.4.1. The adoption of new ultimate policy goals in innovation policy

The Netherlands is considered an international transport hub in Europe, connecting overseas with mainland Europe via the Port of Rotterdam and via Schiphol Airport in Amsterdam. Moreover, it is a highly densified country. For these reasons, it has a robust and well-developed mobility infrastructure (Connecting Mobility, 2016c). The country is expecting to experience increased mobility in the future, leading to "delays and uncertainty caused by increased congestion, health risks through emissions and noise, and lower safety levels for all road users" (AutomotiveNL et

al., 2012, p. 5). In this context, smart mobility was considered a solution for the expected negative consequences of future mobility. It is an emerging mobility approach with a strong focus on implementing information technologies-based mobility solutions (interviews 1, 2, 4, 5). Smart mobility required deep social and organizational change, as IT is disruptive with regard to how mobility is organized and impacts everyday mobility (see Marsden & Reardon, 2018). Smart mobility differs from previous approaches since rapid IT developments enable a deep reconfiguration of the mobility system (interview 2).

Along this line, the Dutch Minister of Infrastructure and Environment (hereinafter I&M) announced in 2013 in a Letter to the Parliament her intention to foster smart mobility innovations and position the country as a frontrunner in this area (I&W, 2013a). Moreover, the action program 'Better Informed on the Road' (hereinafter BGOW) was announced, aiming to enable a smart transition mobility in the Netherlands by (1) improving traffic information and traffic management; (2) contributing to the public goals of accessibility, quality of life, and safety; (3) improving the efficiency and effectiveness of traffic management; and (4) strengthening the Dutch smart mobility business sector (I&W, 2013a, 2015e). It was acknowledged that in order to achieve these objectives, public and private roles in the mobility system should be redefined (Connecting Mobility, 2016c). Particularly, as smart mobility solutions require market parties to take over activities that were traditionally the scope of public authorities (see de Mooij, 2013).

2.4.2. New interpretative frameworks

The Dutch smart mobility policy has two characteristics resembling the transformative turn: It places societal goals as central elements of its policy design, and it is framed as a transition-oriented policy.

Regarding the former, there is a strong belief among policymakers that smart mobility may potentially contribute to addressing societal challenges (de Mooij, 2013). Particularly, as smart technologies may allow to "speed up the transition towards more sustainable mobility" (interview 1). There is strong technological optimism that suggests that policymakers' activities should focus on capturing the 'societal value' of these innovations (AutomotiveNL et al., 2012; Connecting Mobility, 2016c). However, the policy was not only set up to address societal challenges but also to allow the Netherlands to economically compete with other countries that were also developing similar mobility innovations (interview

2). This linkage was also suggested by an interviewee, who indicated that while smart mobility can contribute to reaching international agreements on CO_2 emissions reduction (e.g. by saving fuel consumption), it simultaneously allows strengthening the Dutch mobility business sector (interview 10) (see Smart Mobility Embassy, 2018). The potential of addressing societal challenges by Smart Mobility is also acknowledged in policy documents (AutomotiveNL et al., 2012; de Mooij, 2013; I&W, 2016b). Most interviewees agreed that policy interventions should capture the societal value of smart mobility, and minimize its potential negative consequences.

The second characteristic is that, unlike previous mobility policies, the Dutch smart mobility policy is framed as a transition policy (see Connecting Mobility, 2016c; de Mooij, 2013; I&W, 2016b). It requires the "dismantlement of the current constellation ([of] services, technology, organization, and finances) and the step-by-step introduction" of a new one (de Mooij, 2013, p. 13). This transition orientation means that public bodies require to phase out the contemporary mobility system to enable the emergence of a new one (I&W, 2016b). This orientation is also clearly visible in reports and policy documents, including a transition roadmap for smart mobility (de Mooij, 2013) and reports from public research bodies dealing with societal impacts of mobility policy (Tillema et al., 2015, 2017). It resonates with the new socio-technical configurations that smart mobility requires according to academic literature (Docherty et al., 2017; Marsden & Reardon, 2018). For instance, automated vehicles require novel legal frameworks for operation, increased user acceptance, new markets, agreements on their insurance and liability, and their certification by transport authorities. They will also have a radical impact in society, resulting in new mobility patterns, business models, approaches to mobility infrastructure, and instruments influencing their demand (T. Cohen & Cavoli, 2018; Docherty et al., 2017; Fraedrich et al., 2015).

This transition approach to innovation also appears in the institutional setup of the smart mobility policy. First, while traditional innovation policies are mostly focused on stimulating economic growth and are normally the responsibility of the Economic Affairs Ministry (EZ), the smart mobility policy was originally developed by I&M to respond to specific societal challenges. This policy also broadens up innovation to players traditionally neglected in previous mobility initiatives (e.g. IT companies, user organizations, implementing agencies, and transport authorities). It includes these actors via intermediary organizations such

as the National Automobile and Touring Club (ANWB) for user involvement (ANWB, 2015). The fact that I&W has opened the policy has led to a shift from a top-down approach to a co-creating one (interview 3). This co-creation is assumed to be central in the smart mobility policy as "the only way to achieve it [a transition] is by working together" (interview 10), especially due to its system-wide scope. In contrast with previous policies, the government today works more as a facilitator of the transition. For instance, it promotes international agreements and standards on deployment issues like liability, safety, and privacy (Connecting Mobility, 2016c), and ensures international interoperability of smart mobility systems (Ministerie van Buitenlandse Zaken, 2016). The Dutch government facilitates their development by offering its national mobility infrastructure as a 'test-bed' for experiments, in which companies and governments can learn-by-doing.

2.4.3. Intervention rationales: Their strategic tasks and policy instruments.

This subsection explores the most relevant strategic tasks and policy instruments used by policymakers to address the four transformational system failures rationales suggested by Weber and Rohracher (2012): directionality, demand articulation, policy coordination, and reflexivity.

2.4.3.1. Directionality: Strategic tasks and policy instruments

The smart mobility policy, aimed to achieve a socio-technical transition in the mobility sector, has a clear direction which was set by policymakers in its conception and sets the route of action to follow.

One major task is the identification of and linkage between innovations (in terms of goods and services) and societal challenges. We can trace back this strategic task to 2012 when several Dutch organizations presented the 'Towards a Smart Mobility Roadmap' report. It explored what technological choices could be used for addressing societal issues, and linked them with services that can be offered to road users (AutomotiveNL et al., 2012). In a similar fashion, the 'DITCM Roadmap for Cooperative Driving' (2015) mapped technologies to their potential societal impacts and required market conditions for their upscaling. In these exercises, the technologies which are expected to contribute to societal challenges are related to those in which the Netherlands excels. These include areas such as High-Tech System Materials and Logistics (see EZ, 2013). Congruently, universities are focusing research on smart mobility technologies in which "universities have

strengths", such as semiconductors, data science, and electronics in the Eindhoven region (interview 1).

A second strategic task identified in this policy was the establishment of general guidelines for the non-technical changes of the smart mobility transition. The aforementioned BGOW action program, resulting from the 'Towards a Smart Mobility Roadmap' report, provides a strategic course of action highlighting six transition pathways (de Mooij, 2013): (1) developing individual smart mobility services; (2) changing the role of roadside systems, (3) integrating traffic and travel information, (4) developing Business-to-Business and Business-to-Consumer strategies, (5) opening mobility data, and (6) developing new types of public and private collaboration (de Mooij, 2013). To safeguard these pathways, the 'Five November Group' was established. In this group, experts on smart mobility technologies work "as keepers of the roadmap" (interview 2) bringing in their individual expertise and visions on this policy. In addition, the organization 'Connecting Mobility' was established to catalyze and evaluate the smart mobility transition based on these pathways (I&W, 2016c).

Another strategic task was to perform *ex-ante* evaluations of the impact of technologies to increase public support. In this way, policymakers aim to assess whether a specific technology will be socially desirable. For example, in the triple-helix platform Connekt*,* policymakers identified the societal value of any technology that might be supported in the pre-commercial stage, by addressing the question "does it [the technology] have an added value and what problem does it solve?" (interview 10). However, by the time of the interview Connekt had no formalized assessment method, but used an informal method, based on views of public officials. Policymakers also use future-oriented exercises to perform this assessment. Based on the level of automation and upscaling of car sharing, Tillema et al. (2015) assessed by scenarios the social, spatial, and economic impacts of self-driving cars. This report was later complemented by stakeholder exercises to develop transition routes for each scenario, and recommended strategies for public intervention, e.g. monitoring and evaluating, researching, experimenting, and regulating (Tillema et al., 2017).

Our interviews suggest that Dutch policymakers are reluctant to make "very explicit technological choices" (interview 3). Instead, they leave these choices to the market (interviews 1, 2), a bigger country (interview 3), or a supranational

body (interview 2). This may occur as policymakers recognize that the Netherlands is too small for making technological choices (interview 3). Moreover, I&W made choices in the past that turned to be suboptimal choices in the long term and that are still impacting the system today, such as in roadside systems (interview 2). However, policymakers want to develop "the original ideas of the [smart mobility] system […] [in] the Netherlands" (interview 10). Since the country has no big car manufacturers (OEMs), it may benefit more from being a "test-ground" of smart mobility (interview 3). One exception is the truck industry, in which a Dutch company produces 14.6% of the total amount of European trucks (DAF trucks, 2017). In truck technologies, e.g. platooning, the Dutch government has a different position, taking the lead by developing business cases for the application of these technologies (I&W, 2015a).

2.4.3.2. Demand articulation: Strategic tasks and policy instruments

The creation of new markets seems of importance in our case study. The whole institutional set-up of the smart mobility policy aims to generate them, public parties playing a key role.

Policymakers are engaged in de- or reregulation strategies for the implementation of novel technologies. Particularly, policymakers have granted exemptions procedures for regulations to exceptional transport (I&W, 2015b). These procedures allow, under governmental supervision, to test automated driving. Without these procedures, testing would be impossible, as it would violate the Vienna Convention on Road Traffic, which requires a driver at all times (ANWB, 2015). This legal change has allowed more than twenty-seven real-life experiments in the Netherlands by 2016 (I&W, 2016b). These procedures reduce "the barriers to learn" from testing in actual mobility infrastructure (interview 3). This capacity to have de-regulated environments has been acknowledged as a key factor for testing autonomous vehicles (see KPMG, 2018). Additionally, governmental authorities have set up an automotive campus, which used to enhance experimentation for automotive technologies, including autonomous driving (Automotive Campus, 2016). Considering that mobility is a highly regulated domain, experiments allow policymakers to grasp the legal requirements of private parties to develop new products and services, while simultaneously allow private parties to know which design features are expected by policymakers to safeguard public value.

For demand articulation also experimentation is an important strategic task since it remains unclear how smart mobility innovations will be implemented in the future (interview 4). An interviewee said that the newness of various smart mobility approaches implies that “we mostly learned by doing” (interview 13). As a result, a set of pilots have been set up to test how public and private parties can work together to enable smart mobility market applications. For instance, this is present in Praktijkproef Amsterdam, public and private parties cooperation for integrating car and road systems to improve traffic flow and safety (Praktijkproef Amsterdam, 2018). In a similar fashion, behavioral change programs have been established to influence the demand for motorized mobility, using financial incentives for daily commuting. Using IT devices, public officials can reward participants by the actual number of cycling kilometers in daily commuting (Beter Benutten, 2016). Policymakers also expect to increase demand by focusing on experiments in which intellectual property rights can be given to other parties to enable rapid market development (interview 12).

Another identified strategic task is to enable new public-private partnerships (PPPs) to develop innovative services. Nowadays, policymakers acknowledge a large overlap between public and private services (e.g. traffic information services such as TomTom), which could be optimized by cooperation under new PPPs, suggesting that public authorities should ‘embrace’ rather than ‘compete’ with market products (interview 1). These PPPs are expected to bring better mobility management, allowing policymakers to focus on aspects in which private parties are not expected to deliver (interview 3), e.g. cycling infrastructure. Policymakers cooperate with private parties to determine the areas in which markets could potentially take over the contemporary public management, reducing the “disturbance of the market by the intervention of the public sector” (interview 2). As a result, PPPs are expected to encourage private investments in these areas, e.g. in travel information and mobility services.

These partnerships do not follow the traditional PPP mobility schemes, which are characterized by concessions. Concessions generate limited risks for private parties, as profit and costs are guaranteed during the concession period (interview 2). In contrast, smart mobility schemes allocate risks both in public and private parties, e.g. by mutual financing of projects. The objective of these schemes is to test services and products that can be widely diffused in the mobility system, favoring the collaborating private parties’ solution(s). In short, public parties

incentivize risk-taking by private parties with the potential of high returns in the near future. Until now, there is no dominant PPP scheme, but rather 'ad-hoc' schemes for experimenting with new types of partnerships that can enhance policy learning (interview 6).

Finally, we also identified a strong focus on user-centered design in smart mobility applications. At a general level, the BGOW roadmap suggests that improved "traffic flow, safety, and quality of life […] [will] be possible when road users have access to better information" (de Mooij, 2013). This user-centered approach has been implemented in several ways. For instance, the 'Beter Benutten' program aims to "create a market for mobility services" (interview 13), by enhancing the adoption of smart mobility innovations by behavioral changes (e.g. by financial incentives or other types of rewards) (Beter Benutten, 2017). Additionally, a round table of experts on 'Human Factors and Behavior' of smart mobility technologies have been set up, to advise policymakers and industry on aspects such as comfort and safety (Smart Mobility Community for Standards and Practices, 2018a). User-centered design is also achieved by developing projects in which parties collaborate and share their experiences about how to incorporate more users and identify any obstacle for the adoption of new technologies from a user perspective (interview 10).

2.4.3.3. Policy coordination: Strategic tasks and policy instruments

The transition orientation of the Dutch smart mobility policy positions coordination as central, e.g. suggesting the need of "a structural cooperation at the European level" (I&M 2016a, p. 14), the need of cooperation to accelerate the deployment of smart mobility solutions (Kennisinstituut voor Mobiliteitsbeleid, 2016), and coordination between public and private parties (de Mooij, 2013).

The I&M ministry works as the main coordinator in this transition and has the ambition to "connect separate projects and niches" with similar goals (interview 3). One example is Connecting Mobility, an organization in which stakeholders cooperate and know the activities of others (Connecting Mobility, 2016a). At an international level, policymakers participate in projects to harmonize implementation, such as in the Cooperative Intelligent Transport System corridor, in which Germany, Austria, and the Netherlands intend to optimize freight transport (Rijkswaterstaat, 2015).

Another strategy followed by the Dutch government is the decentralization of decision making for smart mobility. Albeit the general guidelines of the transition are developed in the BGOW roadmap, this policy is characterized by a multiplicity of decision-making arenas. Most of the current projects are on a small scale and consider local characteristics, e.g. traffic flows, built environment, etc. In the program Beter Benutten (2017) each participating region has its own local decision-making body considering these characteristics. This program has a local 'administrative trio' as a governing body, consisting of one representative of the ministry, a local/regional representative, and a representative from the marker sector. This corresponds to the vision of the Ministry that societal actors should be more involved in decision making to deal with major societal problems (van der Steen et al., 2014).

This decentralized approach is complemented by coordination activities at a national level, e.g. via consulting groups. For instance, the Five November Group works as a high-level expert group advising the Ministry on the transition pathways (interview 2). Moreover, six roundtables have been established to identify factors that affect smart mobility implementation (Smart Mobility Community for Standards and Practices, 2018b). This coordination is also achieved by the deployment of networking platforms to enhance public and private coordination. For instance, in the triple-helix platform, Connekt stakeholders deal with societal challenges related to mobility, and Connecting Mobility worked as a catalyzer for stakeholder cooperation (Connecting Mobility, 2016c; I&W, 2016c).

Policymakers also provide long-term coordination to the policy. This is done through implementation agendas and future-oriented exercises. Stakeholder workshops have been developed to assess what type of policy interventions are required to achieve smart mobility scenarios (Tillema et al., 2017). This coordination is both operational and strategic; leading to concrete policy actions and strategic courses of action (Noordegraaf et al., 2016). This has regularly resulted in a relatively high level of commitment for future developments of smart mobility technologies. For example, the 'Declaration of Amsterdam on Cooperation in the Field of Connected and Automated Driving' (2016), was signed by all ministries of transport at a European Union level. It aims to enable high level dialogue and cooperation with regard to the harmonization of regulations and thus "legal consistency" in the EU, e.g. in terms of security, privacy and data protection from a user perspective, interoperability of smart mobility systems and cooperation

between different mobility agents (Ministerie van Buitenlandse Zaken, 2016). Albeit this declaration is rather an informal mechanism, it provides a way to coordinate implementation strategies within the EU.

2.4.3.4. Reflexivity: Strategic tasks and policy instruments

The fourth intervention rationale suggested by Weber & Rohracher (2012) is reflexivity. In order to provide reflexivity to this policy, policymakers aim to incorporate wider publics and to enable self-governance processes.

A main strategic task is the establishment of autonomous public organizations in which public authorities together with stakeholders co-create smart mobility projects. Albeit supported by I&M, these organizations are autonomous and treat various parties (knowledge institutes, governments, companies, etc.) equally. For instance, Connekt works under a membership scheme, through which public, private and knowledge institutes equally fund it. The role of public officials in Connekt is to "listen to the members" and "see if there are any possibilities" for collaboration among them (interview 10).

We also observe that in this novel governance approach, public authorities do not want to lead a transition, but aim to facilitate one. Policymakers are aware of their limited decision-making capacity. Accordingly, the role of state authorities in this transition is to create "a big playing field within well-defined and well-thought borders" (interview 1). This is done by translating market needs to public action, such as in the exemption procedures, aforementioned explained. These procedures were originated as a proof of concept from market parties to I&M, showing that automated driving was technically feasible to be developed in the Netherlands. As a result, the ministry asked for suggestions to market parties about how to allow the development of this technology (or, in other words, "what can we [as public authorities] do to make it happen?" (interview 10). This also works the other way around, by translating public interest to potential market applications. For instance, the Five November Group was commissioned to develop a roadmap for implementing smart mobility technologies, considering societal factors and the role of public authorities (interview 10).

Engaging stakeholders in broader consultation platforms is also a strategic task for providing reflexivity to the policy. For instance, the Five November Group was set up because policymakers "wanted their knowledge, wanted their point of view, but not precisely the one from the company" (interview 2). Also, the

organization Connecting Mobility engages itself with a broad set of societal stakeholders (DITCM, 2015). Some of these platforms, allow to "hear what is happening in companies, what their concerns are, and other technological developments" and "what is happening in the field of smart mobility […] [allowing policymakers to] create better policies" (interview 10). These platforms mainly provide non-binding policy advice. These platforms also allow Dutch smart mobility stakeholders to share and discuss reasons for success and failure, stimulating learning (interview 10).

In order to stimulate a smart mobility transition, policymakers aim to connect several spheres of action. In this way, they expect to keep the 'momentum' of smart mobility innovation. This is primarily done by demonstration projects such as the Truck Platooning Challenge. This challenge made visible to a wider audience the feasibility of automating freight transport and its potential benefits (DITCM, 2015), as well as by raising public awareness that some novel smart mobility technologies are actually being developed (interview 10).

2.5. Discussion

Mapping the five dimensions proposed in our framework to the case study, we found several elements that certainly resonate with the transformative approach. In figure 2-2, we summarize our main findings according to the five dimensions of the framework. It was found that new ultimate policy goals have been developed, followed by new interpretative frameworks. As a result, novel strategic tasks and policy instruments were identified, aligned with the four intervention rationales suggested by Weber & Rohracher (2012). Our analysis of the Dutch smart mobility policy provides the reader with several insights into current developments in the field of STI governance, which we would like to discuss along the lines of the framework dimensions.

The Dutch smart mobility policy is characterized by the establishment of societal goals that go hand by hand with economic ones. It also shows a strong linkage between the three societal goals safeguarded by the ministry and the Dutch top sectors. It mobilizes expertise in which the Netherlands excels (e.g. electronics, high-tech, and IT) to crucial areas for the Dutch economy (transport and logistics). This approach suggests a reorientation of STI to priority societal areas without forgetting the economic goals of STI processes. The case study suggests that novel interpretative frameworks have been developed in this policy. Particularly, we

identified that it is framed as a transition-oriented policy and that policymakers mobilize transitions thinking for its governance. Consequently, several elements of the policy design may easily fit in transitions literature (e.g. 'learning-by-doing', regime destabilization, etc.; cf. Geels & Kemp, 2012; Grin et al., 2010).

A framework defines the expected role of state authorities in STI policy. In transformative innovation literature, this new state role a central topic for inquiry (cf. Boon & Edler, 2018; Mazzucato & Semieniuk, 2017). Our case study offers a tentative answer to it. We observe that public authorities take on a key role as 'orchestrators' of the transition (e.g. by setting institutions or by demonstrations projects), which indicates a broader and more active role of the state. Aligned with contemporary scholarship, our research suggests that state intervention occurs at every place in the innovation chain, from production to consumption that a central activity is the acceleration of markets creation for emerging technologies.

Additionally, the emerging role of the state is not filled in a classic top-down perspective, but rather by shifting from a hierarchical to a 'first among equals' approach (cf. Boon & Edler, 2018). State authorities are opening up the decision-making mechanisms to new stakeholders, in which the main role of these authorities is to safeguard the societal benefits of innovation. For instance, policymakers do not dictate missions or select technologies, but rather act as wardens of societally desirable paths for market technologies. They also engage in novel schemes for public-private collaboration, mobilizing expertise of the private sector to foster innovations. This reduction of hierarchy also re-conceptualizes the state authority in STI policy (cf. Borrás & Edquist, 2013). Albeit this approach suggests that public and private parties negotiate on equal terms, public parties continue to have the 'final word' in selecting technologies that deserve public support, e.g. prioritizing certain technologies.

Our case study shows that the four transformative system failures identified by Weber & Rohracher (2012) offer a valuable starting point for mapping strategic tasks and policy instruments in transformative policies. Regarding directionality, we identified that the tasks of performing an ex-ante evaluation of existing technologies and linking societal challenges with technological innovations are central. Moreover, enabling new public-private partnerships seems of importance for demand articulation. In recent debates on transformative change demand-oriented policy instruments seems to play a central role (see Edler & Boon,

2018), and our research highlights instruments influencing demand, e.g. behavioral change programs. For policy coordination, new governance models have been developed. Finally, for reflexivity, policymakers are engaging in developing new autonomous organizations and allow stakeholder self-governance.

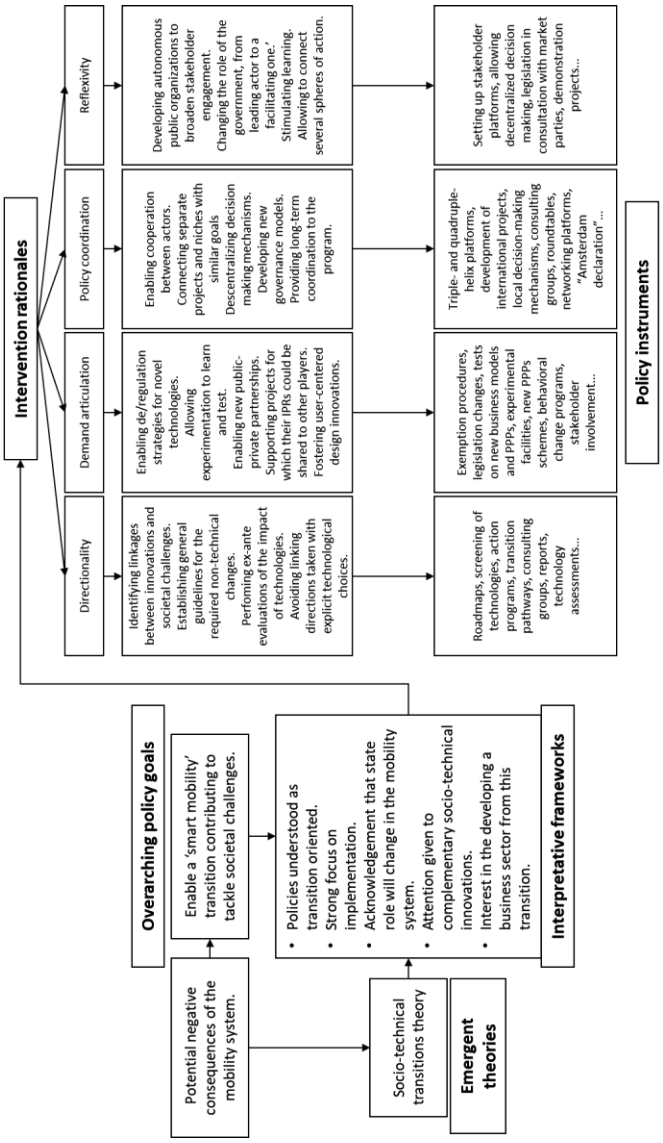

FIGURE 2-2: THE DUTCH SMART MOBILITY POLICY AS A TRANSFORMATIVE INNOVATION POLICY

Two strategic tasks were identified that can be associated with each one of the four transformational failures: experimentation and stakeholder engagement.

Experimentation is a central asset for learning-by-doing, for which policymakers are opening up the infrastructure to test potential technologies in real-life situations. This approach may be easily replicated in other settings, and accelerate transformative policies dealing with other societal challenges. In addition, stakeholder engagement allows mobilizing experts of private parties to the public domain, suggesting an increasing role of public and private cooperation. It fosters interaction among relevant societal actors in this policy domain and can play a role in legitimizing policy.

Regarding stakeholder engagement, we observed deliberation between stakeholders in the case study, but limited contestation, tensions, and conflicts between them. As an interviewee suggested, in "political terms, no one is really against" this policy (interview 3). This contrasts with socio-technical transition literature (cf. Loorbach, 2010). This may be actually explained in two ways. First, we believe this occurs due to the specific conditions of the Netherlands. The country lacks a 'big smart mobility player' shaping smart mobility activities as in other countries (e.g. car manufacturers in Japan or Germany). Moreover, the Netherlands is characterized by a consensual decision-making model, which enhances cooperation rather than conflict (interview 10). Albeit these institutional characteristics may explain the lack of conflict in this study, we believe it can also be explained by how this policy was designed. This policy is broad in scope, allowing a comprehensive range of projects and stakeholders to participate. Additionally, limited implementation has been carried out, and it remains in an experimental phase. Conflict and contestation may emerge when the ministry starts favoring the implementation of certain innovations at the expense of others (interview 10). This argument resonates with other interviewees' positions, who suggested that despite the agreement that using smart mobility technologies can contribute to tackling societal challenges, there are some applications that will result in a higher conflict in the near future (interviews 4, 5, & 7). For instance, while vehicle fleet automation seems a widely accepted potential solution to the current auto-mobility regime problems, its application to prioritize individual transport is likely to be challenged by environmental and social groups, e.g. by its impact in urban space (interview 7). Finally, we acknowledge that this research focuses on a limited circle of actors who are knowledgeable about smart mobility policy. It is important, therefore, that further research also includes actors who look at smart mobility from a societal perspective (c.f. KPMG, 2018).

As expected from a paradigm shift, the 'instrument toolbox' at the disposal of policymakers is broadening. Following policy paradigms literature, the adoption of a new paradigm implies the development of new instruments, rather than re-developing old ones in new contexts. We identified high-level consultation groups as 'keepers' of the transition roadmap (Five November Group) and the Amsterdam Declaration as two novel instruments. Further research is required to map and conceptualize new instruments that can be associated with strategic tasks and intervention rationales. Improving our understanding of transformative innovation instruments may be a starting point for a rigorous analysis of how to govern societal-challenge oriented STI policies. However, the reader should be warned that policy instruments are not easily transposed to others contexts, as they depend upon multiple underlying factors (see Edler et al., 2016b; Le Galès, 2011).

2.6. Conclusion

To answer the research question of 'can the Dutch smart mobility policy be regarded as an STI policy for transformative innovation?', a conceptual framework was elaborated inspired by policy sciences literature. Particularly, the concept of 'policy paradigms' of Hall (1993) was used to study the normative shift we are witnessing in STI policy. Using our framework for operationalizing STI policy paradigms and paradigm shifts, we found that the Dutch smart mobility policy showed new ultimate policy goals, new interpretative frameworks, new intervention rationales that are directly connected to the four transformational failures identified by Weber and Rohracher (2012), and related novel strategic tasks and policy instruments. For this reason, we suggest that the Dutch smart mobility policy can be seen as an example of a transformative change policy. We note, however, that our research has focused on an early phase within the development of the Dutch smart mobility policy. This implies that our case study cannot shine a light on the important question of how to shift a 'transition' from the experimental phase to a scaling-up phase.

Despite this limitation, this chapter contributes to transformative innovation literature in several ways. First, we developed a framework that allows for future improvement and refinement, e.g. by redefining relationships, identifying new dimensions, or mapping new strategic tasks and policy instruments. It may also be used to perform comparative studies for identifying different approaches (e.g. strategic tasks and policy instruments) among countries embracing the transformative approach. In addition, this chapter provides an

empirical illustration of this approach, which remains rather limited in academic literature. This illustration allowed us to identify central elements of the policy design, while at the same time finding specific mechanisms which are used for transformative change governance. It also permitted to map strategic tasks and policy instruments associated with the transformational system failures (Weber & Rohracher, 2012).

This chapter also outlines further research areas. STI literature may benefit from mobilizing concepts and approaches from other disciplines to study the governance dimension of STI policies. In this chapter, we used Hall's (1993) contribution to paradigms, but STI policy may also benefit from looking into other policy sciences theories and frameworks. Additionally, it highlights the need for conceptualizing new policy portfolios in STI policies for transformative change. An important research goal is to determine which policy instruments are more effective than others for enhancing transformative change approaches. Moreover, this chapter used a one case study research design, and comparative case studies are required to discriminate between specificities of our study (in terms of national, institutional, and domain-specific characteristics) and transition-oriented policy designs in general. Our proposed framework may be used to perform that kind of comparative research. This research presented a general overview of a paradigmatic shift in STI policy. Future research could specifically focus on particular elements or stages of transformative change policies (e.g. agenda setting, implementation, legitimation) to get a better understanding of the policy processes of transformative change. Particularly relevant is the area of policy evaluation and assessment, as we found limited formalized assessment methods to evaluate this policy effectiveness.

A final point for further research concerns the trade-off we found within the smart mobility policy between stimulating the development of smart mobility technologies, striving for economic growth, and contributing to societal challenges. Non-smart technology approaches for addressing societal challenges (e.g. stimulating cycling) may have a greater societal impact, but their economic contribution remains limited in comparison to smart mobility solutions. The Dutch smart mobility policy we studied indeed shows the tendency to address societal challenges by means of stimulating new emerging technologies contributing to economic welfare. In such a 'techno-centric' approach to innovation policy, technological innovation may prevail over other types of innovation (e.g. social or

institutional). Future research may look for alternative innovation approaches to address societal challenges, and inquire which approach receives the most political and societal support.

3. The directionality of transformative innovation policies: The case of the Dutch self-driving car initiative[7]

Abstract

Central questions in transformative innovation policies are how and by whom the directions of policy change are set. So far, scholars have advocated for participatory approaches to determine these directions. Limited attention has been given to empirical cases to determine how directions are actually set, and the role of actors in determining them. Following policy studies, institutional entrepreneurs may play a central role in defining directions in innovation processes. They align their own interests with policy developments and sell their preferred solutions to policymakers, expecting future returns from policy. This chapter uses an adapted version of the Multiple Streams framework (MS) (Kingdon, 1984), to study how these entrepreneurs may influence this direction. We have selected the Dutch automated driving initiative as a case study, which was part of a national transformative agenda in the mobility system. As MS suggests, we found that well-positioned policy entrepreneurs framed automated driving as a transformative innovation and championed it in policy arenas. Therefore, vehicle automation became a top priority in this agenda, despite having unclear transformative benefits. Soon after becoming a priority, the initiative's transformative potential was forgotten and focused on entrepreneurs' interests. This paper suggests that more attention should be given to the role of entrepreneurial activity in transformative innovation, and highlights the shortcomings of the current understanding of directionality in contemporary innovation policies.

Keywords: Policy entrepreneurship, directionality, STI policy, policy process, transformative innovation, automated driving.

[7] This chapter is an adapted version of the manuscript "The role of policy entrepreneurs in defining directions of STI policy change: A case study of Automated Driving in the Netherlands", submitted.

3.1. Introduction

In recent years, 'grand challenges' have become major factors for designing innovation policies. The societal-challenge orientation, labeled as 'transformative innovation', has exposed the limitations of current governance to deal with such challenges, resulting in proposals for new policy approaches (Mazzucato, 2016; Schot & Steinmueller, 2018; Weber & Rohracher, 2012). Unlike contemporary innovation governance, these approaches acknowledge the need to give innovation processes a societally desirable strategic orientation. This orientation, labeled as *directionality*, refers to addressing societal challenges that favor certain changes at the expense of others (Edler & Boon, 2018; Mazzucato, 2016; Weber & Rohracher, 2012). A directionality function in transformative change policies is needed, as they are purposely designed to achieve certain societal outcomes (Markard et al., 2012; Mazzucato, 2018a).

Up till now, research on directionality has mostly focused on innovation policy instruments (Edler & Boon, 2018), policy practices (Schot & Steinmueller, 2018), and modes of governance (Daimer et al., 2012; Lindner et al., 2016). Moreover, most research has studied how and by whom these directions *should be* set rather than how they *are actually* set. Sustainability transitions scholars suggest societal engagement as a major source for direction-setting (Lindner et al., 2016; Schot & Steinmueller, 2018). This view may be limited, as transformative change is political in nature, with contestation, conflict, and winners and losers (Schot & Steinmueller, 2018; Stirling, 2008). Moreover, innovation literature has given limited attention to the early phases of transformative innovation (e.g. agenda setting and policy formulation). These phases are crucial as they define the contents of a policy, narrowing down societal problems to manageable problems that policymakers can address.

Taking this research gap as a starting point, we aim to provide an alternative explanation of how and by whom directions in transformative change are set using policy studies literature. To do so, we use the concept of policy entrepreneurs and the framework that has theorized extensively their role in policymaking, the so-called Multiple Streams (MS) (Kingdon, 1984). Policy entrepreneurs are actors that incorporate their preferred issues and solutions in governmental agendas, for later translating them into government actions. This is the case as they expect future returns from policy. Entrepreneurs are considered central agents for policy change (Bakir & Jarvis, 2018) and MS was developed to

understand entrepreneurs' strategies to influence policy processes (Kingdon, 1984). We believe that MS may fit the current conditions in which transformative innovation is unfolding, e.g. ambiguity, time constraints, uncertainty, vested interests, and fluid participation (cf. Köhler et al., 2019).

To illustrate the value of the application of institutional entrepreneurs and the MS framework, we present an in-depth case study of the Dutch automated vehicles (AVs) initiative. AVs are interesting for the following reasons. First, their transformative potential remains open to debate (cf. Wanzenböck et al., 2019). They may transform the mobility system in a positive way, but they could also reinforce the negative aspects of the current mobility system centered around the automobile (Marsden & Reardon, 2018; Tillema et al., 2015). This has resulted in a call for capturing AVs' public value and direct their development towards societally desirable outcomes (T. Cohen & Cavoli, 2018; Docherty et al., 2017). The Dutch AVs initiative had a similar intention, namely to maximize their societal potential. This initiative was part of a smart mobility agenda, aiming to achieve a transition in the mobility field and contribute to three societal goals (quality of life, reachability, and safety) (de Mooij, 2013). We believe that our case study is suitable for inquiry, as AVs were not originally incorporated in the agenda. However, they were included soon after its establishment and rapidly 'championed' by policymakers, becoming a central priority in it (I&W, 2014b, 2016b; Tillema et al., 2017). However, it is unclear why AVs brought so much attention, particularly if their transformative impact is unclear. Therefore, we have three guiding questions that we aim to answer in this research: What role did policy entrepreneurs play in adopting AVs in the Dutch smart mobility agenda, how did policy entrepreneurs facilitate their adoption, and what returns did they get from it?

We start by outlining in section 3.2 the theoretical background, including the concept of directionality for transformative innovation. In section 3.3, we present the Multiple Streams (MS) framework, which, to the best of our knowledge, has only been applied to a limited extent in the innovation domain (see Jones et al., 2016). We proceed with methods in section 3.4 and findings over nine years in section 3.5. We end this chapter with discussion (3.6) and conclusions (3.7).

3.2. Theoretical background

The emergence of the transformative innovation paradigm was the result of the need for orientating innovation policies to societal benefits (Schot & Steinmueller,

2018; Weber & Rohracher, 2012). We see evidence of this focus in programs such as Horizon 2020, which fosters innovation in seven categories of societal challenges, e.g. green transport and wellbeing (European Commission, 2016a, 2018), as well as the current set up for the Horizon Europe program. This societal-challenge orientation has led to a call for a new generation of innovation policy designs, with proposals primarily in terms of market creation/mission orientation (Edler & Boon, 2018; Mazzucato, 2016, 2018a), and socio-technical transitions literature (Schot & Steinmueller, 2018; Weber & Rohracher, 2012)

Researchers agree that transformative approaches need a 'direction-setting' function, which Weber and Rohracher (2012, 1042) labelled as *directionality*: such policies should set collective priorities and identify societal demands to design STI policies. This direction-setting will favor "certain types of changes [rather] than others" (Mazzucato, 2016, p. 141), enabling societally desirable systemic changes (Geels, 2010; Markard et al., 2012; Smith et al., 2005). It also offers numerous benefits: it allows us to map the social desirability and potential of emerging technologies (Mazzucato, 2018a), provides conditions for market creation (Edler & Boon, 2018; Mazzucato, 2016); enables coherent policy implementation (Coenen et al., 2017; Weber & Rohracher, 2012); aligns innovation processes with societal and environmental values (Daimer et al., 2012), and fosters the development of complementary innovations required for transformative change (Schot & Steinmueller, 2018; Steward, 2012).

Despite an increasing amount of literature on directionality in the past decade, limited attention has been given to how and by whom these directions are set in policymaking. Transformative change scholars suggest that these directions should be set by societal participation and deliberative processes (Schot & Steinmueller, 2018; Weber & Rohracher, 2012). This participatory and democratic exercise is expected to include a wide range of stakeholders, in which they debate, negotiate, and ultimately incorporate different ideas and interests in transformative innovation policy. However, this view may neglect other relevant aspects of transformative change policymaking. For instance, contemporary policy processes are not necessarily fully democratic, as they favor unrepresentative expertise and rational decision-making at the expense of participatory approaches (deLeon, 1995; Ingram et al., 2016). Moreover, transformative change is prone to political conflict and contestation (Rogge et al., 2018; Schot & Steinmueller, 2018). Thus, factors such as confrontation, power, interests, access to decision-making

arenas, and capacity of mobilization should be considered (P. Sabatier, 2007). This call for a better conceptualization of how and by whom directions of change in transformative innovation are set.

Potential answers to these inquiries can be drawn from the discipline of policy studies. Part of these studies has focused on understanding directions of policy, particularly under the lenses of advocacy coalitions (P. A. Sabatier, 1987) and policy entrepreneurs (Mintrom & Norman, 2009). In this research, we would like to focus on the latter: policy entrepreneurs. These entrepreneurs seek to influence policy change by bringing ideas to policy arenas, convincing policymakers about their adoption, and translating these ideas into policy decisions and implementation (Herweg et al., 2017; Mintrom & Norman, 2009). They do it with the expectation of future returns (Bakir & Jarvis, 2017).

We have selected policy entrepreneurship for two reasons. First, they have been central for conceptualizing change in innovation studies (Battilana et al., 2009), but they have been limitedly studied in transformative innovation contexts (Grillitsch et al., 2019; Rogge et al., 2018; Weber & Truffer, 2017), even though Kuhlmann and Rip (2018) acknowledged that institutional entrepreneurs modulate *de facto* directions of transformative innovation. Second, policy entrepreneurship is a well-established approach to study policy change prioritizing agency. We intend to go beyond structural explanations, for better understand actors role in direction-setting. Moreover, focusing on entrepreneurs as agents of change, allow us to also understand how ideas and power interests are mobilized to policy circles. In other words, the ideational and power dimensions of policymaking are not 'out there', but are embodied in entrepreneurs. In this paper, we focus on a well-established framework in policy studies: The Multiple Streams (MS) framework (Kingdon, 1984).

3.3. The Multiple Streams Framework

The MS framework was originally developed by Kingdon (1984) to explain policy change under conditions of ambiguity. According to Feldman (1989), ambiguity is "a state of having many ways of thinking about the same circumstances or phenomena". Ambiguity leads to unclear problem and goal definitions (Zahariadis, 2007). For this reason, how policymakers frame policy issues is crucial for understanding different policy responses (Herweg et al., 2017). For example,

treating sustainability as an economic or political issue will result in different outcomes.

MS is based on Cohen, March and Olsen's (1972) garbage can model, suggesting that decision making is a chaotic and not fully rational process, that occurs in messy environments and for unstructured problems (Herweg et al., 2015; Jones et al., 2016). This results in policymakers operating under significant time constraints; having problematic preferences, and under unclear jurisdictions, limited accountability, or fluid political participation (Herweg et al., 2017; Jones et al., 2016). In such circumstances, policymakers are highly vulnerable to political manipulation from entrepreneurs (Zahariadis, 2007).

The MS framework acknowledges three independent streams: problems (*problem stream*), solutions (*policy stream*), and choice (*political stream)*. Policy change occurs when these streams come together in windows of opportunity (*policy windows*). Windows open by policy entrepreneurs. These entrepreneurs can be representatives of think-tanks, NGOs, and industries, businessmen, policy makers themselves, or lobbyists.

Originally, the MS framework dealt with policy decisions during agenda-setting, which is considered the first stage in the policy process. However, Herweg, Huß, and Zohlnhöfer (2015) and Howlett (2017) adapted the framework for use in later policy stages. For our research, we study the windows of opportunity in the first three stages, namely agenda-setting, decision-making, and implementation.

Agenda-setting is the recognition of a policy problem, with the selection of potential solutions (Wegrich & Jann, 2006). During agenda-setting, policy windows emerge when "*attention lurches to a policy problem* […] *a solution to the problem is available* […] [and] *policymakers have the motive and opportunity to turn a solution into policy*" (Cairney & Jones, 2016, p. 40, italics in original). It is the stage when entrepreneurs attempt to champion their preferred alternatives and bring them to the agenda. Decision-making refers to the stage when issues raised during agenda-setting become government programs and legislation is proposed, ultimately leading to policy formulation (Knill & Tosun, 2012). In this stage, entrepreneurs bargain more in detail the policy and build majorities for its support (Herweg et al., 2015, 2017). Finally, implementation refers to the execution of a policy. In this phase, entrepreneurs translate the details into particular policy instruments for carrying out the policy and determine policy outcomes (Howlett et

al., 2017). While going through the various stages, the entrepreneurs' scope for alternatives narrows as problems become less ambiguous and policy more structured. For this reason, entrepreneurial activity mostly occurs during early policy phases, where there is more room for action and framing. The concept of entrepreneurs stresses how these actors, due to their interests and position in policymaking circles, are minimally accountable to the general public, which raises questions about their accountability and the transparency of the policy making process. Figure 1 is an overview of the MS framework. We discuss each of its elements: the three streams, policy windows, and policy entrepreneurship

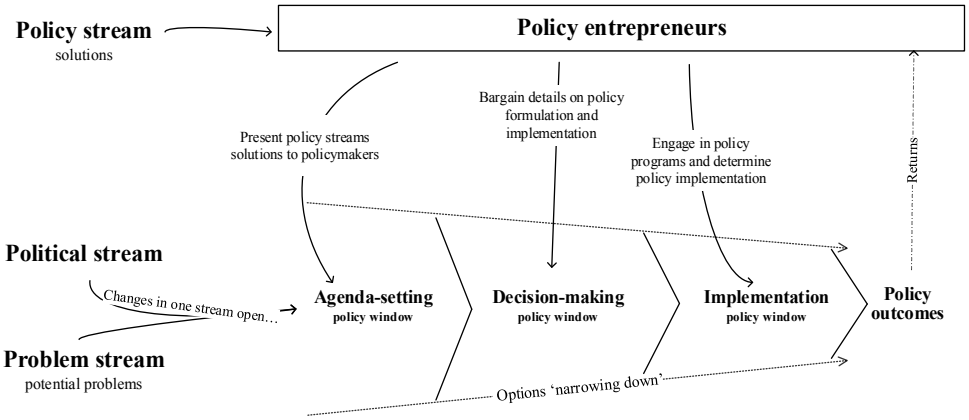

FIGURE 3-1: A VERSION OF THE MULTIPLE STREAMS FRAMEWORK (BY AUTHORS)

- *Problem stream.* This stream covers the socially relevant issues requiring policymakers' attention. Due to policymakers' limited time and resources, only a few issues make it to the top of the policy agenda at any time (Cairney & Jones, 2016). Issues high on the agenda which policymakers are willing to solve are considered policy problems (Knaggard, 2015). In the MS framework, three elements direct policymakers' attention to these problems: *indicators* (measurements, e.g. CO2 emissions per year), *focusing events* (triggering public response, e.g. accidents), and *feedback* (previous knowledge facilitating measures for a given problem such as similar policies in the past) (Herweg et al., 2017).

- *Policy stream.* The policy stream entails the ideas and solutions developed by expert communities like technocrats, engineers, think tanks, etc., and that is still to be implemented (Nowlin, 2011). Whether a policy solution is adopted depends on how fashionable it is in policy communities (Jones et al., 2016).

Solutions likely to be adopted are considered *easy to implement,* have *positive value acceptability* (aligned with policymakers values, beliefs and ideologies), have *major public support*, and are *financially viable* (Herweg et al., 2017).

- *Political stream.* The political stream refers to the broader institutional and political context where policy decisions are made. Under MS, includes factors such as the *national mood,* broader societal opinion regarding values, issue and solutions to policy problems; *party ideology*, the government's dominant political orientation that affects institutions; and the *balance of interests,* the aggregate positions of actors interested in a problem (Howlett et al., 2017; Jones et al., 2016).

- *Policy window*. This is a window of opportunity where the three streams come together. It is created when changes occur in the political stream (in the legislature, balance of interests, or elections), or in the problem stream (major instances of worsening indicators (Herweg et al., 2017)). Windows usually have a short time span (Zahariadis, 2007). Thus, policymakers need to make decisions "against the clock", particularly if a problem seems to be getting worse.

- Finally, *policy entrepreneurs* are actors who invest resources in policy, expecting future returns (Herweg et al., 2017), such as organizations, interest groups, companies, and academics (Herweg et al., 2017). Their role in policy is to couple problems and solutions, convince policymakers to adopt their solutions, and guarantee their implementation (Mintrom & Norman, 2009; Zahariadis, 2007). To do so, they 'politically manipulate' policymakers: they use facts to modify policymakers' views, control policy meeting access, align problems and solutions, and frame problems accordingly (Ackrill et al., 2013). Their success depends on whether they have access to decision-making events, political strategies, and resources (Jones et al., 2016), and their ideological affinity to policymakers (Zahariadis, 2007).

The understanding of MS of how entrepreneurs define directions of policy change can be useful to study the concept of directions of change in transformative innovation policies. Studying direction-setting by MS require to follow entrepreneurs and map their strategies.

3.4. Methodology and case study

To ascertain *how* and *by whom* directions are determined in innovation policy, we carried out a qualitative study using the MS framework. We opted for a single in-depth case study, common in innovation and transition studies. It allows researchers to unfold complex causation in particular geographical and institutional contexts (Köhler et al., 2019). This approach is also used for theory building, to refute preconceived taken-for-granted views that should be revised (Flyvbjerg, 2006).

We selected the automated driving initiative in the Netherlands, part of a 'smart mobility' agenda aiming to implement IT-based innovations in the mobility system and ultimately achieve a socio-technical transition (de Mooij, 2013). This agenda resembles a transformative change approach because of its strong focus on the potential of smart mobility innovations to address three societal challenges: accessibility, quality of life, and safety (I&W, 2013a).[8] Studies have argued that this agenda have a transformative potential (Manders et al., 2018; Salas Gironés & Vrščaj, 2018), and that the Dutch smart mobility policy is an example of a policy with a transformative orientation (Salas Gironés, van Est, and Verbong, 2019).

Automated driving is an interesting subject of inquiry for our research as several studies have placed it as an innovation with a transformative potential (Schreurs & Steuwer, 2015; Wanzenböck et al., 2019). However, its contribution to societal challenges remains inconclusive. It can favor populations with limited mobility today (Fagnant & Kockelman, 2015); offer cleaner freight transport (I&W, 2015a); reduce car ownership (Docherty et al., 2017), and decrease human-related accidents (Fagnant & Kockelman, 2015). However, automated driving may also reinforce the negative features of the current mobility system, such as inequity and exclusion (Docherty et al., 2017), natural resources depletion (Milakis et al., 2017), urban sprawl (Tillema et al., 2015), and reinforce the digital divide (Docherty, 2018). Consequently, research on governance of automated driving has been centered on how to capture its public value and provide a normative direction to its development (T. Cohen & Cavoli, 2018; Docherty, 2018; Milakis et al., 2017).

We gathered the data for our case study through desk research and interviews. Documents gathered consisted of primary documents from the

[8] I&W stands for the Ministry of Infrastructure and Water Management (Ministerie van Infrastructuur en Waterstaat), formerly the Ministry of Infrastructure and Environment (I&M, 2010-2017).

initiative (such as policy briefs and communication between parliament and government), secondary sources aimed at the general public (brochures, public reports, promotional material, etc.), news articles, and consultancy reports. Documents gave us a chronological view of the activities and decisions for this initiative since the establishment of the smart mobility agenda. As the documents did not capture all policy participants' motives and views, we proceeded with in-depth interviews. Following MS scholarship, we interviewed policy entrepreneurs and decision-makers (Mintrom & Norman, 2009). We found these entrepreneurs through (1) recommendations from public officials, and (2) via organizations working with automated vehicles. In total, we interviewed nine entrepreneurs and seven policymakers/public officials. Interviews took place between the years 2017 and 2018. These interviews were semi-structured, with four sections: Their view (and their company) on AVs, their role and cooperation with other players in the AVs initiative, their interaction and participation of activities with policy actors, and in the last section they had the opportunity to reflect upon their participation throughout the AVs initiative.

For our data analysis, we took a 'directed qualitative content analysis' approach (Hsieh & Shannon, 2005). It is a deductive approach whereby the coding process takes into account pre-defined categories, primarily drawn from theory (Assarroudi et al., 2018) to test the validity of a framework (Elo & Kyngäs, 2008). In our case, the predefined categories were the three streams proposed by MS (problems, political, and policy streams). We identified elements of these streams in our empirical data, to place them in each policy window as shown in figure 3-1. Thus, by a coding exercise, we mapped the activities and decisions in the self-driving car initiative and link them with the MS framework.

3.5. Findings

This section views the AVs initiative's activities through the lens of the MS framework over a nine-year period (2010-2019). First, we identified that the agenda-setting window occurred from 2010 to 2013. Social, environmental, and economic issues reached the top of the agenda, coupled by entrepreneurs with a technology-driven approach already developed in the policy stream ('smart mobility'). This coupling was possible thanks to entrepreneurs' and policymakers' strong political and ideological affinity. Afterward, a decision-making phase occurred between 2013 and mid-2014. The AVs initiatives were incorporated into the agenda, and favorable legislation established to support their development.

The implementation window ran from 2014/15 till October 2017, when entrepreneurs' gains materialized. We conclude this section with the most recent developments, that, as explained below, have greatly diminished policy circles' interest in AVs, unexpectedly disrupting the implementation stage. Table 3-1 shows a general overview of our findings for each of the three policy stages as well as 'recent developments' affecting the logical course of action for AVs initiatives, which are explained in the next subsections.

Phase	**Problem stream**	**Political stream**	**Policy stream**	**Policy entrepreneurs**	**Outcome and Impact on policy direction**
Agenda-setting (2010-2012)	Potential accessibility and reachability problems in the Netherlands. Increased congestion, primarily in urban areas.	The emergence of a pro-business, pro-innovation cabinet. Changes in innovation policy (top sectors). Interest in reducing I&W Ministry's work and financial load in mobility.	Technologies in the fields of IT, electronics, and high-tech system materials labeled under 'smart mobility' ready for testing.	Coupled problems with solutions from policy streams. Reduced the scope for potential technologies by mapping those that could gain support as smart mobility. Translated societal issues into mobility problems that technology could solve.	A smart mobility agenda was established to solve societal issues through technological deployment. Proposed solutions were aligned with policymakers' interests in promoting innovation, which led to economic growth.
Decision-making phase (2012-2015)	Similar to the agenda-setting stage, but new elements emerged such as the risk of lagging behind in vehicle automation technologies, based on developments, particularly in the U.S.	No significant changes.	Automation technologies proved technically feasible, particularly in other countries' experiments. The Netherlands seemed to have a strong research position in most technologies enabling vehicle automation.	Entrepreneurs used international developments as a focus for prioritizing autonomous driving within the smart mobility agenda. They mobilized indicators and a sense of urgency. They also framed the support for AVs in terms of economic benefits.	AVs incorporated as the ministry's top priority, led to I&W Minister's political commitment to make the Netherlands a frontrunner. Many institutions were established, all with some form of entrepreneurs' input. Five knowledge domains created to gain public support.

Phase	Problem stream	Political stream	Policy stream	Policy entrepreneurs	Outcome and Impact on policy direction
Policy implementation (2015-2018)	No significant changes.	No major changes. I&W Ministry announces political commitment to make the Netherlands a frontrunner, followed by legislation changes.	Developments changing at a fast pace influence short-term application of AVs.	Entrepreneurs participated actively in experiments and decision-making events. Here we see the first gains from this policy, including entrepreneurs' capacity to influence policy under state sponsorship, proofs-of-concept, testing, and potential partnerships.	Knowledge gained in the experimentation phase and roundtables guaranteed entrepreneurs could shape indirectly the direction of AVs. The government aimed to set European & international standards. AVs deployment was thus tailored to entrepreneurs' input.
Recent developments (2018+)	After 8 years of promises, the smart mobility agenda did not seem to be solving problems. Similar issues as in agenda-setting phase re-emerged, but without smart mobility as a solution.	Major disruption due to elections and new cabinet. New priorities were set, promoting less technology-driven solutions. Less affinity between entrepreneurs and policymakers.	AVs never 'took off', causing a reorientation of the solutions. Shift from experimentation to more integration of existing technology, dismissing multiple projects on the smart mobility agenda.	Entrepreneurs were not able to maintain support (compared to 2012-2018) for automated driving in the Netherlands. AVs, albeit still of interest to the I&W Ministry, play a less central role in the smart mobility transition.	The inability to show actual results for AVs caused a switch in priorities (and thus direction) in innovation policy towards new priority areas. Support for AVs shifted from experiments to real applications.

TABLE 3-1: FINDINGS OVER FOUR STAGES OF SMART MOBILITY POLICY

3.5.1. Agenda-setting (2010-2013): Smart mobility high on the policy agenda

The origin of the Dutch smart mobility agenda dates back to 2010 and 2011, at a time when several issues were emerging from the *political* and *problem* streams in the mobility system. From the political stream, a pro-liberal, business-friendly minority right-wing cabinet 'Rutte I' was formed in October 2010 and ended in November 2012. This cabinet aimed to overcome the effects of the 2008-2009 recession, by placing innovation as central for economic growth and productivity. This was part of the Dutch Ministry of Economic Affairs' objective to position the Netherlands as one of the 'top 5' knowledge economies by 2020 (Tweede Kamer der Staten-Generaal, 2011) through a high-tech industrial approach, labeled Top Sector Policy, supporting nine priority science, technology, and innovation areas that accounted for 80% of business R&D (EZ, 2013; OECD, 2014a). These sectors included Logistics and High-Tech Systems & Materials (HTSM), which were expected to play a central role in developing a smart mobility agenda.

Cabinet Rutte I also reorganized government institutions and created the Ministry of Infrastructure & Environment (I&W), by merging the former ministries of Transport & Water Management, and of Housing, Spatial Planning, & Environment (*Besluit opheffing ministeries van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer en van Verkeer en Waterstaat en instelling ministerie van Infrastructuur en Milieu*, 2010). This merging brought new issues to the top of the problem stream. First, reducing public expenditure in infrastructure was considered a top priority for mobility policy. A general guideline for this reduction was to achieve it without compromising the safety and traffic conditions of the road network (interview 1). Together with this problem that policymakers were facing, environmental and societal issues were high on the agenda. Mobility forecasts suggested that the Netherlands would be facing increasing congestion, particularly due to a 10 to 25 percent increase in car use between 2011 and 2020, primarily in urban areas and international freight corridors (I&W, 2011a). Individual mobility was expected to rise by 20 to 50 percent between 2009 and 2040, having a direct impact on the environment (I&W, 2012; KNMI, 2009).

In contrast, the policy stream seemed to develop some preferred alternatives for organizing mobility. First, programs with an increased market involvement in deploying mobility innovations were proven successful modes of collaboration between public and private parties. The best example of this

approach was the program 'Better Utilization' ('*Beter Benutten', BB*), that fostered collaboration for behavioral change between public and private actors (I&W, 2011b). This program would have a strong influence in the way in which policymakers placed their work in relation to private parties' activities. The BB experience suggested that private parties had the expertise to unfold innovations improving the mobility system. For this reason, market parties were expected to participate more in mobility innovation, and made the public sector more open to ideas coming from market parties.

The promises of public and private cooperation, together with a strong pro-innovation environment, created suitable conditions to push forward a concept a technologically driven approach. By 2012, at least three organizations can be mapped in which policy-makers together with entrepreneurs were studying the potential of smart mobility: AutomotiveNL, Connekt, the Dutch Integrated Test-site for Cooperative Mobility (DITCM). Automotive NL worked as the cluster organization for the Dutch automotive industry, mobility sector and automotive education. In contrast, Connekt is a triple-helix collaboration platform for smart, sustainable, and social mobility. Finally, DITCM was a purpose-built platform for the development, testing, and validation of cooperative driving technologies.

These organizations worked as venues in which policy entrepreneurs managed to couple the politics, problem, and policy streams. These entrepreneurs incorporated their interests by championing smart mobility as a technological approach, and sell it in policy circles as potentially transformative. This can be seen in the document 'Towards a Smart Mobility Roadmap' (immediate predecessor of the smart mobility agenda), presenting different types of technologically feasible services that could be "rolled-out" to achieve societal and policy goals (AutomotiveNL et al., 2012). This document linked a technology-driven service with a societally relevant mobility issue (e.g. incident warning), as well as reported projects that were related to this service. It also evaluate these projects from an environmental, efficiency, and safety perspective. In total, 16 services and 47 enabling technologies were identified. As a follow-up exercise, the smart mobility agenda, under the name 'Better Informed on the Road' *('Beter geïnformeerd op weg'*, BGOW) action program was announced (I&W, 2013a). In summary, this document brought the problems and potential solutions together, framed smart mobility in terms of a transition, and outlined routes to follow. Smart mobility was presented as a potentially beneficial sector building on the strengths of the Dutch

Top Sectors logistics, ICT, and high-tech systems. The programme and follow-up documents also outlined the minimum requirements that smart mobility required. These requirements included new experimental governance approaches, strategies for financing smart mobility experiments, the development of transition pathways, and the need of demand-driven approaches for rolling out new mobility services (Beter Benutten, 2016; Connecting Mobility, 2016a; de Mooij, 2013; I&W, 2013a). Four themes for further policy development were identified, including network mobility management, logistics, urban multimodal transport, and automotive & in-car technologies (I&W, 2013b). By late 2013, each theme had at least one pilot project, as the I&W Minister explained, "based on the results from these projects, we will determine the possible policy choices and next steps" (I&W, 2013b).

BGOW marked the end of the agenda-setting phase. The directions for the smart mobility agenda were set in two ways. Firstly, selecting a technology-driven mobility approach that was linked to the Dutch top-sectors to solve the social, environmental, and economic issues heading up the agenda. Secondly, by positioning the societal challenges of quality of life, reachability and safety as core ideas supporting policy interventions in smart mobility. In this way, an innovation such as AVs could be potentially championed in the decision-making phase.

3.5.2. Decision-making (2013-2014): Incorporating AVs on the smart mobility agenda

The original version of the BGOW program did not select any technologies *ex-ante* (e.g. automated vehicles) but outlined the changes expected for a smart mobility transition that could contribute to the three societal goals (de Mooij, 2013). By early 2013, policymakers and entrepreneurs thought that automated driving was not a 'mature enough' innovation to receive public support (interviews 1, 14 & 24). For this reason, although AVs were not explicitly considered in the agenda-setting phase (interviews 1 & 2), their enabling technologies, particularly for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication (see Hobert et al., 2015), were part of BGOW. We see the attention given to enabling technologies in programs such as 'Practical Trial Amsterdam (PPA)' to integrate vehicle and infrastructure communication (Praktijkproef Amsterdam, 2018), or 'Spookfiles' to reduce 'ghost' or shockwave traffic jams by providing speed advice (van Koningsbruggen & Kerstjens, 2014).

These projects, which can be seen as cumulative steps towards an explicit recognition of automated driving in the Netherlands, were developed in a time in which AVs were rapidly becoming a central technology in the smart mobility field in the world. Several interviewees (interviews 1, 2, & 20) pointed out to developments of Google and Tesla as turning points for incorporating automated driving in BGOW (interviews 1 & 22). Interviewees shared an optimistic view regarding the potential short-term deployment of some type of AVs on public roads. Google reported that its autonomous cars had driven 300,000 miles by 2012 without an accident (Lardinois, 2012). Apparently, by 2014, its AVs were able to handle thousands of urban situations (Associated Press, 2014). Tesla announced a commercial application of its autopilot system by October 2014, allowing auto-steering, automatic lane change, and traffic-aware cruise control (Tesla, 2014). These events evoked a public policy response: Several U.S. states adopted favorable legislation for AVs deployment and experiments on public roads. The first AVs licenses were granted in the state of Nevada, coming into effect on March 2012 ("Google Gets First Self-Driven Car License in Nevada," 2012). Other states followed (sixteen by 2015) according to the U.S. National Conference of State Legislatures (NCSL, 2019). These international developments were seen in the Netherlands as problematic, as the possibility of lagging behind in this technology increased. An interviewee indicated the public sector concerns about the low penetration rates of automation functions in the cars in the Netherlands, such as adaptive cruise control (interview 14). Another interviewee suggested that this low advancement in vehicle automation was the result of governmental inaction, suggesting a strong mobilization of skills and knowledge available in the country (interview 10).

The Netherlands, despite having no 'big player' in the mobility field (e.g. car manufacturers as in Japan or Germany), has several tier 1 suppliers for original equipment manufacturers (OEM). For this reason, the sense of urgency was well received in policy circles. There seemed to be a wide support from Dutch automotive players and policymakers (Tweede Kamer der Staten-Generaal, 2012). However, at that time no particular direction for AVs development was established: The general view was that vehicle automation could be used from a wide range of applications, from public transport to private vehicles.

The legitimization of AVs in the Netherlands we developed in two ways: within and beyond I&W. Within I&W, entrepreneurs mobilized arguments to convince policymakers about the adoption of AVs in the smart mobility agenda.

These arguments were developed both at a societal and economic level. Beyond I&W, the ministry required to legitimize the adoption of AVs as a central feature of its activities. In this respect, communication to the parliament and to the public 'sold' vehicle automation as a potential solution for almost any problem in the Dutch mobility system. Thus, for instance, I&W mobilized facts and expectations to gain parliament and public support. Thus, automated driving was presented as an innovation that could reduce human-related accidents, which accounted for 90% of the total vehicle accidents in the Netherlands (I&W, 2014b). AVs were also sold as solutions to improve traffic conditions with minimal environmental impact, enabling mobility access to underserved groups (e.g. older people), and giving public transport more space (Taskforce Dutch Roads, 2016). These arguments resonate with interviewees' views. These interviewees suggested that automation would also reduce greenhouse emissions (interviewee 10 & 2). Along with these promises was their significant economic impact: Knowledge of AVs could lift them to the status of 'export product' for the Dutch economy (de Mooij, 2013; Smart Mobility Embassy, 2018).

At this stage, entrepreneurs were the key actors in decision-making, ultimately defining the directions of policy change. They provided direct input for developing AVs. As part of the BGOW program, a steering group was established with entrepreneurs from industry, government, business, and knowledge institutes helping "to define a strategic course of action" (de Mooij, 2013, p. 3). Policymakers were receptive to what entrepreneurs had to say about AVs development, on account of their technical expertise and knowledge (interviews 8 & 18).

This approach involving private parties in decision-making ran parallel with setting up institutions that gave private parties a voice in choosing what direction to follow. By early 2013, the Dutch Automated Vehicle Initiative (DAVI) was launched to foster automated driving developments in the Netherlands (Hoogendoorn et al., 2013). It became the organization responsible for researching and demonstrating automated driving, focusing on human factors and safety (Connekt, 2016a). The DITCM facility gained momentum, aiming to garner more public and private support for accelerating automated vehicle implementation (AutomotiveNL, 2018). The Innovation Central ('Innovatie Centrale') was established to bring actors together for developing innovations, including automated driving (Innovatiecentrale, 2016). The collaboration network Connekt enabled governments, consultancy firms, universities, and industry to propose

solutions for automated driving. Finally, the organization Connecting Mobility was established to execute and monitor the smart mobility transition under the terms established in BGOW (Connecting Mobility, 2016a; Rijkswaterstaat, 2014).

These institutions were 'spaces' where policy entrepreneurs and policymakers could work together on vehicle automation. Their main function was diffusion and adoption, rather than just technological development. For this reason, their activities focused on issues such as future legislation, human behavior, business partnerships, standardization and so forth. This focus enabled them to envisage AVs vehicles' potential contribution to the sharing economy or their impact on traffic and infrastructure management (interview 19). Other topics discussed included AVs integration in existing technologies such as mobile devices (interview 20) and establishing communication protocols (interview 14). At that time, an autonomous Dutch organization for mobility research (KiM) was working on potential scenarios to introduce AVs in society (Tillema et al., 2015). This allowed entrepreneurs to envision automobile design and its role in society, linking it to the I&W Ministry's future policy actions.

The enthusiasm for self-driving vehicles reached policy circles and parliament. In June 2014, the I&W Minister presented parliament with a letter suggesting that AVs developments would impact the mobility system in the following two decades and that her aim was to position the Netherlands as a frontrunner in this field (I&W, 2014b). To this end, the Minister announced large-scale testing for automated vehicles' potential contribution to traffic, safety, and livability (I&W, 2014b). As a follow-up, the Minister announced the first changes required in legislation by January 2015 (I&W, 2015c). Factors beyond legislation were also considered, particularly by establishing in April 2015 a Knowledge Agenda ('*Kennisagenda*'). In this agenda, societal stakeholders identified knowledge areas for focus to enable automated driving. As a result, five research domains (legal, technical, impact, human factors, and deployment) became core areas of policy implementation. By December 2015, vehicle automation was officially incorporated in the BGOW program (I&W, 2015f).

We consider the I&W Ministry's communications to parliament in 2014 and 2015, as well as the announcement of the Knowledge Agenda, as the start of the implementation phase. The decision-making phase had led to incorporating AVs in the BGOW agenda, defining themes for implementation, and determining an

approach later framed as '*learning-by-doing*' (large-scale testing) (I&W, 2016b). During this phase, entrepreneurs 'shaped' directions by providing input for policy actions (participating in steering groups, experiments, and workshops). These directions, as we show in the following section, had a profound impact on the Dutch authorities' approach to AVs.

3.5.3. Policy implementation (2015-2018): Experiments & deliberation spaces for AVs

In early 2015, soon after the Minister announced an action agenda for experimentation in the Netherlands, the AVs initiative's implementation phase got off to a flying start. In less than a year, AVs transformed from an experimental technology lacking public support, to a flagship project on the smart mobility agenda. Most of the transport authorities were involved in this initiative, including the road agency (Rijkswaterstaat), the Dutch Vehicle Authority (RDW), the Dutch Institute for Transport Policy (KiM), and several directorates of the I&W Ministry, as well as regional and local transport authorities, such as in the city of Amsterdam. We see two major trends in the implementation phase. Initially, there was a strong focus on experiments and tests to show the feasibility and potential applications of vehicle automation. Then spaces were created for deliberation between policymakers and entrepreneurs to plan national and international actions for vehicle automation. These trends were supported by the I&W minister's political (sometimes referred to as 'personal') commitment to automated driving (interviews 4 & 5).

There were two different types of experiments. Some required amendments to existing legislation due to legal limitations (ANWB, 2015, p. 5). Accordingly, the Ministry proposed legal exemptions for market parties to experiment, on request to I&W ('*testaanvragen*'). By January 2015, at least five AVs deployment projects had been requested (I&W, 2015c): two on vehicle automation for trucks, or platooning (Scania & TLN; DAF, TLN & the Rotterdam port operator); two for public transit (Wageningen University, TNO, TU Delft & Gelderland province; and TU Delft); and one for private vehicles (DAVI). Similar projects followed, such as in Lelystad in October 2015 for adaptive cruise control (Prins et al., 2015). Exemption rules for testing automated driving on public roads came into force in July 2015 (I&W, 2015b). The other types of experiments were projects to enable innovations for AVs, but not directly related to automation, including

Praktrijkproef Amsterdam and Talking Traffic, facilitating real-time travel information in cars (Talking Traffic, 2019).

These experiments resonated with the I&W Ministry's two strategic focus areas. First, a *learning-by-doing* approach to overcoming the uncertainties related to implementing new technologies (I&W, 2016b). Learning-by-doing also involves executing and facilitating projects for their outcomes in terms of methods, results, and impacts (City of Amsterdam, 2016, p. 22). This approach and experiments were also necessitated by the rapid developments in automotive innovation (interview 21 & 23). Secondly, the Ministry was keen to facilitate experiments, using public infrastructure as an asset to encourage international players to test smart mobility innovations in the Netherlands.

The entrepreneurs hoped that these experiments would open up new markets to accelerate vehicle automation (interview 14). Experiments in platooning aimed to show to industrial and business actors the feasibility of this technology and its application in the short term for the logistics sector (Janssen et al., 2015). A relevant aspect of these experiments is policymakers and entrepreneurs' acknowledgment that the major barriers for AVs deployment were not technical, but operational. The Dutch Organization for Applied Scientific Research (TNO) suggested that the main challenge with platooning was getting this innovation adopted in the field of logistics, rather than its technological development (I&W, 2015a, p. 40). Similarly, an interviewee indicated that drivers barely even use some of the car applications at their disposal (e.g. cruise control, interview 23). Other interviewees shared this view, stating that several AVs technologies have been tested and applied in other domains and that their adoption in the mobility system was the main focus of public intervention (interview 24). Entrepreneurs benefited from these experiments by presenting proofs-of-concept and business models for potential commercial partnerships in automation to industrial players. Without experiments, such collaboration would have been impossible (interview 14). Other policy entrepreneurs had less defined expectations of participating in this stage. They engaged in implementation activities to develop or adapt their business strategies based on policymakers' expectations and needs. Aiming to adapt their technologies based on AVs developments, they wanted to learn about the impact of sharing in-car data on traffic management and travel information (interview 19 & 20).

Alongside these experiments, other activities fostered knowledge development in limiting automated driving. DITCM played a major role, taking as starting point the five domains of the Knowledge Agenda, then organized roundtables for industrial partners and researchers to provide "answers for the steps to be taken" in automotive developments (DITCM, 2015). They were set up to exchange information and enable discussion among experts in each domain; in general, these experts were industrial, business representatives, public officials, and policymakers. The roundtables provided input for future policy, as their agreements and recommendations were linked to future government actions, e.g. for standardization (DITCM, 2016). Moreover, they examined advancements in legislation and the standardization of automated driving (interview 25).

Thus, the knowledge acquired from the experiments, together with the roundtables, contributed to policy developments in automated driving. In this way, entrepreneurs were able to shape indirectly the course of policy actions for AVs deployment. DITCM decisions linked national decision-making processes at the EU level, to position 'Dutch profiles' ahead of other alternatives for AVs (interview 26; DITCM, 2015; Holland, 2016). These profiles aimed to "influence the [set of] international standards that will eventually be adopted for cooperative driving" (DITCM, 2015, p. 7). Similarly, the European 'Truck Platooning Challenge' (2016a) was set to demonstrate the feasibility of vehicle automation in different countries, and to harmonize policies and technical issues. The road agency (RWS) and Dutch Vehicle Authority (RDW) were leading actors in this challenge, establishing the guidelines and technical parameters (I&W, 2015a). The input for this project, nevertheless, came from experiments and decision-making arenas with industrial and business partners.

Yet at this stage, the acknowledgment of AVs' contribution to societal challenges seemed to be fading. At the time of the interviews, most entrepreneurs argued that AVs could solve mobility challenges, by enabling Mobility-as-a-service schemes or car-sharing (interview 14) and reduce maintenance costs for public mobility services. However, we identified that entrepreneurs are more interested in societal challenges as a legitimizer to support AVs under the smart mobility agenda. One interviewee indicated that achieving societal goals is beyond their scope, and left that to policymakers (interview 22). This view is in sharp contrast with the original aim to incorporate automated vehicles in the BGOW agenda, making AVs the main rationale for public intervention. Interviews also signaled the

'inherent' societal benefits of autonomous driving, such as being safer or cleaner than human-driven cars. In most policy documents, we find limited progress in the arguments supporting AVs development. Their contribution to reducing CO2 emissions and human-related accidents feature repeatedly, without new insights or lines of argument (I&W, 2015f, 2017; RLI, 2016).

3.5.4. Recent developments (2017-2019): Fading focus on automated driving

The implementation of autonomous driving seemed to gain 'momentum' in 2017, going by the intensification of events and experiments throughout the Netherlands. However, this momentum began to fade for various reasons. The political stream that had helped to support smart mobility in 2010, changed significantly. The general elections held in October 2017 led to the formation of a new cabinet (Rutte III). It restructured the I&W Ministry and appointed a new minister. This change represented an important shift as the institutional landscape drifted and new priorities were established. One year after the elections, the new Minister redefined the priorities for smart mobility in the Netherlands. She announced a shift from experimentation and trials to the integration of existing smart mobility technologies in practice (I&W, 2018). This ended the interest in experimentation characterizing the implementation phase. Recent I&W reports confirm the limited focus on AVs; in contrast, the priority is multimodal, greener, and fairer transport modes (I&W, 2019a).

The BGOW agenda seemed to come to an end, as despite some changes proposed for 2016, there has been no updated version by 2019. The program Connecting Mobility, responsible for executing the BGOW agenda until 2023 (I&W, 2016d), stopped in 2018. That year, DITCM's program, which was running from 2015 to 2019, also stopped. By 2019, there is no flagship project in platooning, and smart mobility innovations are no longer monitored (Connecting Mobility, 2016b). Some websites are out-of-date or not even available anymore. Experiments such as the self-driving bus in Ede-Wageningen stopped due to technical and operational challenges, safety concerns, and low transit speeds (NOS, 2019; van Dinther, 2019; van Olst, 2019). AVs remain on the I&W Ministry's policy agenda, albeit not with the same momentum as before. Current policy actions are limited to legal and operational frameworks to allow the short-term introduction of automated driving on open roads (Duursma, 2019; I&W, 2019b; Schenk, 2019).

3.6. Discussion

This paper adds to the ongoing debate on how directions in transformative change policies are set. To do so, we examined institutional entrepreneurs as key actors influencing this direction, using the Dutch automated driving initiative as a case study. We studied, using the Multiple Streams (MS) framework, policy developments between 2010 and 2019 in three policy stages, from agenda-setting to policy implementation. This research had three guiding questions, namely: What role did policy entrepreneurs play in adopting AVs in the Dutch smart mobility agenda, how did policy entrepreneurs facilitate their adoption, and what returns did they get from it? These questions structure this section. We also would like to reflect on lessons learned, to avoid committing similar mistakes to the ones we identified in this case study.

Our research highlights that policy entrepreneurs played a central role in the adoption of AVs in the smart mobility agenda in the Netherlands. Following MS, they mobilized resources to make automated driving a top priority for I&W, and demonstrated the technical feasibility of this innovation. We observed that the primary roles of policy entrepreneurs were to champion AVs as a transformative technology. This was done by coupling AVs with potential societal and economic benefits, bringing their expertise and demands to decision-making arenas, and by proposing measures to accelerate AVs implementation.

Strategies used by entrepreneurs were appropriately 'timed' throughout the policy process, and we observed how entrepreneurs narrowed down multiple alternatives during the first years. In a brief period (2010-2014), entrepreneurs increasingly directed smart mobility towards autonomous driving. At the agenda-setting phase (2012), they exploited the opportunities of new innovations by linking them to the problem and politics streams. In other words, they were pushing forward a set of solutions, all technologically driven, that could provide an answer to the challenges that the I&W ministry was facing back then. An interesting insight can be drawn from the policy formulation phase, in which entrepreneurs demanded not a particular course of action, but the political and institutional support of the ministry in the future. In this way, we believe, that entrepreneurs had the possibility to shape AVs agenda without concrete commitments about their implementation. We see that the promises of their transformative potential were kept at a general level, without any explicit transformative contribution.

This research also suggests how the entrepreneurs' views on AVs were included in the agenda by an appropriate timing, framing, and coupling. We believe that this was only possible thanks to the strong political and ideological affinity between entrepreneurs and policymakers. As one interviewee suggested, the prioritization of private vehicles was only possible with a right-wing liberal party (interviewee 5). However, this affinity was also the main reason for their removal by 2017, as political priorities changed because of a new ruling coalition.

Our final guiding question is about what returns did these entrepreneurs receive from the AVs initiative. Entrepreneurs overall benefited from access to learning by doing approach, that allowed them to put in practice the concept of automation with the support of public institutions. This would not have been possible without positioning AVs as part of this transformative agenda. We should remember that, despite the entrepreneurs' interests in developing AVs in the Netherlands, there was not such an interest of a company of automated vehicles. In contrast, entrepreneurs represented interested parties facilitating in one way or another vehicle automation (e.g. electronic equipment or software). For this reason, we believe, entrepreneurs had an interest in shaping AVs' development as long as it was aligned with their interests. It should not be surprising to the reader that by today, as the interest on AVs has been largely diminished in the Netherlands, some of these entrepreneurs have shifted towards more receptive venues to push their preferred solution in policy circles. Moreover, entrepreneurs' decisions still influence the policy today, as the knowledge produced during the implementation phase has been pushed forward by the Dutch government at a European level. In this way, they largely set the playing field of vehicle automation at a European level in Dutch terms, mobilizing expertise and knowledge produced in the Netherlands to an international level.

These findings leave us with a realistic but disappointing view of the transformative potential of AVs. First, we consider that the stronger economic and business focus rather than societal is, to a large extent, self-evident when stakeholders representing business interests participate in the policy processes. They were particularly interested in demonstration projects and trials, as well as in multiple organizations and events to influence decision-making. However, they showed limited interest in the societal benefits of this technology. We believe, however, that a central inquiry for future research is how, within the public sector, capacities can be built to guarantee that innovations such as AVs can deliver their

expected public value. This could be done by fostering projects that have a stronger societal value, or by promoting automation in public transit systems.

A central question is whether we can keep the directions that were originally set in early policy phases. Our findings indicate that a direction should not only be set but safeguarded as policy unfolds. A direction can be easily changed by defining the details of a policy, e.g. the instruments, decision-making mechanisms, or implementing agencies. A potential way to overcome this challenge is by being more specific about the expected goals of transformative innovation. Even though we recognize the value of open-ended transformative innovation, this case study suggests that without specific goals (e.g. in terms of technologies used, actors involved, societal benefits) the policy can easily be captured by interests and result in disappointing outcomes such as in our case study. Unless new instruments are developed, transformative change may face the risk of becoming an 'old wine in a new bottle', without any tangible contribution to the societal challenges that it is framing its adoption in policy circles. Moreover, our research reopens the critical issue of how to pick winners within transformative innovation initiatives (Mazzucato & Semieniuk, 2017; Steward, 2012). In this research, private parties picked the winning technology and presented it to policymakers. However, market parties were unsuccessful in maintaining long-term policy directions, resulting in limited policy outputs. Finally, our research also highlights the lack of societal engagement in this policy. We found that societal challenges that were selected based on I&W's legal responsibilities, and that stakeholder engagement was mostly limited to stakeholders from the industry. The under-representation of societal interests may also be a factor in the limited success of this policy.

3.7. Conclusions

We address the research question of how and by whom directions in transformative change are set, using the AVs initiative within the smart mobility initiative as the case study. Employing an adapted version of the well-established Multiple Streams (MS) policy framework, we study how policy entrepreneurs shaped a smart mobility agenda to incorporate automated driving. Our findings indicate that policy entrepreneurs skillfully narrow the agenda to foster AVs, framing the benefits of this innovation a potentially transformative. We found that these entrepreneurs were able to shape policy right from the early stages, championing autonomous driving as an alternative, and translating demands and actions into policy programs supported by Dutch authorities. During the

implementation phase, entrepreneurs benefited from preferential treatment by policymakers and participated in decisions that, even though the implementation phase ended in 2017, still affect policy developments at a European level.

This case study continues the recent efforts in innovation policy studies to unravel the policymaking process of transformative innovation, which remains highly 'black-boxed' in academic literature. Our study deviates from previous research that intends to provide a normative view on innovation governance. This paper shows that, even though normative approaches should still be considered for understanding transformative innovation governance, policymaking is prone to conflict and contestation, and easily captured by entrepreneurs expecting future returns. Despite the societal potential of AVs, the actual effect of this innovation remains negligible in the Dutch mobility system. Ultimately, the initiative changed the direction of policy change, from a societally relevant one to one that mostly prioritized the economic benefits for entrepreneurs. There was a mismatch between the framing of technology and the logic of policy implementation. The policy implementation responded to the economic benefits, but not to the transformative framing brought by entrepreneurs to the agenda.

Our research presents potential areas for further research and limitations. Regarding further research, we propose to inquiry about new mechanisms for guaranteeing the alignment between societal goals and innovations beyond the agenda-setting phase. We also believe that similar case studies can be produced to systematize adequate approaches that can contribute to better policy approaches for transformative innovation. Stronger attention should be given to assessments and evaluation of the contribution of technologies to transformative goals. Our chapter also points out to the need of understanding direction-setting not as an input, but rather as an unfolding process that is constantly shaped by players in policy venues. Regarding the limitations, it is difficult to assess the long-term impact of the direction taken for AVs, as it may take several years to determine the actual implementation outcomes. The routes chosen for this policy may not necessarily define vehicle automation developments in the coming years

4. Policy coordination for the implementation of AVs in the Netherlands.

Abstract

In recent years, multiple countries have embraced ambitious agendas to foster the development and implementation of automated vehicles (AVs). Governing AVs is a challenging endeavor, as vehicle automation is an emerging technology surrounded by multiple uncertainties, institutional voids, and without (yet) clear guidelines on design and implementation. Moreover, most studies on AVs governance have primarily taken a quantitative approach in which aspects such as ideas, institutions, or forms of governance are neglected. Taking this gap as a starting point, this research aims to study the governance of AVs through the lenses of a policy studies framework, to identify factors enabling or hindering AVs implementation using a case study.

This chapter investigates the Dutch AVs initiative that was implemented in 2013, to shine a light on how these initiatives can occur. We have selected the Netherlands as it is a frontrunner in this technological field, and it followed an experimental approach for governing AVs, by favoring novel governance arrangements. To perform our analysis, we investigate the case study through the policy regimes perspective, that places ideas, institutional arrangements, and interests as central features for governing complex issues such as AVs. This research found that a powerful framing of AVs as an imminent and breakthrough innovation, the strong political commitment of a national ministry, and a rich institutional set-up contribute to the success of AVs implementation. However, the regime felt short with expectations and interests of participants which, combined with political national changes, ultimately lead to the dismissal of AVs as a top priority in the Dutch national mobility agenda. By studying the AVs regime of the Netherlands, this chapter provides interesting and valuable insights on the benefits and shortcomings of AVs implementation agendas.

Keywords: Automated driving, self-driving cars, policy regimes, mobility governance, emerging technologies.

4.1. Introduction

Automated vehicles (AVs) are developing at a fast pace. While in the early 2000s AVs were mostly confined to controlled environments (e.g. DARPA's grand challenge), today it is possible to acquire commercial versions with automation levels between 2 ("hands-off") and 3 ("eyes-off") (Davis, 2018; Korosec, 2019). Several automotive players are experimenting on automation level 4 ("mind-off") for its potential commercialization in the near future. Reports suggest that we may witness large-scale diffusion of AVs in the following years (Catapult Transport Systems, 2015; KPMG, 2019). By 2030, we may see the first fully autonomous vehicles (level 5) (McKinsey, 2017), and by 2040 50 percent of vehicle purchases and 40 percent of travel may correspond to automated models (Littman, 2017).

The optimism towards AVs deployment has led to governmental strategies intended to accelerate their implementation in countries such as the Netherlands, Singapore, and the U.S. (KPMG, 2019). These strategies have been set up because AVs is expected to have a great impact on the organization of contemporary mobility (Fagnant & Kockelman, 2015), their potential economic benefits for countries leading this emerging technology (KPMG, 2019), and due to their unforeseeable societal consequences (T. Cohen et al., 2018; Stilgoe, 2018).

Implementing AVs strategies is a complex issue. This is so as vehicle automation is a technology 'on-the-making', for which standards, algorithms, and protocols are not yet defined (see Stilgoe, 2018); and its less 'technical' aspects remain unanswered, e.g. insurance and liability. These challenges have no clear straightforward solution at sight. Moreover, AVs development occurs in an institutional void, spanning institutional arenas of decision making, and pose organizational challenges. For this reason, AVs require an institutional set-up allowing collaboration between a broad set of interested parties. AVs have resulted in the rise of players unknown (till recent years) in mobility policy, such as IT or high-tech companies. Other actors are redefining their role in the mobility system, e.g. consultants (see Arthur D. Little, 2018) and navigation technology companies. Despite this complexity, limited research has explored ways to organize AVs implementation (T. Cohen et al., 2018; T. Cohen & Cavoli, 2018; Docherty et al., 2017; Milakis et al., 2017).

This chapter takes this research gap as a starting point, and shines a light on how AVs strategies could be implemented. For doing so, we look into the

governing arrangements that have been set up for this purpose in the Netherlands. The Netherlands is a suitable case study for our aim as it is a frontrunner in AVs implementation (KPMG, 2018, 2019). This has occurred because of an ambitious agenda to foster smart mobility technologies by the Dutch Ministry of Infrastructure and Water Management (de Mooij, 2013; I&W, 2015d). Because of its top priority, the Netherlands set up, from 2013 onwards, a wide range of institutions aiming to accelerate their implementation, bringing together actors together from multiple policy domains, such as public transport and urban planning (see Connekt, 2016b; I&W, 2016b; Smart Mobility Embassy, 2018), and generated attention of sectors such as insurance, and traffic management. The case study consists of a wide range of experiments on vehicle automation, including platooning (I&W, 2015a), autonomous public transportation (Zelfrijdendvervoer, 2019), and personal-use vehicles (Prins et al., 2015).

In order to study the implementation of AVs in the Netherlands, we mobilize the policy studies' Policy Regimes' perspective (Jochim & May 2010). This perspective indicates that, under policy fragmentation, unclear answers to policy issues, and many actors, adequate governance will depend on the ideas, institutional arrangements, and interests that foster collective action (a 'regime'). The closer the affinities in these dimensions, the more likely its policy success (May & Jochim, 2013).

By a qualitative research study, consisting of policy documents analysis, we aim to answer the research question of to what extent can the governance of AVs in the Netherlands be conceptualized as a policy regime, and what can we learn for future AVs implementation? This chapter is organized as follows. The next section (4.2) presents the theoretical background, including an overview of the policy regimes perspective (4.2.1). We proceed with methods in section 4.3. Section 4.4 presents the governance of AVs in the Netherlands as a policy regime. In section 4.5, we perform an evaluation of the regime. We finalize with a conclusions section (4.6).

4.2. Theoretical Background

In recent years, there has been a 'hype' surrounding AVs. They have received enormous attention from media outlets and consultancy firms, by today the first commercial automated models can be acquired on the market, and there is a strong belief that their large-scale diffusion is possible in the near future. This 'hype'

resulted in governmental attention to AVs implementation. They are part of the research agendas of transport authorities and innovation agencies around the world. The Dutch Touring Club identified in 2015 more than fifteen countries in which AVs experiments were occurring with some level of governmental involvement (ANWB, 2015).

The literature on AVs suggests that three main rationales are driving governmental strategies worldwide. First, AVs promises high economic benefits, generating strong incentives for supporting their development. They are expected to improve competitiveness and investment (T. Cohen et al., 2018) and contribute to more than seven trillion dollars to the global economy by mid-century (Marshall, 2017). Second, AVs require legislative, institutional, user behavior, and organizational changes to 'hit the roads'. Governmental authorities require a reorganization of the mobility system. This is why AV's diffusion has been framed in terms of a 'socio-technical transition' (Docherty et al., 2017; Fagnant & Kockelman, 2015; Marletto, 2019; see also Geels, 2012). A transition is a reconfiguration of the multiple dimensions that currently sustain the current automobility system, to enable a widespread diffusion of self-driving cars in society (see Geels, 2012). Think, for instance, in the legal adjustments (regarding the Vienna Convention on Road Traffic), licensing procedures, and users' mobility patterns and habit, that AVs demands.

The final rationale for policy intervention refers to the uncertainties and deep impact that AVs are expected to have in the mobility system. AVs will likely have a radical impact in terms of car usage and ownership, urban planning, urban space, etc. (T. Cohen et al., 2018; Docherty et al., 2017). In short, AVs may redefine the concept of mobility and as we know it today (Fagnant & Kockelman, 2015). They will also have a considerable socio-economic impact in terms of actors and institutions (T. Cohen & Cavoli, 2018; Rotolo et al., 2015, p. 1828). However, it is unclear what directions will AVs take in the future. Scenarios suggest that AVs' outcomes may range from societally desirable futures, enabling the sharing economy and reducing road fatalities, to potential dystopias, in which car ownership is reinforced and accessibility reduced (Die Verkehrsunternehmen, 2015; Tillema et al., 2015). For these reasons, governmental action in the field of vehicle automation has been set in place to capture AVs' 'public value' (Docherty et al., 2017).

For AVs implementation, governments do not have a 'blueprint' to follow. This is so as AVs are an 'emerging technology' (T. Cohen & Cavoli, 2018) requiring to learn 'on the making'. Stilgoe (2018, p. 26) proposed that AVs governance is a process of social learning, by which "society and its institutions make sense of novelty" as technology unfolds. This also occurs due to an institutional void: required decision-making does not match the traditional decision-making arenas (Hajer, 2003; Stilgoe, 2018). Limiting decision making to a policy subsystem (e.g. national transport (generally in charge of the primary road network), the local public transport or regional urban planning) would not work. In contrast, AVs require institutional arrangements beyond subsystem, considering the multiplicity of actors, challenges, and issues that AVs should entail. This institutional may lead to incoherent policy portfolios and institutional fragmentation, ultimately resulting in policy failure (Jones & Jenkins-Smith, 2009; Pump, 2011).

To overcome these challenges, it has been argued that AVs governance should take a regime perspective (Jochim & May, 2010). By a regime, it has been referred to the three dimensions that allow the governance of boundary spanning problems: ideas, institutional arrangements, and interests. If aligned, they allow overcoming the barriers of AVs governance. The policy regime perspective has been used in complex policy problems such as healthcare (May, 2015), climate adaptation (Henstra, 2017), homeland security (May et al., 2011) and sustainability (Bednarek et al., 2018).

4.2.1. The policy regime perspective

A regime can be conceptualized as a construct in which governance processes occur without an enforcing agent. Therefore, the goodwill and the perceived potential benefits for participating actors are central for collaboration (B. J. Cohen, 2008). A main assumption is that under such a complex environment, each group of actors mobilizes its own actors, institutional dynamics and decision-making mechanisms, safeguards its own interests, and frames a policy issues in its own views (Jochim & May, 2010; May & Jochim, 2013; Pump, 2011; Tosun & Lang, 2017).

This perspective suggests that a regime is composed of three dimensions: ideas, institutional arrangements, and interests. *Ideas* are the 'glue' that brings together multiple subsystems to work on a common policy issue (Pump, 2011). They also work as organizing principles for policy implementation (May, 2015), provide directions for governance (Henstra, 2017), and allow a common framing

for a policy problem (Mayer et al., 2016). For these reasons, ideas influence and affect policy actors' behavior (Erikson, 2015). Ideas on AVs implementation may include 'accident reduction', 'improved quality of life', or 'AVs' economic potential'. *Institutional arrangements* refer to the structures needed to put these ideas into action and for the achievement of policy goals (May, 2015). In other words, these arrangements are the institutional set-up of a policy (Peters, 2011), or 'arenas' of decision making. Examples of institutional arrangements include agencies, networks, platforms, and other organizations that allow cooperation, but also informal mechanisms of cooperation (Henstra, 2017). Finally, *interests* are the positions that actors have regarding a policy issue. Interests can be supportive, neutral, or against a policy issue (Jochim & May, 2010). The literature on policy regimes states that interests should be aligned (or, at least, compatible) in a policy regime for its success.

The framework proposes that the closer the alignment between ideas, interests, and arrangements, the stronger a regime. The literature differentiates between strong and weak regimes. In the ideal type of strong regime, the three dimensions are perfectly aligned, while in a weak regime these dimensions work as disintegrating forces. A general overview of the two ideal types of regimes is shown in table 4-1.

	Strong regimes	**Weak regimes**
Ideas	Ideas are clear for policy actors. Policy actors from multiple subsystems have shared views on the policy goals. Actors are convinced about the ideas that support a regime. Shares ideas generate a sense of shared 'mission' for policy participants.	Ideas are ambiguous and open for interpretation to actors. These ideas are conflicting and incompatible. Ideas are not shared by all actors and may seem incompatible with the policy goals.
Institutional arrangements	Strong regimes are characterized by a strong 'org-ware'. Linkages and channels between policy participants are clear. Institutional structures work towards the policy goal and cooperation between participants is enhanced. Cooperation prevails over competition.	Arrangements do not foster collaboration; they make actions of policy participants difficult to coordinate. Institutional mechanisms are unclear to participants. Institutional arrangements are limitedly used and seen as a burden. Strong incentives are generated for self-interest.
Interests	All relevant interest parties are involved in the regime. Relevant stakeholders' interests are aligned with the goals. A 'positive feedback' loop reinforcing the path development of policy.	Not all relevant voices are incorporated in the policy regime. Some interests are barely represented in policy implementation. For this reason, opposition outweighs support.

TABLE 4-1: DISTINCTION BETWEEN STRONG AND WEAK REGIMES

The Policy Regimes perspective indicates that strong regimes contribute to successful policy implementation, and weak regimes tend to policy failure. 'Success' or 'failure' is evaluated based on three criteria: Legitimacy, coherence, and durability. *Legitimacy* refers to the acceptance of the approach for addressing an issue. It is about what is considered appropriate, adequate, and just (May & Jochim, 2013; Tyler, 2006). There are three sorts of legitimacy: input (e.g. user engagement, citizen participation), output (e.g. results), and throughput legitimacy (e.g. quality of governance) (Schmidt, 2013). *Coherence* is the consistency of actions regarding a policy issue (May, 2015). Coherent regimes minimize contradictory policy actions, reduces conflict, and generates synergies between participants (Nilsson et al., 2012). Finally, *durability* indicates the maintenance of political commitments over time (May & Jochim, 2013). A durable policy regime indicates the goals, priorities, and interests are stable over long time periods, with limited changes. Table 4-2 summarizes the main characteristics of the two ideal policy regime types based on their legitimacy, coherence, and durability.

	Strong regimes	**Weak regimes**
Legitimacy	The policy approach is accepted and generates support outweighing opposition.	The policy approach is contested, alternatives are formulated, and goals are questioned.
Coherence	The regime's actions are consistent and generating synergies. Actors collaborate and cooperate in a coordinated way. Conflicts are minimized.	Regime governance is inconsistent and has loose ends. Policy interventions are fragmented. Regime participants work in different ways and follow different paths.
Durability	The regime gets support for its long-term implementation. The defined goals and political views are stable over time.	Regime priorities are shifting constantly over time. Its implementation time span also changes. Priorities shift as time go by.

TABLE 4-2: LEGITIMACY, COHERENCE, AND DURABILITY OF POLICY REGIMES

4.3. Methodological approach

To study how AVs governance through the regime's perspective, we one in-depth qualitative case study. These types of studies allow elucidating the conditions that ultimately led to the success and failure of particular approaches, giving rich and detailed information regarding a research inquiry (Creswell & Creswell, 2017).

We selected the AVs policy in the Netherlands (hereinafter 'AVs regime') as it is a suitable inquiry for our research for several reasons. First, the country is considered a frontrunner in AVs implementation (KPMG, 2019). The regime is part of a broad smart mobility agenda, initiated by the I&W ministry back in 2013 (de Mooij, 2013), aiming to achieve a transition in the mobility sector. This regime is

adequate for our aim as it has been characterized by novel governance approaches, a rich and novel institutional set-up (Connecting Mobility, 2016a; Connekt, 2016b; Innovatiecentrale, 2016), based on experimentation.

Component	Strong regimes
Ideas	What ideas were developed for the AVs regime? What is the ultimate policy goal of AVs implementation in the Netherlands? How are ideas related to the goals of the regime? How are ideas framing AVs implementation? How these ideas mobilize actors?
Institutional arrangements	What institutional arrangements have been set in place to foster implementation? What type of arrangements have been developed (e.g. formal or informal)? How does the organization of the regime look like? How are the arrangements of this regime connected to each other? What type of complementarities can be identified among arrangements?
Interests	What actors and interests are (not) participating in the regime? How are these interests represented in the regime? What actors support (and not) the implementation of AVs regime? How are interests organized for AVs implementation?
Legitimacy	How is the policy regime legitimized? What type of actions allow the regime to legitimize? What factors contribute or undermine the legitimacy of this regime?
Coherence	Are actions taken in this regime coherent? Is policy implementation fragmented? Are the ideas, institutional arrangements, interests contributing to or clashing with AVs' goals? Is the AVs' implementation coherent with participants' ideas and interests?
Durability	What is the expected time of AVs implementation? Is the timespan of the regime in accordance to the policy goals? Have interests, ideas, and institutional arrangements shifted over time? If so, how?

TABLE 4-3: ANALYTICAL GUIDING QUESTIONS FOR STUDYING THE AV'S REGIME.

We collected the AVs regime data from primary documents, consisting of publicly available information from the I&W ministry, the parliament, as well as the implementing agencies for AVs. Additionally, we obtained information by the Dutch Autonomous Vehicle Initiative's (DAVI) 'Knowledge Agenda' database, containing more than 300 documents that policymakers deemed as important for improving their knowledge of AVs deployment and implementation. The DAVI's database consists of documentation ranging from meeting presentations, grey literature (e.g. from consultancy and advocacy firms), international and national governmental reports, and non-peer reviewed related academic outputs (e.g. Ph.D. or master thesis). Even though some of these documents satisfy no rigorous scientific standards (e.g. green papers or unfinished versions of research), we believe that

they capture relevant views on AVs implementation, as they were intended to broaden the knowledge on AVs (Kennisagenda Automatisch Rijden, 2018). For the data analysis, we followed the research strategy of May & Jochim (2013), who developed analytical questions for each of the dimensions of the regime, which we complemented for the evaluation criteria for a policy regime (legitimacy, coherence, and durability). The documents were coded for analysis. Table 4-3 presents the analytical questions per dimension, used to guide or analysis and structure of the findings section.

We proceed with the findings. First, we briefly explain the emergence of the AVs regime. We continue with studying the three dimensions of the regime (ideas, institutional arrangements, and interests) and the three evaluation criteria as suggested by the policy regime perspective (legitimacy, coherence, durability).

4.4. The Dutch AVs regime

To study the AVs regime in the Netherlands we need to trace it back to its origins. It was originally developed under the Dutch 'smart mobility' agenda, which was set up by the Dutch Ministry of Infrastructure and Water Management (I&W) in 2013 (I&W, 2013b). Overall, this agenda aimed to foster a transition in the mobility system by intensive use of information technologies in the mobility sector (de Mooij, 2013). AVs were not originally considered in this agenda but were incorporated as part of it during 2014-2015, due to fast developments of automated driving throughout the world. Various unanswered questions of a socio-technical nature stimulated the government to become involved in AVs implementation. In particular, it was unclear what the future role of public authorities in AVs diffusion should be (I&W, 2015a, 2015d) and how do public authorities could accelerate their implementation.

The complexity and the socio-technical nature of AVs implementation seemed to require a policy approach beyond the jurisdiction of I&W. Drawing from previous policy initiatives (Beter Benutten, 2015; I&W, 2011b), policy circles seemed to acknowledge that a regime-based approach would be suitable for AVs. A regime would allow multiple subsystems and jurisdictions to come together to implement AVs. Consequently, a policy regime emerged, encompassing the following subsystems. First, a subsystem related to road and traffic management at a national level, including players such as Rijkswaterstaat (RWS), several directorates of the I&W, and suppliers of services and goods for management and

infrastructure of the primary network. The second subsystem consists of secondary road network, public transport, and urban planning actors. The third subsystem is composed of industrial actors, who work in the automotive sector, in which also consultancy firms and insurers are part of. The last subsystem includes local and regional authorities.

Actors came together in a 'kick-off' meeting that set the implementation agenda for AVs and resulted in a Knowledge Agenda. A heterogenous set of actors participated in this meeting -that defined the development of AVs by prioritizing areas of public intervention-, including representatives of the I&W Ministry, consultants (Capgemini, Goudappel), network platforms (Connekt, Connecting Mobility), advisory institutions (Rathenau Instituut), Rijkswaterstaat, insurance companies (AON, Aegon), provincial authorities (Gelderland, North Brabant, North-Holland), municipalities (Amsterdam), vehicle manufacturers (Scania), among others (Alkim & Veenis, 2015).

Component	The AVs policy regime
Ideas	'Economic and societal potential of AVs', 'The Netherlands as a frontrunner in the knowledge economy', 'contribution to the mobility system' 'a transition-oriented approach'.
Institutional arrangements	The collaboration was fostered by a transition narrative, learning by doing approach, networked organizations, the strong role of I&W as a political leader, case-by-case studies, informal institutional channels.
Interests	The interest of the ministry on her personal capacity to foster AVs development, a wide set of interests, ranging from economic to societal interests. Economic interests, however, dominate AVs implementation.

TABLE 4-4: THE AVS POLICY REGIME

This meeting initiated the regime-like type of approach in the Netherlands. In the following subsections, we zoom into the three dimensions of the regime. A general overview of the regime characteristics can be seen in table 4-4.

4.4.1. Ideas

The policy regimes literature positions ideas as a 'glue' allowing different policy subsystems to collaborate. In our case study, one overarching idea allowed the regime to develop: The idea that the Netherlands should become a frontrunner in vehicle automation. This work as a sort of a narrative, in country AVs were framed as a type of 'mission' of wide impact, that promised benefits to the Netherlands (I&W, 2015d; also de Mooij, 2013). This 'mission' was enacted by the I&W ministry, which presented the transition towards AVs as an inevitable

phenomenon, leaving the Netherlands with the options either to 'lead' or 'lag' their implementation (de Mooij, 2013; I&W, 2013a; NU.nl, 2014). This idea gave limited room for contestation and disagreement for the regime. In contrast, it generated strong attention and invited stakeholders to 'jump on board' and cooperate for their implementation. In one way or another, stakeholders were expected to benefit from AVs (I&W, 2015d; Wilmink et al., 2014).

The mission on AVs implementation was supported primarily by two main ideas. First, the need for 'catching up' with international competitors. Strong attention was given to developments in the United States, the United Kingdom, and Japan. Catching up would allow the Netherlands to develop their ideas 'at home' and was intended to become a blueprint for further developments. The second idea was AV's societal relevance. As suggested, by the I&M minister, Schultz van Haegen, vehicle automation "will change the relationship between the driver and the vehicle in the next twenty years more than what occurred in a century" (NU.nl, 2014, own translation). These words, coming from the head of the Ministry herself, show the expected relevance of AVs implementation. AVs were expected to offer benefits to the mobility system (e.g. in terms of urban accessibility and security in the transport sector (TNO, 2018; TNO & Royal Haskonning DHV, 2016)) as well as to other changes in the mobility system (e.g. the rise of service- or sharing-based business models (Bakker, 2018)). In just a few months, vehicle automation became a mobility 'panacea', to tackle almost any problem of the current system, such as transport poverty in cities or last-mile connectivity (Platform 31, 2017; Taskforce Dutch Roads, 2016). Database documents portray a rather over-optimistic view of AVs from a societal perspective. This optimism resonates with the 'hype' that, at that time (2014) mobility consultants created for AVs, placing them as central elements of a mobility revolution (e.g. 'mobility 4.0') (Arthur D. Little, 2018). AVs were compared to exponentially rapidly diffused and breakthrough innovations, such as smartphones (Deloitte, 2017).

The mission towards AVs implementation has one major aspect that required to be operationalized: AVs diffusion required to answer the "known unknowns" of these vehicles, that were identified as hindering AVs implementation and their commercial feasibility with no clear answers yet. These known unknowns refer to legal conditions, technical factors, impact, human factors, and deployment (Alkim & Veenis, 2015).

4.4.2. Institutional arrangements

These five known unknown areas that were developed in the regime structured the institutional arrangements of the regime. Because of their unknown nature, I&W intended to solve them by a comprehensive stakeholder engagement approach. The solutions to these areas were not expected to come from the ministry itself, but rather from deliberation and consultation with experts of AVs (de Mooij, 2013; Noordegraaf et al., 2016).

Even though cooperation among different players was set in place, a central feature of the institutional arrangements was a strong political commitment and a leading figure of I&W. I&W intended to work as a catalyzer or facilitator for AVs deployment. It became almost a personal 'top priority' for the minister herself. This type of commitment can also be seen at the local level. For instance, a manifesto on AVs was declared to encourage the development of expertise in AVs in the province of Gelderland (KpVV CROW, 2016).

Even though the I&W commitment fueled AVs developments in the country, the regime was not characterized by a command-and-control type of governance. The position of I&W therein fit into what Sørensen & Torfing's (2009, p. 246) refer to as network meta-governance: "subtle and indirect forms" to stimulate the achievement of goals defined by the meta-governor (in this case, I&W). I&W had a limited role in defining the content of the decisions in the regime, but rather it stimulated arenas for cooperation (e.g. platforms, test-sites, etc.), such as networking platforms and events, pilot projects, consultation platforms, roundtables, and so forth. These activities would not have emerged without public support, redefining the type of activities that state authorities should engage with. In these activities, I&W had a limited as a facilitator and as a guarantor of public values in vehicle automation development.

Under the I&W leadership, the regime was characterized by favoring experimentation in the five known unknown areas (legal conditions, technical factors, impact, human factors, and deployment). Experiments worked as 'arenas' in which multiple subsystems working towards AVs implementation were brought together in protected environments. For instance, experiments on automated trucks ('platooning'), allowed vehicle manufacturers, retailers, and logistics companies to work on technical feasibility and business models for automated trucks ('platooning') (I&W, 2015a). Experimentation was so important

for the regime that part of the branding of the country on AVs was as a 'test-land' for vehicle automation development (RLI, 2018). Examples of these experiments include the Cooperative-ITS corridor, the Amsterdam Practical Trial (PPA), Brabant-In-Car (three stages, I to III), and the Ghost Traffic Jams (Spookfiles) (Wilmink et al., 2014).

The arrangements set in place were organized as followed. Beyond the political commitment of I&W, cluster organizations permitted actors to cooperate for addressing the technical and operational challenges of AVs (AutomotiveNL, 2016). The Dutch Automated Vehicle Initiative (DAVI) was a public-private cooperation platform for stimulating AVs' research, improvements, evaluations, and demonstrations (Provincie Gelderland, 2015). In addition, a dedicated network for cooperative driving was established (DITCM), with the main purpose of providing advice and generate consultation among stakeholders on the five known unknowns areas. DITCM provided a potential answer to the implications of AVs in society, e.g. by analyzing the possibilities and limitations of collecting AVs data considering EU's privacy and data regulations (Otto & van Haaften, 2015). Finally, the Innovation Central, in which actors with technical background cooperated for solving operational challenges of AVs in the Automotive Campus of Helmond, worked as a facility for AVs test and developments (Innovatiecentrale, 2016). All these arrangements have an aspect in common: They were set to enhance informal mechanisms of collaboration between interested parties, e.g. roundtables, meetings, brainstorm sessions, etc.

Institutional collaboration, in these arrangements, answered *how* to implement AVs, as well as *what type* of implementation was desirable for stakeholders. The former required stronger expertise that the latter (e.g. for setting standards, etc.). The *how* questions were addressed by institutional arrangements limitedly open to stakeholders, or by commissioning of the I&W ministry to the responsible authority. For instance, I&W commissioned the Road Transport Authority to develop a framework for AVs operation on public roads (RDW, 2017). In contrast, the latter invited for a more open approach of stakeholder consultation, in which participants brainstormed about the AVs' functionality and role in society. It does not have straightforward answers but is prone to diverse framings and perspectives from participants. This type of consultations occurred in the region of Ede-Wageningen, where an autonomous public transport pod was intended to connect the two cities. The local

government invited societal stakeholders to rethink how users may benefit from this pod, e.g. by making this vehicle a 'hospitality car' that is not a replacement of traditional public transport, but a vehicle that allows passengers to know about the region during its usage (RCT de Vallei, 2015).

4.4.3. Interests

Depending on their background, actors showed different interests in the AVs regime and supported the regime in different ways. While road and traffic management actors supported the regime for their potential implications to the main road networks, public transport companies and urban planning saw in AVs the possibility of improving transport services at a local level. In this respect, these actors aimed to align AVs developments with political and societal priorities, such as a responsible introduction of AVs. Industrial players participated in the AVs regime to make the Netherlands gain a competitive advantage over other countries in this emerging innovation. These industrial players, some of them are enablers of high levels of automation, had a prominent role in defining priorities of the regime (see Zwijnenberg, 2018). These priorities included the development of technical knowledge, addressing commercial implementation issues (e.g. business models). Other actors, such as local governments, participated to know the implications of AVs deployment in their respective areas of interest. Institutional actors primarily represented interests. This resulted in an over-representation of actors such as businesses and industrial partners, at the expense of societal actors, that were inadequately represented. This led to limited civil society engagement, except for the Dutch Touring Club (ANWB).

The strong I&W commitment on AVs worked as a 'two-edged' sword: While it allowed bringing actors that were keen on vehicle automation, it also generated a window of opportunity for players to position themselves in the AVs regime. Regarding the former, the intensive consultation with stakeholders on implementation issues had a positive effect on the creation and maintenance of support for the regime. Stakeholders had the chance to 'raise their voice' and provide input to the regime. Consultations on a regular basis with stakeholders occurred primarily through two organizations: the triple-helix platform Connekt (2016b) and the intermediary organization Connecting Mobility (2016a). However, the incentives for cooperation brought the attention of entrepreneurs that saw in this regime a potential mechanism to 'take off' benefiting from the public support to AVs. This has to do with the linkages and assumptions made by the regimes (as

mentioned in the ideas subsection): vehicle automation seemed to enable other changes in the mobility system. We believe that, for this reason, some start-ups saw these linkages as a perfect opportunity to "pitch" their idea in the mobility sector (see Amber, 2018).

Even though this strategy seemed to work in the early stages of the regime, three developments reduced the support of it in the longer term. First, business actors were overrepresented in this regime, particularly in relationships with societal actors. An example can be found in the database, in which a large part of stakeholder consultations business sector involvement is considerably higher in comparison to the involvement of societal actors (cf. Except, 2016). Second, it seems that the regime failed to incorporate critical voices towards AVs. Limited contestation towards the way in which the AVs regime was developed can be found in official policy documents (e.g. parliamentary briefs). Third, the regime felt short in the results of AVs implementation. Without any commercially developed application of AVs by 2019 –five years after the establishment of the AVs regime–, political support started to erode, having a negative impact on the regime strength.

4.5. Evaluation of the policy regime

In this section, we evaluate the policy regime based on three criteria suggested in the literature: Legitimacy, coherence, and durability. A general overview of the characteristics of the AVs regime can be seen in table 4-5. We aimed to integrate the six components of the framework to evaluate the AVs regime. In the following lines, we evaluate the regime in an extensive manner.

4.5.1. Legitimacy

To evaluate this regime's legitimacy, we follow Boon & Edler (2018; see Schmidt, 2013) and distinguish three sources of it: Input legitimacy (by political participation and representation), output legitimacy (in outcomes), and operational intelligence (as the throughput processes, referring to the quality of decision-making and governance).

In terms of input legitimacy, the regime's ability to incorporate multiple actors can be considered as a considerably legitimate approach. This legitimacy is the result of the development of decision-making arenas. The variety of these arenas, including consultation platforms (Connecting Mobility, 2016a; Connekt, 2016b), meetings (Alkim & Veenis, 2015; Connecting Mobility, 2016c), and steering groups (de Mooij, 2013), as well as internet consultations (ANWB, 2016; I&W,

2014c), allowed multiple actors to be heard. However, this approach had a major drawback, namely that it required actors to be organized in collectives to participate (e.g. as companies, intermediary organizations, etc., except for the internet consultations). For this reason, this regime had limited engagement from crucial actors such as user groups or regular citizens.

Components	*Legitimacy*	*Coherence*	*Durability*
Ideas	Strong and powerful at the beginning, but contested at the end (-)	Worked as an integrating force (+), to incorporate multiple actors.	Malleable & shifting (-). AVs' ideas did not keep up with the societal promises.
Institutional arrangements	The institutional set-up allowed multiple actors to be incorporated, leading to policy legitimacy (+)	Institutions worked along-side, but not together, towards the same goal (-)	Networked approaches allowed the regime adaption to new policy realities (+)
Interests	Perceived interests in the hands of a few actors (-)	Most participants shared interests (-/+)	Shift on interests resulted reduced political commitments. (-)
Evaluation	Partially legitimate regime	Partially coherent regime	Non-durable regime

TABLE 4-5: SUMMING UP: THE AVS REGIME IN THE NETHERLANDS

As of output legitimacy, the policy outputs were contested. the Dutch AVs regime confined most of the activities to experimental settings in real-life situations. Till today, there are limited commercial applications of AVs, except for platooning, by which automation in trucks seems to be commercially feasible in the short-term (Janssen, Zwijnenberg, Blankers, & de Kruijff, 2015; KPMG, 2019). Thus, the outcomes of the regime seemed to be rolled out at a slower tempo than originally expected, despite it seems that this tempo is faster than in other countries. A sense of the performance of the Netherlands in AVs can be seen in consultancy reports suggesting the leading position of the country in several rankings (KPMG, 2019; Roland Berger, 2017). For these reasons, we believe that this regime is partially legitimate: It achieved the goal of positioning the country in the lead of AVs implementation, but at a slower pace than expected. The lack of outputs has had negative impacts on its legitimacy.

Regarding operational intelligence, the AVs regime outstands the regular engagement of stakeholders in decision-making. Automotive stakeholders, mobilized as experts, participated throughout the policy through consultation. This involvement allowed the policy to be considered legitimate in the eyes of participants. This involvement, based on expert-based consultation, resulted in

criticisms of the AVs regime. Stakeholder meetings mostly worked as brainstorming sessions. A drawback of this approach is that, based on the documentation available, the decision-making procedures about AVs seemed like a 'black-box' to the public. Together with these developments, the regime lack of accountability, and it was limited to parliamentary procedures or by voluntary communication of the I&W ministry to wider publics (see I&W, 2016b).

The database we used for this case study is an adequate example of this consultation, and in which the reader could find several expert reports from stakeholders in the fields in which they commercially operate. Insurance companies presented views on potential solutions to liability and insurance of AVs (AON, 2015) or by companies suggesting the changes in infrastructure that AVs require (Astrin, 2015).

4.5.2. Coherence

The regime was conceived to enable AVs implementation in general terms, without any technical requirements or automation paradigm in mind. For this reason, every project or idea that had a (even weak) linkage with vehicle automation was supported by the regime. This approach resulted in a paradoxical situation: Every idea with limited connection to AVs could be potentially part of the regime, resulting in a weaker coherence as not all projects that were supported were, in fact, contributing to achieving AVs implementation. This, in other words, made the regime lose its sight and not prioritize actions that could contribute to AVs' development.

In this respect, we believe that the regime could have benefited from more defined goals or a more elaborated strategy. The regime shows that a comprehensive and wide-reaching approach is not only necessary but that a higher consistency between projects should be made. A striking aspect of the regime is that it seems that experiments were not articulated in ways that allowed policy learning. Documents in the Knowledge Agenda database show limited connections between projects, and every trial or project seemed to start from 'scratch'. Experiments were scattered and did not build upon previous experiments. In addition, the networked institutional arrangements operated in parallel, sometimes with overlapping functions. There were limited cooperation and communication between the actors working in these arrangements. The regime would have benefited from less overlapping functions among institutions set in

place, more guidance of the I&W ministry in terms of next steps to be taken, and building up from previous experiments to take further AVs implementation.

4.5.3. Durability

As suggested above, the policy obtained a strong momentum of the policy regime from its start (2013) till 2017/18. The regime stopped after the slow pace of the unfolding of AVs and political changes that resulted in less legitimacy.

From 2013 onwards, AVs implementation benefited from the regime's stability, aligned interests, and strong institutional arrangements. In its early stages, the AVs regime fueled expectations of stakeholders about the potentials of self-driving cars in the near future, and the outcomes of the policy were still impossible to materialize (e.g. commercial applications of AVs). However, this policy weakened dramatically due to political and policy wear, at least for two factors. A first factor can be attributed to the limited outcomes of the regime. By 2018, no commercial application of AVs sponsored under this regime was feasible, generating reduce expectations of AVs regime's participants. In other terms, the lack of results affected the regime's output legitimacy. Drawing from science and technology studies, this may be explained by the 'hype' that promising innovations generating in the Gartner Hype cycle: An early period of 'inflated' expectations was followed by a disappointment period in which the expectations become more realistic. A proxy to evaluate these expectations can be seen in figure 4-1, which shows the trend of searches on self-driving vehicles in a popular search engine. It shows that interests grew between 2013 and 2016, showing a decreasing trend after this date (with the exception of 2018, in which accidents involving AVs brought (negative) media attention (see Lubben, 2018)).

The second factor was exogenous to the regime and refers to the changes in the political landscape of the regime. If the I&W ministry's leadership was the main driver for initiating this regime, it became also its driver for its termination. By 2018, a new I&W minister was appointed. Appointing a new minister resulted in a shift of government priorities and the reorientation of the role of innovation that had immediate impacts on the improvement of safety and accessibility in the Netherlands (I&W, 2018).

The regime was not able to overcome the changes in political commitments and reduced expectations of vehicle automation. Even though the Netherlands remains a player in AVs implementation, as suggested in several local smart

mobility action plans (see Provincie Flevoland, 2017 add other action plans), AVs implementation became more departmentalized. In other words, the boundary-spanning regime was replaced by governing arrangements limited to jurisdictions or policy subsystems. This shift has had a visible effect in the attention given in policy circles to AVs: The institutional arrangements connecting subsystems disappeared (e.g. network platforms), and vehicle automation has a less prominent role in current policy documents.

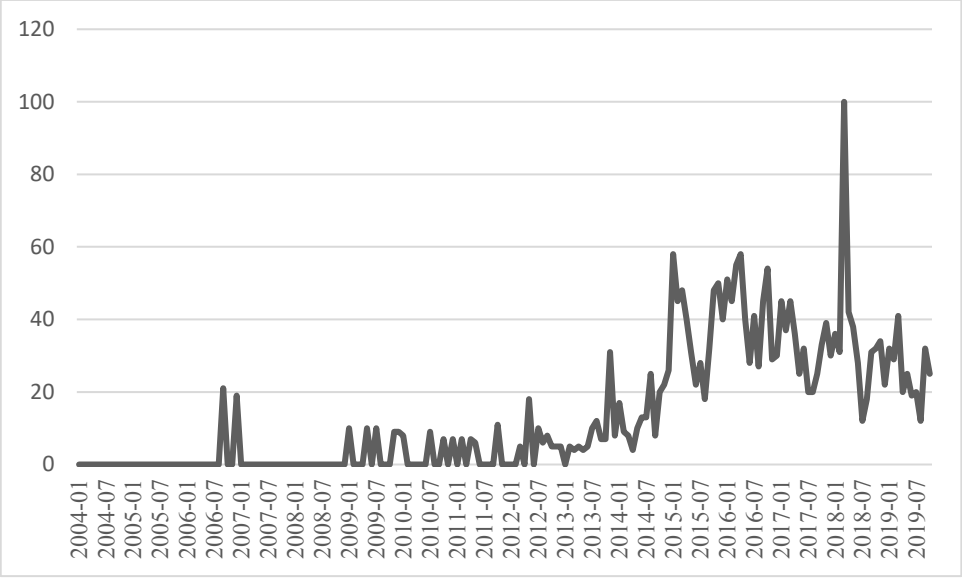

FIGURE 4-1: ATTENTION GIVEN TO AVS IN THE NETHERLANDS (SOURCE: GOOGLE)

4.6. Conclusions

By analyzing the governance of AVs in the Netherlands by using the policy regimes perspective, this research aimed to answer the research question of to what extent AVs governance can be conceptualized as a regime and what can we learn from it for future AVs implementation. We found that the Dutch AVs policy can be conceptualized as a sort of policy regime as framed by Jochim & May (2010). It was set in place in the Netherlands for the governance of AVs. This occurred because of the boundary-spanning nature of AVs: It was impossible to confine adequate governance of vehicle automation to one policy subsystem but instead the collaboration and cooperation among multiple players from different domains were required.

The evaluation of our case suggests that the AVs regime is close to the ideal type of a 'strong regime', in which legitimacy was unquestioned at the beginning and for which a rich institutional set-up was established. A mix of powerful ideas, institutional arrangements allowing cooperation, and aligned interests allowed the emergence of AVs as a top priority. However, it was not durable, and over time its legitimacy and coherence eroded. This was primarily the result of limited outputs and political changes. Our case study also highlights several weaknesses of the regime, including how it broadened up to almost any actor and encompassed any project with limited linkages to vehicle automation. Even though it enabled multiple stakeholders to 'jump on board', this approach undermined it by reducing its coherence.

The analysis that we performed in this chapter can shine a light on how to govern future AVs' implementation. In the next few lines, we would like to discuss some aspects that the regime perspective unraveled about AVs governance, that can be part of future research and some implications for similar AVs initiatives.

First, we found how strong political leadership (by I&W) resulted in short term gains but was not sustainable in the long term. In establishing similar policy arrangements, policymakers should consider that the cycles of technological development do not necessarily correspond to realistic expectations of technological diffusion. Following van Lente (2012), expectations structured activities of business and governments based on the *future* rather than the present potential of AVs. However, not all these potentials are achieved, leading to disappointment. This weakness suggests that public authorities require moderate expectations to avoid 'hype' leading to future disappointment. Secondly, the Dutch AVs regime did not consider the political cycle that was beyond its reach. I&W had a strong position in the governing coalition that ended up in 2018. After that, some responsibilities that it had were transferred to the Ministry of Economic Affairs. These changes were problematic as the regime was based on central figure of I&W. Having this ministry disappearing in 2018, resulted in a reduced interest in AVs, the cease of mechanisms of collaboration, and the dismantlement of several organizations that were used for AVs governance. By now, out of all the organizations we identified through the text, only two are still operational.

Our research also highlights some conditions in which the regime seemed to have worked appropriately. It seems that the input's legitimacy and strategic

intelligence were highly beneficial to the regime's development. Incorporating a broad range of actors as decision-makers offers benefits for maintaining the regime in place. This, however, should also be contrasted with the potential limitations of participation as shown in our case study, in which non-organized interests have a limited say in the regime institutions. Moreover, even though the regime was strongly weakened, the economic goals of the regime were achieved, positioning the Netherlands as a frontrunner player in the field. Despite its leading position, the country has not been able to roll out AVs as originally expected. The contradictory outcomes indicate that the regime worked better for some goals (leadership position in AVs) that others (deployment). This seems paradoxical as the main rationale for setting up the agenda was AVs deployment, which has not (yet) occurred. Despite the dismissal of the regime, AVs still remain part of national and local agendas, but considerably weaker than when the regime was running (I&W, 2019a; Provincie Flevoland, 2017).

Lastly, our case study shows weaknesses of the policy regime perspective that require refinement. First, this framework portrays ideas as generally stable over time. This could work in other domains in which the regime perspective has been applied (e.g. health or defense). However, ideas about technological innovations are different, as they are constantly evolving based on technical progress and the opportunities that it opens. The framework, as well as the policy sciences field, may learn from the sociology of expectations literature, suggesting that ideas are performative -they do something in reality-, aligning actors and generating momentum. Finally, similar case studies should be carried in the near future to evaluate how the regime perspective can be refined to study emerging technologies such as AVs.

5. Demand articulation for the adoption the connected bicycles in the Netherlands[9]

Abstract

We analyzed the unequal treatment of target groups and the role of technology in the Dutch smart mobility policy, by looking into the connected bike projects of Maastricht and Brabant. For doing so we combined insights from the Social Construction of Policy Design frameworks and Science and Technology Studies. We identified four target groups, receiving a differential treatment in policy. This treatment is targeted via incentives to encourage behavioral change for the adoption of the connected bike. In this preferential treatment, technology plays a crucial role. We concluded that car users are the winners while students benefit the least from these projects. This raises pertinent questions about social equity and the contribution to sustainability of smart mobility technologies in the mobility system.

Keywords: smart mobility, connected bike, innovation policy, social construction and policy design, target populations, cycling policy, science and technology studies.

5.1. Introduction

The current mobility system faces several challenges, including sustainability, efficiency, congestion, and safety (Geels, 2012). Thus, sustainability transitions and mobility scholars have promoted a transformation towards a smarter and more sustainable system (Geels et al., 2012). One approach to achieve this transformation is by incorporating smart mobility solutions and behavioral change. In this chapter, we study the 'connected bike': a(n) (e-)bike with tracking technology recording providing feedback on traveler's activity. This technology provides multiple benefits to the mobility system, in terms of congestion and accessibility; and for users, regarding health benefits, reduced travel times, and wellbeing.

[9] This chapter is an adapted version of the book chapter: Salas Gironés, E., & Vrščaj, D. (2018). Who Benefits from Smart Mobility Policies? The Social Construction of Winners and Losers in the Connected Bikes Projects in the Netherlands. In *Governance of the Smart Mobility Transition* (pp. 85–101). Emerald Publishing Limited.

Promoting the adoption of the connected bike heavily relies on the capacity of policymakers to induce behavioral change in target groups. Such selection raises questions about equity and justice relating to these beneficiaries: What target groups are included and excluded by policymakers, and why? How are these groups treated in policy? Is there any preferential treatment among the selected groups? To answer these questions, policy scientists have relied on the Social Construction and Policy Design framework (henceforth SCPD) (Ingram et al., 2007). This framework indicates that preferential treatment of these groups can be explained by their social construction, referring to their social and cultural characterizations based on values, symbols, and images (Pierce et al., 2014).

The SCPD framework has been extensively used in other policy domains but its application in the transport domain remains limited (Ingram et al., 2007). Previous applications of this framework have also neglected the role of technology in providing differential treatment to target groups. We address this by incorporating insights from Science and Technology Studies (thereinafter STS), to understand the role of technology in society (MacKenzie & Wajcman, 1999).

This chapter applies the SCPD and STS methods to analyze the differential treatment of target groups and the role of technology therein. It takes two connected Dutch bike projects from Beter Benutten (BB), a national Dutch program to reduce traffic congestion and travel time by behavioral change: 'Burn Fat not Fuel' (BFNF) project in Maastricht and 'B-Riders' in Brabant. This allows for a comparative case study approach as they are both contextually similar (geographically adjacent and localized in the same authority of the national road authority (Rijkswaterstaat)) but have distinct approaches to behavioral change, decision-making mechanisms, and technological choices.

Our research question is 'what is the role of technology in the differential treatment of target groups in the Beter Benutten connected bike projects in the regions of Maastricht and Brabant?'. To answer this inquiry, we address the following questions: 'which target groups are identified in these regions?', 'what type of preferential treatment occurs in the target groups identified?', and 'what is the role of science and technology therein?'. To answer these questions, we interviewed project stakeholders and a literature review. In this chapter, we expect to unravel the smart mobility technologies policymaking implications, particularly

regarding questions of equity and justice, while simultaneously reflecting on the dilemmas that policymakers may face in the diffusion of these technologies.

The structure of the chapter is: section 5.2 entails the theoretical background for our research. Section 5.3 contains the methods. Section 5.4 introduces the case study, and section 0 contains the findings. This chapter finishes with a conclusion section (5.6).

5.2. Combining SCPD and STS for studying smart mobility target groups

Target groups are "the persons, groups, or firms selected" for behavioral change by public policy initiatives chosen to receive wins and losses (Schneider & Ingram, 1993, p. 334). Putatively, target group treatment should be based on policy expertise. However, in practice, some target groups receive preferential or negative treatment.

To explain this preferential treatment, the SCPD framework looks into how policymakers distribute differentially wins and losses to target groups based on social constructions. By social constructions, we refer to the social and cultural characterizations that policymakers (and society overall) have about social groups, based on attributes, values, symbols and images (Pierce et al., 2014). These can also be seen as the stereotypes attributed to beneficiaries of policies. These characteristics are used as a selection-criterion for specific kinds of treatment or for access to policy-regulated resources.

Following the SCPD, two dimensions influence target groups treatment: their social construction in positive or negative terms, and their level of power (Ingram & Schneider, 2004). Classical positive constructions include 'honest', 'socially committed', 'trustworthy', or 'in need of support', while negative characterizations are 'dishonest', 'inconsiderate', or 'irresponsible'. Positively constructed target groups include elderly, entrepreneurs, and orphans; while negatively constructed groups encompass thieves and terrorists. The second dimension is their level of power, which is reflected in elements such as group size and wealth, as well as their capacity to mobilize and influence public debate (Ingram & Schneider, 2013). While powerful groups may contest unfavorable treatment in policy, powerless groups can limitedly do so. Based on these two

dimensions, SCPD policy scholars have proposed four 'ideal types' of target groups, shown in table 5-1.

We can explore how this social construction results in differential treatment by following the distribution of wins and losses. By wins, we refer to policy measures aiming to benefit or reward a target group, while by losses to measures for punishing or burdening them. We adopt the SCPD theory's (implicit) distinction between materialized and rhetoric wins or losses. Materialized wins and losses are tangible policy measures for target groups, such as fiscal incentives or taxes. These are best understood in contrast to rhetoric wins, which are non-materialized because they are promised but never put into practice or symbolic. According to the SCPD literature, each of the aforementioned 'ideal types' groups receives the differential treatments also set out in table 5-1.

	Positive construction	**Negative construction**
High level of power	Advantaged Wins: Oversubscribed, overfunded, underregulated, materialized, framed as societal wins. Losses: Limited	Contenders Wins: Primarily hidden, e.g. in legal loopholes Losses: Highly visible, but difficult to implement and rhetoric.
Low level of power	Dependents Wins: Highly visible, but more rhetoric than materialized, receive less wins that advantaged. Losses: Hidden	Deviants Wins: Limited or non-existent. Loses: Disproportionate and in large quantity.

TABLE 5-1: FOUR IDEAL TYPES OF TARGET GROUPS ACCORDING TO THE SCPD.

The STS field suggests that we cannot understand our technologically-penetrated society without studying the role of science and technology (Felt et al., 2016). Specifically, STS scholars focus on who benefits from S&T (Oudshoorn & Pinch, 2003), and question the power and politics of it by exploring inclusion in decision-making processes about them, their access to knowledge, and groups which are defined as non-users and thus excluded from the access to technologies. STS scholars' endeavor is typically described as "opening the black box", carefully analyzing the workings key sites of S&T, e.g. R&D departments (Hyysalo et al., 2016). We expect that focusing on science and technology will enable us to better understand the unequal treatment of target groups in smart technologies.

5.3. Methods

In order to answer the research question, we conducted qualitative research by studying the two behavioral change programs. We gathered our data via semi-

structured interviews and primary documents. First, we conducted twelve interviews with decision-makers responsible for implementing the BB program. Responses of interviewees are shown as '(interview x)' in the following sections, using table 1-1 as reference for their backgrounds. Semi-structured interviews are a valuable method for obtaining knowledge about the interviewees' attitudes and values towards a specific issue (Byrne, 2004), which is necessary for analyzing the differential treatment of target groups. Second, we analyzed primary policy documents and project websites, which informed us about program aims as well as about the solutions developed to reach those aims. We analyzed the data through applying the SCPD framework, especially its four target group categories. We mapped our results on these four categories and we analyzed the role of science and technology in distribution of wins and losses.

5.4. Introduction to the case study

Our case studies, namely the projects 'Burn Fat not Fuel' (BFNF) in Maastricht and 'B-Riders' in Brabant, are part of the national program Beter Benutten (BB). BB was established by the Dutch Ministry of Infrastructure and Environment (I&M) with two policy goals: reducing 20% traffic congestion and 10% door-to-door travel time during rush hours (Beter Benutten, 2016). To achieve these goals, BB relies on the use of long-term behavioral change of daily commuting, e.g. by making travelers shift from car to bikes or public transport for their daily commuting.

One particular solution fostered in this program is the 'connected bike': a(n) (e-)bike with tracking technology recording providing feedback on traveler's activity. Policymakers are fostering the introduction of connected e-bikes with a battery that can be used to travel long distances. In contrast with regular bikes, e-bikes are seen by policymakers as similar to the car: It offers an excellent alternative for people using cars for everyday commuting because, as an interviewee suggested: "the e-bikes are cars without a roof", offering the benefits of motorization to commuters with limited environmental impact and relative comfort.

5.4.1. Maastricht

Maastricht is one of the oldest Dutch cities, with an internationally recognized university. It also holds several big companies, attracting thousands of employees each, including from nearby cities. According to the interviewees, Maastricht faces daily traffic congestion due to the A2 cross-European highway, crossing the city

center, dividing it in two parts. Additionally, the only traffic light in the A2 highway is located at the entrance of Maastricht. Following interviewee's utterances, it "creates a sense of urgency" (interview 28) of policy interventions to improve mobility.

In order to address these challenges, Maastricht established the 'Maastricht Bereikbaar' (MB) organization to run the BB program in this region. It is characterized by a close collaboration with employees. To be part of MB, employees are required to pay an annual membership fee. This membership approach is considered highly successful for engaging private parties, and making them collaborate in BB. However, an interviewee suggested a potential exclusion of small and medium enterprises, which, due to their size and limited resources, usually lack of dedicated mobility budget necessary to pay these fees (interview 29). The connected bike program in the region (BFNF), is mostly directed to employees with a MB membership. According to the BFNF website, participants benefit from: "healthier employees with lower absenteeism, better accessibility of the company location, lower CO2 emissions, a better company image and savings on parking costs". From a technological view, participating in BFNF requires a set of two receivers placed on the employee's bike. These receivers calculate participants daily commuting by bike. Circa 1,821 employees have participated in this program (Burn Fat Not Fuel, 2014).

To encourage participation, potential participants are offered free-trials and discounts schemes, assistance for purchasing an e-bike model, motivating coach as well as feedback techniques e.g. on users' savings in terms of CO2, fuel costs and health gains. They are about to launch a new initiative, in which an app connected to the users' agenda provides them with travel advice. Whereas in the previous solution the financial incentive was primary and the feedback was secondary, in the current solution feedback is the primary win. Furthermore, whereas BFNF was exclusive to the car users, the new program broadens its scope to any employee working in a BB company, based on the assumption that it will create social pressure to car users to switch to bikes. However, due to their specific institutional arrangements of collaborating with employers, in Maastricht only the employees working for the companies partnered with MB can participate.

5.4.2. Brabant

The Brabant region encompasses five cities: Breda, Den Bosch, Helmond, Eindhoven, and Tilburg. The region is a major contributor of the Dutch national GDP. Its biggest city, Eindhoven, is a hub for technological innovation resulting from an interplay amongst knowledge institutions (e.g. Eindhoven University of Technology) and major technological companies (e.g. NXP and ASML). It is also characterized by having a strong collaboration between actors, especially in the IT sector, and its application to other domains, such as smart mobility (Brainport Development, 2016).

The multi-city approach in Brabant raises different questions about dealing with the BB goals. In contrast with Maastricht, Brabant focuses not just on inter-city mobility, but also between cities. The structure of BB Brabant differs from BB Maastricht. It is based on a networked organization, with less engagement of employees. Policymakers in this region acknowledged that they have faced difficulties in making employees participate in the program. The connected bike project in Brabant, 'B-riders', is similar to BFNF, but it does not require any additional hardware to operate. It uses smartphones to calculate distances, provide feedback, and offer incentives to participants. B-riders is limited to a maximum number of project participants (5,000) (B-Riders, 2016).

The B-riders implementation consists of three phases, of which they are currently in the second one (interviews 29 & 30). In the first phase, car users were offered monetary rewards calculated by a mobility app. This app traced user's activity, rewarding every kilometer using their bike instead of a car (12¢ (<10 km) or 15¢ (>10 km) per km during rush hours, and 8¢ per km outside rush hours). This has been changed in the second and third project phases, where the reward is 10¢ per km only in rush hours and reward points for outside the rush hours. It is only in the later phases that people not commuting by car, but using bikes before the program was established, started obtaining access to the motivational coach, collecting online points to redeem rewards (e.g. a museum ticket), or entering a lottery (to win a weekend getaway). As one interviewee phrased it: "to get the money reward you need to be using a car and really change your behavior" (interview 29).

5.5. Findings

We identified four target groups in both BB programs: (1) "modality switchers", or car-users employees working for companies with BB membership, (2) non-car users employees working for companies with BB membership, (3) students, and (4) "traffic participants" or car-users not participating in the program. The latter group, is targeted indirectly: any solution offered to the other three groups will impact car-users regardless their relationship with BB. See figure 5-1 for the relationship between the groups and the SCPD framework**.** The target groups are mostly constructed in positive terms**.** However, their wins and losses differ greatly. Table 5-2 holds an overview of wins and losses. The differential treatment will be described in the following four subsections.

Target group	***Ideal target group type***	***Wins***	***Losses***
Modality switchers	Advantaged	Materialized: e-bike purchasing discounts, lottery, online credit, financial rewards for using a bike; purchasing advice, e-bike trials, online motivational coach, increased health, fuels savings, less stress; common wins.	Common losses, social pressures to change their behavior, non-materialized (financial or legal) losses
Non-car users, employees working for BB companies	Between advantaged and dependents	Currently in Maastricht: materialized wins; online motivational coach, online credit, being fit, healthier lifestyles	Currently in Brabant: Exclusion from the connected bike schemes; ii) no financial incentives for purchasing e-bikes Currently Brabant and Maastricht: common loses.
Students	Dependents	Rhetoric wins, i.e. MOOCs, change in lecture times, currently still undefined "e-bike solutions",	Exclusion from the connected and e-bike schemes; limited access to public transport in rush hours: no financial incentives for e-bikes
Traffic participants-car (indirect group)	Contested social construction	Common wins	Common losses, worse lifestyles and health
Common wins and losses		Less congested roads, better accessibility of cities	Increased parking fees, narrower roads, more stress, more CO2 pollution, longer travel time

TABLE 5-2: WINS AND LOSSES PER TARGET GROUP

While answering how technology participates in the distribution of wins and losses, we identified that Ingram and Schneider's categories of materialized and rhetoric wins are limiting for capturing the wins of the connected bike technology. Instead,

we propose that a category of digitally mediated wins would better "open up" the materiality of the wins distributed by ICT. These wins are non-materialized and putatively non-quantified before the use of the connected bike because while users could calculate overall their personal fuel costs, CO2, or health savings, we do not expect most users deriving detailed calculations in terms of their health and financial gains resulting from them switching from using a car to using an (e)bike. Hence, these promises are more similar to the rhetoric wins as they are only about to become materialized through appearing on a screen of the ICT-personal device, once they are digitally mediated through the use of the connected bike. The smart sensors installed in the connected bike quantify the wins, based on individual performance of the user. For instance, the health gain quantification is seen on a mobile screen. Even when materialized on the screen, the digital materiality does not necessarily equal fiscal wins - especially not in the latest phases of the BB program.

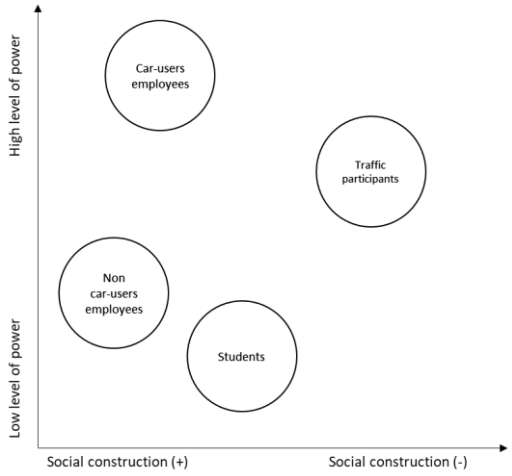

FIGURE 5-1: SOCIAL CONSTRUCTION OF THE TARGET GROUPS

5.5.1. Modality switchers: Car-users employees working for BB companies

The daily car users commuting to a BB participating company, who are expected to shift towards the connected bike, have a high level of power, particularly in relation to the other three groups, and are portrayed as the major cause of congestion problems. However, policymakers do not socially construct this group in negative terms. Albeit we observed that this group is considered as untrustworthy (e.g. they are required to submit proof of using the car signed by their employer to participate

in the program), they are perceived as potentially obeying and socially responsible group if the right policy incentives are placed. Consequently, we claim that this group receives a similar treatment to what the SCPD framework suggests as an *advantaged* group: high materialized and rhetoric wins, and no losses.

Policymakers prioritize this group by offering them financial incentives to leave their car at home and to daily commute by bike. Next, they received financial incentives and personalized purchasing advice, especially in Maastricht. These incentives were complemented with other benefits, e.g. an online motivational coach. In addition, these wins were easily accessible for the target group. Aligned with the SCPD framework, policymakers consider that this type of wins are societal wins as it is in the best interest of both regions to induce long-term behavioral change in this group. Additionally, policymakers perceive that this group's participation in the program can improve their quality of life and health, being the two main incentives for this group to adopt the connected bike. Yet, this group has limited losses. The limited symbolic punishments are social pressures to change their behavior, without materialized losses.

5.5.2. Non-car users- employees working for BB companies

The non-car users- employees working for BB companies are positively perceived by policymakers as they already changed their commuting from car to any other transport mode. Policymakers aim to reinforce their behavior and allow them to continue using their bikes for daily commuting. However, we see limited financial rewards for this group, and their benefits are less materialized than the first group. We consider that this group fits between the categories of *advantaged* and *dependents* of the SCPD framework, implying a mix of rhetoric and materialized wins, but less materialized that the advantaged group of the first identified group, and few losses.

This group has been treated differently in the two regions and throughout the different phases of the BB project. In an early stage, Maastricht excluded this group from any wins while in Brabant it was offered an online motivating coach, credit, and participation in a lottery (interviews 12 & 29). In later stages, policymakers in Brabant took out these benefits. When excluded from participating in the connected bike scheme, this group is the overall losers because they do not have access to the overall wins. Several policymakers highlighted that keeping this

group using the connected bike is, rather than a goal itself, a policy instrument that can be used to influence modality switchers' behavioral change.

5.5.3. Students

Albeit interviewees acknowledged that students are a target group of BB, they benefit from limited operationalized measures. Often, interviewees suggested materialized wins which are expected to be implemented in the near future, but up till now not realized. We observed a tendency of prioritizing the other three target groups at the expense of students. For example, policymakers aim to change the behavior of students commuting to the university by taking them out of rush hours, allowing employees to benefit from less congested transport infrastructure. We identify a social construction in which policymakers see them as *dependents:* a positive social construction, but limited power to access and participate in the connected bike initiatives.

Students are considered *a priori* as a group which is not entitled to the e-bike to monetary constraints. Albeit policymakers consider this group as predominantly bike users, limited attention is given to measures for reinforcing this behavior. Additionally, we perceived policymakers consistently talking about future materialized wins, which during the time of our research, were never materialized. Students do not have access to any financial incentive to switch their behavior. Strikingly, while the students are also members of the car-users daily commuters target group in both regions, student car-drivers are excluded from the behavioral change policies for switching to (e-) bikes. They do not have access to other solutions such as e-bike buying schemes. The main argument of policymakers to neglect this group is that it already has concrete mobility wins, such as free access to public transport.

Furthermore, students are considered to complicate the behavioral change of other groups as they use mobility infrastructure (public transport) during rush hours. The major tool used to induce behavioral change is reducing students' mobility during peak hours. Thus, policymakers offer students solutions such as Massive Online Open Courses, to avoid them commuting during rush hours. However, we perceive this solution as a burden for students, as their main intention is to limit their mobility. We identify students as the overall losers in our case-study.

5.5.4. Traffic participants -car users not participating in the program

Traffic participants group are daily car commuters not participating in the BB program. Unlike the other groups, they have a contested social construction, indicating that policymakers have a neutral view on this group. However, they remain a powerful group as policymakers acknowledge that making traffic participants leave the road without any incentive is difficult, so their "bad behavior" is not punished by any means. Policymakers suggested that this group has high rhetoric losses. For example, policymakers state that this group will be affected as their continued car commuting results in worse lifestyles and health. However, there are no materialized losses. This group may access the most symbolic wins provided by the BB program, such as rewards points or an online motivational coach.

5.6. Conclusion

Returning to the question of 'what is the role of technology in the differential treatment of target groups in the BB connected bike projects in the regions of Maastricht and Brabant?' we identified four groups. Each group receives a differential treatment in policy, which is primarily targeted via incentives to encourage connected bike adoption. We found that the "modality switchers" group, which contributes most to the problem of congestion and travel time in the Netherlands, is also receiving the highest number of material-wins in the connected bikes projects of Maastricht and Brabant. In contrast, other groups, such as students and people cycling before the program started, are neglected or attributed to a reduced number of wins. This policymaking approach may hinder the transition towards smart mobility technologies, and limit the emergence of alternative transportation modes to lower congestion and sustainability.

We propose that Dutch attempts towards stimulating the adoption of the connected bike should adopt a broader focus, including other groups. Moreover, we found it striking that the connected bike projects lack clear losses to groups that are contributing to the problem the most. A more balanced approach in the policy design should adopt measures for punishing negative behavior, hence the car users. Furthermore, it should aim for more symmetrical approaches and supporting a more inclusive distribution of the wins. Policymakers are increasingly relying on market parties for the social construction and preferential treatment of target groups. This raises questions about equity and justice in the policy design of smart

mobility technologies. Market parties are incentivized to participate in areas in which profit is reachable. However, some groups (e.g. students) would not entail one of these groups. This approach raises questions about the long-term impact of favoring a reduced population-based on market incentives. It portrays a case of market failure. Thus, public intervention may be justified in these circumstances to maximize the benefits of smart mobility technologies to underserved populations.

ICTs allow individualized tailoring of treatments, which implies a high need for policy intervention in setting ground rules, to ensure ICT solutions are consistent with supporting outcomes that are both fair and sustainable. Incentivization and reward alone will not resolve the market and operational failings that characterize the system today.

6. Demand articulation for accessibility measures in Dutch urban areas.

Abstract

Societal challenges call for new ways of organizing transport planning. We study a sustainable accessibility approach that discourages car usage and simultaneously encourage environmentally friendly options: the Dutch Program Beter Benutten. We compare three Dutch cities: Amsterdam, Rotterdam, and Utrecht. We propose four categories for studying sustainable mobility therein: contextual factors, organization, user involvement, and outcomes. Our research suggests that a 'one-size-fits-all' approach is not sufficient for achieving sustainability since contextual factors and organizational structure contribute to different sustainability approaches in three cities. We also identified that the three cities set different priorities which resulted in diverse user involvement strategies and outcomes. This has realized in a range of approaches, such as improving traffic management and new narratives on mobility relating to sustainable accessibility approaches, such as mobility poverty and justice. Our contribution lies in clarifying the rather vague conceptualization of sustainable accessibility; studying the organization and implementation rather than the outcomes, and enriching the understanding of sustainable accessibility in policymaking.

Keywords: Accessibility, behavioral change, Dutch transport policy, urban accessibility, sustainability.

6.1. Introduction

One of the most pressing issues for transport policymakers is sustainability. In particular, it has been extensively argued that today's transportation systems, centered around the automobile, are not sustainable in the long term. Automobiles have multiple negative impacts on society, including greenhouse gas emissions, and impacts on health and the urban (Banister, 2008). Consequently, experts have called for new ways of embedding sustainability in accessibility planning (Curtis & Scherer, 2010), described as sustainable accessibility (Bertolini et al., 2005; Curtis, 2008; Curtis & Scheurer, 2010).

Sustainable accessibility, according to Bertolini et al. (2005, p. 12), is accessibility "with as little as possible use of non-renewable, or difficult to renew, resources, including land and infrastructure". This definition implies that car use should be discouraged, making people adopt more environmentally friendly and socially desirable travel behaviors, including public transport, cycling, and car-sharing. It also suggests that sustainable mobility goes hand-in-hand with stimulating changes in target populations' mobility behaviors (Geels & Kemp, 2012). This is particularly relevant in urban environments, where due to space constraints, behavioral change is the most cost-effective way to improve accessibility, compared to (costly) infrastructure-solutions (Steg & Tertoolen, 1999).

Sustainable accessibility is expected to have a radical impact on transport policy (Banister, 2008; Vega, 2012). Most of the literature focuses on measures or indicators for evaluating accessibility improvements (Cheng et al., 2017; Vega, 2012). Despite the general acknowledgment that sustainable accessibility requires new interventions, such policy remains under-explored. We aim to address this gap by mapping some implications of organizing sustainable accessibility in the transport sector.

For doing so, we adopt the Dutch government's program Beter Benutten (or 'better utilization' in English, in this text referred to as BB) as a case study. BB was established in 2011 to improve accessibility and reduce traffic congestion in twelve of the Netherlands' urban regions. In our view, BB is an example of a sustainable accessibility program as it aims to make cities more accessible by reducing car congestion and inducing changes in commuters' behavior, ultimately optimizing the existing infrastructure. It aims to make commuters leave their cars at home, encourage them to use other transport modes, or avoid travel altogether during rush hours (Bertolini et al., 2005). BB is also interesting to investigate because, despite the national scope, it was adapted to each region's local conditions. Thus, BB encouraged a variety of innovative policy solutions, designs, implementations, and evaluations.

For our study, we selected three of the twelve regions in the BB program: Amsterdam, Rotterdam, and Utrecht[10]. We chose these regions for two reasons:

[10] Utrecht is part of a Beter Benutten region of Middle-Holland. In this paper, we merely study the city of Utrecht and do not consider the other nearby-urban centers in the Netherlands.

first, they form part of the 'Randstad' area, an urban conglomeration of more than 8 million inhabitants (Burdett & Hajer, 2011). Randstad has numerous large, medium, and small urban centers in close proximity, with a well-developed infrastructure enabling inter-urban commuting. Thanks to its polycentric character, there is no predominant city in terms of travel destinations (Goess et al., 2016). Second, the three regions differ in their socio-economic built environment. Amsterdam is a highly compact city, a tourism and entertainment hub, with an international financial district and a high-tech economy. It is considered one of the most cycling-friendly cities in the world. In contrast, Rotterdam is traditionally a working-class city and a major European port. In terms of urban design, after the Second World War, the city had to be rebuilt and favored car-centered urban development. Finally, with its unique geographical location in the heart of the Netherlands, Utrecht has the busiest railway station in the country and is one of the country's fastest-growing big cities (Burdett & Hajer, 2011; Goess et al., 2016; I&W, 2011a).

The research questions we address are: How have Amsterdam, Rotterdam, and Utrecht approached the 'Better Utilization' program for sustainable accessibility, how do their approaches differ, and what is the impact on policy outcomes? Our aim is to provide a better understanding of policy interventions for improving accessibility aligned with sustainability. We start by discussing the theory behind the concept of sustainable accessibility in section 6.2. Section 6.3 describes our methods, followed by an introduction to our case study in section 6.4. We present our findings in section 6.5 and end with a discussion and conclusions in section 6.6.

6.2. Theoretical approach

Hansen's (1959) seminar work defined accessibility as "the opportunity which an individual or type of person at a given location possesses to take part in a particular activity or set of activities". It is a central concept for urban, spatial, and transport planning (Geurs et al., 2010). Accessibility is strongly related to socio-economic benefits (Geurs et al., 2016). It allows exchanges of goods and services between people and firms (Holl, 2007), and fosters socio-economic regional development (Martín & Reggiani, 2007). Accessibility also favors market expansion and economies of scale, enabling higher market efficiencies due to agglomeration benefits and activity clustering (Lakshmanan, 2011).

According to Geurs & van Wee (2004, p. 128), accessibility has four integrated components. The land-use component refers to the spatial conditions and possibilities for travel; the transportation component covers the potential travel alternatives including costs and travel time; the temporal component entails time availability and constraints, and an individual component relates to the personal factors that determine individual mobility behaviors. Policy interventions for accessibility aim to address at least one of these four areas, for instance, by improving network efficiency (Linneker & Spence, 1992) or public transport (Saghapour et al., 2016), or by a better spatial distribution of activities (Guzman et al., 2017). Current measures tend to focus on maximizing individual mobility, rather than limiting or adapting the reasons for which people travel, e.g. employment, leisure, etc. (ITF-OECD, 2017).

Until recently, transportation policy -and accessibility measures- still considered the car as the "ultimate mean" of urban accessibility (Gil Solá et al., 2018). However, car usage reinforces inequalities and disadvantages for underserved social groups and limits their socio-economic development (Pyrialakou et al., 2016). Cars also have a negative impact on the environment and land use. These negative consequences have resulted in new accessibility approaches that instead position concepts as transport equity, mobility poverty, quality of life, and fairness as central narratives for transport planning (Geurs et al., 2016; ITF-OECD, 2017). Accessibility is expected to contribute to citizens' quality of life and wellbeing, allowing "the expansion of people's freedom of choice and promotion of equality of opportunities in terms of employment, healthcare, education services, etc." (Pereira et al., 2017, pp. 177–178). This human-centered and low-resource intensive approach is what some scholars have called "sustainable accessibility" (Bertolini et al., 2005; Gil Solá et al., 2018; Papa & Ferreira, 2018).

6.2.1. Sustainable accessibility

According to Vega (2012, p. 412), sustainable accessibility is an emerging transport framework for achieving a "balance between seemingly contradictory policy objectives such as enhancing the accessibility of the urban region and improving the sustainability of the transport system". It prioritizes low resource-intensive mobility options, with limited impact on land and infrastructure (Bertolini et al., 2005). Sustainable accessibility also highlights user behavior as the key to better use of mobility infrastructure, making it a cost-effective approach in transport

policy. Thus, this type of accessibility can improve urban regeneration and public transport (e.g. Banister, 2011). The European Commission's Sustainable Urban Mobility Plan (European Commission, 2016b), aimed to improve urban accessibility aligned with sustainability criteria, e.g. access for all users, various transport modes, improved infrastructure use, and reduction of motorized transport.

Despite a greater focus on sustainable accessibility in recent years, its implications have not been extensively explored. Studies show that it remains "multifaceted and somewhat vague" for transport planners (Gil Solá et al., 2018) and that it is open to a broad interpretation by practitioners (Curl et al., 2011). We, therefore, propose to analyze sustainable accessibility based on four aspects that could help us to a better understanding of this concept: contextual factors, policy organization, user involvement, and expected outcomes. These four categories are explained below, where we also explain their references to sustainable mobility literature and their linkages to other appropriate concepts. These categories will be the basis for the structure of the rest of the chapter.

6.2.1.1. Contextual factors

Sustainable accessibility defies the dominant 'one size fits all' view in transport planning and places local contexts at the heart of policy interventions (Banister, 2008). This approach proposes that sustainable challenges depend largely on local conditions (Barr & Prillwitz, 2012). Accessibility literature emphasizes spatial structures and the built environment (e.g. infrastructure) because they determine the mobility of goods and people (Scheiner & Kasper, 2003). These structures also determine the socio-spatial organization of everyday life (Frändberg & Vilhelmson, 2010), as they can limit spatial integration.

However, sustainable mobility literature suggests that not only physical conditions influence travel behavior. Acker et al. (2016) indicate that lifestyles determined an individual's travel preferred choices of transport. This is also reinforced by individuals' choices regarding housing or work location (Scheiner & Kasper, 2003). Everyday mobility is also influenced by social and cultural factors. This has been taken further by authors such as Cairns et al. (2014), who suggest that travel behaviors can be understood as social practices. Consequently, mobility has its own symbolic dimensions and entails different experiences for commuters.

For this reason, sustainable accessibility requires a change in mobility practices and habits bearing in mind the physical and cultural conditions, as well as

symbolic meanings of travels, of individuals. Thus, sustainable accessibility relies on behavioral change as a key policy tool: policymakers, through tailor-made interventions, can influence individuals to make more transport choices, taking into account the opportunities and constraints of individuals (Anagnostopoulou et al., 2018).

6.2.1.2. Organization

Traditionally speaking, major policy interventions in the field of transport are based on improving infrastructure, or on financial incentives for reducing network usage. This has resulted in prevailing public-private partnerships schemes, whereby governments form contractual relationships with private parties to deliver services (Hodge & Greve, 2010). This suggests that the state has a limited role as an enforcing agency of contractual agreements (Chung & Hensher, 2018). However, sustainable accessibility challenges this perspective. Sustainability requires different modes of collaboration between public and private parties (Gil Solá et al., 2018), resonating with the recent uptake of the so-called 'New Public Governance' (NPG) approach in public administration.

The NPG approach suggests new mechanisms for cooperation between public and private parties in terms of trust, collaboration, and network governance (Osborne, 2006). It also broadens the concept of private parties, to incorporate non-market actors such as users (Sorrentino et al., 2018). This occurs because policy interventions are not only meant to maximize efficiencies through market mechanisms. In the field of transport, this would mean that societal actors are included to have a say in transport interventions. NPG enables co-creation in delivering public services. Actors such as employers can co-design interventions with state authorities to reduce the travel demand of employees. Societal actors (particularly users) are considered 'problem solvers' for generating public value (Bryson et al., 2014; Osborne, 2006). This view, overall, aims to change the way in which users are conceptualized: They are not only 'consumers' of new services, but citizens with a say in transport interventions.

6.2.1.3. User involvement

Involving users in sustainable accessibility calls for a different type of user engagement. This is the case for three reasons. First, sustainability literature acknowledges that users are the major 'vehicles' for achieving socio-environmental change (Barr & Prillwitz, 2012). This occurs as sustainable mobility requires citizens

to change their practices and habits. Users are thus agents of change, particularly as sustainable accessibility demands new changes in behaviors of citizens, leading to an increased interest in travel choices and practices. Second, and drawing from innovation studies, involving users is crucial for the uptake of innovations. They facilitate a faster new product or service adoption (Sopjani et al., 2019). Users can help generate new research ideas (Von Hippel, 2005) and improve policymakers' understanding of their requirements and wishes (Bano & Zowghi, 2014). They also enhance user-system satisfaction and acceptance of an innovation (Sopjani et al., 2019). Overall, their contribution leads to a better quality of novel designs in products and services. Lyons & colleagues (Lyons et al., 2012) found that a greater user involvement leads to the rapid diffusion of innovation at minimal cost to agencies or operators, and Sopjani et al. (2019) have identified the advantages of user involvement in building momentum for sustainable mobility innovations.

Third, user involvement is expected to contribute to the legitimation of sustainable mobility options. It is also considered a democratizing tool in innovation processes. According to Von Hippel (2005), users have the right to be involved in the decision-making of the services and products they are expected to use. Involving users differs from technocratic approaches, by constituting an inclusive way of taking into account citizens' needs and experiences (Löffler & Bovaird, 2009). Users are more likely to participate in processes requiring intense engagement if they feel it is critical for the process and if their expectations are clear (Hennig-Thurau et al., 2004). Despite the widely documented benefits of user involvement, the implementation of user-centered approaches has proved to be challenging. This is mainly due to the experimental and informal nature of user involvement initiatives (Sorrentino et al., 2018). Moreover, flaws can also occur in the institutional designs of these initiatives, in which users are involved but not necessarily included in decision making (Sopjani et al., 2019). De Vries and colleagues (2015) mapped different degrees of user involvement with a so-called "participation ladder". Users can be involved in three categories of innovation-related developments: (1) 'listening' to users, (2) asking them about their needs and preferences, and (3) building, co-designing, and co-creating.

6.2.1.4. Outcomes

As suggested by Farrington (2007), a greater aim of sustainable accessibility is the condition that "accessibility levels are high for all groups and individuals" and includes "all appropriate policy sectors into the holistic provision of accessibility".

The expected outcome of sustainable accessibility is that daily travelers avoid car use and are encouraged to take non-motorized journeys (Acker et al., 2016). However, outcomes may differ among regions based on the three factors mentioned above: contexts, organizations, and user involvement. Context determines behavior, organizations create new ways of societal involvement, and user involvement is crucial for the uptake, and legitimation of novelty. Overall, sustainability interventions are expected to generate public value for the entire population and not just travelers. Examples of societal outcomes include a better urban landscape, more livable cities, and an improved quality of life (Johansson et al., 2016).

6.3. Methods

To answer our questions on sustainable accessibility approaches to the 'Better Utilization' program in Amsterdam, Rotterdam, and Utrecht, we applied qualitative research. This consisted of primary document analysis and nine semi-structured interviews, with ten interviewees. The policy documents were sourced via the Beter Benutten program and Dutch Government websites, as well as electronic resources based on interviewees' responses. These documents gave us a general overview of how policies were devised, in what way users were involved and data on the program's impact. However, as the program was running while we were conducting our research, there was a limited amount of documentation enabling us to identify the differences in approaches to the BB program. We compensated for the lack of data by conducting semi-structured interviews with experts working on this policy program. The interviewees have in-depth knowledge of the cases and have participated actively in their design and implementation. We applied the snowball method to identify relevant interviewees until we reached an information saturation point.

We transcribed all the interviews and analyzed the responses through thematic analysis and category coding. This approach tracks connecting topics within the data and generates initial codes, helping us to define thematic patterns (Williamson & Johanson, 2017). The codes were based on the four categories mentioned in the previous section. The authors individually coded the data, which was then merged into one project using qualitative research software. The authors proceeded by analyzing the individual coding and discussing the emerging multiple patterns.

6.4. Case study introduction

Accessibility is a key concept for transport policy in the Netherlands due to its exceptional spatial and demographic conditions. The country is highly densified and urbanized (513 inhabitants/km2 and 74 percent of the population live in cities (CBS, 2019). In contrast with other predominantly urbanized countries, Dutch urban centers are relatively small (i.e. the most populated city, Amsterdam, has ca. 854,000 inhabitants (CBS, 2019). A large part of its population lives in a mega-urban agglomeration consisting of four major cities (Amsterdam, Rotterdam, The Hague, and Utrecht) called "The "Randstad". The Randstad has a polycentric structure of multiple urban centers which are near to each other (Nabielek & Hamers, 2015). As an urban agglomeration, the Randstad operates in conditions of political and institutional fragmentation (Goess et al., 2016).

Randstad's international and regional accessibility is a key priority for transport policy (Raad voor Verkeer and Waterstaat, 2009). This region has an internationally oriented economy, increasing mobility of people via Schiphol airport, and of freight transport via Rotterdam harbor. It is also densely connected to inner Europe via water, roads, and train networks. Moreover, a rationale for improving its accessibility is to strengthen its international position (PBL, 2014b, 2014a). Additionally, good accessibility can benefit the Randstad in terms of agglomeration benefits (PBL, 2014b). Finally, the high level of urbanization and compactness of the cities make local and main transport networks highly interconnected (VROM, 2008).

According to the Dutch Bureau for the Human Environment (PBL), so far, the typical Dutch approach to accessibility is as follows. Accessibility can be improved by bringing origin(s) into proximity with destination(s) (e.g. reducing travel distance); by increasing travel speeds; by improving linkages between the built environment and mobility infrastructure; and through cost-reduction, increased comfort, or better travel information (PBL, 2014b, 2014a). Policy interventions to increase costs (e.g. congestion pricing) are barely used, due to the rising relative costs of travel (Central Plaanbureau, 2016) and its political contestation.

In recent years, and due to spatial and budgetary constraints, Dutch authorities have prioritized policy measures to improve accessibility in the Netherlands with better use of existing infrastructure. In the Dutch Ministry of

Infrastructure and Water Management (I&W 2012) Comprehensive Planning Report of Infrastructure and Space, it is stated that better accessibility can be achieved by multiple modes of transport (e.g. bus, train, bicycle, and car). Policy documents also encourage mobility innovations with a limited impact on transport infrastructure and the shifting role of users (de Mooij, 2013). Among these measures, one which explicitly aimed to improve accessibility by better utilizing urban regions' infrastructure is the program 'Beter Benutten'.

6.4.1. The Beter Benutten program

The Dutch Ministry of I&W initiated the Beter Benutten ('Better utilization', BB) program in 2011 to improve accessibility in the twelve most congested regions of the country, including our case studies of Amsterdam, Rotterdam, and Utrecht in the Randstad. As its name suggests, the program's main goals were accessibility improvement, by favoring better use of existing infrastructure. The original approach consisted of a new collaboration to find cost-effective accessibility solutions, taking as a starting point the users and their behaviors (I&W, 2014a). The program intended to foster new modes of cooperation between state authorities and private parties (e.g. Public and Private Partnerships) to propose new solutions to the problems of accessibility in the participating regions. It has three phases: Beter Benutten (2011-2012), and Beter Benutten Vervolg ('follow-up', 2015-2018), and a follow-up program without the central coordination initiated in 2018.

This program resembles the approach to sustainable accessibility mentioned above. Overall, it aimed to improve mobility network usage via behavioral change and traffic management approaches, to modify everyday travel patterns, increase infrastructure efficiency, hinder car usage, and rule out any major infrastructure measures. BB was developed on a regional basis, considering each region's context and characteristics (including the demographics of potential target groups, employers, city infrastructure, etc.). BB also developed 'ad-hoc' decision-making mechanisms for each region, based on these circumstances. These mechanisms only stipulated having at least one I&W Ministry representative (in charge of the main road network and inter-city connections), a local level representative of the city or the region, and market representatives (employers). Consequently, each region developed its own organizational structure. The program emphasized collaboration through 'smart deals' to reduce employee travel during rush hours. These deals differed from region to region, based on target groups. Finally, though this accessibility program set two major targets:

Reduce congestion by 20% in the first phase of BB, and travel time by 10% in the second phase.

6.5. Findings

By comparing the three regions' approaches to accessibility, applying the aforementioned categories of contextual factors, organization, user involvement, and outcomes, we identified several differences between the regions. Table 6-1 presents a general overview of the findings, which are explained below.

6.5.1. Amsterdam

6.5.1.1. Contextual factors

Amsterdam is the largest urban agglomeration in the Netherlands with 854,047 inhabitants (CBS, 2019). Its metropolitan region has over two million inhabitants (Gemeente Amsterdam, 2019). (Gemeente Amsterdam, 2019). The city's population density is 4,908 inhabitants per km2 (CBS, 2019). The capital has one of the highest tourism rates in the world, welcoming more than 19 million tourists in 2018 alone (Deutsche Welle, 2019). Amsterdam is home to many cultural and entertainment centers, including Rijksmuseum (National Museum) and the Van Gogh Museum (2,3 and 2,2 million visitors per year (ANP, 2019)). Additionally, in the city's south-east area (Bijmer), several entrainment halls and a national football stadium are located. Nearby is the country's biggest airport (Schiphol Airport), transporting yearly over 70 million passengers (Sondermeijer, 2019). Finally, the city has a prominent start-up scene and the most prominent financial district of the country. Moreover, the city is expected to continue growing in the following, particularly around the financial district (interview 33).

The above-mentioned condition makes travel behavior in Amsterdam exceptional. First, because 50 percent of the traffic during rush-hour is related to work-related traffic, which contrasts with 80 percent in other Dutch cities (interview 10). That means that half of the traffic is non-work related, including tourists and attendants to entertainment or cultural venues. Secondly, the city tech-scene and financial sector both provide higher levels of income in comparison to other cities. Consequently, there is no point in applying traditional measures to motivate behavioral change through financial incentives, as the relative gain is lower with high incomes (interview 10 & 34). This occurs, for instance, as some companies are willing to pay for up to 10,000 euros of parking per year for their employees (interview 33). Here, new intervention modes are required for

behavioral change, including 'smart deals', whereby local authorities incentivize behavioral change in terms of non-financial value (e.g. wellbeing, spare-time not behind the wheel, less stress, etc.) (interview 33).

	Amsterdam	Rotterdam	Utrecht
Context	Densified city, tourist and entertainment hub, sense of 'crowdedness'. Work-related is significantly less than the Dutch average (50%). The large percentage of non-work-related travel cannot be influenced by financial incentives.	The most car-friendly city of the three cases. Modern urban-centered as the result of post-war reconstruction. Large freight transportation due to the Rotterdam port. The city faces some socio-economic inequalities that are reinforced by a physical barrier (river).	The central location of Utrecht in the Netherlands. Hub for inter-city travel to/from Utrecht. Limited railway infrastructure, some urban developments are not well connected to the transport network (e.g. Science Park). Demographic expansion and major infrastructure works.
Organization	Lack of central organization, traditional schemes of public and private cooperation. Limited collaboration with employers. Accessibility problems are defined by public parties, and their solutions left to market creativity.	Verkeersonderneming as the most comprehensive dedicated organization of the three cases. The organization works as a coupler between supply and demand. New approaches were developed (e.g. marketplace for mobility). It also aims to work with underserved populations, to foster new markets to improve the accessibility of the region.	Problem and solution defined by the government then outsourced to private parties. Project-based collaboration between public authorities and stakeholders. BB network worked independently and had limited cooperation with big corporations.
User involvement	Users were primarily involved in the regions via surveys, and no meaningful involvement was identified in the case study. Other methods included data gathering from entertainment destinations.	Most organized user involvement of the three cases. They take new concepts on sustainability (e.g. in terms of mobility poverty) to think about users in a different way. The program has expanded to contribute to the accessibility of underserved populations.	User involvement in the traditional way, particularly with surveys. The surveys worked as a major input for defining the problems and solutions by state authorities.
Outcomes	Limited impacts on target population behaviors. Most of the activities were encouraging smart mobility and traffic management vs. accessibility. Overall, we can assess that the impact on sustainable accessibility of this program is limited.	The interventions in Rotterdam contributed to a different way of understanding accessibility. Their approach to accessibility promotes a more fair and equal mobility approach in the city.	The program promoted alternative options for travel. Some local benefits were identified and primarily aimed to improve the livability and quality of life within the city.

TABLE 6-1: OVERVIEW OF THE BB PROGRAMS IN THE SELECTED REGIONS

6.5.1.2. Organization

The BB program in Amsterdam was governed by the Minister of I&W, the deputy commissioner of the Province of North-Holland, and the CEO of Amsterdam Arena.

In contrast with other cities (see sections below), Amsterdam BB interventions are not organized as centrally as in other regions. This may occur due to the lack of 'culture of collaboration' in the city (interview 35), and a strong view on organizing behavioral change programs under traditional concessions to private parties (interview 10 & 12). This may also be the case due to a strong 'technology-fix' view on how to solve problems (interview 35). In other words, the BB in Amsterdam did not differ much from traditional accessibility schemes. This has had three major consequences. First, private parties saw the BB program as a potential source of income in Amsterdam (or, as an interviewee suggested, an 'ATM') for developing their technological solutions. Second, there were limited incentives for market parties to develop innovative solutions for urban accessibility that were beyond technology-fixed. Third, the program barely dealt with the cooperation and co-creation of new mobility services like other regions.

An interviewee took this view further and suggested that Amsterdam was not actually doing behavioral change, but rather traditional traffic management (interview 35). However, there are a few exceptions to the traditional accessibility programs, albeit on a much smaller scale than in the other two cities. One example is the 'Breikers' project. On the advice of policymakers, more than 200 employers provided accessibility solutions. The solutions were not fixed but developed on an ad-hoc basis (Breikers, 2019). This program also created a mobility budget, providing reduced travel costs for employees. Another exception is Amsterdam Zuid, where the authorities provide Park & Ride options in an attempt to influence and change financial district employees' mobility behavior (Hello Zuidas, 2019).

6.5.1.3. User involvement

Out of the three regions in our study, Amsterdam developed the least comprehensive approach to users. Documents indicate that users are generally seen as 'customers' by policymakers, rather than citizens with whom they can co-create accessibility measures. According to interviewees (interview 10 & 33), this also has to do with the lack of a culture of collaboration. Therefore, the type of input policymakers receives from users was quite limited. This input was primarily by mobility surveys to determine travel behaviors and destinations of users. The information about the surveys was not revealed by the interviewees. A similar input can be seen in the Bijmer region, in which knowledge about users was primarily defined by data sharing from some of the entertainment venues (interview 38).

It is also difficult to involve users who are not organized such as visitors. As one interviewee suggests, the only way to influence behavior is by asking for feedback on how they experienced the accessibility of the venue during their visit (interview 32) or offering commercial deals to use public transport instead of cars.

6.5.1.4. Outcomes

The goals for the program in Amsterdam were aligned with the overall BB goals: reduce travel time by 10 percent. The program had around 90 measures for behavioral change. The city's technology-fix orientation meant relying heavily on influencing traffic via technology, such as the Intelligent Transport System (ITS). As suggested by an interview, Amsterdam BB program prioritized stimulating more smart solutions to accessibility problems rather than stimulating new modes of mobility (interview 12). In the inner city of Amsterdam, however, we found certain policies aiming to revitalize urban neighborhoods, by replacing parking spots with Park-and-ride (P+R) options. This measure, however, has a limited relationship with accessibility (interview 10 & 33) and is more about land use.

6.5.2. Rotterdam

6.5.2.1. Contextual factors

Rotterdam is the second-largest city in the Netherlands, with a population of over 635,000, and its population density is 3,087 per km2 (CBS, 2019). Being the largest European port makes Rotterdam the major logistics hubs in the country. Unlike many other Dutch cities, including Amsterdam and Utrecht, Rotterdam has a car-oriented infrastructure due to the large destruction of the city during the Second World War. The River Maas crossing through the city divides medium to high income central and northern Rotterdam from lower-income Rotterdam South. This generates socio-economic differentiation within the city. Accessibility, therefore, has also a social aspect, namely a tool to reduce these inequalities. As suggested by an interviewee (39), only prioritizing car avoidance would have a limited impact in the south, not serving other underserved groups.

In contrast with Amsterdam, this city faces the challenge of work-related rush hour traffic. The car orientation and high levels of commuter traffic qualify the city for behavioral change from motorized transport to public transport and cycling. Also, the city's port generates freight traffic and congestion on the major roads in the transport network. Crucially important for Rotterdam is the expected increase

in freight transport due to technological advancements such as platooning (truck automation).

6.5.2.2. Organization

The body governing the program in Rotterdam consists of the I&W Minister, the mayor of Rotterdam, and the CEO of a container port terminal operator. Interviewees seemed to agree that Rotterdam has the most advanced organizational structure of the three cities. Its central transport organization (Verkeersonderneming), is a public-private collaboration platform comprising the Rotterdam-The Hague Metropolitan Area, the Ministry of I&W, Rijkswaterstaat (Waterways and Public Works Agency), the Port of Rotterdam Authority, and employers of the city. Originally developed before BB was established, the platform took on the role of a dedicated organization in BB.

This platform operates differently than other regions' mobility-dedicated organizations, in that it aims to couple of market innovations (in products or services) with demand. This happens through the so-called 'Marketplace for Mobility'. Demand defined user groups (e.g. as employees) who need to be reached through intermediary organizations (e.g. as their employers). In other words, this marketplace couples supply and demand, making the platform function as an "enabler" between the two. The rest (e.g. the development of business models) is left to the stakeholders (interview 12, 36 & 37). This has allowed the development of new services -not always successful-, to improve urban accessibility, including water taxis, water transport, travel advice apps, rental bicycles, on-demand cars and shuttle buses (Beter Benutten, 2018). This model has been replicated in the city to incorporate a marketplace for infrastructure, and a mobility lab for start-ups and upscaling (interview 36 & 37).

The original Mobility lab was intended to find new funding mechanisms for policy interventions. Market parties seeking to develop new solutions would get partial funding in the form of a loan (up to 50 percent). The loan was expected to be paid back either in cash or company stock once their solution showed profitability (interview 36 & 37). This reduces public-private organizations' costs and forces market parties to consider their solutions in terms of commercial profitability. The choices are broader as the platform presents the problem, not the solution. Thus, market parties are free to define and design their solutions (interview 12).

One concern raised in the interviews was how to improve accessibility to destinations (e.g. services or job locations) to underserved populations. Under market conditions, private parties would have limited incentives to operate for these groups, primarily located in the South of Rotterdam. However, with public support, private parties can improve accessibility for these groups with the expectation of making them 'more mobile' and integrate them into society. Consequently, market parties expect to obtain future mobility market segments, while simultaneously contribute with public authorities to reduce mobility inequalities in the city (interview 36 & 37).

An example of projects developed in Rotterdam via the Mobility Lab is myJINI, which stimulates behavioral change by rewarding users willing to avoid the traffic jams with either webshop credit, or earning back up to 30 percent of their insurance premium. Our interviewees shared that users found this project interesting and contributed to between 1000 to 1500 peak hour savings daily. It has nothing to do with employers. Furthermore, the platform won the Golden Wheel and was nominated for the 2014 Eurocities Award in the Cooperation category (Beter Benutten, 2018).

6.5.2.3. User involvement

The platform prides itself on having a user-centric approach (interview 10). The data supported this argument, as users were more comprehensively involved in designing platform activities. It started by conducting a survey of mobility needs among Rotterdam citizens, aiming to include a broader array of user-profiles than the typically surveyed white middle-aged male. Consequently, it identified that many inhabitants, especially those of other ethnicities, struggled with the above mentioned 'mobility poverty'. This approach can be seen throughout the development of the program. Early programs were primarily meant for car users. For instance, the program 'File Dier' to address traffic congestion was aimed (unintentionally) to a really specific group of young professionals, mostly ethnically Dutch between 35 and 55, who use the car for commuting to work. However, a new program was set to incorporate new target populations to reduce poverty in the city (interview 36). This can be seen in the 'mobility bank', where people on low incomes can get a bicycle free of charge. A central rationale for intervening in these underserved groups was to make them 'mobile' and integrate them in the Dutch economy, with the expectation of making them 'future users' of transport modes that they cannot use in the present (interview 36).

Rotterdam is the only example where we see citizens highly involved in co-creation. For instance, as part of an 'Algera' project, public parties invited social media users traveling over or living near Algera Bridge, which connects areas of Rotterdam, to share their experiences and innovative solutions for tackling the traffic jams on the city's bridges. The only limitation was that participants should not propose building another bridge or cable cars (interview 36 & 37). Over 100 users responded and around 30 ideas have been further developed (Beter Benutten, 2018). Nevertheless, the national government has been pushing for infrastructure expansion by building a new bridge or a tunnel. In 2019, the I&W ministry, the province of South Holland, the Rotterdam-The Hague Metropolitan Region (association of 23 municipalities) and the city of Rotterdam decided to collaboratively build an additional connection between north and south.

6.5.2.4. Outcomes

The interventions in the Rotterdam region aimed to improve accessibility to what policymakers call an "anti-traffic-jam" (Beter Benutten, 2018). They were not meant to hinder cars, but reduce rush-hour traffic and enable accessibility in Rotterdam South. This is important in the Dutch context, a few cities are as car-friendly as Rotterdam. Thus, the collaborative platform was able to focus on issues such as sustainability and social inclusion, and on underserved target groups, such as people on low incomes and from different ethnic backgrounds (interview 36 & 37). The spotlight on these groups was followed by new narratives and concepts on accessibility. They refer to "mobility happiness" as a way of dealing with transport poverty in certain Rotterdam suburbs. It is a having a different and broader perspective on mobility, that has to with social justice and inclusion (interview 37). In this way, user needs are incorporated in the BB program. These views were materialized in mobility hubs that, beyond having a transport function, also contribute to integration, wellbeing, and better social opportunities for minorities (interview 36 & 37).

6.5.3. Utrecht

6.5.3.1. Contextual factors

Utrecht is the fourth largest and fastest-growing city in the Netherlands, with 347,483 inhabitants (CBS, 2019). It has a unique geographical location in the center of the country, and is the major transfer hub for the Dutch railway network, with an average of 186,000 passengers every working day. Thus, the city experiences the biggest inter-city daily commute in the country: over one million people travel to

and from work there every day, and Utrecht accounts for 30 percent of the country's car congestion (Beter Benutten, 2018). Despite its central location and its prominent role for inter-city travel, the city has limitations in terms of mobility infrastructure. It has only one major railway ('intercity') station, Utrecht Central Station, lacks a subway system (interview 35), and some of the destinations attracting a large number of commuters, such as the University hospital and the Science Park, are not located in the city center. This is different from other cities, including the cities of Amsterdam and Utrecht.

The city has also some dynamics that are unique. The city is considered to be part of a "green province" with long-standing traditions of sustainability, left-wing and environmental politics. Moreover, the city is home to new young families and/or first starters, who relocated to the city because of its central location (interview 4). Finally, the city, as part of its demographic expansion, has major infrastructure works in the city. BB is not part of this infrastructure renewal, but rather a program to deal with the consequences of the city renewal (interview 34).

6.5.3.2. Organization

Utrecht has the most government-driven approach: the government first determines both the problem and the solution, which then outsources to private parties (interview 35 & 36). The city's approach to the BB program is governed by the I&M minister, the provincial executive and a company working on sustainability and climate adaptation. The BB program is composed of seven geographical sections, by which the policy interventions are organized. Thus, the projects work at a really local level with employers and other organizations based on their location (interview 38).

The city has a major employer network, called U15. Its name is based on the 15 initial employers taking part, although this number rose to over 200 in 2019 (interview 34). Together with this organization, other mechanisms were established to improve urban accessibility. For instance, in 2015, the "Goedopdeweg" (good on the road) network began promoting innovative projects to co-create new services for accessibility. Among the projects developed under BB, we also see some collaboration with organizations such as hospitals, schools, and universities (interview 12). As suggested by an interviewee (36), most of the cooperation between public and private parties is project-based, for this reason, the cooperation is less intensive than in the BB project of Rotterdam.

The BB program had some flaws. U15 suffered an internal 'crisis' due to the lack of both national government funding and follow-up to the prescribed policy goal (interviews 12 & 38). Thanks to being independent, this organization could create its own projects, without following BB guidelines (interview 12). This meant there was little contact with big corporations (interview 34). As the organization is facing a crisis, the government has stepped in to ensure mobility accessibility is achieved at a faster rate.

6.5.3.3. User involvement

The user involvement in Utrecht's program was traditional, in the way that it primarily relied on gather demographic information of target populations. This was done primarily by surveys asking about preferences and the need to switch transport modalities, e.g. "How likely are you to take a bike instead of a car?" (Interview 38). The focus was involving users in a unidirectional way, without seeking their input on co-creating mobility solutions. The surveys identified interesting target groups such as young families (the city's demographic growth is primarily composed of younger generations), but the number of activities involving them in accessibility measures was limited. The Utrecht program tried to influence behavior by negotiating contracts with public transport suppliers (interview 34) or encouraging the large student population to get on bikes. Other policy interventions were offering personal travel advice in the Science Park just outside the city.

6.5.3.4. Outcomes

The program aimed to solve congestion in the Utrecht region, particularly by reducing the number of cars during peak hours and promoting alternative travel options (Beter Benutten, 2018). Unlike the two previous examples, the case study on Utrecht shows that its policymakers wanted to provide locals with the societal benefits of a more sustainable and healthier urban environment. This impacted the type of activities sponsored by BB Utrecht, such as promoting faster public transport connections and improved cycle routes. Other measures stimulated parking outside congested areas to increase the use of public transport. The program "Kindje Onderweg" was created to help young parents choose suitable modes of transport for traveling with infants. This program emerged due to the dominance of the car as the preferred transport mode for traveling with kids (Kindje onderweg, 2019).

6.6. Discussion and conclusion

In this chapter, we analyzed three approaches for improving sustainable accessibility in the Netherlands via the national Beter Benutten program. By sustainable accessibility, we imply limiting car use and fostering greener and healthier modes of transport. The concept suggests a limited role of infrastructure measures to improve accessibility. Rather, it intends to make cities more accessible by a better use of infrastructure. We selected three cases that are part of the Randstad conglomeration: Amsterdam, Rotterdam, and Utrecht. These cases revealed that different approaches were developed for sustainable accessibility measures. To structure our findings, we propose to look into four aspects of sustainable accessibility: contextual factors, organization, user involvement, and outcomes. We would like to discuss our research findings along these categories.

For practitioners and academics alike, our case study reveals interesting dynamics in implementing interventions for urban accessibility. A 'one-size-fits-all' approach is not sufficient for achieving sustainability, as each region has a legacy and conditions to consider. This legacy is not just in terms of physical conditions, but also in the ways in terms of organization and institutions. We found that, to a large extent, the ways in which parties used to cooperate defined the approaches towards accessibility in our case studies. Furthermore, we identified that this legacy is not the only source of explanation, but that accessibility measures depend on the expectations and values that policymakers have regarding sustainability. Even though we found reasons to believe that Rotterdam offers the most advanced sustainable accessibility approach out of our three cases, it is not to say that it is better. Each city prioritizes different outcomes: Rotterdam prioritizes inclusivity and social justice; Utrecht, the built environment and quality of life within the city; and Amsterdam, with limited room for maneuver due to a high percentage of non-work-related commuting, better traffic management of groups that cannot be influenced by traditional behavioral change programs.

The type of priorities and limitations defined the structure of the programs in each city. On one extreme, Amsterdam worked under a primarily technology-fix and traditional market-driven approach, while on the other Rotterdam worked on experimental approaches for improving the accessibility of the city. We found, moreover, that the way in which Rotterdam is organized is radically new, and learning from that case could foster similar policy implementation in other cities dealing with sustainability issues.

Regarding users, we identified that, despite their central role in policy changes, they are limitedly engaged meaningfully for improving accessibility. We believe that Amsterdam and Utrecht may have developed better approaches for reaching users are a source of information for developing solutions, and that Rotterdam is the most progressive example of user involvement. Rotterdam has a more open-ended and inclusive survey of targeting a broader array of users and identifying their needs, rather than asking for their feedback on pre-given solutions (using sharing bicycles). However, we are still far away from actual co-production, and more meaningful ways to incorporate users could be developed. This case also highlights the importance of policy priorities of decision-makers in achieving sustainable accessibility: Without any actual mandate, the Verkeersonderneming organization looked forward to working with vulnerable populations to improve their access to the city. This type of actions is expected to give a prominent result in the future.

Our research highlights that the four conditions we proposed are interrelated. For example, in the city of Rotterdam we saw that contextual factors (e.g. having an infrastructure for facilitating car commuters, having stable and creative management) have influenced the policy accessibility priorities (focus on quality of life), which have, in turn influences their user involvement approaches (co-creation), organization (collaborating with private parties in a creative way which gives them a lot of freedom and requires a minimal amount of public money investment), as well as their outcomes (e.g. establishing the bicycle bank to reduce “mobility poverty”).

This research aims to go beyond a traditional assessment of accessibility measures, but rather focus on the outcomes that each sustainable accessibility policy program intends to reach. It should be acknowledged that, despite this focus, we found limited rigorous assessments to compare the outcomes of these regions in terms of actual impacts in travel behavior. We should stress that this lack of data negatively affects which programs provide the greater effects in terms of the number of beneficiaries and actual impact in the mobility system. However, learning from these experiences can illuminate how innovative approaches towards accessibility can be organized and implemented. In this way, we contributed to a better understanding of contemporary transport policies aligned with sustainability goals.

7. Conclusions

This dissertation explored to what extent the Dutch smart mobility policy can be considered transformative innovation. With this goal, I aimed to identify how the emerging paradigm of transformative innovation guided smart mobility policy and governance, in terms of instruments, organization, and policy processes. Policy sciences literature played a key role in this research, enabling us to identify similarities and discrepancies between the theory and practice of transformative change, and consequently provide policy recommendations and avenues for future research.

This final chapter contains a summary of our findings for each of the chapters (7.1.), followed by responses to the research (sub)questions based on these findings (7.2). Section 7.3 encompasses the theoretical contributions of this dissertation. Section 7.4., the policy recommendations. Section 7.5, the research directions. This work ends with its scientific contribution (7.6) and limitations (7.7).

7.1. Summary of results

In chapter one, I showed that societal demands, described as 'societal challenges' or 'sustainable development goals', have gained prominence in innovation policy. Societal demands have exposed the deficiencies and limitations of current innovation policy and governance and call for a new generation of policy designs, referred to as 'transformative innovation'. Chapter one presents the theories that inform transformative innovation (transformative change and mission-orientation) and the governance challenges in the literature. It also outlines the research question, research aims, and methodological approaches.

Chapter two examines the impacts of adopting the transformative innovation approach on policymaking. We analyzed transformative innovation as an emerging policy paradigm as coined by Hall (1993), who states that a new paradigm will lead to a radical change in all policy dimensions. In order to study a paradigm shift, a literature review of innovation policy enabled us to develop a conceptual framework with five dimensions: overarching policy goals, interpretative frameworks, intervention rationales, strategic tasks, and policy instruments. In our view, a paradigm shift should see a change in each dimension

of this framework. After applying this framework to the Dutch smart mobility policy, we found changes in all the dimensions, proving that a paradigm shift was taking place. Chapter two shows that the transformative innovation paradigm, and particularly socio-technical transition thinking, made smart mobility policymakers consider innovation policy in a different light. They increasingly considered smart mobility in terms of a transition, for which new tasks, rationales, and policy instruments had to be developed. The dimensions overlapped and complemented traditional approaches to innovation policies, so much so that we identified the emergence of exemption procedures and intermediary organizations to achieve policy goals.

From chapters three to six, we zoomed into smart mobility policy subcases to discover more about the governance and policy processes of transformative innovation. In chapter three we examine directions, using the automated vehicle (AV) initiative as a case study. We investigated who determines these directions and how, by applying the Multiple Streams (MS) framework (Kingdon, 1984). MS is applied to study the role of institutional entrepreneurs in determining directions of policy change, suggesting that these directions will be aligned with entrepreneurs' self-interests. We found that policy entrepreneurs skillfully framed AVs as a potentially transformative innovation, leading to their prioritization in policy circles. By looking into institutional entrepreneurs as sources of policy change, we exposed the limitations in direction-setting for overall smart mobility policy. Entrepreneurs were not able to internalize societal demands, thus reducing the original focus on the transformative potential of smart mobility technologies, including AVs. The direction set by entrepreneurs was business-oriented, resulting in a limited focus on other promising (e.g. MaaS) innovations. This is in sharp contrast with the findings in chapter two, where we identified that smart mobility was a broader transition than just personal vehicles. However, as time went by, smart mobility policy increasingly focused on vehicle automation.

Chapter four explores AV governance in terms of policy coordination. AV governance is challenging as it was developed in what Hajer (2003) called an 'institutional void', not fitting in with classical institutional structures and requiring policy learning and novel arrangements. We applied the Policy Regimes perspective (Jochim & May, 2010) to study this void, proposing cross-boundary arrangements as a solution. The framework has three core concepts (ideas, institutional arrangements, and interests), that function as a glue for effective AV policy

implementation. The regime is typically a central narrative aiming to capture the societal potential of AVs and place the Netherlands as a frontrunner in this field, which paved the way for a regime-like governance arrangement. The ministry of I&W played a key role in supporting this regime. Despite having varied institutional structures for stakeholder collaboration, the regime was eroded due to inflated expectations, external political changes, and lack of 'next steps' for achieving AV goals. We can draw lessons about the pros and cons of a regime approach for emerging innovations. A regime does not account for the changing ideas that go hand in hand with technological development (e.g. fluctuating actors' expectations, changing coalitions of policy participants), nor how expectations and changing interests unfold over time. This is in sharp contrast with the sociology of expectations, which considers technology ideas as mutable and performative (Borup et al., 2006).

In chapters five and six, relating to the demand articulation failure, we examine the Beter Benutten (BB) program. This was set up to improve the accessibility of the most congested regions in the Netherlands through behavioral change. We reflect on the various implementation approaches to new mobility services and products that emerged under this program. In chapter five, we look at who benefitted from transformative innovations through the 'connected bicycle' programs in the southern province of Brabant and in Maastricht. We see two different approaches whereby policymakers prioritized policy interventions based on local conditions and stakeholder involvement. While the Brabant case had a more technically advanced approach (the technology selected was easier to use), the Maastricht case put more emphasis on social innovation.

Despite these different approaches, in both cases car users benefitted the most from the connected bicycle schemes, perpetuating mobility disadvantages for students and other social groups. To make room for car-commuters shifting to cycling, policymakers incentivized changes in underserved groups' mobility patterns. Groups such as students and cyclists had limited financial incentives for aligning mobility behavior with sustainability. We identified difficulties for policy implementation in terms of reaching target populations and lack of financial incentives, which was solved with higher involvement of market parties.

The final sub-case chapter (six) discusses how the BB program to achieve sustainable accessibility was carried out in Amsterdam, Rotterdam, and Utrecht.

These three cases, with their different approaches, priorities, and organization of innovation policy initiatives, demonstrated novel ways to target groups that could benefit, and explained how accessibility interventions can be aligned with societal and environmental values. They also highlighted the emerging roles of market parties in co-creating and co-designing transformative innovation. Certain ideas influenced the BB outputs: while Rotterdam had a strong focus on transformative innovation and its societal potential to address issues such as mobility poverty, Amsterdam had a more technologically-driven approach and mobility poverty was not a consideration. Each case shows the advantages and disadvantages of different ways of organizing policy implementation.

7.2. Answers to the research questions

The research question I address is: *To what extent is Dutch smart mobility policy an example of transformative innovation?* I show in chapter 2 that this policy does relate to the transformative innovation approach. Although the findings in chapters 3-6 reinforce this view, the case study reveals characteristics that are not fully in line with this approach. I respond to the four-sub questions below before returning to the general research question.

RQ1) What and how do novel ideas present in the Dutch smart mobility policy resonate with the transformative innovation approach?

The Dutch smart mobility policy certainly incorporates ideas that echo the transformative innovation approach: a societal-challenge oriented policy with potentially transformative outcomes, promising to radically change how the current mobility system operates. The most significant aspect of transformative innovation in our case study is the concept of "transition". Smart mobility was initiated as a transition-oriented endeavor. Although transition policies are not new in the Netherlands (for the Dutch energy transition, see Kern & Howlett, 2009), there was no precedent in the mobility sector. Transformative innovation ideas worked as 'grand narratives' that organized and generated coherence and momentum for smart mobility. The policy was framed as societally and economically relevant for the Netherlands, inviting multiple parties to 'jump in'. Thus, the narrative had an instrumental function, encouraging legitimacy and generating support for developing smart mobility in the country.

Transformative innovation ideas also informed policy design and implementation. These ideas enabled policymakers to define policy issues, shape

actions, and formulate potential solutions, in other words, 'make sense' of the new policy realities of smart mobility. We see how ideas were used to interpret the policy and to gain an implicit understanding of innovation processes for a transition. Consequently, terms like 'socio-technical innovations', 'market formation', 'niches', 'transitions', 'upscaling', etc., became part of this policy's everyday language. Moreover, they guided policy implementation in multiple ways, for instance by acknowledging that implementation should explicitly recognize the numerous aspects of the current mobility system that needed to be changed. Institutions were established that resonated with this language, e.g. Connecting Mobility (chapter two) working on innovation niches and as intermediaries (Kivimaa et al., 2019). The aspect of socio-technical orientation is visible in the program Beter Benutten, influencing travel behavior (chapter five), and in the DITCM round tables dealing with cooperative transport and connected-automated driving (chapters two and three).

Our case study also suggests that policymakers address the four transformational system rationales proposed by Weber & Rohracher (2012): directionality, demand articulation, policy coordination, and reflexivity. These rationales were considered part of public action in smart mobility policy, although reflexivity was found to be of only minor relevance for policymakers (I return to this issue in RSQ4). The focus was on experimentation and broadening innovation policy, also seen as part of the policy's normative turn.

Another policy aspect we identified, and which has not been explored in-depth, is the alignment of societal and economic goals. We noted major tension in that innovations which are societally desirable do not necessarily have the "right" economic incentives (e.g. support from business actors, profitable margins). As seen with AVs, business interests dominate societal ones, limiting the transformative potential. We show in chapters five and six the role public officials can play in aligning innovation's societal and economic goals. To do so, policymakers have to participate differently in innovation processes (e.g. as watchdogs of societal values) and incorporate market parties in different ways (as facilitators or intermediaries between producers and end-users of innovations).

We see that policy prioritized different social values and provided different advantages depending on the scope and governmental level. The overall policy highlighted the three societal goals presented in chapter two. At the local level,

policymakers adapted societal goals to suit the conditions in each region. We see this in BB, in which each program attached different values and concepts (e.g. quality of life) to sustainable accessibility. These goals guided policymakers' decisions by mapping technologies' potential societal applications. As suggested throughout these chapters (especially chapters two and six), the linkages between societal goals and innovations were developed on an ad-hoc basis, almost discretionally by policymakers. For instance, policymakers evaluate ex-ante the potential benefits of smart mobility technologies, without clear guidelines or formalized methods. This approach has drawbacks: first, as shown in chapter three, policymakers may be subject to 'political manipulation' by institutional entrepreneurs. Thus, evaluations may be biased in favor of solutions that are framed as transformative to fit policymakers' criteria. Second, informal methods make assessments difficult to replicate, limiting policy learning and the diffusion of evaluations.

Both strands of the literature, transformative change and mission orientation, feature in the case study. However, transformative change seems to be used more as a model at national level (and as overall policy structure). Mission orientation, on the other hand, features in policy niches such as AVs. The two streams work simultaneously in our case study but in different geographical dimensions.

RSQ1) What kind of new policy instruments have these novel transformative innovation ideas in the Dutch smart mobility policy led to, and how?

Our response to RSQ1 shows that transformative innovation guided the design and implementation of the smart mobility policy. However, it remained unclear how to instrumentalize some of the concepts. The literature suggests that traditional instruments do not work well for transformative goals, and our case study confirms this. Policymakers needed to develop new instruments to meet the policy's transformative potential, by finding new ways of involving market parties, and socio-technical policy instruments to enhance learning (e.g. via legal exemptions). We also identified familiar instruments in traditional innovation policies such as scenario studies, foresight exercises, transition pathways, and roadmaps. The main difference, between the old and the new instruments, is that the old ones assessed

the future impacts of innovation on society, whereas the new ones put more emphasis on enhancing socio-technical change.

This mix of old and new instruments corresponds with the transformative innovation literature. It demonstrates a significant implication of adopting transformative innovation approaches, namely the limited blueprints for developing new instruments. This invited policymakers to improvise and experiment with new tools to achieve the desired outcomes. As there are too many to mention, we highlight just two key features of new policy instruments: they increasingly favor socio-technical change, and are increasingly 'soft'.

Regarding policy instruments' socio-technical change orientation, they were developed to directly impact the societal configurations that hinder the emergence of novel smart mobility innovations. Consider the behavioral change programs (Beter Benutten) to induce changes in user practices or the exemption procedures for modifying vehicle legislation. These instruments worked as 'sandboxes', in which policymakers tested new ideas, played with potential socio-technical configurations, and observed their impact in real life. Sandboxes are not recent developments, having been used for emerging technologies such as fintech. However, sandboxes are usually meant to enable legal changes. Our case study suggests that their role in transformative innovation goes further, addressing different dimensions of a socio-technical regime (e.g. institutional arrangements). Further work should be done to determine how policy instruments can empower niche innovations in these environments.

The second characteristic, instruments considered soft, emerged because by encouraging participation and deliberation, soft instruments allowed interested parties to engage in this policy. We found no coercive instruments for encouraging socio-technical changes as they all aimed to facilitate change through voluntary agreements that were not legally binding. These instruments were applied to address the transformation as follows: for directionality, transition pathways and roadmaps were used; for demand articulation, exemption procedures and legislative changes were encouraged; for policy coordination, new platforms for collaboration, as well as multiple informal mechanisms for deliberation were established; and finally, consultation and stakeholder engagement arenas were set up to give the innovation process reflexivity.

RSQ2) What novel ways of organization have been developed to translate transformative innovation ideas into action in the Dutch smart mobility policy?

A key feature of smart mobility policy that resonates with both the mission orientation and transformative change literature, is the strong focus on problems which innovations are expected to solve (Mazzucato, 2018a; Weber & Rohracher, 2012). Thus, policymakers focused on the mobility system issues that they assumed technology would solve (private transportation, freight transport, etc.).

In line with the literature, we found that the innovations which this policy aimed to implement did not correspond with the mobility system's original institutional structure. As there was no department or organization working on mobility innovations such as vehicle automation or connected bicycles, these technologies required cross-boundary collaboration, for which new institutional set-ups were arranged. We observed new modes of collaboration emerging, both for AVs (see chapter four) and behavioral change for adopting new technologies (chapters five and six). Collaboration could be seen in policy regimes, but also in new public-private partnerships, and organizations such as Connekt or Connecting Mobility offered new institutional arenas for smart mobility policy (chapters two and three).

These arenas demonstrated a dual relationship between public and private parties: while the policy was developed under the firm ministry of I&W leadership, it also enabled strong market involvement. From a transformative innovation perspective, this involvement exemplifies the new modes of collaboration, deliberation, and participation by non-state actors in the design and implementation of transformative innovation policies. In short, I&W seemed to have the moral leadership and political authority to enable a smart mobility transition, working as an enabler or facilitator for transformative innovation. However, to devise the policy's content, such as innovative programs and supporting projects, the ministry increasingly relied on market parties. In chapters two and three we describe the routes that market parties provided for decision making, then chapters five and six explain how market parties enabled policy implementation.

This public-private approach led to novel governance arrangements aimed at 'bringing in' the expertise of market parties that public authorities lacked. The

Five November Group and DITCM, as well as the AV regime's openness to private parties' perspectives, are examples of this need for private sector expertise. However, private parties did not just design policies, but also implemented them. Evidence of this is the market parties' key role in connecting users with producers in the BB program. In chapters 4 to 6, we show how incorporating market parties in smart mobility raised issues of equity and justice (which remained unaddressed throughout the policy's implementation phase). Market parties may gain societal benefits from implementing smart mobility solutions (as shown in the Rotterdam Zuid community centers, see chapter six). However, our closer look at smart mobility's winners and losers reveals that market parties do not always work in the public's best interest; potential bias and distortions require a more active state role.

This novel way of organizing innovation policy saw the emergence of a new role for public institutions: they barely participated in shaping decisions, and only intervened when the public value of smart mobility innovations was at stake. Thus, in this way, the leadership of I&W was political and administrative, but more limited in informing and creating knowledge about smart mobility. This is palpable throughout the chapters, explicitly confirmed by interviewees in chapter two, and corresponds with the role government authorities were expected to have in AV development. However, *how* these authorities can guarantee public value is an understudied question, and belongs on a future research agenda.

We can take a closer look at the organizational structures created for smart mobility policy. The case study shows that platforms such as Connecting Mobility, or test-sites such as the Innovation Central, formed a bridge between players and joint initiatives. Connecting Mobility is a relevant intermediary because it was expected that joining up initiatives would speed up the transition to smart mobility. Moreover, as shown in chapters two, four, and five, public authorities contributed to the innovation process, adding assets and capacities that market parties cannot provide alone, such as organizing collaboration among competitors, facilitating infrastructure for tests, or enabling changes in legal frameworks.

The new approach to organizing smart mobility policy raises a general query about which structures managed to align societal and business goals. We found that the structures for mapping the societal potential of innovation worked (e.g. Connekt), along with the collaboration for sustainable accessibility (chapter six). What is not known, however, and is therefore an area for further research, is

how to maintain the alignment of societal and economic goals in the long term. In chapter three we suggest that a weak point with the AV policy emerged during its implementation. Although it was possible to align the societal and economic benefits of AVs in the early stages, it was impossible to maintain this alignment over time.

RSQ3) How do the practice of the Dutch smart mobility policy and the theory on transformative innovation relate to each other, and what can we learn from them?

Throughout this work, we identified that smart mobility policy in the Netherlands resonates with, but does not fully replicate the transformative innovation policy literature. Right from the start, we assumed there would be differences between theory and practice, giving us the opportunity to reflect on and learn from them.

As suggested in the literature, the transformative innovation paradigm has not fully replaced the Innovation Systems and Neo-Classical approach. The strong influence of the Innovation Systems approach is still visible in our case study, suggesting that these two paradigms may co-exist in the future. It would then be necessary to explore the linkages between them, whether they work in parallel or in opposite directions, and how they affect achieving societal and economic goals in practice. Moreover, having two paradigms simultaneously implies the need for developing new modes of governance.

In terms of similarities, we found that the policy echoes the need to open up the innovation system to new players, define new modes of governance, and expand users' roles, along with new state roles for transformative innovation. In short, the case study resembles aspects of the new generation of innovation policies (see sections 1.1. and 2.3). We did, however, observe that this policy is not as transformative as the literature suggests. For instance, although the chapters on the BB program describe new and different modes of user involvement, these modes are not as 'meaningful' as the transformative innovation literature would advocate. Similarly, in chapter six we show that, despite a user-centered narrative, users had limited say in the design of innovations to improve accessibility. Indeed there is a mismatch between the rhetoric of transformative change and its use in practice.

Other aspects of the policy confirmed what we call a lack of intensity in adopting transformative innovation. We discovered that the public sector only financed a limited amount of smart mobility innovations. This may be down to new modes of governance for transformative innovation (see RSQ 2), or reluctance on the part of public authorities to become risk-takers by offering financial incentives for a socio-technical transformation. The literature suggests that societal consultation is a core function for state authorities. However, we observed that this consultation was limited to organized interests, thus restricting consulted parties' scope, and there was little end-user involvement in the policy.

We found certain aspects of the innovation policy that had not been developed in line with the transformative innovation literature. Evidence is the public financing of innovation, which played a less prominent role than expected. However, during the policy's implementation, other public sector assets became essential. These were the state's non-financial assets that innovation actors need to achieve transformative change (e.g. coordination, infrastructure, etc.). Such assets featured prominently in our case study, where we also observed a strong technological orientation to smart mobility. Although transformative change is about socio-technical innovations, technological innovations were ultimately technologically-driven, possibly thanks to technology's prominent role in economic growth. This also indicates a discrepancy between the theory and practice of transformative change (Schot & Steinmueller, 2018). As framed in chapter two, orienting innovation policy towards societal challenges does not directly tackle but rather contributes to tackling societal challenges. Thus, transformative innovation policies such as in our case study need to find the right balance between societal and economic goals.

Smart mobility policy seems to address all the transformative system failures described by Weber & Rohracher (2012). However, actions to overcome reflexivity failure are only present to a limited extent in the case study. This may be the case, as suggested earlier, due to tension between societal and economic goals. Reflexive approaches were actually "off the table" in technologies such as AVs. This may be due to the lack of support from public authorities to set up arenas for addressing reflexivity. In contrast with the rationales of directionality, policy coordination, and market creation, the reflexivity failure was harder to address due to the policy's short time-span.

In summary, we can identify differences between the case study and the transformative change literature: First, the policy is less ambitious than how scholars conceptualize transformative innovation. Second, smart mobility is highly technocentric compared to the transformative change literature. Finally, the policy is less normative than what the reader would expect from academic accounts. Even though these three differences suggest a deviation from the academic literature, the responses to sub-questions 1, 2, and 3 indicate that transformative change framings (in terms of processes, areas of policy intervention, types of instruments, actors, how to safeguard public value, etc.) were present in Dutch smart mobility policy.

Returning to the research question of:

RQ1) To what extent is the Dutch smart mobility policy an example of a transformative innovation policy?

I can conclude that the Dutch smart mobility policy clearly echoes the transformative innovation approach. We observed that new framings, theories, and ideas about innovation policy aligned with transformative innovation, resonate with our case study. Evidence of this novelty is in the experimental and innovative approaches that policymakers developed. Moreover, we can see smart mobility as a practical example of deviating from a normative view of transformative change. Thus we observed a strong focus on smart mobility's economic potential, a robust technological approach, and a less normative stand on achieving policy goals.

7.3. Theoretical implications

Acknowledging that the Dutch smart mobility policy can be considered as an example of transformative innovation, we can draw implications for the theory that could go beyond our case study (even though this project was bounded to the Netherlands).

This dissertation showed how innovation policy scholars can learn substantially from the policy sciences discipline. Particularly, as this work exemplifies how contemporary innovation policies are becoming increasingly political. This is in sharp contrast with the technocratic governance that has dominated innovation policy. In our case study, this can be seen in the decisions and the implementation phase, that did not unfold purely on a technical basis. In contrast, decisions were based on values, beliefs, and ideas that decision-makers had about the innovations they supported and future expectations. These non-

technically motivated policy choices seem to show how innovation policy is getting closer to domains such as health, in which, despite its largely technical basis, decisions can follow different logics (e.g. constituencies, economic interests, etc.).

What can also be observed throughout this dissertation is how innovation policy is becoming an increasingly ambiguous policy field. Particularly in chapter two, I discussed how the scope of innovation policy broadens substantially. By broadening the scope of innovation policy, policymakers are largely blurring the boundaries of innovation policy. This move may be dangerous, as even though it may reflect an issue-orientation as suggested by transformative innovation scholars, it goes against the logics of accountability and jurisdictions that prevail in the public sector. For instance, as seen in chapter three, know party became accountable for the failure of the AVs initiative. Overlapping jurisdictions seem to be present also in chapter 6, in which for addressing accessibility measures several parties came together.

Such a level of undefinition has strong implications for policy and governance. It was found, as shown in chapter 4, that the dismissal of the policy in 2018 did not come with any investigation of its failure (e.g. in terms of parliamentary inquiries). Even though this may sound anecdotical, it is difficult to learn lessons from this case study for future similar initiatives. Failure is a critical source of knowledge in which innovation policy scholars require to engage more. It can shine a light on the tensions, incompatibilities, and incapacities of the public sector to deal with transformative innovation.

A final theoretical remark, that I observed throughout the chapters, is that the concept of transformative innovation does not necessarily travel well to practice. The level of ambiguity of the concept of transformative innovation -not in its negative connotation, but rather as a concept indicating that it allows multiple interpretations- makes it extremely prone to discursive strategies. In this context, decisions are made on the capacity of policy actors to convince other actors about their preferred solutions. This has been explored in detail in discursive institutionalism (Carstensen & Schmidt, 2016; Schmidt, 2008). In short, this approach may indicate that new ideas, in order to become part of the policy circles, require to be institutionalized, and this institutionalization will depend on who has better resources, e.g. access to policy venues, narratives, and so forth. This was shown by Blyth (2001) who found that in the adoption of economic liberalism in the 1970s, ideational factors of decision-makers -and those with access to them- resulted in different new institutional settings. Nevertheless, it is worth mentioning that these situations oblige us to mobilize theories on institutional change to ‘make

sense' of the implications of the adoption of this paradigm in practice. What remains to be seen in how transformative innovation is adopted in policymakers circles is the interplay between ideas and institutions shape the adoption of transformative innovation. Previous studies in the field of political science and international relations have dealt with this issue (e.g. Goldstein & Keohane, 1993; Campbell, 2004).

All of these arguments, together, are strong claims to further unpack the 'politics of policymaking' of transformative innovation. It is not sufficient only to acknowledge that innovation is becoming increasingly politicized (following more political dynamics) and political (closer to the politics realm). We require, in contrast, more systematized studies on this topic.

7.4. Policy recommendations

Four recommendations can be derived from this work, regarding the design and implementation of innovation policies with transformative aims: First, policies should be oriented to issues, which can potentially be achieved by giving a ministry of the socio-technical system in question (such as I&W for mobility) a leading role. Second, transformative innovation policies require institutional capacities and political leadership as we observed in our case study. Third, transformative innovation policies could benefit from - unlike the case study - more ambitious transformations. Finally, this type of experimental policies should be better documented.

Regarding the first recommendation, we found that the issue-orientation in our case study was possible because of I&W's central role in the mobility system. Without its support, the initiative would probably not have such scope or gained such considerable momentum during implementation. Other policies could benefit from a similar issue-orientation, and a ministry taking the lead, like the I&W ministry for smart mobility, would enable the legal competencies, capacities, and institutional structures that are required (or could be developed) for a socio-technical system. These competencies are not the traditional ones we would expect to see in ministries regularly leading innovation policies (e.g. Economic Affairs), but relate to the functioning of a socio-technical system.

Our second recommendation concerns the ministry's role. Transformative innovation policies require institutional capacities and political leadership. In the case study, we demonstrated the advantages of I&W's political leadership in

transformative innovation policy, particularly for mobilizing resources and generating momentum. This capacity, which enabled active implementation, was seen primarily from 2013 to 2018. What is more, institutional capacities and political leadership seem to go together. The institutional transformation was enabled by political leadership, and this leadership required institutional capacity. Thus, policies dealing with transformation may benefit from similar approaches. However, we have to keep in mind that political leadership has a downside: the changes to the I&W ministry in 2018 had a considerable impact.

Third, transformative innovation policies can be more ambitious than in the case study. Intended to meet societal demands, the smart mobility policy was not entirely clear on how to achieve a system transformation. It also limitedly addressed the societal goals which by law are the I&W ministry's responsibility. The policy could have benefited from a more ambitious agenda addressing societal challenges, and a stronger focus on concrete outputs. Output legitimacy would benefit transformative innovation policy and have a greater impact on society. It could also allow more rigorous and systematic approaches to designing and implementing projects. Something we did not observe in the policy, was the aim to build upon previous experiments or projects. Policymakers seemed to only learn a limited amount from previous policy experiences.

These three recommendations point out that innovation policy should be designed and instrumentalized in a different way. In particular, we observed that, throughout this dissertation, policymakers were constantly facing collaboration and cooperation challenges. Almost all the instruments identified in chapter two, and which are developed in the following five chapters, are dealing with these issues. More attention should be given to expanding the portfolio of instruments that are used to influence the innovation process.

A final recommendation is that these initiatives should be better documented. There was no concrete intention to systematize the knowledge produced. After 2018, most information on its actors, institutions, and approaches is impossible to retrieve. This is really negative for policy learning, as its approach may be used in the future to study "what went wrong" with this policy with transformative aims. For this reason, in setting up these policies, policymakers should also consider a better systematization of the activities, approaches, and knowledge produced, that could help similar initiatives in the future. If a similar

policy is set up in ten years, policymakers would have limited capacity to look back at this experience.

7.5. Research directions

This study highlights several avenues for future research. First, by presenting the connections between theory and practice, this dissertation highlights the tensions that emerged from adopting a transformative innovation approach in policymaking. These tensions occurred due to the mismatches between the old and new paradigm, as well as institutional inadequacies in policy implementation (for which, in the case study, new institutions were set up). These tensions should be explored and further developed. We believe this should be researched as in countries adopting transformative innovation approaches (e.g. recent mission-oriented Top Sectors in the Netherlands, High-Tech Strategy in Germany), are following a similar strategy, namely aligning the traditional economic scope of innovation policy with transformative innovation ideas. A central inquiry for future research is how to reconcile the tensions from two frameworks that prioritize different aspects of the innovation process.

Secondly, this work also shows the role that public officials and bureaucracies play in transformative innovation policies. The case study highlights their level of discretionality and leeway for translating transformative ideas during public implementation. We believe that more attention should be given to generating adequate capacity in public servants to respond to the demands of transformative innovation. In this respect, looking into contemporary studies on governance and policy capacity can shine a light on how to foster an adequate policy implementation strategy.

Finally, the approach we presented shows the advantages of applying insights from policy studies to the innovation field. Urgent points for future research are policy learning and policy diffusion for transformative innovation. So far, a limited amount of studies has pointed out how new transformative ideas are adopted in different policy circles, and what type of activities can induce learning and diffusion of such ideas in the future. Other similarly relevant aspects for transformative innovation are studies on instrumentation, agenda-setting, and policy evaluation.

7.6. Scientific contribution of this dissertation

This dissertation contributes to contemporary research on transformative change as it aimed to apply concepts and framings developed in the transformative innovation literature to a real case study, from which we can draw policy implications and discover what type of changes in policy this approach achieves. The case we took as starting point improves our understanding of what the transformative change approach looks like in practice, and provides lessons on how to adopt such an approach (see sections 7.3. and 7.4). We unravel the mismatches between theory and practice that should work as a starting point for future research.

This thesis also contributes to the literature regarding more focus on transformative innovation policy processes, which has been extensively called for as a direction for future research (Kern & Rogge, 2018; Köhler et al., 2019). It also shows the benefits of applying policy sciences theories to innovation policy, because they can better explain the policy processes and dynamics of transformative change. In this way, this research echoes similar attempts performed in the fields of innovation and transition to study policy as a process.

Additionally, this thesis contributes to mobility studies. Even though there have been multiple studies of innovation policy in the mobility field, the reduced focus has been given to the role of smart technologies in addressing societal challenges. This dissertation also revealed the characteristics of the Dutch approach towards smart mobility in the Netherlands. We also paid attention to the changes at a systemic level. Few studies at a system level have been developed in the field of innovation policy until recently, as scholars have prioritized studies at a project level.

7.7. Limitations

This research has limitations regarding its exploratory nature and choice of an in-depth one-case study. The aim was not to provide an exhaustive view of several cases, and the findings cannot be generalized to other areas. The case study could have considered institutional and organizational structures in the Netherlands that other democratic systems do not account for. Similar one in-depth case studies could reveal these potential limitations, and reveal different ways of organizing transformative innovation policies.

Moreover, the reader should acknowledge that smart mobility may not be the most representative case and that the findings of this dissertation may not be replicated in other contexts. However, this is a weakness of case-based approaches like the one I explored in this work (cf. Beach & Kaas, 2020). The specificity and uniqueness in which this project unfolded makes this dissertation, as its best, research with exploratory aims. As stated in the introduction, this work should be analyzed in this way.

This thesis has also limitations in terms of its set-up. Smart mobility was an ongoing development when this research project began, limiting access to data sources. In addition, policy changes since 2017 have reduced the focus on smart mobility in policy circles, abruptly diminishing the established transformative policy aims. This is primarily seen in the recent political dynamics developing after the appointment of the new minister of I&W.

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Summary

In recent years, we have witnessed how societal demands have become central drivers for innovation. This orientation towards societal challenges demands a new generation of innovation policies, as the current one does not fit the requirements of such endeavors. While current policies have a primarily economic focus, societal challenges require a new role of the state to articulate societal demands and to achieve societally desirable outcomes.

This novel generation of innovation policies, which has been labelled as 'transformative innovation', raises questions about how to design, organize, and govern policies, with few answers in sight. In short, it requires to 'rethink' how innovation policy looks like. Even though answers to these questions have been proposed in academic literature, they mostly have been developed as theoretical contributions, with limited insights for practice. This thesis aims to address this gap, by using the smart mobility policy as a case of transformative innovation. This policy was initiated in 2013 by the Dutch Ministry of Infrastructure and Water Management (I&W), to enable a 'smart mobility' transition. It resonates with the transformative innovation approach, as it intends to position the Netherlands as a frontrunner in this technological field while simultaneously address three societal demands: quality of life, accessibility, and safety.

This dissertation aims to explore to what extent is the Dutch smart mobility policy an example of transformative innovation, and what we can learn from it. For doing so, I mobilize policy sciences frameworks and theories, which have been used to study policy changes in practice, and reflect upon their impacts for policy design, implementation, and governance. This work follows an 'embedded one-case study design', in which the overarching case study (smart mobility) is complemented with two sub-cases (automated vehicles and smart mobility behavioral change programs). Data was collected by more than forty interviews and by primary documents. Interviewees vary in terms of backgrounds, expertise, and functions.

The findings indicate that smart mobility can be considered a transformative innovation policy. However, it was identified that several tensions emerged as the result of putting the transformative innovation framework into practice. It was found that policymakers use new frameworks to understand innovation policy, followed by new modes of governance and organization of innovation processes.

This research also shows institutional arrangements and novel policy instruments that have been used in practice to orientate innovation processes towards societal challenges. However, this thesis also describes the tensions between the economic and societal goals of this policy. The dissertation shines a light on the role of market parties in the new organization of innovation policies. These parties, by innovative approaches, are increasingly participating in delivering innovation, but they are unable to fully internalize societal demands. This research also shows how and why innovation policies with transformative ambitions could not fulfill their original ambitions, the differences between theory and practice, and provides useful avenues for further research.

This work contributes to the field of innovation studies. First, it adds to the recent interest in this field to mobilize policy sciences insights to better understanding the policymaking processes. Second, by focusing on a case study, it shows in detail how transformative innovation policies could be designed, organized, and governed in practice. Third, it provides insights on theory that may require refinement, as well as recommendations for societal-challenge oriented policies.

Curriculum Vitae

Edgar Salas Gironés (Mexico City, 1988) obtained his bachelor degree in International Relations at the National Autonomous University of Mexico. During his bachelor studies, he obtained an excellence scholarship for an exchange program on Political Science at the University of California, Riverside. Edgar also worked in NGOs and research institutes during his time in Mexico. In 2013, he also obtained an excellence scholarship to study a MSc in Innovation Sciences at Eindhoven University of Technology.

In 2015, Edgar started the PhD program in Innovation Sciences at Eindhoven University of Technology, in the topic of innovation governance, focusing on smart mobility in the Netherlands. His project was supported by the Dutch Ministry of Infrastructure and the Environment. He has presented in international conferences and remained an active member in public policy associations. His research has appeared in Science and Public Policy and a book of the OECD-ITF research day on Governing the Smart Mobility Transitions. Since 2020, Edgar works at the Fraunhofer Institute for Systems and Innovation Research (Fraunhofer ISI).

List of publications

Salas Gironés, E., van Est, R., & Verbong, G. (2019). Transforming mobility: The Dutch smart mobility policy as an example of a transformative STI policy. *Science and Public Policy*, *46*(6), 820-833.

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Manuscripts:

Salas Gironés, E., van Est, R., & Verbong, G "The role of policy entrepreneurs in defining directions of STI policy change: A case study of Automated Driving in the Netherlands", submitted.

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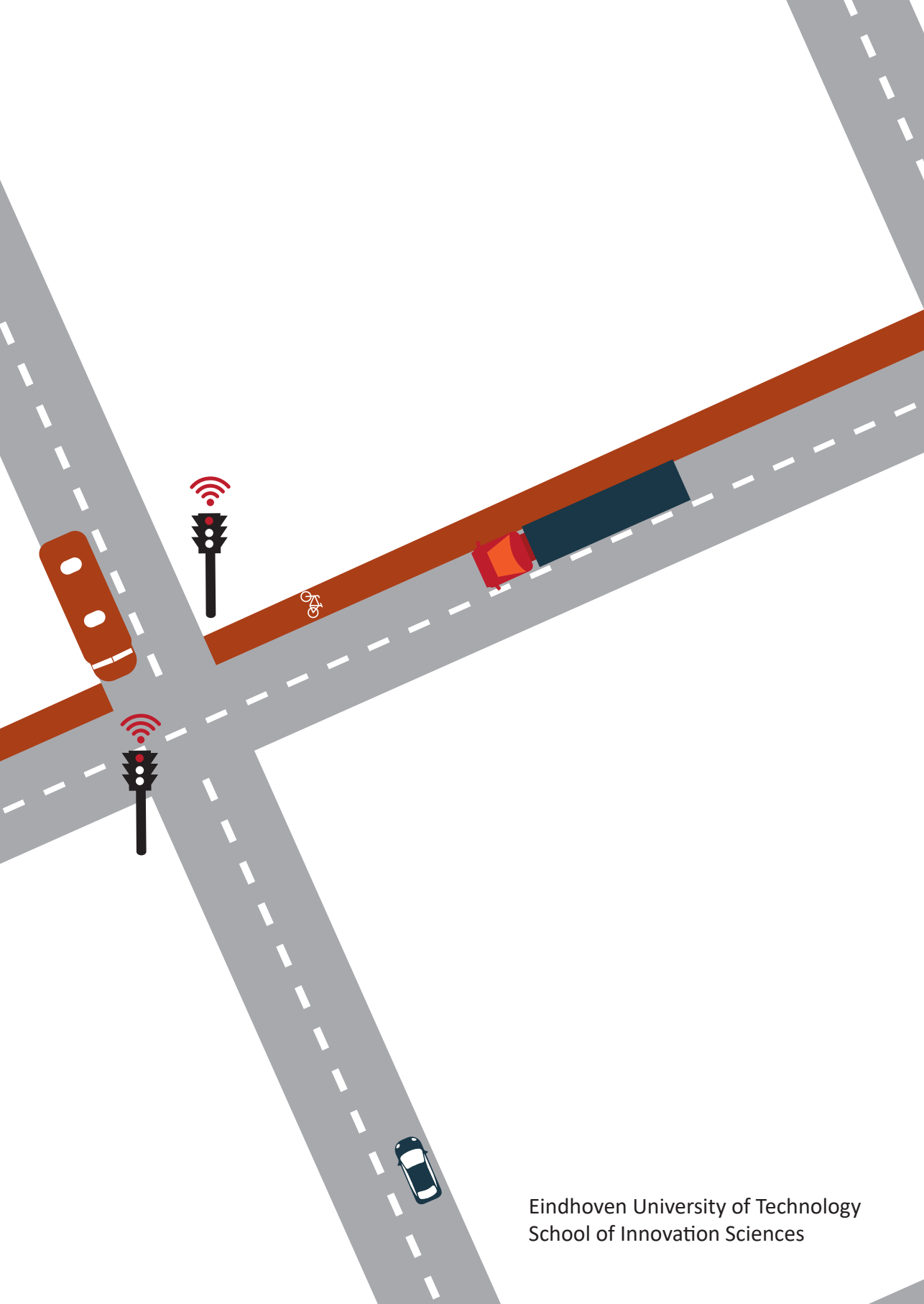

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