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Automated driving in the policymaking: The productivity of the void

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Abstract

During the past decade, automated driving has gained momentum in terms of its potential to transform urban mobility. Automated driving is not a ready-made technology, but a socio-technical process in the making. As such, its potentials are ambivalent and they come along with challenges, which call for new policies and regulations. These challenges have to do with it being inextricably entangled with the dynamics of different socio-technical systems, such as the system of automobility, the system of ICT and public transport as well as with multi-level governance settings. Thus, it has been shaping through a diversity of industrial, technological and administrative arrangements. The interplay of these arrangements creates uncertainty and ambiguity regarding how to plan for the implementation of automated driving, resulting in an *institutional void* in policymaking, as there are not pre-defined rules of how to handle it. Eventually, it is policymaking that will determine, to a great extent, what will happen and to what effect. Policymaking is the process through which the different arrangements are gathered, interact and ultimately define what will become of automated driving.

This dissertation examines how automated driving is produced in policymaking and what kind of impacts this production has on mobility and beyond. To do so, it develops an analytics of studying policymaking by redeveloping the concept of storylines as an analytical lens. Storylines allow for studying the historically emergent and dynamic processes through which actors, technologies, practices, narratives and settings interact and produce policy developments. The concept brings a balance between the interpretation of these developments and their performativity; how these developments emerge and play out. Thus, it allows for a comprehensive study of the contingencies and uncertainties of policymaking as well as their outcome and potential for future mobility.

Based on different qualitative methods, such as interviews, document analysis and participant observation of events, the policymaking of automated driving is analysed in two case studies. The first case study of Munich unfolds policymaking as a trajectory of dispersion of automated driving from car-centric incremental automation in industrial and federal settings to diverse mobility services at the urban level. The chapter shows how automated driving opens up new perspectives for rethinking long-existing urban issues, such as urbanization and lack of space, without it being implemented. The second case study of Stuttgart presents a trajectory of relegation of automated driving from a connected transport system as a strategy of economic restructuring of the State Baden-Württemberg to a proxy for on-demand public transport at the urban level. The chapter eventually shows how automated driving as a proxy induced policy change in favour of public transport.

Overall, both cases reflect the impacts of the non-implementation of automated driving on mobility policymaking through two distinct approaches: an industry-focused approach and an urban approach. The dissertation concludes by abstracting these potentials in regard to the institutional void and uncertainty. Ultimately, defensive responses to uncertainty, such as non-implementation of a certain technology, might fill in the void productively by enacting new understandings and solutions to existing problems when technology is contextualised at the urban level.

Contents

List of Figures

Abbreviations

AD: Automated Driving

ADA: Argumentative Discourse Analysis

ADAC: General German Automobile Club

ADC: Adaptive Cruise Control

AMOD: Automated Mobility On-Demand

ANT: Actor Network Theory

BASt: Federal Highway Research Institute

BW: Baden-Württemberg

CDU: Christian Democratic Union

CSU: Christian Social Union

FDP: Free Democratic Party

GRS: Gigabit Region Stuttgart

ICT: Information and Communication Technologies

IHFEM: Integrated Action Program for the Promotion of Electric Mobility Munich

IT: Information Technologies

MaaS: Mobility as a Service

MobiMUC: Mobility Plan Munich

MVG: Public Transport Authority Munich

NVEP: Local Transport Development Plan

NVP: Local Transport Plan

R&D: Research and Development

SAE: Society of Automotive Engineers

SPD: Social Democratic Party

SSB: Public Transport Authority Stuttgart

STS: Science and Technology Studies

V2V: Vehicle to vehicle communication

VDA: German Association of the Automotive Industry

VDV: Association of German Transport Companies

VRS: Association of the Stuttgart Region

VVS: Public Transport Tariff Association of Stuttgart

WRS: Economic Corporation of the Region of Stuttgart

1. Introduction

Coming from an educational background as an urban planner, it was clear to me from the beginning of my research that I wanted to study automated driving in urban contexts. I thought that cities were the most interesting environments to study automated driving, because of their inherent complexity which interacts with the complexity of the issue itself. Besides, most of the visions, illustrations and strategic statements on automated driving from the industry and politics have been focusing on cities, and how it will change the way cities function. Initially, my main interest was to search for ways of facilitating the diffusion of automated driving in cities through identifying possible pathways for its policymaking. After presenting my exposé at several colloquia and workshops, and getting deeper into the literature on automated driving, I realised that the whole process of promoting automated driving was an unmapped territory and there was no template for how to plan for it. I discovered that not only automated driving lacks an established meaning in society, but the technology itself is still unspecified. Automated driving has not reached the stage of becoming, or as Latour would put it, it is 'a black box' (Latour, 1987). And it is this 'black box' that is concealed behind extravagant statements regarding its advent and its potential. While the media and political statements have been full of promises for automated driving, in policy practice there have been a lot of discussions, problematisation and activity, but no concrete policies or solutions have been developed for automated driving so far in cities. In addition, the combination of new and old technologies involved in its *making* complicates even more any attempt to predict or assess its impact and makes it especially difficult for policymakers to develop concrete policies for implementation. After having background interviews with international experts, these initial insights were further elaborated. There have been a lot of uncertainty and ambivalence among different actors about the long-term impacts of automation in urban mobility and everyday life. Policy makers and the industry have been waiting for each other, shifting responsibility from one another regarding who should go first: technology or policy. This creates a *void* in decision-making, where the actors adopt a 'wait-and-see' approach, as there are not concrete rules and structures for how to think and plan for automated driving due to the increasing complexity that it brings to an already complex world. Policymakers have been waiting for technology to become more mature and secure, while technologists and businessmen have been asking for the support of the state to roll out automated driving. Then, it became clear to me that automated driving is not just a set of technologies that are neutral and ready to be implemented. Automated driving is rather entangled with a multitude of rationales, rationalisations and visions regarding the relationship between technology and society and the kind of world we want to live in. Therefore, discovering its politics seemed to me as important as gaining insights into its technical aspects.

> ‘some will object, we’re dealing with technologies, not passions; with drawings; not plots; with logics; not sociology; with economic calculus, not Machiavellian calculations. Ah, but they’re wrong! The two sets come together in research rooms and administrative council rooms’ (Latour, 1996a, p. 101).

Automated driving is not just a technological object; it is rather a socio-technical process, that involves diverse actors and through which many policy objectives materialise that go beyond the issues of urban mobility, efficiency or safety per se. Since automated driving is not here yet, there are many worldviews, controversies and contingencies as to how automated driving should be planned for, and most importantly what it is good for. As I have seen through my experience with engaging with various researchers, practitioners and studies, there seem to be two basic categories for how to deal with automated driving: the technical aspects that deal with technical systems design, modelling, optimisation, cost-benefit analysis on the one hand, and the social aspects; politics, actors, and norms that co-construct the issue on the other hand. While research so far has been dealing with the first category quite extensively – even though there is still a need for further research on the technical aspects - the social aspects of automated driving are highly underrepresented. But even in the first category, there are so many assumptions, which prescribe that the social complexity inherent in technological concepts should be reducible and measurable in order to evaluate the potential value of such concepts. These assumptions are deeply normative, but their normative and political nature is, often, hidden behind algorithms, tools and models that seemingly produce ‘objective’ calculations and results. If automated driving, then, consists of both the technical and the social, how can we study it in a way that acknowledges both these aspects and their intricacies?

I would like to provide an example of the complexity of some of the worldviews embedded in automated driving, using a story from my personal experience in dealing with the topic. In 2018, I was invited to give a talk at the Urban Futures International Conference in Vienna. The title of my presentation was ‘Who talks about automated driving and how? Insights from policymaking in cities’. My talk was about how policy makers deal with the issue of automated driving in cities. After reviewing studies and public documents on policy initiatives in several cities in Germany and in Europe, I argued that cities were having a hard time to define how automated driving would fit in the existing institutional frameworks, infrastructure and networks of the cities, pointing out the policy void in which policymakers find themselves in. My presentation also pointed out that technological fetishism and economic imperatives of defining one universal strategy for automated driving do not comply with the complexity and the local particularities of cities. The way(s) automated driving, if at all, would be implemented in cities would be dependent on the context factors and local contingencies, such as integration with existing framework, local administrative structures, landscape, interdependencies with other administrative-political levels (urban, regional, national) and with the industry and so on. After my presentation, we had a coffee break. While I was picking up a cup of coffee, a man working for an automotive company came up to me

to discuss my arguments. He thought my presentation was interesting, especially because I had pointed out the contextual elements in the potential implementation of automated driving in cities. However, he was puzzled about my objection to defining one universal strategy, as he claimed that the industry needs that to be able to set up new standardised business models for cities. Thus, he tried to convince me that cities should work together to develop a unified framework based on the least common denominator that would allow the industry to operate within. What can we learn from this narration? I think that there many things to learn:

- The point that I was trying to get across about the need of considering the local context of each city for the policymaking of automated driving was acknowledged by the man. Yet, he also felt that the industry needed universal strategies in order to have a unified business case that they could sell to every city.
- This reflects a long-established mentality that technologies should be shaped by the industry first, and then presented to the cities as pre-defined solutions for implementation. There is detachment between what technicians and businessmen think that should be done and what cities need in terms of everyday mobility. This detachment is materialised through reducing the implementation criteria of new mobility technologies to generic technical aspects, while neglecting the social complexities as a way of dealing with these complexities.
- This mentality is highly institutionalised and sustained not only in industrial and organisational routines, but also in different public administrative and political levels. However, in the models and tools that are used to plan for new technologies there is not enough capacity to acknowledge the normativities, values, broader objectives and negotiations that influence the (policy)making of technologies nor the great complexity that comes along with them. These objectives go beyond sectoral issues, such as mobility per se. They extend to matters of urban development, regional competitiveness, national economic objectives and industrial interests.
- Automated driving brings to the fore and intensifies obscured complexity in policymaking for mobility, as the interplay between old and new players, technologies and business models makes the void in decision-making even more obvious and hard to ignore by interested parties.
- Thus, the challenge is that automated driving be acknowledged as a hybrid of hardware, software, infrastructure, diverse actors, competing visions, industrial interests and societal needs. Even though the man was still holding on to the perception that we need generic strategies for planning for mobility technologies, he understood that there needs to be room for flexibility and adoptability. That presents opportunities for filling in the void between different kinds of technical expertise and the social context of policymaking. The term social context refers to a type of policymaking that is informed by the specific needs of a certain context, its politics, norms, values as well as the physical landscapes and infrastructure that shape it.

Thus, my research interest ultimately changed into exploring what automated driving is becoming and how it came to become. In this work, I unfold the process of automated driving in its making in two cities, in order to understand what it is made of, who participates and how, how the participants account for automated driving and from which position, how their sayings and their doings produce automated driving and what this means for urban mobility and policy. I will argue that it is important to understand automated driving as an entangled process of social and technical elements, in order to truly understand its potential and its limitations for mobility. It is also important to study automated driving in specific contexts, in order to acknowledge the embeddedness in the particular settings where it is negotiated. In order to provide an analysis of context-dependent complexity, this thesis will apply a qualitative two case study method to analyse the emergence of the socio-technical entanglement of automated driving. I consider policymaking as the vehicle through which this entanglement is enacted and shaped.

1.1. Automated driving as a socio-technical entanglement

Automated driving, often labelled also as autonomous, driverless, self-driving refers to the automation of road vehicles (Fraedrich, Beiker and Lenz, 2015), as well as subways, light rails, trains and aircrafts (Greenblatt and Shaheen, 2015), which renders the role of the human driver as monitoring or even unnecessary. There is a continuum between no automation, partial automation and full automation, in which vehicles partially or fully drive themselves (Anderson *et al.*, 2014). The Society of Automotive Engineers (SAE)[1] defined five levels of vehicle automation. While levels 1 and 2 include some automated functions (driving assistance systems), it is level 3 that enables the driver to have hands-off the vehicle in certain traffic or environmental conditions[2]. In the highest levels of automation, an automated system performs all dynamic tasks of driving in certain (e.g. in highways on level 4) or in all conditions (level 5). The driver is not expected to take control of the vehicle in levels 4 and 5. Some of the lower levels of automation are already being offered in newer cars today, such as adaptive cruise control and parking assistance. Currently, most car manufacturers pursuing automated driving technology are focused on partial automation (levels 1 to 3) (Stocker and Shaheen, 2018). The headlines in the announcements of car manufacturers and the media often fail to make the distinction between automating certain driving functions in specific environments (partial automation) and automating the full driving task in any environment (full automation). It is the latter that is the most difficult to achieve, especially in urban contexts (POLIS, 2018). In the case of full automation, vehicles can be phrased as driverless, as no intervention from a human driver is needed, but the terms autonomous and self-driving

[1] Levels of driving automation as defined by SAE International Standard J306: 0 (no automation), 1 (driver assistance), 2 (partial automation), 3 (conditional automation), 4 (high automation), 5 (full automation) (Source: www.sae.org/autodrive, Assessed 15/03/2018)

[2] In SAE level 3, an automated driving system performs all dynamic tasks of driving but the driver should be ready to take control of the vehicle at any time (Milakis, 2019).

are ambiguous. As Stilgoe (2018, p. 43) imparts '*autonomous vehicles are not as heroically independent as their enthusiasts would have us believe, nor are they as autodidactic. The story of autonomy is a way of downplaying a car's connections with other vehicles, the built environment and the infrastructure of regulation*'. By saying that, Stilgoe refers to the algorithms, machine learning and digital connectivity technologies, which are used to steer the vehicles. In this sense, vehicles cannot be autonomous or self-driving, as they are steered by big data, and are connected to each other, to infrastructure or to an online central system. As Wood *et al.* (2012) wrote, the term 'autonomous' is the term that is currently in more widespread use, and thus is more familiar to the general public. However, the term 'automated' is more accurate. 'Automated' implies control or operation by a machine, while 'autonomous' connotes acting alone or independently. Currently, most of the vehicle concepts have a human in the driver's seat, deploy a communication connection to the Cloud or other vehicles, and do not independently select destinations or routes (Wood *et al.*, 2012). The term 'automated' more accurately describes the actual function of automation. Therefore, the term 'automated driving' is used in this work, except for the cases where the interviewees are quoted as using different terms, such as autonomous driving.

Automated driving is an important element of the discussion about the future of mobility, while its advent is expected to have impact on cities as significant as the invention of the car. In media and political statements, it is often assumed to radically change the way we move in the future (Fraedrich, Beiker and Lenz, 2015; Lipson and Kurman, 2016). While applications of automated driving on highways are already expected by 2022 (Kellerman, 2018; Freudendal-Pedersen, Kesselring and Servou, 2019), its implementation in cities is considered much more complex (Kröger, 2016; Kellerman, 2018). This is because cities are complex highly populated environments with multiple interactions between infrastructure, persistent mobility patterns and humans. In this sense, especially during the transition phase, automated vehicles might need to share urban space with vehicles with a driver, and other road users (e.g. cyclists, pedestrians) as well as human activities. Therefore, there are a lot of debates and questions surrounding the implementation and implications of automated driving in cities. To name but a few: will automated driving reduce or increase today's car use and ownership, traffic volumes, and transport emissions? To what extent will it be integrated into public transport, be combined with on-demand services and sharing schemes, and replace private conventional cars? Will automated driving increase accessibility in mobility (e.g. for the disabled, children, people who don't drive) or will it be available only to the people who can afford it?

All these expectations, open questions, hopes and fears are articulated in an institutional void (Hajer, 2003b) in relation to how to govern for the future of mobility. Mobility has been organised in and through systems, the main of them being automobility (Sheller and Urry, 2016), which provided structures for the organisation of mobility. Yet, now there has been a clash and integration of a diversity of systems that affect mobility, which has led to the emergence of the institutional void and the blurred structures and rules for governing. The multiplicity of understandings of the word 'system' or 'mobility

system' has been at the core of the socio-technical tradition in social science (Beckmann, 2001), bringing together analyses of different technological and social networks with a focus on the socio-technical dynamics that constitute them. As Callon (1986) argued, the development of technical systems should be understood in their social contexts. John Urry, when explaining mobility systems, argued:

> 'the focus upon objects combining with humans into various coupled relationships also implies the significance of systems that distribute people, activities and objects in and through time-space and are key in the metabolic relationship of human societies with nature (…) in the modern world automobility is by far the most powerful of such mobility systems, while other systems include the pedestrian system, the rail system and aero mobility (Urry, 2007, p. 51).

It was also John Urry, in his book the 'System of Automobility' that argued, referring to Slater (2001), that 'a car is not a car because of its physicality but because systems of provision and categories of things are materialised in a stable form, and this generates the distinct affordances that the car provides for the hybrid of the car driver' (Urry, 2004, p. 6). In this sense, the car is not just a means of transport, but a socio-technical object deeply embedded in society. As such, the car is part of the socio-technical system of automobility, which is made of a multitude of regulations, institutions, practices, actors, technologies that constantly reproduce it (Ibid.). Thus, the system of automobility is a net of material and social elements, comprising the industrially manufactured object of the car, its social meaning as one major item of consumption, its economic meaning within the involved industries, services, its dominating position with regard to other modes of movement and transportation, its cultural associations and its ecological impacts (Geels, 2011). As such, the current system of automobility represents the foundation of mobility cultures in cities today (Urry, 2004). Big part of the promotion of automated driving takes place by established players (i.e. the automotive industry) and practices originated in the system of automobility. This can be further confirmed by the fact that there have been defined five levels of automation ranging from zero automation to full automation, which refer to road vehicle automation.

Automation has been at the core of car manufacturing for many decades, in order to optimise the car as a product and facilitate driving in an evolutionary way by integrating computer systems in the hardware, in order to execute navigational, longitudinal and lateral control of vehicles (Cotgrove, 1972; Fraedrich, Beiker and Lenz, 2015). Automation technologies have already been available since 1921, when the U.S army introduced the first remote-controlled vehicles. Later, automatic transmission in 1939 and automated guided vehicles in 1954 became available in the US. However, the first tipping point for the beginning of the computerization of the car was in the 1960s and in the 1970s when microelectronics coming from computers and IT (Information Technologies) enabled the introduction of electronic cruise control (US), emission control technologies and anti-lock braking systems (Germany) in automobiles (Kröger, 2016; Kellerman, 2018). This was the tipping point, when the automotive industry and the IT industry started converging. Ever since, there has been increasing convergence of the two industries further accelerated by artificial intelligence (1980s), GPS navigation

systems, etc. that are targeting mainly safety, connectivity as well as convenience (Servou, 2019). The last decade, new players from the socio-technical system of ICT (Information and Communication Technologies) entered the field. These players have a background in digital connectivity and online services, and aim to apply their expertise in data systems, mapping technology, and artificial intelligence to the mobility field. Canzler & Knie (2016) argue that the integration of digitalisation into transport will change mobility markets, business models, infrastructure development and the social practices of travel and communication. Companies like Google and Tesla build fully automated vehicles that do not have pedals or steering wheel anymore from scratch, without following the engineering path of the automotive industry (Fraedrich, Beiker and Lenz, 2015; Freudendal-Pedersen, Kesselring and Servou, 2019); they are basically building computers on wheels. Thus, the term automated driving is often combined with the term connected driving. In this context, it is also the telecommunication companies, which are a big player through the promotion of broadband technologies. In a background interview, an Australian urban planning scholar on automated driving argued:

> By installing new 5-G connectivity technology in the cell phone towers, they are expected to be the drivers of technological developments and open new opportunities for usage, while people are being driven in automated vehicles and are no longer being occupied by driving themselves. (Interview 1, 2017, p. 7)

Thus, automated and connected driving implies the convergence of these two different industrial traditions, creating a hybridity between the digital and the material world. As several studies show, this hybridity contributes to the emergence of synergies with new forms of mobility, such as electrification and mobility as a service (MaaS), where automated sharing concepts and on-demand offers based on software applications blur the boundaries between the private car and public transport (Greenblatt and Shaheen, 2015; Pakusch *et al.*, 2018; Stocker and Shaheen, 2018; Salonen and Haavisto, 2019). In these emerging forms of mobility, the automotive industry, the public transport authorities but also new startups compete to be the mobility providers for cities (Fraedrich, Beiker and Lenz, 2015; Trommer *et al.*, 2016). Besides that, automated driving intersects with the system of urban public transport per se as well. Discussions about automated mini buses, robo-taxis, but also subways, trams are also part of the promotion of automated driving in the system of public transport (Legacy *et al.*, 2019; Rupprecht *et al.*, 2019). The vision of automated public transport systems has its origins in the late 1960s, when microelectronics were integrated into automobile technology. This led to a parallel trend in public transport, namely Personal Rapid Transport Systems (PRTs). PRTs were automated train systems on demand; a combination of private cars and public transportation. They were trains consisted of small programmed vehicles electronically-connected, with no driver, guided by a computer (Latour, 1996a). However, the hybridity between software and hardware does not only develop synergies, but also clashes. In a background interview with a digitalisation and innovation expert, he elaborated on this clash of the two socio-technical systems of automobility and ICT sector:

> In the past, if the software was bad or insufficiently written...the main problem was that you had a blue screen on your phone or a dead MAC and you started over and maybe lost some bits and bytes, but nothing else really bad happened. This changed...this massively changed; the software interacts with the world (…) So, a lot of software systems right now interact with the real world and, of course, can do harm to people (…) these industries ship products although they are not ready for mass use and fix them later (…) This is standard in the personal computer world, in the mobile phone world, smart phone world (…) The car industry, of course, is heavily regulated and they ship their products when they are fairly tested and have driven several hundred kilometres in real driving conditions to make sure everything works as expected and nobody is harmed. And these two cultures we have collide in the case of automated driving and connected car, where new entries like Tesla or any Chinese company or Google or anybody else coming from a software world with high speed, low quality products...just high speed delivery products collide with what we expect from a car. And this is more or less a clash of cultures here (…) automated driving for now is maybe the most important aspect of this (Interview 2, 2017, p. 5).

Stilgoe (2018) further argues that the clash of the two industrial cultures raises immediate questions of governance. These two cultures understand product liability very differently. The automotive industry sees cars as final products, while the ICT sector sees software as a service rather than as a product. The norm is to evaluate software liability when defects are detected, which makes its regulation way more flexible. Machine learning, which is by default more unpredictable than conventional algorithms, might further exacerbate issues of online security and liability (Stilgoe, 2018). Hence, there is an emergence, co-existence and intersection of different interests, expectations and fears about automated driving that constitute the void in which automated driving has been produced and negotiated. Dangschat (2017) differentiates between two main different narratives: the optimist and the sceptical. The 'optimist' narrative has been promoted strongly by engineers, ICT companies and suppliers, consultants, and politics – specifically in urban contexts. In this narrative, a 'techno-centric paradigm' (Miciukiewicz and Vigar, 2012) has been predominant, which in its most positive connotations is promising solutions for almost all contemporary transport problems. The 'sceptical' narrative has been strongly promoted by critical journalists and partly social scientists. This position challenges the assumption that the application of automated driving in mobility leads to any significant reductions in traffic volumes.

Overall, scientific research on automated driving is dominated by the techno-centric narrative and has paid insufficient attention to the social and political aspects of automated driving. Even the majority of social science studies, focuses on few fragmented aspects, such as legal and regulatory issues of licensing and standardization (Fagnant and Kockelman, 2015), machine ethics and legal dilemmas of decision-making and liability (Marres, 2018) as well as user perceptions and acceptance (Bjørner, 2017; Fraedrich, 2018). Bissel *et.al.* (2018) argue that these social science aspects are rather examined

separately from more technical issues of safety, congestion and efficiency. However, as Science and Technology Studies (STS) and transitions theory show, to separate dimensions potentially neglects the broader socio-technical complexity of technologies and favours a technological deterministic style of analysis which overlooks the multiple forces at play in their emergence (Geels, 2012; Sheller and Urry, 2016). Mobilities scholars and STS researchers (such as Bissell, 2018; Jafarinaimi, 2018; Manderscheid, 2018; Stilgoe, 2018; Weber and Kröger, 2018) argue that the dominant narrative of automated driving reproduces the old familiar logic of a 'technological fix', in which technology is understood as a tool to shape the social in a one-directional way rather than as an entanglement of social relations, produced by socio-material practices and actors. Vannini (2012) further argues that viewing the objects and processes of mobility (such as automated driving) as constellations of humans, technologies, spaces, discourses etc. allows to better understand the politics behind, and eventually understand their opportunities and challenges.

To sum up, automated driving is not just one technology and it does not belong to one socio-technical system. It rather integrates and intersects at least three socio-technical systems, namely the system of automobility, the system of urban public transport and the system of ICT. Furthermore, it brings together a wide range of actors from different industrial sectors, public transport, administration, and politics in an institutional void where there are a lot of discussions and actions, but no concrete policies on its implementation. Automated driving has not taken shape yet. There are multiple visions, interests, worldviews, technologies, actors and conflicts that have been shaping its making. That is why, in this work, automated driving is viewed not as an object, but as a process. It is viewed as an entangled socio-technical process in the making. Srinivasan *et al.* (2016) argue that there are three things that contribute to the making of automated driving, but also in the uncertainty around it; technology, policy and user behaviour. This study focuses on the second, because policy is what mediates between technology and users, but also incorporates all the formal and informal actors, institutions and events that shape the process of automated driving. In other words, it is the policy in its making that can reveal what will become of automated driving and what the impact of its institutional void will be. It is the study of policymaking that integrates the social and the technical and allows to unfold what the entanglement of automated driving is made of in its particular contexts.

1.2. Why policymaking of automated driving matters

Policymaking

Latour (2004) argues that in all European languages, there is a strong connection between the words for 'thing' and a quasi-judiciary assembly. Icelanders boast of having the oldest Parliament, which they call 'Althing', for example. A thing represents something that matters, and it is highly complex and historically situated; it comes into place through a 'gathering'. 'Gathering' here can be considered as another word for entanglement. In other words, a thing represents something which is socially and politically relevant. In contrast, an object is rather utilitarian, and it does have an important meaning for specific contexts: '*You can do whatever you want with mugs, rocks, cats, mats but not with Einstein's Patent Bureau electric coordination of clocks in Bern. Things that gather cannot be thrown at you like objects*' (Latour, 2004, p. 237). He argues that objects are objects because their gatherings have failed to assemble properly. Based on this, Latour calls for a manifold inquiry to detect how many participants are gathered in a thing to make it exist and to maintain its existence.

Meadowcroft (2007) wrote that policymaking is the formation of collective courses of action to address societal problems. These collective courses of action are shaped through discursive exchange (Hajer 2009). As Fischer and Forester (1993) argue, policymaking is a constant struggle over the conceptual framing of problems, and the ways people create the shared meanings which motivate them. These courses of action are also shaped by the specific material conditions of a particular society that enable certain possibilities over others (Rutland and Aylett, 2008; Barry, 2013). For example, besides the role of ideas and norms conveyed through discourse (e.g. efficiency and competitiveness), policymaking of automated driving is also (re)shaped by material aspects, such as existing infrastructure and technologies. These material and discursive aspects are interdependent, in the sense that the availability and readiness of certain technologies over others might lead to specific discursive formulations, and thus specific policies for automated driving. For example, 5G technologies are currently ready to be implemented, while there are still many open questions about how artificial intelligence can deal with ethical dilemmas. This might lead actors to discursively articulate 5G as a prerequisite for automated driving, and then develop a policy for 5G connectivity infrastructure to prepare the ground for automated driving, instead of developing policies for direct implementation of automated vehicles on streets (Servou, 2019). Yet policymaking is not only a technical project, although technical expertise is essential, but a mainly political project. This is because its practical bearing cannot be established independent of the concrete life circumstances of a particular society and the needs, values and aspirations of its members (Meadowcroft, 2007). This work views policymaking as a context-dependent political project that 'gathers' and coordinates courses of action, diverse actors and material aspects, in order to deal with a specific matter of concern.

Going back to Latour, it is policymaking that will, to a great extent, determine how the 'gathering' or the entanglement of automated driving will be assembled, and whether it will eventually be a 'thing' or an 'object'; whether it will be a bubble blast, or it will have a long-term existence. This is because automated driving is not here yet, it has not been realised yet, there is not even consensus on what it is and what is made of. It is policymaking that will determine if and how any kind of policy for automated driving will come into place and what the potentials of the void are. Subsequently, it is policy that mediates between technologies and users, and eventually determines the relationship between the two; weather and how the technology will become available to the users, whether it will be implemented and how.

Multi-level governance

Nowadays, more than ever, policymaking takes place outside of the domain of formal politics and institutionalised political processes including actors with indirect power, such as the private sector (Gomart and Hajer, 2003). Policymaking is rather performed through governance processes which include both formal and informal politics and actors, such as private industries, but also different administrative and political levels (e.g. national, federal state, regional, local). Policymaking is thus performed in governance networks, which typically function in the absence of clearly defined institutional rules. In the classical modernist approach, various administrative units would provide legitimacy through technical and scientific expertise, while the political councils would make the final decisions. Governance networks function differently. They are relatively stable sets of interdependent negotiating actors, focused on problem solving. Since there are no standard norms and procedures to predetermine where and how a legitimate decision is to be taken, network governance is characterised by institutional ambiguity and uncertainty (Hajer and Versteeg 2005). Djelic and Sahlin-Andersson (2006) argue that in a world where boundaries are largely in flux, it is hard to see where policymaking takes place, as the role of the state is dynamic and should not be taken for granted. In other words, the settings, where policymaking takes place, as well as the procedures and practices through which it takes place are not fixed, but dynamic, extending beyond institutional routines and regulations. This type of governance has been also termed as 'fuzzy governance' (Bache *et al.*, 2015) and 'decentred governance' (Bevir and Rhodes, 2006), and serves the purpose of dealing with the increasing complexity of society, something that one political-administrative level cannot cope with alone (Hajer and Wagenaar, 2003b; Hajer and Versteeg, 2005; Wagenaar, 2011).

This is particularly relevant for automated driving, where national governments, federal states, regions and cities are all involved in its policymaking, being dependent on each other, while at the same time engaging in deliberative processes with different industries (e.g. the automotive and ICT). Most importantly, the role of each of these actors and settings changes temporally and spatially. It is exactly because automated driving brings together different socio-technical systems that its governance is multi-level. As I already mentioned, the main framework of reference in this work is the urban level. This

is because it is the cities with their high complexity that are more than anything at the core of the global discussions for automated driving (Freudendal-Pedersen, Kesselring and Servou, 2019). It is also the local level that will eventually determine if and how automated driving will be implemented in cities. However, this work presents a multi-level governance analytics, considering relevant developments at the national, federal state, regional level and urban level of the two cities of Munich and Stuttgart in Germany. While the focus is the urban level, the other levels are integrated into the analysis to the extent to which they influence the urban level. Adopting a multi-level perspective, thus, allows for tracing the starting point of the emergence of automated driving in different contexts and unfold how automated driving became relevant in urban contexts.

The urban as the framework of reference

According to Latour (1991), the global can be understood from the networks that created decisions at the local level. That is to say that macro structures are built up by local micro decisions. These micro-decisions were co-shaped by both social and material conditions (Gomart and Hajer, 2003). Based on that, cities are complex micro places where decisions for the implementation of new mobility concepts and technologies are made, which ultimately influence global developments and investments. Cities have long been shaped by new technologies that alter and extend the possibilities for human life (Graham and Marvin, 2001). Urbanisation is inherently hybrid and 'cyborg' in its combination and coevolution of the economic, social and technological. Technology and infrastructure per se modifies and co-shapes human activities, networks and functioning in cities (Items *et al.*, 2020). Against this background, local governments play a crucial role in the implementation of automated driving in cities, because they are the ones that know the potentials and the limitations of the existing mobility systems. It is cities that can make concrete decisions about how to regulate in terms of land-use allocation and traffic management in mixed-use, new mobility concepts and so on.

Historically, urban mobility policy has focused on organising motorised transport systems as the key enabler of individual mobility (Urry, 2004). So far, policymaking for urban mobility has been primarily based on the negotiations between the established automotive industry and the public sector. As such, it has been characterised by specific path dependent principles and objectives (e.g. prioritization of highway capacity, tunnels, parking spaces, etc.) (Hajer and Dassen, 2014). Currently, with the increasing convergence of different socio-technical systems, namely the system of automobility, the system of public transport and the system of ICT, mobility policy needs to develop the capacities for integrating alternative mobility modes, such as automated sharing concept and inter-modality, while often acting as a mediator between diverse actors, such as automotive industry, public transport. This renders automated driving a 'messy policy problem' (Fischer and Gottweis, 2012), as there is no template on how to develop policies that go beyond the path-dependent ways of governing.

Urban mobility policymaking over the last half century did not take place separately from the socio-material context of urban everyday mobility. The actors, institutions and

practices of mobility policymaking did not merely derive from economic and technical choices prescribed in an overarching structure (Tschoerner-Budde, 2019). They were rather enacted by societal, cultural and material contexts. That is to say that automated driving is emerging through particular contexts of policymaking, and every urban context shapes and translates differently the global developments. These reflections are rarely done by mobility policymakers nowadays. By focusing only on the technical and economic aspects of policymaking, though, policymakers might not realise how and where opportunities and challenges of automated driving emerge. JafariNaimi (2018) argues that automated driving presents opportunities for reframing mobility governance. The common perception of the automobile in the 20th century was dominated by the idea of what a car is, namely a mere object rather than a socio-technical system. This is exactly what led to a governance regime that concentrated power in cars as an artefact, their drivers and the automotive industry (Stilgoe, 2018). Against this background, automated driving is an emerging socio-technical process, which of course partly originates from the system of automobility, but it is grounded in more than one socio-technical systems with open-ended promises and unknown effects. This is what renders automated driving an uncharted territory; it brings together so many diverse actors, technologies, political and industrial settings, visions and discourses. And this complexity is hard to ignore. That is exactly why it presents an opportunity for policymakers to see automated driving beyond the technological fix. Instead of trying to fill in the legal gaps or ensure public acceptance, this work positions automated driving in its policy realities in cities.

1.3. How to study policymaking of automated driving

Hypothesis and research question(s)

Automated driving is not only made by means of policymaking, but it also represents a crucial case of contemporary mobility policymaking in urban contexts. It combines the uncertainties of various technologies, a wide range of established and emerging actors and is meant to be implemented within the highly complex socio-technical environment of cities. Automated driving makes contingencies in the networked mobility governance relevant more than ever due to the complex assemblage of actors and technologies that continuously intermingle with and enact decision-making. Therefore, the goal is to reveal these contingencies of urban mobility policymaking. Through unpacking the story of automated driving in two cities, this research attempts to open the black box of its politics, and how the big promises of its promotion, obscure latent conflicts, ambiguities, and unpredictable developments and opportunities. Thus, in this work automated driving is the research object of analysis, which is produced and enacted by several arguments, practices, interactions between diverse actors in dynamic processes of policymaking. In analysing the policymaking processes of automated driving, this study rests upon a more fundamental question: how can we understand contemporary policymaking processes, which are far from fixed in terms of structures, patterns and

levels of governing? It is this question that is in the background of the study of automated driving and structures this work.

In this loose and networked governance environment that represents the institutional void, a concrete policy or a programme for the implementation of automated driving has not been in place by the moment these lines were written. Porter et. al. (2018) and Legacy et.al. (2019) point out that it is challenging for policymakers to find the right forms of governance, policy and regulation that could lead to a 'good' future of automated driving. However, several cities around the world are being active in dealing with the topic in many different ways. Many of them compete with each other for public funding to develop scenarios and studies on automated driving or to facilitate demonstrations (POLIS, 2018; Items *et al.*, 2020). Some cities have integrated automated driving in their transport plans or in other urban strategic documents, while others deal only with tests, pilots and urban experiments as part of smart city projects (Marres, 2018; Joss *et al.*, 2019). Other cities, like Barcelona, define their pilots in purely technological terms by focusing on the construction of optical fiber and 5G networks as backbones for automated driving. Some cities, like Stockholm, deal with the issue in collaborative terms, while the main objective of the pilots is to integrate municipal networks under a common topic (Joss *et al.*, 2019). While it seems that public authorities are inertial in terms of implementation, waiting for technology to become more mature, there is a lot of activity on different levels. *Therefore, the hypothesis of this study is that policymaking for automated driving has different objectives than the implementation of the issue per se*, *and these objectives differ in each context.* Through studying how automated driving is made in policymaking, this work elicits broader insights about how policymaking develops strategies to deal with high complexity and fill in the institutional void. Therefore, this work asks the following research question and sub-questions:

How is automated driving discursively and practically produced in urban policymaking?

- *How has automated driving emerged in policymaking?*
- *How do actors account for automated driving?*
- *What issues does policymaking for automated driving touch upon?*
- *What is the impact of policymaking of automated driving?*

The research question does not indicate an aspiration to provide a model or a step-by-step guide for urban mobility policymaking. Instead, it aims to bring up a set of analytical problematics emerging from the empirical data at hand, focusing on the production of facts, events, practices, technologies and values-norms in policymaking. By deploying a range of complementary conceptual tools, this work aims to shed light, elaborate on and interpret these problematics, in order to explore the interplay between technology and its policymaking.

Combining three strands of literature

Research on the policymaking of automated driving has been underrepresented so far. There are some reports with policy considerations for the implementation of automated driving (see Anderson *et al.*, 2014; Litman, 2014; Fagnant and Kockelman, 2015). There are also few studies describing governmental legislative initiatives in several countries (such as Taeihagh and Lim, 2019). Overall, traditional policy analysis approaches in mobility and planning focus on the inputs and the outcomes of policymaking. These approaches treat policymaking as a linear and rational process focusing mainly on the formal institutions while neglecting the processes through which policy objects (and subjects) have come to be. They have little to say about the role of diverse actors in making policies (Schwedes, 2011). Much research on transport planning has dealt more with the political context and the formal structures of institutions, rather than the interactions and dynamics among diverse policy actors as conceptualised through the term governance (Hajer, 2017; Tschoerner-Budde, 2019). Thus, they fail to adequately reveal latent power struggles as well as black-boxed conflicts, uncertainties and ambiguities, and to offer opportunities for engagement. As Wagenaar (2011) imparts, everyday life policymaking is non-linear and dynamic and a precondition of engaging with policy, of affecting it and of changing it is the ability to grasp these dynamics. This study argues that an inquiry of policymaking for automated driving calls for an approach that focuses on the interaction of diverse actors, identifies the issues at stake surrounding automated driving, while crosscutting the range of political settings from different levels of governance, informal industrial political arenas, and so on. Therefore, this study approaches policymaking of automated driving along the following lines, without hesitating intermingling different disciplines and scientific traditions. In the following chapter, a conceptual approach will be built based on storylines as a key analytical concept combining three literatures:

1. The mobilities turn in social sciences: The mobilities paradigm takes into account the economic, social and cultural, virtual and digital aspects of mobility and not just the physical aspects of movement (Urry 2000; Urry 2007; Sheller and Urry 2006; Urry 2002). It views the social and technical as relationally constituted, exploring, in a holistic way, the assemblages of mobility entities. This approach helps conceptualise policymaking for automated driving as fluid and dynamic (co)production of ideas, objects, practices, institutional routines and actors, providing an ontological background for the study. This fluidity lays the basis for an analysis that crosscuts the different socio-technical systems that automated driving intersects (i.e. automobility, ICT, public transport). Insights from literature on uncertainty (Beck, 1992; Kesselring, 2008b) are used to further conceptualise the fluidity of rules and the institutional void in policymaking.
2. An interpretive-discursive approach to policymaking: As policymaking is dependent on specific contexts and contingencies, it is also shaped by the values and norms of these contexts. The interpretive approach focuses on the socially

constructed meanings of the world, and how these influence policymaking (Hajer, 1995, 2006a; Hajer and Wagenaar, 2003b; Wagenaar, 2011). Hajer's argumentative discourse analysis (ADA) approach provides a means of understanding how rationalities and normativities are distilled into policy argumentation and debates. The concept of storylines that this work uses as its main analytical tool originates in ADA. Argumentative Discourse Analysis (ADA) is more suitable than other discursive approaches for research on policy processes of future technologies, because it provides a more holistic picture of the (re)configuration of the practices that enable policy change. However, ADA still fails to capture aspects of policymaking that have to do with the emergence of developments, interaction and the position of certain actors within a network.

3. A performative approach to policymaking: Drawing on literature on Science and Technology Studies (STS), Actor Network Theory (ANT) (Callon, 1984; Law, 1992; Latour, 1996b, 2005) and literature on dramaturgy (Edelman, 1964; Goffman, 1974; Hajer, 2005c), this study broadens the perspective of ADA by reconceptualising policy practices as performative interactions and adding the concepts of settings, staging, scripting and translation in policy analysis to shed light to the production and emergence of developments and debates. Even though the performative approach has influenced Hajer (Gomart and Hajer, 2003; Hajer and Versteeg, 2005), who drew on ANT to provide an account of the simultaneous knowledge production and power relations as performance, Hajer's approach still has the tendency to explain policy change with reference first to the discourse itself and then to turn to a consideration of interactions between policy actors (Rutland and Aylett, 2008). In contrast, ANT starts with the premise that discourses are enacted as an outcome of networks and explores the processes through which these networks are assembled: it is bottom-up rather than top-down.

Through the combination of these three strands of literature, the study redevelops and expands the concept of storylines as an analytical lens for the empirical case studies. It will be used to show how actors at the micro level translate, contextualise and make sense of the broader developments at the macro level. Storylines will function as detailed storytelling to build the cases step-by-step, bundling together global, national, regional and local political and technical developments. The storytelling is organised around practices and events (i.e. projects, studies, agreements, debates). The storylines are understood as a means that actors deploy to convey facts and evidence and align their actions. By deploying storylines, actors reduce complexity of the problem of implementation of automated driving, gain acceptance, and legitimisation. Thinking in terms of storyline-versus counter-storyline helps to highlight how storylines are produced in relation to each other, and how a counter-storyline only gains its meaning through its relation, or contrast of a another storyline (Hajer, 2006).

Originally, the concept of storylines as an analytical lens reflects a constructivist approach, in which the researcher enters the process under investigation and interprets

it. A storyline reflects a specific framing of policy, a framing which is on the one hand explicated by the researcher and on the other hand embedded in and legitimated through the practices and narratives of actors. However, in order to not fall into the trap of constructivism as thorough relativism in the sense that all realities are valid and 'anything goes', failing to provide a concrete picture of reality and its practical implications, this study adopts a combination of social constructivism and pragmatism as its philosophy of science. By doing so, the arguments articulated by the actors are considered in terms of what implications they have in practice. Pragmatism is a position based on inquiry and we inquire only when we question (Hickman, Neubert and Reich, 2009). A practical inquiry starts always with a puzzled feeling and an indeterminate situation, and converting into a determinate entity requires both causal explanations and normative understandings (Shields, 1998). The combination of constructivism and pragmatism allows for the simultaneous inquiry of how specific discursive and non-discursive components come into place, how the complexities of multiple understandings translate into a unified coherent story, and what they mean in their practical local contexts.

Empirical starting point

To examine the policymaking of automated driving, 4 background interviews with German and international experts on automated driving and 29 expert interviews from the public and private sector in the areas of Munich and Stuttgart were conducted (see Appendix). The interviews were conducted in English and they were triangulated and supplemented with the analysis of approximately 100 documents from the national, federal state, regional and urban levels along with several press releases and the author's attendance of 4 stakeholder events in the two cities. Triangulation is one of the key designs of qualitative research and entails calling upon various sources of information in the development of the cases (Flick, 2011).

This study adopts a case study method of analysis. A case study is a detailed, empirical enquiry of a phenomenon and the context of which it emerges. It allows the researcher to bring together theoretical and empirical elements in order to generate knowledge about the phenomenon under investigation. Since policymaking is an entangled, contingent and context-dependent process, the case study method was identified as the most fitting method for analysing such a process. The aim of the case study is not necessarily to produce generalisable conclusions but rather context-specific knowledge (Flyvbjerg, 2006). Providing a thick description of the two cases entails an engagement with the uniqueness of Munich and Stuttgart: the historical context of mobility and policymaking, the infrastructure and the landscape as well as the relationships with other administrative levels and the industry. Germany, in general, is characterised by deeply embedded car-culture and it has the biggest automotive sector in Europe. It aspires to become the lead market in automated driving globally. At the same time, the German government is the first worldwide to legalize highly automated vehicles by passing a federal law, which allows the driver to hand over control to the technical system of the

vehicle in certain situations. Against this background, Munich and Stuttgart were chosen as the arenas of policymaking for automated driving in this study for the following reasons:

- Both are congested cities struggling with issues of air pollution, that call for sustainable mobility solutions.
- They are both home to the most powerful automotive industry manufacturers, and ICT companies in Europe and globally (i.e. BMW, Siemens in Munich and Daimler, Bosch in Stuttgart). These industries compete to develop innovative technologies, business models, and services for the implementation of autonomous driving.
- Their local governments play a key role in the development of innovative mobility policies.
- Their mobility cultures are quite different, in the sense that Stuttgart is a car-oriented city in the transition towards sustainable modes of transport, while Munich has been investing in multimodality for some decades now and has not decided on which mode of transport is representative of the city.

Generalisability of the findings is not seen as a goal of this work. However, as it is explained in the last chapter, both cases reflect the same broader approaches to policymaking of automated driving, even though these approaches are manifested and materialised in different ways. That is precisely where the comparative potential of the case studies lies. The cases are not developed for strict contrast as the main goal of the research. Eventually, despite their differences, there are lessons to learn that have to do with their similarities. Thus, even though the emphasis of the analysis will be on contingencies and detailed insights into the way policymaking works in each case, the more general insights that will be abstracted from the cases regarding uncertainty and the institutional void in policymaking can be considered relevant for other contexts too.

Outline of the dissertation

In this introduction, the notion of storylines has been mentioned without fully explaining what is meant by the term. The second chapter explains why policymaking of automated driving requires a dynamic form of analysis through storylines and develops the conceptual framework of this study. It argues that a shift from traditional positivist policy analysis focusing on the outcomes is necessary towards the processes that create and transform policy outcomes, objects and objectives. In order to achieve such a focus on the dynamic processes of policymaking that *make* automated driving, the chapter elaborates on the fluidity, uncertainty and the institutional void in which automated driving emerges and is negotiated, which can only be analytically captured through storytelling. The chapter, then argues that a combination of an interpretive and a performative approach is necessary in order to make sense of and interpret the developments in the process of policymaking, but also explain how these developments came to be through performative interaction. Therefore, the chapter shows how these two approaches are combined under

the concept of storylines, in order to achieve a thorough and comprehensive analysis of policymaking for automated driving.

The third chapter presents the case study of Munich for the period 2010 to 2019. The case shows a trajectory of dispersion, where automated driving was translated from automation of the private car to multiple mobility perspectives, such as automated subway, automated buses and ride-pooling. The case study traces the first storyline of automated driving, namely 'fixing the system of automobility' from 2010 to 2017, when increasing automation was considered as an evolution of the private car and as a means to the growth of the automotive industry. During this storyline, which was initially traced in 2010 at the R&D of automotive industry and the federal level, automated driving was perceived as a technological fix for car use on highway driving. The main players of this storyline were the automotive industry, research and the federal government. The City of Munich was involved around 2016 through lobbying together with other cities for getting involved in the discussions on automated driving. Eventually, the City applied for federal funding for a research project on automated driving in Munich in 2017. Yet, through the involvement of the City with the federal level, automated driving was not contextualised in the urban realities and maintained a car-centric connotation. Interestingly, it was a parallel development in 2016 that signified the emergence of an alternative storyline, namely 'fostering new mobility services' (2016-2019). This parallel development was a scenario study developed in the context of the urban development framework of Munich, and it integrated the potential of automated driving in the city beyond the private car. For one year 2016-2017, the two storylines co-existed at the urban level. The local actors during this year were in a transition phase, where on the one hand were influenced by the perceptions of the federal level, on the other hand they started contextualising what automated driving meant for the city. After the study, a diversity of local actors started engaging in policymaking for automated driving connecting it with solutions to urbanization, lack of space and optimisation of the overall transport system. Until the end of the empirical case study, automated driving was not implemented but it opened new perspectives for tackling long-existing urban problems through mobility services, yet while co-existing with automobility.

The fourth chapter presents the case of Stuttgart, which stands for automated driving assuming the role of a proxy for legitimizing other policy objectives. Similar to the analysis of Munich, an analysis of the case study of Stuttgart spans over the period 2010 to 2019. The case presents a trajectory of relegation, where automated driving was translated from a proxy for a generic connected transport system to a proxy for on-demand public transport. In contrast to Munich, policymaking of automated driving in Stuttgart has interdependencies not with the federal level, but with the State of Baden-Württemberg (BW) and the Region of Stuttgart. The first storyline 'fostering a connected transport system' spans over the entire period of the case study (2010-2019). This storyline is shaped mainly by connectivity technologies, such as 5G and broadband networks with the ICT industry having a dominant influence in policymaking. The outset of this storyline was traced at the State of Baden-Württemberg, where the main objective of policymaking was restructuring the economy through investments in ICT technologies

and establishing a symbiotic link between ICT and automotive. The City of Stuttgart got involved in this storyline around 2016 through an application for hosting the test field of Baden-Württemberg for automated driving, but they failed. The City was also involved in the implementation of 5G network together with the Region of Stuttgart and Deutsche Telecom. The implementation of 5G was phrased as the backbone for automated driving assuming that connectivity and automation are interdependent. Once again through the first storyline, automated driving was not contextualised in the urban context, but remained as a facilitator for ubiquitous connectivity. The second storyline 'supplementing public transport' (2016-2019) emerged through a scenario study on automated driving for Stuttgart. This study was used as 'authoritative data' from local politicians to argue that automated driving should only be part of public transport. In parallel, the local actors critiqued the abstract connectivity visions of the industry that lacked specification in terms of mobility modes. The concrete outcome of the second storyline was a new an on-demand mobility service called SSB-flex that arose through a partnership with moovel (daughter company of Daimler) and SSB (Public Transport Authority of Stuttgart). This service, which was phrased as a precursor to automated driving, came along with new regulation that allowed the public transport authority to be in control of the service.

Overall, both cases, despite their differences, show that policymaking of automated driving contributed to rethinking and implementation of other policy objectives without it being implemented. It is the non-implementation of automated driving and its presence in the policy agendas that develop productive ways of filling in the void created by the uncertainty about its implementation. The fifth chapter abstracts the key findings of policymaking of automated driving from the empirical cases and discusses its dynamics and impacts in relation to the scripting of automobility and its imposed disruptions, the kinds of expertise and legitimacy that staged policymaking, and the settings where it was produced. This takes place through outlining two distinct approaches to policymaking reflected in both cases, namely an industry-focused approach and an urban approach. Through discussing these two approaches, the lessons learned from the two cases are presented. In order to put these learnings into perspective, the concluding chapter reflects on how they derived from the process of policy analysis, their relevance for research and praxis and the potential avenues for further research.

2. Conceptual framework

Automated driving is usually positioned in relation to something else or somebody else, be it government, the city, users, industry, digital and material technology, regulation as well as other mobility concepts. For example, it is often related to on-demand mobility and Mobility-as-a-Service (MaaS), connectivity technologies as well as issues beyond transport and mobility per se, such as land use development, urbanisation and urban sprawl, economic competitiveness, innovation and so on. Therefore, this chapter argues that the study of automated driving in policymaking arenas requires a conceptual framework that allows for a relational and dynamic understanding of the issue, in order to capture and analyse the processes of its policymaking in uncertainty. To do so, the concept of storylines is redeveloped as the main conceptual tool under which several other concepts are integrated. Why is there a need for the redevelopment of such a concept? The concept of storyline originates in Hajer's Argumentative Discourse Analysis (ADA), where it has been used as one of the components of discourse as a form of analysis of policymaking. In ADA, storylines are perceived as abbreviations to stand for a more complex reality and refer to a connecting thread that runs through a narrative. Storylines are a common way for actors to ensure that their discourse on a certain policy issue is heard and understood by other actors and to position themselves in a certain policy debate. Yet, they have been used so far for the analysis of policy objects, which are already materially and technologically available, such as acid rain, environmental problems, electric vehicles, cycling, light rail and so on (Hajer, 1995; Hajer, 2005a; Olesen, 2014; Tschoerner-Budde, 2019). In other words, they have been used for the policy analysis, interpretation and evaluation of policy objects that already exist. However, they have not been used to trace the dynamic, complex and often messy ways of new mobility technologies in the making, which have been unfolding in-between and beyond the established settings, such as automotive R&D and national governments. There is a need to understand and reflect on these new policy trajectories and the opportunities and limitations they entail. Automated driving is quite representative of these new policy trajectories of mobility technologies, because of the complexity and uncertainty it adds to an already complex world. To understand and analyse such dynamic and entangled processes, a redevelopment of the concept of storylines is needed.

This study expands the concept of storylines, by deploying it not only as an interpretive device, but also as a historically emergent and dynamic set of collective procedures, that produce and organise automated driving. Storylines are not only used to interpret certain structural developments, but also to show how these developments emerge through performative interaction over time. Thus, this study adopts storylines as the main analytical tool of policymaking, which integrates a wide range of components of policymaking, such as events, actors, narratives, actions, technologies and artefacts as well as the settings where these components are produced. Storylines are used here as a form of dynamic storytelling and as a heuristic tool for the researcher to accommodate a combined analysis of the emergence of developments over time and their interpretation, connecting them with their context. In this sense, storylines function as an analytical lens

that allows for embracing the complexity, contingencies and interrelationships of automated driving within the contexts in which it is produced. As such, they allow for tracing the different trajectories of policymaking in the different locations where they develop. Thus, the concept of storylines is redeveloped to be a time-and-process-sensitive concept that unfolds the process of becoming of automated driving.

The following theoretical discussion will explain in detail why and how policymaking of automated driving requires a dynamic form of analysis through storytelling. The first parts of the chapter, which discuss fluidity, structure and agency, uncertainty and ambivalence in policymaking, draw on theories from different fields; mainly on the mobilities paradigm in social sciences and well as reflexive modernization and post-positivist policy research. The second part, which discusses meaning production and discourse is strongly based upon interpretive policy analysis (Hajer, 1993; Hajer and Wagenaar, 2003a; Wagenaar, 2011), especially Hajer's Argumentative Discourse Analysis (ADA), which provides a fruitful ground to think and analyse dynamic policymaking processes. The third chapter takes up a performative approach to policymaking based upon Science and Technology Studies (STS), in order to supplement and broaden the perspective of the interpretive approach in terms of the emergence and production of events and developments. The chapter ends with an outlook on how storylines are deployed in terms of analytical perspectives and strategies in the empirical cases.

2.1. Policymaking in flux

The relational understanding of automated driving suggested above indicates that technology is understood in terms of socio-technical systems (Ropohl, 1999; Geels, 2012; Hopkins and Schwanen, 2018). A technical artefact, in this view, can only be part of something if it is part of a complex of relations to social practices, organisations, norms and so on. In this sense, a driver assistant technology also co-configures its user and enables or restricts particular actions. This understanding puts technology into perspective showing that to be able to use technology, many more things need to be in place, work together, align and coordinate. However, there is one limitation in this understanding of technology. It refers to realised technologies and a stabilized socio-technical system that they are part of. Schneider (2018) argues that such an understanding of technology as things ready to be used is stabilized within industrialized and technologized societies where vast amounts of ready-made technical stuff are available. This is the case for most available hardware or software technologies in the western late modern societies. What happens though with technological concepts that are still in the making, and bring together hardware and software, the material and the digital? As already mentioned in the introduction, automated driving is not a fixed or a realised technology yet, and it does not belong to one socio-technical system only; it rather intersects and brings together multiple socio-technical systems with different institutional traditions and timelines. In parallel, research so far has not adequately examined technologies in the making, namely in the phase of brainstorming and experimentation. In other words, there is a lack of research regarding the processual part

of making highly complex technologies, such as automated driving. This making, as mentioned in the introduction, is highly contingent of the making of policies, for technologies to really exist, to be part of the social realm and to be used by people. Subsequently, the policymaking for the making of these technologies is not adequately researched. These processes of policymaking do not take place in a stabilized environment, they rather occur and emerge through an uncertain and ambivalent balancing game of interests. Even though processes of all kinds are inherently dynamic; they are in process, the processes of policymaking of automated driving are not just dynamic themselves, but they take place in and move through several unstable, fluid and uncertain premises. They take place in 'quicksand', as Bauman and Donskis (2013) would put it. Policymaking processes in these fluid premises resemble 'skating over thin ice', to borrow a phrase from Kesselring (2008a). As such, their study requires something more than a relational understanding; it requires a mobile understanding. Therefore, a study of policymaking of automated driving needs a conceptual and methodological understanding of fluidity that goes beyond administrative and sectoral boundaries and allows for an examination of socio-technical developments located in diverse policy settings.

Thus, this work takes its conceptual point of departure in the mobilities paradigm in social sciences. The mobilities paradigm as an ontology enables research to theorise the social as a wide range of economic, social and political discourses, practices and infrastructures that all involve and entail various kinds of movement of people, ideas, information or technologies (Sheller and Urry, 2006, 2016). The mobilities paradigm should not be confused with mobility research, which focuses on aspects of physical mobility and transport. Of course, this work deals with the topic of mobility in cities through examining policymaking for automated driving. Yet, the term mobilities is in principle coined as an ontology for thinking about social-technical processes and change, and that is how it is used in this study too. The reason why it is called mobilities instead of mobility is because it refers to the different kinds of mobilities that shape society, such as physical, virtual and social mobilities, and their interrelations. This implies that mobilities as a notion is not just viewed as moving from A to B, but also in regards with how these mobilities emerge in society. John Urry, who is the key scholar of the mobilities paradigm argued that societies are built upon and structured by mobilities. He also wrote that the future of sociology will need to examine '*the complex interdependencies between, and social consequences of' the diverse mobilities of 'peoples, objects, images, information and wastes*' (Urry, 2000, p. 1). Based on that, the mobilities paradigm allows for examining the fluid interdependencies of diverse actors, narratives, technologies, visions and political-administrative settings in processes of policymaking. The mobilities paradigm places more emphasis on cultural aspects of change, as well as examining wider processes of socio-technical change beyond transport per se, including, for example, mobile communications (Sheller, 2011; Sheller and Urry, 2016).

> (…) this paradigm emphasizes how social practices can emerge through 'unintended consequences' stemming from how people use, innovate and combine different systems. New or existing technologies are not bounded to certain sectors or 'domains', such as 'transport'. (Sheller and Urry, 2016, p. 12)

Thus, the mobilities paradigm provides an ontological basis of viewing policymaking processes of automated driving as being mobile and consisting of multiple mobilities. Mobilities of technologies, of actors, narratives, issues, practices that are crosscutting different political, industrial and administrative settings. And it is these multiple mobilities that are gathered through policymaking processes, which are in flux too. This calls for conceptual and methodological diversity in studying policymaking of automated driving. This diversity needs to reflect an ontology of movement and fluidity, implying that policymaking is both inherently mobile and is mobilized by the settings in which it takes place. It is the ways in which this mobilization occurs, that determine if and how automated driving fits in existing urban contexts. As Latour argued, '*a technological project is not in a context; it gives itself a context, or sometimes does not give itself one*' (Latour, 1996a, p. 133). It is, thus, through the concept of storylines that this multiplicity, diversity and context is being unfold.

2.1.1. Beyond structure and agency

Traditional political science approaches to policy analysis tend to conceptualise policymaking processes as instrumental, pre-defined and fragmented steps of a course of action (Tschoerner-Budde, 2019). These steps often include '*agenda setting, formation and decision, implementation, evaluation, and termination or reinstitution'* (Bevir, 2009, p. 153). This fixity in the steps of policymaking is justified by the assumption that policymaking resides only in stable structures, such as formal institutions (e.g. ministries, the state, parliaments, city councils). In traditional political science, institutions exhibit fixed operating procedures and rules that constrain and determine people's activities in pre-given, seemingly non-problematical ways (Bevir, 2003; Wagenaar, 2011). They are perceived as structures for problem solving and information encoding by accumulating knowledge from previous experience regarding social conduct (Douglas, 1986). Based on that, actors actively associate specific situations and actions on what is appropriate for a particular person in a particular situation according to institutional structures (Schmidt, 2008). However, Bevir and Rhodes (2006) argue that this kind of policy analysis seeks to improve the ability of the state to manage the markets and bureaucracies. As such, it treats hierarchies, markets and networks as fixed structures that governments can manipulate if they use the right tools. They further argue that everyday policymaking occurs differently, contingently and continuously. Thus, we cannot have toolkits that fit in each case. Although traditional policy approaches provide an overarching framework for analysis, they overlook context and provide a descriptive and static account of policymaking without reflection on the everyday politics, the dynamic interactions, contingencies, which are inherent in policymaking, as well as the institutional void that

new technologies are negotiated within. Thus, such approaches fix or assume the objective of policymaking before engaging with the chaotic empirical world. However, as already mentioned in the introduction, this work hypothesizes that the objective of policymaking of automated driving is not fixed. It is rather enacted and produced on the spot through continuous negotiations.

Based on that, shedding light to the everyday politics of policymaking with changing objectives is an important task of policy analysis, if its purpose is to better understand and then help improve policy practice. Bevir and Rhodes (2006) argue that this cannot happen through predictions but through reflexivity. Giddens (1991) defines reflexivity as the regular use of knowledge about the conditions of social life. This highlights the ability of actors to reflect on different aspects of social activities, and material conditions that are constantly revised based on new information or knowledge. It is this type of knowledge that is renegotiated among actors and is created on the basis of and constituted by new institutions (Giddens, 1991). That is not to say that the type of knowledge derived from statistics, models and claims to expertise does not have a place in policy analysis, but that it should be part of a wider story that explains practices and actions in relation to context. Typically, we see new aspects of a problem when someone tells us a story that highlights them. Therefore, it is informed conjectures conveyed through stories that can help policy practice see opportunities and challenges of a certain policy field or problem anew.

Making such informed conjectures through storytelling requires a more fluid reconceptualisation of structures and institutions. Institutions do not completely fix actions of actors. They are also contingent of national and local variations and unintended consequences abound. Thus, the concept of institutions is 'fatally ambiguous' (Bevir and Rhodes, 2006, p. 63), as while it suggests a structure, it is at the same time susceptible to contingencies. For this reason, Bevir and Rhodes (2006) prefer to explain institutions as the contingent products of actors' ongoing actions, struggles, and negotiations. This is not to say that there are not structural path-dependencies in the formation of institutions, but rather that actions arise from the attitudes that actors adopt against the background of these path-dependencies and in response to dilemmas. Against this background, they argue that policymaking is performed in a 'decentred' mode of governance. A decentred mode of governance is increasingly defined by new structures in which the '*boundaries between and within public and private sectors have become blurred*' (Stoker, 2018, p. 15). It does not occur through the formal institutional processes, but through (re)arrangements and modifications by and between diverse actors. Thus, a decentred mode of governance represents a shift of topos of institutions to meaning in action and production of policy networks (Bevir and Rhodes, 2006). In other words, a decentred mode of governance reflects mobilities. As Urry (2000) argued, there is no originating centre of stability. In the same vein, Massey argues '*what is necessary is a way of approaching this fluidity, openness and density of interaction: a thinking about process*' (Massey, 1999, p. 157). There is a need for an approach to policymaking that recognises its mobilities without maintaining a polarized dichotomy between structure and agency.

Thus, studying policymaking as a process of decentred governance is about how the macro (structures) and micro (agency) level interact, instead of examining either structures or agency. Urry argued that societies are co-constituted through structures and actors, blurring the boundaries between structure and agency. He further elaborated on the tradition in social sciences to assume that structures are ordered through continuous iteration of practices:

> (…) the millions of individual iterative actions are largely subsumed under the notion of 'structure' (such as that of class structure, or the structure of gender relations or social structure). Such a structure does not then have to be further examined; it is 'ordered' and will be reproduced through continuous iteration. The concept of structure solves the problem of iteration for sociology. Of course social systems do change and the sociological trick is then to draw on the concept of agency, to argue that some sets of agents do somehow manage to escape the structure and change it. (Urry, 2000, p. 206)

This assumption of interation creates methodological and analytical lock-ins for social scientists, as they do not get to explore how these structures or regimes emerge and how they get to evolve and transform. Thus, it creates a false dichotomy between structure and agency, leading to deterministic approaches. It is assumed that it is either structure or agency which produces action for change or inertia. Yet, by focusing on these iterative processes, there is insufficient space for examining how order can generate chaos, unpredictability and non-linearity, a grasp of which is essential to make sense of social phenomena.

> So, although there is recurrence, such recurrent actions can produce non-equilibrium, non-linearity and, if the parameters change dramatically, a sudden branching of the social world. And this is the crucial point; such complex change may have nothing necessarily to do with agents actually seeking to change the world. The agents may simply keep carrying out the same recurrent actions or what they conceive to be the same actions. But it is through iteration over time that they may generate unexpected, unpredictable and chaotic outcomes, often the opposite of what the human agents involved may seek to realise. Moreover, of course agents are not just human but will be a variety of human and non-human actants that constitute the typical mobile, roaming hybrids. (Urry, 2000, p. 207)

This suggests that it is through the structural path dependencies developed through iterative practices of actors and reoccurrence that unexpected changes might unintentionally occur. For example, local policymakers in Munich and in Stuttgart might have not even thought themselves about deploying automated driving to change or disrupt mobility, but they got to deal with the issue through the interaction with other administrative and political levels and the industry. Even if they partly deal with the issue in the same institutional procedures as before, it is the issue itself that might call for new deliberative and policy practices. Therefore, as Urry argued, analysis should go beyond the specific actors' actions within their specific socio-historical and institutional context.

This means that actors are not the only shapers of policymaking. Agents of change are not necessarily actors and appear in relation to other agents. Agents of change can also be the structural path-dependencies themselves or technologies as other constituents of policymaking. Most importantly, it is the interaction between established and new constituents (be it actors, recurrence or technologies) that induces change. One could even argue that interaction itself is an agent of change. Of course, actors have an active role in the process of policymaking by constructing potential futures through the formation of ideas, arguments and strategies. Technologies; the ones made and the ones in the making influence policymaking processes, as they enable or restrict certain decisions and developments. It is also the availability of certain technologies over others that enables actors to construct certain arguments.

> Focusing on the complex relationship of networked technologies within the sphere of mobilities, it is shown that we need to move beyond the dichotomies of global or local, nomad or sedentary, digital or material (…) how such technologies shape the foreground/background attention of social agents seems crucial. (Jensen, 2013, p. 124)

Then, both humans and technologies interact with existing administrative structures and institutional routines, and it is this interaction that shapes policymaking. The mobilities approach, thus provides a more pragmatic, practice-oriented, and comprehensive conceptualisation of these interactions and interrelations that shape policymaking. Most importantly, the mobilities approach highlights the uncertainty and ambivalence in contemporary policymaking, despite the efforts of policymaking to regulate and order society.

2.1.2. Uncertainty and ambivalence

Uncertainty and ambivalence are at the core of contemporary society. Decentred governance along with multiplicity and diversity of options and actors are constitutive of this uncertainty and ambivalence. Policymakers do not rely on traditional structures of society, such as the state, anymore, but they have to constantly reflect on the multiple available options provided and organised by governance networks for making decisions (Hajer and Wagenaar, 2003a). This resonates with the work of Beck (2006) on reflexive modernisation and cosmopolitan sociology, Castells's (1996) work on networked society and Kesselring's (2008b) work on mobile risk society. Urry (2000) argued that it is no longer relevant to analyse societal phenomena based on the nation-state as the main structure. Instead, the focus should be on the notion of mobility itself as the basis of the emergence of diverse local and global networks and developments that produce the social structures, which sociology has been traditionally dealing with. At the core of this thinking is that social phenomena, such as policymaking, are characterised by mobilities. Mobilities are conceived as an ambivalent phenomenon and as containing ambivalence(s) (Kesselring, 2008b). If policymaking takes place in mobile premises, then it takes place in ambivalence. Bauman (1991) defines ambivalence as the '*possibility of assigning an object*

or an event to more than one category' (Bauman, 1991, p. 1). This means that there are multiple possible ways to go, and classification of options in decision-making is not only pre-defined, it rather occurs through practice.

Hajer and Wagenaar (2003a) wrote that the failures of the classical modernist government have created a widespread awareness of the ubiquity of the unintended consequences of rational governing and the limits to centralised, hierarchical regulation as the dominant authority of problem solving. In the old regulatory system, prevailed the idea that decisions can only be made once all appropriate knowledge is available. Governmental levels were conceived to fit into one another; local fits into the regional, fits into national, fits into international. The political system was related to this governing system in a linear way. Nowadays, policymaking takes place in networks, characterised by multiplicity of actors and settings, marked by unclear rules as to how to arrive at a legitimate decision. All these actors bring their own institutional expectations and routines with them (Hajer and Wagenaar, 2003a). As a result, there are multiple goals involved in policymaking processes. Winship (2008) calls that 'conflicting ends in policymaking'. Conflicts over policy ends are ubiquitous. Different groups give different priorities to alternative goals. Some may see economic growth as a priority, others a clean environment, others safer streets or greater protection for privacy rights. In the case of automated driving, there are multiple policy goals involved in the policymaking processes, especially because of the intermingling of the old and new players (e.g. automotive industry, ICT sector and public authorities), which complicates even more the possibility to determine a coherent policy goal among the interested parties. In many cases, actors are not even able to agree on what the problem is, as they struggle to develop a common definition of a problem (Hajer and Laws, 2009).

Politics is, thus, made in several settings by diverse actors, and not only in the formal political institutions (e.g. parliaments, city councils and so on) by formal political representatives (e.g. political parties) (Hajer, 2003a). Beck (1992) called this 'displacement of politics' or 'sub-politics', suggesting movement of political activity from traditional institutions to several other spheres of social activity, in order to deal with uncertainty and ambivalence. This is especially the case about politics of innovation and technology. It is the 'politics of artefacts' (Winner, 1980) that locate politics beyond formal institutions. Beck (1992) highlights a proliferation of decentralised settings of sub-politics, such as the economy, trade unions, media, science, industry, courts and social movements. These new settings initially exist in an 'institutional void', as Hajer (2003b) put it. There are no pre-given rules that determine who is responsible, who has authority over whom, what sort of accountability is to be expected. Hajer and Versteeg (2005) call this absence of agreed upon rules and procedures of governing 'institutional ambiguity'. This does not suggest that state-institutions have suddenly vanished. Rather it suggests that there are certain complex and messy policy problems for which political action takes place '*next to*' or '*across*' such institutions, thus challenging the rules and norms of the respective actors (Hajer, 2003b, p. 175). It is very often the case that actors are mobilized not so much because of shared normative or ideological beliefs, but rather because they feel affected by the intended policy issue at hand. This is particularly

relevant in cases of large socio-technical complexity (Torgerson, 2003). In the case of automated driving, as mentioned earlier, it could be that certain actors are mobilized and react because the issue itself causes uncertainty and changes in the established ways of conducting politics. This is not to say that everything is contingent and that there is no cognitive and strategic effort from the side of actors. It is rather to say that policymaking is much more than cognition, it is also about legitimacy being gained in situ. Policymaking is, thus, as much about defining the rules of the game and the dynamics of credibility as it is about figuring out its content and the objective (Hajer and Wagenaar, 2003a). Thus, while conventionally policymaking was considered as the outcome of formal politics, it is now a process that also produces politics. Policymaking has a new role nowadays; to create a space for diverse actors to deliberate on the future and their mutual interrelationships to the state. Thus, policymaking can be constitutive of politics, as it provides the practices through which actors start to deliberate (Hajer, 2003a).

> Actors not only deliberate about the solutions for the problems on their agenda, but while doing so, also negotiate new ways of doing things, resulting in new political practices (…) They design new concrete conditions, and search for new shapes of legitimate political intervention. (Gomart and Hajer, 2003, p. 34)

Now, there is a widespread appreciation that policymaking occurs under conditions of uncertainty (Fischer, 2003). Especially, when it comes to technologies, such as automated driving, that blur the boundaries of the material and the digital world, the public and the private sphere, there is an increasing recognition of uncertainty concerning processes of policymaking for the future. Beck called this an increased '*awareness of our unawareness*' (Beck, 1999, p. 123). Johnson (2016) elaborated on the interplay between policymaking and technology, in order to better understand uncertainty and ambivalence. She argued that no one back in the 1970s anticipated the computerization of the car as an outcome of emissions and safety regulations (see Clean Air Act in the U.S.), which obliged car manufacturers to introduce new technologies coming from the field of IT. Thus, the automobile's changes since the 1970s are significantly driven by the regulation of technologies emerged in the 1960s and 1970s.

Therefore, policymakers need to rethink how uncertainties are dealt with. As the myth of absolute knowledge is collapsing, policymakers need to be aware of the limits of the knowable. It happens, though, that despite the 'awareness of our unawareness', institutions are often slow in responding to the new challenges of uncertainty. This might lead policymakers to rely on path dependencies of knowing-how and problem solving (Hajer and Wagenaar, 2003a). In other words, policymakers often try to reduce uncertainty and complexity by following iterative procedures. Policymakers and humans in general, seek to establish stabilities in their everyday realities in an uncertain world, and they seek ways of dealing with uncertainty by constructing relative certainties (Freudendal-Pedersen, 2009; Hajer and Laws, 2009). This is because it is often assumed that ambivalence is a deficit, something that should be overcome. Yet, the appreciation of ambivalence is arguably essential of a reflective way of acting in an uncertain world. Quite often, the acknowledgement of these limits calls for the introduction of concepts such as

the 'precautionary principle', according to which policymakers institutionally aim to avoid risks. As Beck, Bonss and Lau (2003, p. 20) put it, the precautionary principle practically means '*under conditions of uncertainty and doubt, decide for the doubt*'.

Yet, the question of how policymaking deals with uncertainty and ambiguity is an empirical one and context specific. As Barry (2016) imparts, the contingency of everyday politics represents a limit for political theorists, who usually shy away from digging too deeply in the specific and varied forms of temporality and place or the particular circumstances or conditions. Against this background, the presentation of automated driving as a disruptive technology that will certainly come and revolutionise mobility can be misleading, as it is, at the moment, far from certain if and how automated driving will be implemented. Therefore, it is essential to move the policy analysis of automated driving beyond the statements and the claims made by its proponents and focus on the practical realities of policymaking. It is important to recognise they cannot be inherently objective and cannot be objectively 'good'. There is a need for understanding the way in which normative assumptions inform the policymaking processes. However, policymaking processes should not be seen merely as a product of normative assumptions conveyed through discourse, but also as a product of interactions between diverse actors and technologies. The aim is to balance an appreciation of the effects of discourse in policymaking, with an understanding that interactions are, ultimately, the makers of policy. The following chapters will show that a combination of an interpretive approach and a performative approach to policy analysis under the concept of storylines can go beyond structure and agency, open up the question of what policymaking of automated driving stands for and how it is mobilised to empirical investigation, and thus allow for developing an informed conjecture to policy practice.

2.2. The interpretive-discursive approach to policymaking

Since policymaking is not neutral and value-free, but dependents on norms as well as historical and cultural dimensions, it is not possible to conduct a rational and objective analysis of policymaking. Thus, one key approach that the concept of storylines builds upon is an interpretive approach, which focuses on meanings, instead of rules and laws, correlations between social categories or deductive models. An interpretive approach to policy analysis asks 'what is the meaning of it?' (Bevir and Rhodes, 2006). Even positivist policy analysts admit that correlation and causal models of policymaking processes cannot provide an account of why and how policy change occurs, without being unpacked into the meanings that actors produce. As Bevir and Rhodes (2004, p. 130) wrote, '*interpretive approaches to political studies focus on meanings that shape actions and institutions, and the ways in which they do so'*. Meaning is constitutive of political actions, governing institutions and public policies. But how do we trace the meaning of policies? The starting point of this question is that policy is a social construct; it is constructed through the actors' own social realities. Hence, objective or universal knowledge about the world is replaced by an appreciation that the production of knowledge is always contingent upon actors' subjectivities and interpretations. Viewing policymaking as a

construct of multiple realities and interpretations allows for studying decentred policymaking (Bevir and Rhodes, 2006). This means that an interpretive approach allows for studying the construction of policymaking in networks as an alternative to hierarchies. It shifts the analysis to an examination of the ways in which actors produce policies in networks consisting of diverse settings, such as different industries, urban level, regional level, state level and so on. Change in policy is seen as the result of contests over meaning. Subsequently, this view shifts the focus of the analysis into the creation of these meanings and how they produce truths. Thus, the focus is on the role of the language in the shaping of facts and truths (Ibid.). The truth of an event is always the uncertain outcome of a struggle between competing discursive exchanges which transform '*what is out there*' into something socially and politically relevant (Gottweis, 1999, p. 63). In other words, it is the discursive exchange of meanings that partly determines whether automated driving will remain a mere technological object or whether it will turn into a socially relevant thing, as Latour (2004) would put it. Therefore, an appreciation that discourse is constitutive of reality is essential to the analysis of policy. It takes into account the social and historical context of policymaking, as well as the normative concerns conveyed through discourse (Fischer, 2003). This means that researchers can only offer contingent interpretations of the different realities and normativities of the actors. Fischer (2003) pointed out the embeddedness of the researcher in policymaking. Researchers in policy analysis are not neutral scientists, but they partly become actors, as they engage with the policymaking process as analysts. As Fischer argued:

> Basic to the politics of policymaking, then, must be an understanding of the discursive struggle to create and control systems of shared social meanings. It is an understanding that works on two levels: an interpretation of the first-order meanings and interests of the social actors under investigation, and an assessment of the second-order theoretical interpretations of the analysts themselves. (Fischer, 2003, p. 13)

This suggests that an interpretive approach generate knowledge of the policymaking processes based on the context where policymaking takes place, but also based on the researcher's understanding of the policy processes. It recognises the possible role of the researcher in influencing policymaking processes as a 'quasi-actor', especially in cases of policy objects in the making, such as automated driving. Maasen and Weingart argue that scientific expertise in contemporary society is no longer seen as a source of indisputable truth, as researchers in many cases work together with policymakers on complex problems. Science is rather deemed as a necessary resource of policymaking, which leads to the politicization of science itself and researchers by extension (Maasen and Weingart, 2005). This means that the researcher is part of the policymaking process. The researcher's values, craft and persuasion skills influence problem framings as well as the account of the actors' diverse meanings in policymaking processes (Dunn, 2004; Wagenaar, 2011). Considering the political nature of policymaking, the inherent lack of

objectivity and the everchanging dynamics between actors, the role of the researcher as interpreter legitimizes the research instead of rendering it merely 'subjective'. The aim of an interpretive approach to policymaking is then to move beyond an objective fault-finding evaluation (Beveridge, 2012) to reflexivity. It is not about classifying policy initiatives and actions as right or false, as this would be reductive and contrary to the intricate and context-dependent nature of politics. It is rather about learning from experience. Winship (2008) argues that in policymaking, it is through experience that one learns to recognise specific pieces that potentially can be assembled together. Aristotle thought that the ability to discern which pieces fit together goes beyond scientific knowledge (episteme: in the sense of positivist natural sciences) and technical knowledge or know-how (techne), but rather a type of practical knowledge (phronesis) that is learned through experience (Flyvbjerg, 2002, 2004). It is through reflexivity about how different meanings shape actions that an interpretive approach offers opportunities for learning from experience. It is, thus, the researcher that provides this reflexive account, and in order to do so, they must enter the arena of policymaking and interpret the normative exchange of meaning. In other words, the researcher provides interpretations of actors' interpretations of events and of how the interplay of these interpretations contributes into bringing things into being (Bevir and Rhodes, 2006; Wagenaar, 2011).

Interpretive researchers (such as Fischer and Forester, 1993; Hajer, 1995; Fischer, 2003; Wagenaar, 2011) have connected the discussions about the limited capacities of traditional formal institutions to govern contemporary complex issues, to Beck's 'risk society' (Hajer and Kesselring, 1999) and Castells's 'network society' (Hajer and Wagenaar, 2003a) and the mobilities paradigm (Tschoerner-Budde, 2019). For instance, Hajer (2003b) claims that political order has become discursive: it cannot be captured in the comfortable terms of generally accepted rules, but it is created through deliberation. Thus, if politics is conducted in an institutional void, both policy and political order are dependent on the outcome of discursive interactions. Hajer and Laws (2009) describe discourses as a kind of 'ordering device' in the sense that discourses order social and physical realities. In policy analysis, the concept of discourse is thus useful for capturing how policy actors deal with ambiguity by allocating significance to specific social and physical events over others. Thus, discourse can serve as an analytical concept to understand how actors navigate through uncertainty in policymaking processes.

2.2.1. Discourse as a means of meaning production

The role of discourse is crucial to interpretive approaches, as it is the means through which meaning is conveyed. Michel Foucault is a central figure in the development of discourse analysis. All discursive approaches have roots in Foucault's ideas, while rejecting parts of his theory (Jørgensen and Phillips, 2002). Discourse is more comprehensively conceptualised in Foucault's analysis of governmentality. Foucault's work on governmentality examines the diversity of meanings individuals and groups attach to similar and common experiences, thereafter how knowledge is plural and

historically created through discourse. Through the notion of governmentality, Foucault aimed to expose the rationalities and mentalities of governing that inform political practices. Based on this, the role of discourse is central to how power is dispersed in institutional structures. Discourse is then viewed by Foucault as an '*interplay of statements*' embedded in social structures (Foucault, 1972, p. 117). Through governmentality, Foucault aimed to show how context-specific discourses inform practices of politics and how, in the process they become transformed through practices. However, as Larner (2000, p. 14) critiqued, governmentality literature has failed to conduct the kind of research that it claims is necessary, namely delving into the '*messy actualities*' of specific policymaking contexts by providing in-depth and 'thick' descriptions. This leads to another main point of criticism of the Foucauldian approach, which is the assumption that all subjects and practices are discursively constructed (Keller, 2013). Although Foucault recognises the capacity of individuals to make their own meaning and act on their own, he thought that individual agency is always embedded and inevitably influenced by historical forces and conditions beyond the control of individuals (Patton, 1998). As a result, he never provided an analytical framework for the analysis of agency. This ultimately leads to overemphasizing the macro level of politics and social structures, while underemphasizing the interactions of actors and events at the micro level. The debate about Foucault's work created two different foci on the levels of social interaction in discourse analyses: the micro level and the macro level. A micro-level discourse analysis looks at the specific moments of discursive exchange (e.g. discursive strategies, rhetoric, argumentation techniques) that actors use to persuade and influence others (Hajer, 1995). Through this micro-argumentation the actors define a situation in a specific way (Fischer and Gottweis, 2012). On the other hand, the macro level pays attention to the structural and systemic dimensions that order communication and persuasion. While both levels focus on how discourse manifests in social relations, none of them explains how policy change occurs through the interaction of the different levels. However, in the case of contemporary policymaking that occurs in complexity and institutional void, there is a need for an approach that can accommodate a multi-level mode of governance, while maintaining the urban level as the main framework of reference.

A first response to this need is the publication 'Argumentative Turn in Policy Analysis and Planning', edited by Frank Fischer and John Forester in 1993. This publication collected a series of approaches, which emphasize the relevance of the collective meaning-making processes through argumentation in shaping policymaking (Fischer and Forester, 1993). Approaches within the argumentative turn put emphasis on the negotiation of a diversity of interpretations, meanings, beliefs and realities that are traced across different levels of social interaction. While argumentative policy researchers (such as Hajer, 1993; Forester, 1999; Fischer, 2003; Healey, 2003; Dryzek, 2005; Fischer and Gottweis, 2012) built upon a Foucauldian understanding of discourse, they put more emphasis to the practical side of discourse production in policymaking. Discourse is viewed as an analytical concept that allows for the interpretation of facts, events, actions and phenomena. Yet, it does not only refer to language, but also practices, as it is practices

through which we speak. Discourses only become real and materialise through actors' everyday practices (Jørgensen and Phillips, 2002; Keller, 2013). Maarten Hajer is one of the main contributors to the argumentative policy studies and defines discourse as: '*an ensemble of notions ideas, concepts and categorizations through which meaning is allocated to social and physical phenomena and which is produced and reproduced in an identifiable set of practices*' (Hajer, 1995, p. 44). As such, a discourse analysis of policymaking is not just about what is being said, but about the deliberation of policymaking and the ways language is used to pursue political and organisational objectives and produce knowledge (Hajer, 2006a). Hajer's work is known for developing a more balanced framework between structures and actor's agency by deploying the analytical concept of storylines. His framework for discourse analysis allows for an analysis of the meso-level of policymaking, unpacking the relational interaction between actors' practices and social structures, rather than drawing up a sharp dichotomy between structure and agency. Therefore, this work draws inspiration from Hajer's neo-Foucauldian Argumentative Discourse Analysis (ADA).

2.2.2. Argumentative Discourse Analysis (ADA)

Hajer's Argumentative Discourse Analysis (ADA) focuses on how actors as agents reproduce and transform discourse through practices. The main assumption of Hajer's ADA is that policy change occurs through discursive change. This kind of discourse analysis can explain why certain options become more relevant at the expense of other options (Hajer and Versteeg, 2005). Hajer (2006a, p. 66) defines ADA as '*the examination of argumentative structure in documents or other written and spoken statements as well as the practices through which these utterances are made*'. As already mentioned, the concept of storylines originates in ADA, where a storyline reflects a specific discursive understanding of a given policy, and thus is communicated by political actors in efforts or struggles to institutionalis
e their understanding of a given policy in practice. Storylines are viewed as short-cut phrases that summarize '*narratives on social reality' 'cluster knowledge, position actors and are essential in the formation of coalitions in a given domain*' (Hajer, 1995, p. 63). These narratives reflected through the storylines are more specific than ideational structural discourses, as they convey the frames used in specific fields of action for policymaking (Gottweis, 1999). Ideational discourses, such as neoliberalism or globalisation, are likely to be embedded within the storylines, which usually integrate and conceal more than one broader discourse in concrete contexts of policymaking. Thus, storylines induce policy change by '*bringing together previously unrelated elements of reality*' (Hajer, 2003a, p. 104). In the same vein, Hajer and Versteeg (2005) argue that networks in policymaking can be analysed as discourse through storylines, as discourse represents collective sense-making through the negotiation of multiple meanings. By looking at language-in-use through storylines we might be able to trace how a disparate group of actors finds ways to address public problems in a way that participants all see as meaningful. This resonates very well with the networked, decentred, multi-level

governance dynamics in which policymaking for automated driving takes place. Thus, an analysis of networks through storylines can shed light to the '*bonding in networks that, initially, may seem disjoint and unstructured*' (Hajer and Versteeg, 2005, p. 343). As Fischer (2003) put it, storylines hold networks together through interpreting events and courses of action in concrete contexts. For example, ten years ago, it was not clear how Stuttgart as the 'cradle of automobile', globalised digital economy, the State of Baden-Württemberg, the Region of Stuttgart and automated driving would relate to each other. The storyline of fostering a new connected mobility system through automated driving in the area of Stuttgart stressed that the Region of Stuttgart had to restructure its economy by putting more focus on the ICT sector because of global pressure to catch up with the developments in Silicon Valley. This would lead to promoting connected and service-based automated mobility.

Actors, thus, use storylines as a means to formulate a common understanding of the issue at hand, and subsequently form courses of action. Grounded in the argumentative turn, a storyline is an argumentative practice itself in policymaking. It is the storylines that bridge the gap between the specific micro-interactions and broader institutional changes. Hajer argued that actors use 'discursive strategies', namely employing historical references, symbols or metaphors to position themselves in the network and influence other actors (Hajer, 1995, 2003a). Institutional conditions, such as existing rules and administrative routines only matter when they are taken up by the actors. This is how Hajer attempted to bring a balance between the broader ideational and institutional changes with the argumentative interactions of actors in policymaking. Thus, the focus of Hajer's ADA is on the process of policymaking, the problem formulation and the development of framework for actions, and not so much on the material manifestation of discourses. In other words, it is about the deliberation of policymaking. There are two conditions through which policy change is evaluated:

- Structuration: Structuration happens when a new storyline is formulated by gathering a group of actors and elements of various discourses around it, and thus dominates the discussions in a certain policy field (Hajer, 1995).
- Institutionalisation: After its structuration, a storyline starts to get institutionalised in new rules and routines, planning processes, laws, new business models, new roles for state agencies and market. In other words, it materialzes in institutional practices and ways of doing (Ibid.).

Overall, ADA suggests a more mobile approach to the analysis of policymaking processes, compared to other interpretive discursive approaches (maybe name other discursive approaches), such as Laclau and Mouffe's discourse theory or discursive institutionalism (DI). It emphasizes the dimension of practice to analyse more fluid processes of social relations and their transformation over time. Yet, by evaluating policy change through structuration and institutionalisation, ADA still analytically remains to a rather static conceptualisation of agency and structure. Thus, change would depend on the predominance of one or the other category: new forms of agency or changing institutional

structures. (Tschoerner-Budde, 2019). This even derives from ADA's conceptualisation of practice, which is '*operational routines – mutually accepted rules and norms that give coherence to social life*' (Hajer, 2006b, p. 45). It is the very conceptualisation of practice that is static by referring to the existing structures and the reshaping of structures. This presents limitations in capturing how policies emerge and change. Firstly, policy change often occurs without its corresponding discourse becoming structurated. In other words, sometimes it occurs simply because the actors who want it have power and control over material resources, such as guns, oil, technology or have positional power in a network, so they act without argumentative exchange. Secondly, even if structuration does occur, institutionalisation might not happen due to material factors and/or routinized practices themselves. For example, Germany's aspiration to be the world leader in automated driving might be hindered by a) physical limitations of urban landscapes and infrastructure networks, b) objections of people to trusting technology, c) institutional inertia. This implies that not everything is a matter of argumentation, and discursive change does not always determine policy change. It also suggests that practices as operational routines not only bring change through repetition, as Urry (2000) suggested, but they might also induce inertia. That is to say that during the process of institutionalisation of a storyline, new operational routines might not occur due to already established operational routines. Inevitably then, ADA's conceptualisation of practice always refers to structure, perpetuating the dichotomy between structure and agency.

The problem of always having a structure as the main framework of reference for practice can be better understood by contrasting Austin's (1962) view of language as practice, in the sense that to say something can be an act, with Laws's (2001) view of practice as temporality and circumstances abound. While Austin suggested that speech acts perform by referring back to conventions (structures) familiar to us all, Laws (2001) suggests that in the unsettling situations of today's multi-party and multi-level governance, people first need to agree on a temporary sense of what these conventions are, as contemporary governance occurs in institutional ambiguity. Laws perspective reflects more closely the case of policymaking of automated driving as this process is not only multi-party in the sense that it involves diverse actors from formal and informal politics, and public and private sector, but also multi-level as it includes the engagement of different administrative and political levels of governance.

This means that if the settings in policymaking are unstable and institutional structures uncertain, there is a need for a conceptualisation of practice that does not only refer to the existing structures, but also refers to improvised interaction that allows diverse actors space for manoeuvring. Hajer (2005b, 2006b) himself argued that methodologically, discourse analysis can be enriched if it is combined with a performative dimension of interaction. The dramaturgical term of performance suggests that certain meanings have to be reproduced constantly, that signification must be enacted and that this takes place in a particular setting (Hajer, 2005). This not only views discourse as an act, but also suggests that there are non-discursive conditions that might enact meanings, such as physical, spatial and technological conditions. Thus, statements

in public meetings, policy proposals to the City Council or corporate decision-making related to automated driving are acts, which are enacted by the interaction of both discursive and non-discursive elements. In such cases, performing not only co-determines which rules are followed in the process. It also co-determines which definition of reality is followed, what temporal-spatial frame is seen as appropriate and what constitutes legitimate intervention. Partly, this might be a matter of quasi-ritualistic acts (Ibid); repetition that helps maintain institutions, as ADA suggests with the conceptualisation of practices as operational routines. But while some performances are about replication, others are about improvisation, about the way in which actors attempt to relatively stabilize an unstable situation in their attempt to construct certainties (Hajer, 2005). In this kind of situations, policymaking processes might be staged differently to the existing operational routines and structures. Since automated driving is a policy issue that calls for improvisation in practices, and most importantly for an appreciation of the interaction between existing operational routines and new improvised actions.

This work builds on Hajer's interpretive ADA by deploying the analytical concept of storylines to show how automated driving derives its meaning over time in policymaking, and how it is negotiated between different groups of actors. The difference to ADA is that the storylines are adopted to 1) consider discourse as an enacted discursive practice, which shapes policymaking to a certain extent through allocating meanings to the process, 2) non-discursive conditions, such as technologies and settings, are considered to co-shape policymaking too. This means that whatever overarching (structural) discourses influence policymaking in Munich and in Stuttgart (e.g. such as neoliberalism, smart city, global city) are picked up differently in each case and become relevant only to the extent that are enacted through local argumentation and interactions. It is not within the scope of this study to assume in advance which of these overarching discourses are reflected in the local policymaking. The aim is rather to show what kind of 'operational discourses' are practically enacted in the different local settings through the storylines and what these mean for the way multi-level and networked policymaking is conducted. An operational discourse is a termed coined within the scope of this work to refelct an overall approach to policymaking, which is distinct from overarching ideational discourses. An example of an operational discourse would be a car-centric approach reflected in both case studies, but produced by two different storylines, and manifested and negotiated in two distinct ways, integrating elements from various overarching discourses. In addition, this work opens the conceptualisation of practice from operational routines to interactive performance. It does, of course recognise that there are routinized practices that develop path dependencies through repetition, but these routinized practices are never the same, as they interact with new improvised practices. Ultimately, this work conceives practice as the interactive performance between the old and new constituents in policymaking. In order to do so, it draws on literature on Science and Technology Studies (STS).

2.3. The performative approach to policymaking

Hajer and Versteeg (2005) argued that in order to understand how networks gain influence, it might not be enough to only study cognition in policymaking. Although strategic cognitive action is surely a key component of politics, performance is the way in which the contextualised interaction itself is seen as producing understandings of the problem at hand, knowledge and new power relations. It is exactly because of the uncertainties involved that policymaking depends on various forms of enactment, which are often invented on the spot. This work argues that it is then this improvisation that partly creates a shared storyline to establish a (preliminary) common understanding among the actors. Weick (1995) argues that people coordinate joint actions before they worry about shared visions. This highlights the importance of performativity of incidents in achieving a common understanding and a common goal among different actors in policymaking.

A key concept of the performative approach is the settings. Settings refer to the physical situation in which interactions take place, including the role of the artefacts that are brought to the situation (e.g. the car). They are the 'locations' where arguments and practices emerge, get articulated, are dealt with and play out (Hajer and Versteeg, 2005). Examples of settings are parliaments, councils, and forums, but also laboratories (Latour, 1987) as well as industrial think tanks and meetings. Settings are not neutral; they provide the conditions for the performance of the issue at hand. They are thus the concrete and local condition for debates, negotiations and interactions (Barry, 2014). Settings like the City Council prescribe, to a certain extent define who has access, but also what counts as relevant information, reasonable arguments, and legitimate decisions. The setting of activities and the framing of concepts are never passive or innocent, but they do something, they are performative (Gomart and Hajer, 2003). For example, the meetings at a City Council or at a Department of Urban Planning as settings follow a protocol and a routinized way of communicating and documenting. That is not to say that settings determine the precise moves of actors, as actors can still creatively engage in interactions, make decisions and get influenced by external events. They rather determine the range of appropriate actions when the interaction takes place within them (Nahuis, 2008). It is not in the scope of this study to examine precisely how the settings structure actions. Most important for this study is how actors move automated driving as the object of policymaking to other settings when the current settings do not have the capacities to accommodate the policy object or when external imperatives and contingent events call for displacement to other settings.

This study is also interested in the historical and social context, the organisational context as well as the situatedness of specific events of policymaking (i.e. the positioning of actors, the audience and the objects) that are defined through the settings. For this reason along with the settings, this study considers also two more performative elements, namely scipting and staging (Edelman, 1964). The concept of settings is integrated into the storylines as a key component of the analysis of the two case studies. All three performative dimensions; scripting, settings and staging are used in the final chapter of

this work to contrast the two cases and discuss the wider impacts of the policymaking of automated driving. Scripting refers to those efforts to create a setting and to provide cues for appropriate behavior. The 'script' prescribes courses of action in policymaking; it allows, forbids, prescribes and suggests ways of thinking and doing (Akrich, 1992). Staging refers to the deliberate organisation of interactions as well as to the distinction between active players and (passive) audiences in dramaturgical terms. Staging defines the roles of the actors on stage, who has power to shape policies and from which position and who is the recipient of these policies. Staging is closely connected with what kind of knowledge is considered legitimate to shape policies (Goffman, 1974; Latour, 1991; Hajer, 2005b). Then, it is essential to see how knowledge is produced. From a Science and Technology Studies (STS) perspective, knowledge is a product of practice and performance and it is through an extended engagement of multiple actors that shared knowledge claims are produced (Maasen, 2009). For example, the variety of impact assessments (e.g. studies on the impacts of automated driving in cities) and the ways they are employed in policymaking processes, the necessity of reductionism and simplification and the creation of 'authoritative data' that are used to legitimize policy decisions are particular performances, creating a style of operating which can be analysed as a practice of knowledge production and which is also a way to control an ambivalent situation (Hajer, 2005). The knowledge production as performance is a way to enact meaning and legitimize policy decisions. While Hajer's ADA recognises the importance of interactive performance, it still examines the discourse itself first as shaping knowledge, and then turns to a consideration of interactions between actors (Rutland and Aylett, 2008). Healey (2013) suggests giving special attention to the 'origin stories' of policy ideas, their 'travelling histories' and the 'translation experiences' through which exogenous ideas and practices become localized. Therefore, this work draws also methodological inspiration from Actor-Network-Theory (ANT), which focuses on how the specific determines the broader through interactive performance.

2.3.1. Actor network theory (ANT)

ANT is an approach emerged in the field of STS and was initially developed by Bruno Latour, and further developed by Michel Callon and John Law. Latour founded ANT when he studied the production of scientific facts in a laboratory. He observed that the practices of the researchers in the laboratory were not the only entity that influenced how scientific knowledge is produced (Latour and Woolgar, 1986). Based on these observations, Latour developed an analytical framework (ANT) that allowed him to study how scientific knowledge is produced in the laboratory through the relations between the researchers (humans) and non-humans (machines, maps, graphs). Ever since, ANT has been increasingly popular across diverse disciplines, including management, geography, architecture and transport studies. Despite it has not been widely used in political science, it has certainly influenced some interpretive policy analysts, such as Gottweis (1999), Gomart and Hajer (2003), Hajer and Versteeg (2005), Rutland and Aylett (2008) and Beveridge (2012), who drew on ANT to provide an account of knowledge production

in policymaking as performance. ANT provides an approach to studying how social order(s) is contingently achieved through the enlistment of human (individual, collective, institutional) and nonhuman (artefacts, technologies, infrastructure, documents, etc.) actors into relationships called actor networks (Rutland and Aylett, 2008). It assumes that nonhuman entities have agency too, thereafter hybrid forms of agency define our society (Latour, 1996a, 2005). In relation to policymaking, ANT explains how the subjects and objects of policymaking come together (Rutland and Aylett, 2008). Despite what its name suggests, ANT is not exactly a theory, but it represents a methodological sensibility that introduces uncertainty concerning the nature of agency as not being exclusively human by reconceptualising it as 'the ability to make a difference' (Sayes, 2014).

ANT's most fundamental assumption is that entities are an effect of their relations with other entities, rather than inherent properties (Law, 1999). Agency here is acquired and relational, rather than inherent and individually possessed. For example, software and hardware developments (material agency) combined with a modification of the traffic law (human agency) might result in allowing automated driving on the streets. In this sense, ANT assumes that the world is multiple, performative, constantly changing and different from a pre-existing reality. This multiplicity, though, is often disguised when one truth claim dominates others. ANT is exactly about unpacking this multiplicity behind social structures by investigating how certain interactions between humans and nonhumans relatively stabilize (Law, 1992). For this study, this practically means that when a storyline comes into place in a policymaking process (e.g. automated driving as fostering new mobility services), there has been a lot of work done bringing together different actors and ideas through interactions. And yet, even when this storyline comes into place, it is relatively 'stable' for a certain amount of time, while it keeps changing over time through interactive performances until it gets replaced from another storyline that better corresponds to the new interests and emerging circumstances.

This bringing together of diverse elements is performed through the concept of 'translation', which is a central to ANT. Callon and Latour refer to translation as the means through which different ideas, interests, initiatives, and artefacts are aligned. Translation emphasizes the displacements of people, objects and meanings, in order to capture the dynamics of network formation (Callon, 1986). Networks are defined by the activity of actors to translate their own interests, purposes, problem definitions into those of others, attempting to enrol them into the network and to be able to speak on behalf of them. Strategies of enrolling others while keeping control of their behaviour is a matter of enlarging and unifying networks. Thus, networks are built through the translation of interests, possibly detaching actors from existing networks and enrolling them into others (Callon, 1984).

Translation suggests that our choices are not subject solely to the rational restrains of logic, disciplinary norms, or legal sanctions, but also that technology is never alone in inducing a change in a socio-technical system. Thus, actors rarely act purely rationally as cognition and action are mediated by the socio-technical relations in networks. It is about revealing how agency is realised, how priorities of action emerge through the relation and interaction between actors and objects in networks (Law, 1999). Ultimately, to

translate means to '*express in one's own language what others say and want, why they act in the way they do and how they associate with each other*' (Callon, 1986, p. 223).

2.3.2. Policymaking as performative translation

It should be made clear that this work does not adopt the symmetry of agency (Callon, 1986) that ANT assumes. Nor does it intend to contribute to ontological debates regarding human and non-human agency. This means that this study claims that in policymaking it is human actors that argue, interact with each other, and make decisions for developing and implementing policies. Policymaking is primarily defined through the interplay of new and old actors and fluid institutional settings (movement between settings). Yet, since automated driving as an object of policymaking is in the making, facing experimentation and uncertainty regarding what technologies will be employed and where, the material (non-human) agency in policymaking will be considered in the following two aspects: 1) the influence of availability or lack of certain technologies, 2) the influence of existing landscapes and infrastructure in the two cases studies. That is to say that these two aspects influence the way human actors make decisions by defining, to a certain extent, what is feasible and what is not. After all, the focus of this study is to provide an account of how automated driving has been discursively and practically produced in policymaking arenas. This means that the focus is on the production of meaning and the performative negotiations between actors, in order to provide an account for policymaking processes in flux and their objectives. Against this background, the relevance of ANT for this study is that it brings along an agnosticism that is helpful for analysing policymaking processes without pre-occupations about where these possesses belong (Latour, 2004). Most relevant for the understanding of the dynamics and the divergent objectives of policymaking of automated driving is the idea that its making comes about in the interplay of previously dispersed and new actors and settings. In other words, the idea of ANT that the ability to act is an outcome of relations, instead of an inherent quality of entities is particularly relevant for this study. That is very much in line with the notion of performance, as it views power as displaced across a range of actors and settings (public and private) enabling new practices and objects to emerge. Thus, it also highlights the fluidity of meaning and structures, which is exactly what multi-level, networked and de-centred governance is about.

It is, then, translation that is a useful means of analysing the uncertain and fluid policy processes, as it shows shifts to policymaking through storylines. It captures the sense that politics and policy are co-produced in institutional ambiguity and void. In this work, translation is a way of combining an analysis of broader developments, local interactions and diverse settings. As such, the interests of actors are not considered as fixed in advance and cannot be seen as a cause of action, but they are rather defined through action. For example, the interest of the automotive industry to promote automated Mobility as a Service (MaaS) in cities might have emerged through the interaction with the ICT sector that produces digital technologies and Apps, and the competition with new mobility providers like Uber that are already providing MaaS fleets in cities. Although one might

argue that ANT could make the analysis of the policymaking processes of automated driving apolitical by neglecting the existence of a central figure whose interests dominate, this is not the case here. Rather this study argues that policymakers might outsource some of their regulating ideas and initiatives. This does not mean that asymmetries of power are to be neglected, but rather that the study aspires to reduce pre-existing assumptions regarding 'who governs and how' or which overarching discourse or imperative shapes policymaking, and to avoid establishing distinctions prior to the analysis as much as possible. It is about viewing the policymaking arenas as fields of experimentation, where the unexpected variations and surprises of deliberative interaction can be revealed.

Summing up a combined approach

Both the interpretive approach and the performative approach can be said to be concerned with the practical aspects of governing, arguing that broader discourses and socio-technical developments only have effects to the extent to which they become practical. However, there is a tension between the two approaches regarding the means through which they seek to reveal this, even keeping the material issue out of the discussion. The interpretive approach begins with the premise that discourses are constitutive of social relations and actions, and traces how these discourses are produced and re-produced in different contexts and the effects these processes have through the concept of storylines. As Rutland and Aylett (2008, p. 631) argue, '*Foucauldian discourse approaches show how a piece of given music comes to be performed by multiple actors but tell us little about how this piece was chosen or composed'*. As such, the interpretive approach fails to capture aspects that have to do with improvisation and the performative agency of settings in shaping certain actors, events and interactions. In addition, in the case of socio-technical objects of policymaking, such as automated driving, it does not suffice to consider the influence of material aspects that influence policymaking (i.e. technologies, existing infrastructure). In contrast, the performative approach is bottom-up rather than top-down; it looks first to actions to describe how meanings and relations between actors are produced. The premise of the performative approach is that all action is contingent; that agency is an effect of the sets of relationships or networks, within which actors are embedded. Yet, a performative approach alone could not provide a complete analysis of conflicts, since it does not provide a thorough understanding of precisely how actors attempt to shape perceptions and actions of one another (Rutland and Aylett, 2008). At the same time, the influence of the broader socially constructed beliefs and ideologies that inform interactions are barely considered (Jasanoff, 2004).

Therefore, this study considers the two approaches as complementary despite the tensions between them and focuses more on what unites the two approaches rather than what divides them. The latter is out of the scope of this study, as the main focus here is to provide a comprehensive analysis of policymaking processes of automated driving with thick descriptions, rather than having a philosophical debate about chicken-egg problematics. In this sense, the performative approach could supplement the interpretive

approach by explaining the history and the constant movement of automated driving between diverse policy settings behind the production of storylines, and how the different socio-material aspects of automated driving have been co-produced and come into being. Thus, this combined approach does not assume 'policy goals' and 'information' as flat and given; rather they must be studied relationally in how they are co-produced and used by diverse actors in formal and informal policymaking processes (Latour 1996; Hajer 2009). Ultimately, investigating policymaking of automated driving, using this combined approach, can contribute to acknowledging the political nature and specific values of techno-policies. On the one hand, popularizing technology and denouncing its politics usually leads to disconnection of everyday social realities and missed potential for actual change and problem solving. On the other hand, policy often tends to be a means of promoting efficiency, while the political nature of policymaking is hidden by using technical language. As such, it would be unfair to reduce policymaking to the formal decision making without considering the role of the industry, technologies and technocrats, just as it would be wrong not to see it as a dynamic product of constant political action and hybrid interaction. Thus, the concept of storylines is expanded and enriched to integrate both interpretive and performative elements in the study of policymaking.

2.4. Storylines: the bundling intermediary

2.4.1. What storylines do

> To have a plausible political-historical narrative nowadays means to have viable politics, rather than policies masquerading as politics. Politics becomes impossible without a good story in the form of a convincing plot or an inspiring vision. (Bauman and Donskis, 2013)

This study aims to merge an interpretive-discursive approach and a performative approach to policymaking of automated driving into one single analysis. Storylines are the lens through which policymaking is analysed. They represent a way to go beyond the still powerful distinctions and traditions of macro and micro levels of analysis to policymaking. Eventually, storylines bring a balance between the two levels by capturing what happens in the meso level where the macro discourses (e.g. rhetoric for automated driving as disruptive, smart city) meet the performative interactions of actors. This 'meet-up' happens in the diverse multi-level policymaking settings of the two case studies, such as the federal Ministry of Transport, e-mobil: the innovation agency of Baden-Württemberg, City Councils, informal meetings with the industry. Much STS research has shown in many micro studies the fine details and situations of socio-technical objects, and many discourse analyses have dealt with macro structures. Storylines in this work emphasise the historically emergent policymaking processes beyond strictly defined institutions, and show the emergence and movement of the policy object across different settings over time. The focus here is on the diversity of policy settings instead of formal

institutions, in order to capture the fluidity of policymaking processes of automated driving. It is the concept of setting that allows a balance between the pre-existing biases and improvisations. This is rooted in the time-and-process-sensitive perspective of 'becoming' that is neither simply about the deterministic reproduction of structures nor about a pure contingency and improvisation of situations. This is particularly relevant in the case of automated driving, as it is still unclear what it is. A storyline as a comprehensive concept locates automated driving not only in technical artefacts, not only in discourse, not only in actors and not only in institutions, but in the interface of all of them. Through the lens of storyline, we can see policymaking of automated driving as a complex and dynamic process made up of heterogeneous elements and the connections they create. Contrasting different storylines helps to highlight how storylines are produced in relation to each other, and how a storyline only gains its meaning through its relation with another storyline (Hajer, 2006). This contrast ultimately shows how policymaking evolves through the change of meaning and practices over time. As such, storylines provide the storytelling Bauman and Donskis referred to in the above quote; a storytelling that makes possible to unpack the politics in policymaking. They, then, become an analytical tool to comprehensively explain the history, the dynamics and interactions in policymaking beyond instrumental and positivist accounts of policy analysis that conceal the political nature of policy.

Storylines are understood in this study as resources which actors deploy to make sense of broader developments, facts and evidence, and exchange meaning among them, and thus shape policies. By deploying storylines, actors reduce complexity, gain acceptance, credibility and trust in their interactions. Thus, they hold policy coalitions together through '*interpreting events and courses of action in concrete social contexts*' (Fischer, 2003, p. 102). It is the storylines that bring together previously unrelated elements of reality, by translating these elements into a concrete narrative. As Hajer put it, storylines are potent because they '*help people to fit their bit of knowledge, experience or expertise into the larger jigsaw of a policy debate*' (Hajer, 2003a, p. 104). Potent storylines have ontological flexibility, they stick when they are flexible enough to accommodate actors with different interests, while being specific enough to formulate a course of action. Therefore, storylines are the bundling intermediaries of policymaking processes. They have the capacity to transform, translate, distort, and modify the meaning or the elements they are supposed to carry (Latour, 2005). In the same vein, Hajer (1995) claims that all discursive policy analyses must be based on three interrelated elements: discourse, practices and meaning. While meaning is produced through certain discourses, discourses are enacted through practices as interactive performances. Thus, practices represent the performative dimension of policymaking (informed by ANT) and discourse and meaning represent the discursive dimension of policymaking (informed by ADA). However, this does not mean that each of these elements is to be studied separately. In order to analyse policy in the making it is rather necessary to study the three elements as an entity. In other words, statements, underlying meanings, practices and materialities should be examined together. It is the storylines that connect all these elements and enable their comprehensive studying.

Overall, storylines reflect the agency of actors and partly of the technologies within and across different settings. It is not assumed that actors are the agents of change, but that they have the capacity to change the conditions and framework through which policymaking takes place. Policy actors might also 'act' to not only change policy, but also to 'resist' to change (Tschoerner-Budde, 2019). Furthermore, there are limitations to this capacity of actors to induce change or not. For instance, there are certain physical structures, technological capacities, already established infrastructure and institutional biases of the settings that interact with, limit or enable the agents' capacity to transform policy. It is about how actors interact with existing policy regimes, how they engage in debates, how they attempt to attach meaning to new technologies. In this sense, the identification of storylines and the analytical elements that are made of can analyse not only policy change, but also policy inertia (Servou, 2019).

2.4.2. Identifying storylines

Studying how storylines are produced is key to understanding policymaking. Identifying a storyline is a matter of identifying through which practices and how actors appropriate meaning to policy issues, phenomena, objects and subjects. As Hajer wrote, the identification of policy storylines and, relatedly, how policy change ultimately came about is a matter of empirical research. This study adopts a descriptive, exploratory and interpretive approach based on an abductive process of reasoning. This means that theory develops in relation to the data material at hand in order to explain it. A storyline reflects a specific framing of policy, a framing which is on the one hand explicated by the researcher and on the other hand embedded in and legitimated through the actions and sayings of policy actors. In the data, policy storylines are considered as rather metaphors and/or short-cut phrases that are deployed and shared by actors in an attempt to connect concepts and material aspects that were previously unconnected, in order to develop a common understanding of the topic at hand. In the case of automated driving, it is through six key dimensions that storylines are identified in the empirical material. These six dimensions arise from the combination of an interpretive and a performative approach and are the following:

- A set of practices in which actors engage to literally 'do' or produce a storyline. This includes rules, legislation, initiatives, agreements, economic practices, studies, pilots.
- The set of material aspects that influence the production of a storyline. These material aspects include infrastructure, technological developments (e.g. hardware and software).
- A set of events and tipping points that (re)shape the storylines.
- A set of settings where the storylines are articulated.
- The actors who share a policy storyline (new and established actors).
- A set of narratives actors produce to shape a policy storyline (e.g. efficiency, last mile problems).

For example, in the following analysis, investigating how a storyline is produced and shared by a coalition between the automotive industry and the city administration emerges is a two-fold process: On the one hand, what triggers the interactions between the actors (e.g. tipping points, events, technological developments, emerging interests and goals) and where this happens (settings) is identified in the material. On the other hand, the utterances and arguments actors develop are identified. Then, by combining and contrasting the two sides, the storyline that the members of the coalition articulate is revealed.

The analytical approach follows that policy actors do not randomly and without knowledge, consent or desire developing policy. Despite the contigencies and uncertainty, actors are considered capable for making thoughtful decisions based on the circumstances and the changing dimensions. Thus, policymaking is context-dependent, which means that it takes place in a complex entanglement of institutions, norms, networks, infrastructure, embedded practices, subjects and objects. That is why the storylines that will be identified in the two case studies are a product of particular interactions of socio-material elements during a specific period of time, which might be distinct from other contexts. The storyline identification in the two case studies is not necessarily for strictly comparing the cases, but rather to analyse distinctions in how actors produce different processes of policymaking, and in how they deal with uncertainty and ambiguity.

In the following analytical chapters, the two case studies are analysed symmetrically. This means that both cases will beginn with a brief introduction to the historical and socio-material context of the cases. In turn, two storylines will be identified for each case study. The storylines will be analysed chronologically from 2010 to 2019 for both cases. The year 2010 was set as the outset of the empirical analysis, as for both cases it was this year that was indicated by the interviewees and the document analysis. The year 2019 is when the empirical data collection of this work ended. The first case of Munich takes as its starting line the developments at the federal level focusing on the automation of the private car as a means for growth of the automotive industry and looks at its unfolding from it being a mere evolution of the car to it providing new perspectives for urban mobility and development. The case of Stuttgart traces the emergence of automated driving at the State of Baden-Württemberg and the Region of Stuttgart, where automated driving was used to legitimize investments for ICT technologies through the creation of abstract hyper connectivity visions. Then the case shifts towards the deployment of automated driving as a proxy for urban on-demand public transport and new regulation. Two different trajectories of policymaking, namely dispersion (Munich) and relegation (Stuttgart) are the analytical results of of the case studies explaining how policymaking changed objectives and was translated from industrial and higher administrative levels to the urban contexts, but without automated driving being implemented. These trajectories are discussed at the end of each case study through discussing the storylines in relation to each other, their components and their mutual interaction, in order to get an overview of the case and the impact of policymaking. In the fifth chapter, an abstraction from the concrete case studies of policymaking of automated driving are

presented by identifying two broader approaches to policymaking reflected through the storylines of both cases; namely an industry-focused approach and an urban approach. These approaches can also be considered as operational discourses that the storylines enact. The two approaches are presented through comparing and contrasting the two cases according to the three performative dimensions of the production of automated driving; scripting, settings and staging. This helps to draw out the key lessons learned on the impact of the non-implementation of automated driving and the productivity of the institutional void in policymaking. The conclusion discusses the relevance of the findings for research and praxis and the possibilities for future research.

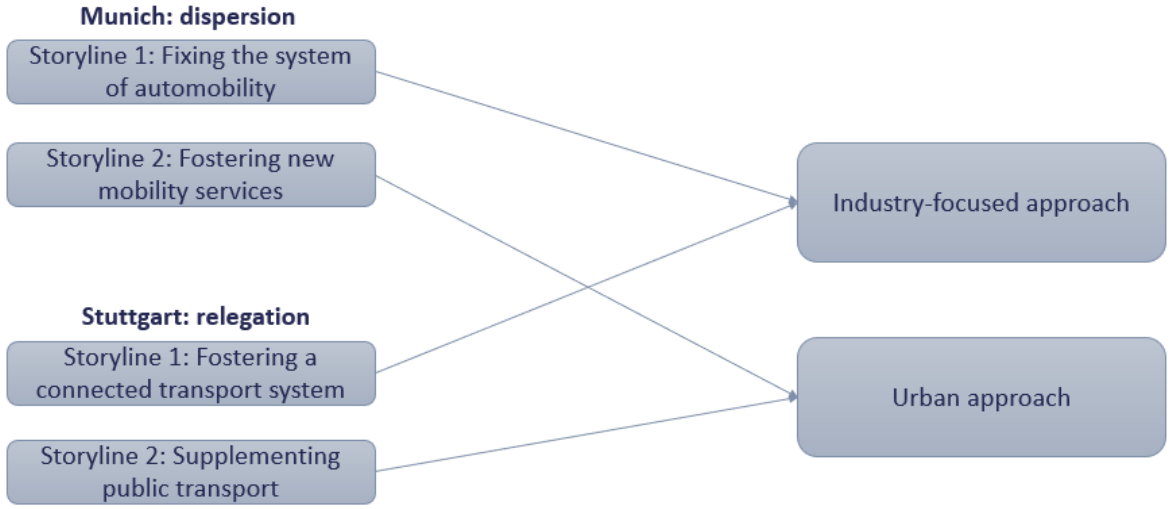

Figure 1: Overview of analytical perspectives

3. The case of Munich: enticed by perspective

The first case study analyses the policymaking of automated driving in Munich. The case study provides insights into how automated driving came to offer a new perspective into rethinking other long-existing mobility and urban issues in Munich. In order to do so, it takes into account policymaking settings of two different governance levels, namely the federal government level and the City of Munich, industrial policymaking settings (e.g. BMW), and public-private settings, in order to trace and contextualise how automated driving emerged and gained relevance for the urban level in Munich. The relevance of these settings was traced with the help of the interviewees, who pointed out from the beginning of the empirical work that policymaking of automated driving in Munich is interrelated with the automotive industry and the federal level. This chapter is organised in four sections. In the first section, a brief overview of the historical, material and governance context and an overview of the storylines in Munich serve as a basis for the analysis of policymaking of automated driving. The second and third sections analyse the two storylines identified in the empirical material. The fourth section discusses and reflects on the trajectory of policymaking in Munich as dispersion as well as the role and the impact of the different components (i.e. actors, settings, narratives, practices, technologies) in policymaking.

3.1. Context

Historical and material context of mobility

The context of the first case study is set to the City of Munich, that is the political and spatial boundaries of the 'Landeshauptstadt München'. It is the capital of the free State of Bavaria, one of Germany's southernmost 16 federal states. It has a population of roughly 1.5 million residents, with around 2.7 million in the surrounding region (Reiter, 2019). Munich is a city which grew substantially in the second half of the 20th century. After the World War II, Munich had to reconstruct large parts of its urban fabric (almost the entire old town), including the transport infrastructure. Although the city strived to maintain most of the historic urban landscapes and buildings, the reconstruction massively favoured roads and the proliferation of private motorised vehicle traffic (Tschoerner-Budde, 2019). This car-centric approach to mobility policymaking was phrased as the 'Autogerechte Stadt' (the car-friendly city). At that time, this approach was a modern way to look into the future of urban development (Kesselring, 2001). In the mid-1960s, public transport was identified as an important element of Munich's transport system and as a key tool for enabling mobility in the city centre, as the policymakers started realizing the limits of private car use in terms of traffic efficiency (Schmucki, 2001). In turn, there were massive investments on improving infrastructure for public transport; the construction of a suburban rail tunnel under the city centre, the inauguration of the subway (U-Bahn) and the largest expansion of the tram network completed by the time of the Olympics in 1972. Yet, outside the inner-city area, the private car was considered as the most efficient

mode of transport. Thus, two inner ring roads were planned, built and finished until the 1972 Olympics to enable car use around the old city centre. In the mid-1990s, the deliberative stakeholder network 'Inzell Initiative' was established between the City of Munich and BMW. This network has been functioning as a cooperative setting beyond ideological differences to provide recommendations for mobility policymaking towards multimodality. According to Hajer and Kesselring (1999), the direction that the Inzell Initiative provided in policymaking is a 'double track' strategy; car traffic should be maintained around the city but without massive investments in car infrastructure, while public transport should be optimised as a superior means of transport on its own right to maintain the attractiveness of the city centre. New mobility concepts, such as parking management, traffic management as well as pilot projects were introduced through the Inzell Initiative.

Since 2000, local politicians and transport planners have been developing more flexible approaches towards sustainable mobility. The City of Munich has been trying to achieve sustainable mobility through improvements in public transport and investments in multimodality and active modes of transport. Generally, the public transport network in Munich is considered to be efficient and appreciated compared to other European cities. However, the expansion of the public transport network has not kept pace with the population increase and the growing ridership is bringing the network to its absolute limits. Presently, Munich is one of the most densely populated cities in Germany and in Europe with 4.800 residents/km^{2,} compared to cities like Berlin (3.800 residents/km^2), Hamburg (2.400 residents/km$^{2)}$ and Vienna (4.300 residents/km2) (Dunkel, 2017). This is partly an outcome of the urban development strategy of Munich 'compact, urban, green', which was introduced in mid-1990s by the urban development framework 'Perspektive München' and aimed to integrate urban development and transport planning (Kesselring, 2016). As most interviewees stated, this strategy has been 'too successful' in the sense that it has attracted way too many people and activities in the city centre, which has resulted to lack of space in the city. The transport planners claim that the road network can only be expanded through building underground tunnels, while the number of cars in Munich is constantly rising causing traffic congestion and air pollution. They also claim that capacity extensions of the public transport network are difficult because of lack of space and high investment costs (Reiter, 2019). Overall, the modal shift away from the private car hasn't been large enough to effectively reduce mobility problems, and policymakers face mobility challenges of growing populations that must be transported, lack of space, congestion and emissions.

Decentralised mobility governance

As one of the largest cities in Germany, Munich has an extensive local administration. The administrative structure around mobility issues in Munich is complicated. In particular, in the City administration, five different Departments are responsible for mobility policymaking: The Department of Urban Planning and Building Regulation for transport planning, the Department of Public Affairs for licensing vehicles, the Department of

Construction for building infrastructure, the Department of Labour and Economics for representing the mobility companies (both private and public), and the Department of Health and Environment for the environmental aspects of mobility. The main reason that there is so much fragmentation and decentralisation of responsibilities between different Departments is that a Department of Transport does not exist in the City administration. Although there are a lot of negotiations and discussions between the Departments, their communication is often impeded by bureaucracy and misunderstandings (Servou, 2016). Many interviewees pointed out the low effectiveness and the delay of the administration regarding the uptake of automated driving, which can be attributed on the one hand to the fragmentation of responsibilities, on the other hand to weak political intervention to the administration.

Regarding the interrelations with other levels of mobility governance, namely the Region of Munich and the free State of Bavaria, the urban level has a lot of power to decide on its own. The free State of Bavaria does not have a great influence on the decision-making at the local level. This is related to the traditionally different political orientation between the two governance levels. The free State of Bavaria is governed by the Christian Social Union (CSU) (Heinelt and Kübler, 2005). At the local level in Munich, a Red-Green Coalition; Social Democratic Party (SPD) and the Green party used to be in charge for many years since 1990. Munich was the only city in Germany, where the Green party was in power. This changed in 2014, when the Greens lost the local elections, and another political coalition between the SPD and the CSU assumed office instead with the SPD being the first governing party. In contrast to the Region of Stuttgart (second case study), the spatial delimitation of the Region of Munich is fuzzy. The regional assembly is not directly elected, but it consists of delegates from the municipalities and counties of the region. Regarding legitimacy, there is no multipurpose association or unitary authority (such as in the Stuttgart Region), which could function as the very centre of metropolitan politics, also in terms of accountability. Overall, the regional level in Munich is weak in terms of governing capacity. The regional mobility governance is rather performed through the informal setting of Inzell Initiative as a post-corporatist form of solving regional problems. While the focus of Inzell Initiative is the City of Munich, since 2004, regional aspects are formally on the agenda. The Inzell Initiative illustrates the dominant pattern of legitimacy in the Munich region. Yet, this goes hand in hand with the exclusion of a broader spectrum of societal actors, as the main focus is the industrial and political actors of the urban level of Munich (Zimmermann, 2014).

The case of Munich can be described as a decentred governance arrangement with fragmented sources of legitimacy, where legitimacy by performance dominates (Ibid.). This decentralised pluralist arrangement is always accompanied by a hierarchical element, because in Munich's administration, everything eventually comes back to the Mayor, who holds a strong position. Furthermore, cooperation with external experts from the federal level, the industry and research are core elements of knowledge generation in Munich's policymaking. External expert knowledge also serves as an external source of legitimacy and not solely as an expert consultation. According to Zimmermann (2018), this approach is a strategy of coping with contingency in dynamic and complex

environment, but it is often characterised by low predictability of successful implementation of solutions. Indeed, most interviewees argued that Munich is the city of slow decision-making for mobility. There has been a long tradition for reaching consensus among a multitude of different actors from the public and private sector. On the one hand, Munich is very strong in decision-making for pull-measures, such as creating new offers for bikes, sharing and public transport. However, policymakers have always been struggling with enforcing push measures with measurable targets. This leads to a lack of prioritisation regarding concrete solutions to mobility problems and having many different strategies in parallel. In sum, the City of Munich has a long tradition of lack of rigid policymaking to tackle mobility problems, and it is often the local automotive industry that is more proactive than the City when it comes to mobility solutions. Munich tends to outsource its expertise and strategies for new technologies and mobility. As the two storylines identified in the empirical material show in the next sections, at the beginning of the uptake of automated driving the relevance for action was outsourced from the federal level and the industry.

Overview of storylines

The case study of Munich focuses on the policymaking process of automated driving from 2010 to 2019. It was in 2010 that the term automated driving appeared in the key-word research in publicly available documents for the first time. At the beginning of the case, relevant developments of the federal policymaking for automated driving are presented, as it was the federal approach that was taken up by the local actors in Munich in the first years of automated driving policymaking, and provided an important backdrop for the initial understanding and contextualisation of the topic. The emergence of two storylines is traced in the policymaking of automated driving in Munich; (1) fixing the system of automobility (2010-2017), and (2) fostering new mobility services (2016-2019).

The first storyline of fixing the system of automobility involves mainly actors from the automotive industry, research, federal government, and the City administration at the last stage. The main objective of the storyline is revolving around the private car, with the main narratives focusing on automation as evolution of the automotive industry, fixing the technology within the car to tackle the unintended consequences of the system of automobility, as well as upgrading the car into a 'third' comfortable place in people's lives. It was around 2016 that the local actors in Munich took up the topic of automated driving, when they started deliberating applying for funding at the federal level for piloting Munich for automated and connected driving. The local politicians were not actively part of the first storyline, but they were rather passive. In sum, local policy during this period strongly reflected federal policy, which was focused on the private car.

The second storyline of fostering new mobility services spans from 2016 until the end of the empirical work in 2019. Between 2016 and 2017, the two storylines co-existed with the local actors sharing both the federal approach and the new storyline of fostering new mobility services, as it was not clear whether automated driving would be promoted as a replacement of the private car or other modes of transport. The switch from the first

to the second storyline occurred when the actors questioned the potential of automated driving to fix the system of automobility through a scenario study and a debate between the administration and the Green party. Local policymakers started diversifying the concept of automated driving from the private car to different mobility services, such as automated buses and ride-pooling. On top of that, the potential of automated driving started being dispersed to a variety of local mobility and urban development issues, such as space efficiency, optimising the overall transport system and reversing the trend towards urbanization.

Overall, there has not been an actual implementation of automated driving in Munich by the end of the case study, since there was no actual decision regarding if, how and who will implement automated driving. Ultimately, the case study provides insights into how an automotive industry-led incremental approach at the federal level has been dispersed into several mobility options and urban issues at the local level offering new perspectives for their resolution. The next two chapters analyse the storylines identified in the empirical material in chorological order, focusing on specific events, technical developments and practices. Last, the two storylines are contrasted to each other showing how a trajectory of dispersion emerged and how the interplay of actors, narratives, settings, practices and technologies impacts policymaking.

3.2. A storyline of fixing the system of automobility (2010-2017)

The storyline of fixing the system of automobility unfolds policymaking in the first seven years of the promotion of automated driving in Germany and shows how it was taken up by the local level in Munich. It partly analyses the developments at the federal level and in industrial settings that influenced the policymaking of automated driving at the local level in Munich. This storyline is rearticulating the success story of automobility, and is mainly driven, especially in its initial years, by incremental technological developments in the automotive industry, especially BMW, which is based in Munich and has been influential in shaping policies for mobility over time. The case study shows how automated driving promotion evolved from an evolution of the private car with adding more driving assistance technologies to transforming the car as a digital platform on wheels. In Munich, it was both top-down federal level policy and funding, and bottom-up lobbying from the City itself which drove the uptake of automated driving at the local level. Overall, automated driving was promoted mainly as an economic and innovation policy for the growth and maintenance of the automotive industry. As a transport policy, automated driving was mainly seen as a technological fix meant to fix the mobility problems caused by previous technologies related to the system of automobility, thus it was mainly articulated around the car as an artefact.

3.2.1. Automotive industry-led policymaking

The local automotive industry in Munich had been thinking, and developing automated driving functions for decades, following an evolutionary approach. In particular, it had been experimenting and working on research projects on automated driving since the 80s. Back then, Prof. Dr. Ernst Dickmanns, had pioneered dynamic vision using cameras to enable vehicles to perceive their surroundings and control their motion autonomously. Within the scope of the research project PROMETHEUES, he enabled two vehicles to drive long distances for experimental purposes (Interview 3, 2018). However, an expert on automated driving from BMW, explained that it was only in 2000 that the automotive company of Munich BMW introduced adaptive cruise control (ADC) in the market (Interview 11, 2018). Thinking in terms of today's levels of automation, ADC represents level 1; assisted driving with longitudinal control (POLIS, 2018). Nevertheless, the key-enabler that accelerated the further development of automated driving in the automotive industry came ten years later. As the BMW expert imparted, the enabler was electric steering that BMW introduced into the market in 2010. It was the switch from hydraulic steering to electric steering that enabled cars to steer themselves:

> (…) only with electric steering you can make automated steering. Hydraulic systems only support the driver's movement on the steering wheel, and with electric steering the car can steer itself. This was the main breakthrough for automated driving (…) So, now every car has electric steering, so every car can be autonomous at last. (Interview 11, 2018, p. 2)

This was a premise for further development and after that, one innovation brought the other. BMW continued with the roll-out of safety functions to prevent cars from leaving their lane, and that is how lane keeping systems were introduced into the market in the 2010s. A couple of years later, BMW updated the system with the first traffic jam assistant, which corresponds to level 2; partial automation. The BMW expert on automated driving concluded '*This was the first time level 2 came to the market and we said…it makes sense that the driver has the hands on the wheel, because it's not so safe and so on, so we need more technology inside*' (Ibid., p. 2).

All three interviewees from BMW confirmed that BMW had already decided their strategy towards automated driving in the early 2010s, which have been focusing on more automation within the vehicle, following an incremental approach in terms of continuous improvements in safety, fuel economy, comfort, performance, and pollution. BMW viewed these technological developments as key enablers of automated driving, as the BMW expert on automated driving stated:

> So, these new technologies make it possible to do new things and that's why the whole development goes on; it's not because somebody thinks we should do this now, but because technology enables it (Ibid., p. 2).

The narrative of technology making things happen reflects a perception of automated driving as an inevitable transformation of the car that will take place no matter what,

because technology itself drives the developments. This narrative is articulated in the setting of Research and Development (R&D) of BMW. Thus, it is the setting of R&D of the Munich automotive industry that reproduced techno-centric path dependencies of an ever-lasting optimisation of the system of automobility. Against this background, in 2010, BMW started lobbying at the federal level together with other automotive companies through the VDA (German Association of the Automotive Industry) and the ADAC (General German Automobile Club)[3] towards the implementation of automated driving. As an interview participant from ADAC explained, for the next two years, the automotive industry had been working together with the BASt (Federal Highway Research Institute) towards preparing the steps for the implementation of automated driving in Germany, as well as discussing the requirements of a legal framework (Interview 12, 2018). The outcome of these discussions was the publication of the consolidated final report of the BASt project group: 'Legal consequences of an increase in vehicle automation' in 2012. This report defined the preliminary levels of automation, ranging from partial to high automation. It also identified for the first time the need to revise the German Road Traffic Law, in order to regulate the role of the driver and liability issues from accidents in use cases of high or full vehicle automation[4].

However, this legal assessment of the BASt group was only of technical content, based on the technical characteristics of each degree of automation. The impacts of automated driving on urban mobility and society were totally absent from the report. At that point, the discussion was only about increasing automation in private vehicles incrementally. Automation was perceived by the federal government and the industry as a necessary development of the automotive industry, that was necessary for its evolution and growth (Interview 14, 2018). For the local authorities in Munich, it was rather a vague futuristic concept, far from any actual implementation in the city. As an interview partner from the Department of Public Affairs of the City of Munich put it:

> It was technical…it was definitely technology-driven…it was definitely coming from the industry…it was definitely an industry topic. So, it was coming up with more and more automation, car-assistant facilities and elements of driving, because this made it more and more visible. And when we started to discuss it as a technical scenario for the future, we couldn't envision how it will come (…) automation is like something the industry needs in terms of growing better and growing faster. So, of course the automotive sector has been talking about this topic for a long time or longer than we have. So, I think the OEMs, the industry and

[3] The ADAC (Allgemeiner Deutscher Automobil-Club e.V., meaning General German Automobile Club) is an automobile association in Germany. With more than 18 million members in May 2012, it is the largest automobile club in Europe. The ADAC was first founded in 1903 in Stuttgart. During the Nazi period, starting in 1934, all motorists' organisations and clubs were replaced by "Der Deutsche Automobil-Club e.V." (the German Car Club) which was closely associated with the National Socialist Motor Corps. After the Second World War, the ADAC was re-established in Munich in 1946. Ever since, ADAC maintains its headquarters in Munich. The core business of the ADAC is providing break-down assistance service to private vehicles (Source: https://www.adac.de/, Assessed 03/01/2020, own translation).

[4] BASt (2012). *Rechtsfolgen zunehmender Fahrzeugautomatisierung*. Berichte der Bundesanstalt für Straßenwesen. Fahrzeugtechnik. Heft F 38 (own translation).

> the entire sector of automation is way more mature in this topic, and it is more like a routine for them in terms of getting better and more comfortable and more efficient (Interview 14, 2018, p. 2).

At the same time, the global competition from the ICT sector was not perceived as very threatening yet. As the interview partner from ADAC stated:

> The German automotive industry and Taiwan are very much leaders in the area of automation. So, they think they were pushing their technology by themselves. At that time…maybe Google had started with this, but…at that time the German industry did not take Google seriously (Interview 12, 2018, p. 1).

The interview partner from ADAC further explained that at that point automated driving was a business case for the automotive industry, targeting people who travel a lot for business with corporate cars. He argued that while most of the official argumentation presented in public has been safety, research on the impacts of automated driving on safety have still been inconclusive until now. This is confirmed by several studies (Fagnant and Kockelman, 2015; POLIS, 2018; Milakis, 2019; Taeihagh and Lim, 2019), which argue that safety benefits might be compromised by behavioural adaptation and cyberattacks. Rather, the most important motivation of the industry for introducing automated driving was comfort and productivity on highway driving:

> (…) we know that people usually are not very eager to spend money on safety and we rather believe that the actual drivers for introducing automation functions is comfort and productivity (…) For people who drive a lot for business, if they can do more work in the car, that will improve their productivity, so they will have a benefit from automation functions on the motorway. And certainly, it is a sort of a comfort function as well; the traffic on our roads and the motorways is way dense, you have a lot of congestion, you have a lot of slow traffic, it's not always fun driving. So, people in some situations will just enjoy the comfort of not having to steer the vehicle by themselves (Ibid., p. 3).

As the BMW expert on automated driving confirmed: *'(…) on highways it's more of a comfort issue for the people who drive, so that they don't need to drive anymore, but they can do other things while being driven*' (Interview 11, 2018, p. 6). The above quotes suggest that safety was, and still is, used as a smokescreen by the automotive industry in their public announcements. Rather, the main goal was to improve the use of private cars on highways, especially in situations in which driving is time-consuming or unpleasant. This also implies that the automotive industry wanted to extend and improve the experience of private car use by reducing the unpleasant elements of driving and replacing them with extra comfort and time efficiency (productivity) (Stilgoe, 2018). To sum up, the automotive industry in the early 2010s rather aimed at optimising and fixing the car as a product, instead of inducing a disruptive mobility change as it was often stated in public discussions and in political statements. This approach was enacted by incremental technological innovations aiming to ensure the prosperity and the economic

growth of the automotive industry and had little to do with the wider context of mobility in cities.

Establishing an expert-driven advisory setting

Against this background, the federal Ministry of Transport and Digitalisation established in 2013 the 'Automated Driving Round Table', which was meant to enable a close exchange of ideas and experience among stakeholders from the industry, academia, associations and public administration, and to pool the required know-how in such a way that a broad societal consensus could be achieved on all relevant aspects of automated and connected driving. Ever since, the Round Table has been meeting twice a year and has, among other things, determined which research areas are to be considered when developing automated driving[5]. The federal government saw this Round Table as an advisory policy setting to further support the automotive industry in the transformation induced by digitalisation in the areas of legislation, drivers and cars.

According to the interview participant from the ADAC, the federal Ministry of Economic Affairs was one of the prominent actors in the round table, as they invest a lot of recourses in research for automated driving, and it is considered as a major issue for the national industrial policy. While there were many representatives from the industry and research, and some from the federal public administration, cities were underrepresented at the Round Table. Urban mobility was not the main focus of the roundtable. Instead, the automotive industry was focused on developing automation functions for motorways. Thus, the priority was given to private cars as the main product that the national industry has been producing, then truck platooning, while only little mention was made about automation in public transport (Interview 12, 2018). This is further illustrated by the following quote from the later published 'Strategy for Automated and Connected Driving':

> For 130 years, Germany has been a leading innovator in automotive engineering. It is now imperative that we roll this success story forward in the digital era. Against this background, we have joined forces with the 'Automated Driving Round Table' to develop a strategy on how we can further advance automated and connected driving. It is our guide for further strengthening Germany's position as the world's number one car manufacturer – and for exploiting the opportunities for growth and prosperity inherent in Mobility 4.0[6].

This shows a tendency to deploy new automation and digitalisation technologies in the existing car-centric mobility system. The federal government aspired to maintain car manufacturing as its main industry and to repeat the 'success story' of automobility. The metaphor 'success story' here illustrates the path dependency that the federal

[5]https://www.bmvi.de/EN/Topics/Digital-Matters/Automated-Connected-Driving/automated-and-connected-driving.html (Assessed 10/01/2020).

[6] Federal Government of Germany (2015). Strategy for Automated and Connected Driving, p. 4.

government is attached to in terms of an industry-led mobility policymaking, which has been normalised and institutionalised over the years. Thus, the primary representation of the private sector in the Round Table implies that the federal government wanted to further stimulate and secure the German economy. The aim of the Round Table is rather reaching consensus among the automotive industry, federal politics and research regarding the implementation of automated and connected driving. As such, it has been expert-driven, following a quite top-down mode of policymaking. The actors involved in the Round Table were relevant for researching and developing new technologies, but they were disconnected from representing relevant societal actors (e.g. citizens, NGOs), and detached from the local mobility realities and problems in cities.

3.2.2. Adding connectivity to automation

As the interviewee from ADAC explained, the frequent meetings of the Round Table from 2013 to 2015 led to a strategic policy paper, called the National Strategy of Automated and Connected Driving, and published by the federal Ministry of Transport and Digitalisation in September 2015 (Interview 12, 2018). For the first time, automated driving was combined with connected driving in a policy document. The strategy was meant to provide guidance for exploiting the opportunities for growth and prosperity offered by Mobility 4.0, for Germany to be a leading location for innovation investments, the lead provider of mobility technologies, and the lead market in Europe and globally. As quoted from the Strategy document:

> The active promotion of automated and connected driving will help to further strengthen the German automotive industry's role as a leading innovator and lend a further boost to adjacent growth markets for information and communications technologies and innovative digital services. This will result in numerous new jobs and potential added value worth billions of euros[7].

In other words, combining automation and connectivity technologies had a dual purpose. The first was to liberate the existing system of automobility from its undesirable impacts, as already mentioned. The second was to strengthen the German economy in the arena of global competition. At that time (2015), Google and other big ICT companies from the U.S. and China had already been intensively promoting their automation and ICT mobility developments and business cases. That put pressure on the German automotive industry and the German government, as the 'Made in Germany' brand-name for high tech innovations was threatened, according to the expert on automated driving from BMW (Interview 11, 2018). For this reason, the German government had to both (re)strengthen the automotive industry, but also further develop the ICT sector in parallel. The metaphors 'lend a further boost' and 'adjacent growth markets' imply that the focus had been put on the automotive industry, while the ICT sector was perceived as a side-business for the federal government. This indicates that the ICT sector was meant to

[7] Ibid., p. 11.

upgrade the automotive sector, and not to really diversify the entire mobility system. As it is quoted from the document:

> Now, digitalisation is about to usher in a historic revolution in the field of mobility – automated and connected driving. As a result, mobility will assume an entirely new dimension – it will evolve into 'Mobility 4.0'. The car will turn into another important place in people's lives alongside their offices and homes. Driving will evolve from an activity that is necessary for getting from A to B into a new, productive time window. Real-time car-to-infrastructure data communication will make traffic flows predictable, combat congestion and reduce the number of accidents. By connecting them with their surroundings, vehicles will become fully digitalised mobility, information and communication platforms[8].

The Strategy was only referring to private cars and how to enable further functionalities of cars. Here mobility meant automobility, where the car as a key-artefact would evolve from a means of individual transport to a 'fully digitalised platform' and 'another important place'; a working place, a relaxation place, an entertainment and communication place. The Mobility 4.0 here was all about the evolution of the car, and how the digital connectivity developments will benefit the industry of the car. In the Strategy, ICT and automotive industry converged, while digitalisation was meant to further transform the incrementally automation of the car. In this case, digitalisation from the ICT sector came to support and add to automation from the automotive sector. As several researchers point out this has to do with the influence of the global competition from ICT companies that have been developing automated cars from scratch, such as Google and Tesla (Canzler and Knie, 2016; Freudendal-Pedersen, Kesselring and Zuev, 2020).

However, the Strategy neither really identified the need for automated driving, nor it tried to argue for how traffic efficiency, safety and emission reduction need automated driving to be solved. It rather took for granted that automated driving has the potential to alleviate these transport issues, while research up to this day has produced contradictory findings about the potential and the ways that automated driving could improve these issues (Frisoni *et al.*, 2016; Stilgoe, 2018; Milakis, 2019; Taeihagh and Lim, 2019). Furthermore, the BMW expert on automated driving, who was involved in the VDA discussions at the federal level, stated that this Strategy was very much influenced by the papers produced at the VDA: '*they (the federal government) took our papers to really…get their strategy out of it*' (Interview 11, 2018, p. 11). This further illustrates that the Strategy was aligned with the interests of the automotive industry. As another interviewee from the Department of Urban Planning of the City of Munich confirmed:

[8] Ibid., p. 3.

> I think one big reason for the Ministry of Transport and the German government to support developing automated cars is to keep the German car-industry in the front of innovation. I think for the German government it is very much something like economic development to support the innovation of the German car-industry. Something like what the steel-industry was in the 60s, it is now the car-industry; the leading industry in Germany. So, the German government is very keen on supporting that industry (Interview 18, 2018, p. 9).

This denotes that the Strategy was more of an economic policy, than a mobility policy. The Strategy considered two scenarios as realistic based on the current status of technological development: (1) the deployment of highly automated vehicles in the structured, less complex traffic environment of highways and standard roads near highways, (2) and the deployment of fully automated driving functions in the low-speed range in complex traffic environments, such as multi-storey car parks. Besides the highways, which was once again the focus, the Strategy spoke about complex traffic environments, using multi-storey car parks as an example. However, there was no mention about the application of automated and connected driving in sharing concepts or urban public transport in the document.

One of the main results of the Strategy implementation was the establishment and coordination of the digital test field on highway A9 between Munich and Nürnberg. The Digital Motorway Test Bed was established on the A9 motorway in autumn 2015, at the same time as the Strategy was published. The actors involved in setting it up was the federal Ministry of Transport and Digitalisation (BMVI), the Free State of Bavaria, the VDA and the Association for Information Technology, Telecommunications and New Media (Bitkom). Even though the digital test field is in the north of Munich, the City of Munich has not been involved in the establishment and the coordination of the test field. The whole process was coordinated only by the federal government with the support of the State of Bavaria. The digital test field was phrased as a technology-neutral offer to the industry and the research community. It can be used by all stakeholders from the automotive industry, the ICT sector and academia for testing innovations of automated and connected driving as well as intelligent infrastructure. The trials have been carried out in real traffic situations. For this reason, on the website of the federal Ministry of Transport the digital test motorway was labelled as '*a laboratory under real-life conditions*'[9]. This justified the choice of the motorway A9, which is considered one of the busiest motorways in Germany, so a suitable test ground for real-life trials. The test field stretches along a 146km-long route, the infrastructure of which has been fully digitalized and equipped with sensor technology[10]. The purpose of the digital test field was phrased as gaining knowledge about how vehicles can communicate with each other and with infrastructure on a highway[11]. To sum up, the test field on A9 motorway in Munich was a

[9] https://www.bmvi.de/SharedDocs/EN/Articles/DG/digital-motorway-test-bed.html (Assessed 15/01/2020).
[10] https://connectedautomateddriving.eu/project/digital-motorway-test-bed/ (Assessed 15/01/2020).
[11] https://www.bmvi.de/EN/Topics/Digital-Matters/Automated-Connected-Driving/automated-and-connected-driving.html (Assessed 10/01/2020).

key action promoted by the actor triangle: federal government, industry and research and was meant to test and support in practice the convergence of the automotive and ICT industries that was instructed by the Strategy of Automated and Connected Driving.

3.2.3. Bottom-up lobbying

In order to further materialise the objectives of the Strategy for Automated and Connected Driving, the Federal Ministry of Transport published, in July 2016, a five - year Research Program on Automation and Connectivity in Road Transport. The research program was developed for funding projects investigating the integration of technological and socio-political questions on automated and connected driving. The main aim of the research program was articulated as '*bringing automated and connected driving into regular operation in mixed traffic as part of the mobility system of the future*'[12], by developing concrete solutions for its implementation. It addressed automated driving in higher levels of automation up to fully automated (driverless) driving as well as connectivity in road traffic. For this purpose, the digital motorway test field on the A9 federal highway and other digital public test fields were also included in the research program. What was different in this initiative, compared to the previous ones, was that it included the consideration of the interfaces with other modes of transport in complex applications beyond highways, and that it referred to the mobility system as a whole for the first time. The funding was focusing on research and trials in the following fields: driver-vehicle interaction, traffic management and transport planning, connectivity and data management, safety and social aspects. In the published document of the research programme, it was made clear that:

> Projects to be funded under these funding guidelines are to deliver significant new findings on how automated and connected driving can be integrated into the existing transport system (…) and what factors can help to bring about widespread acceptance by society[13].

In order to achieve these target contributions, application-oriented and collaborative research projects were meant to be funded. The transfer of innovative solutions to road traffic was also supposed to be achieved through comprehensive interdisciplinary and public-private cooperation[14]. In the research program, the aspect of social acceptance gained more importance than ever before. In the document, it is stated that a key factor for the acceptance of automated and connected driving is the question of whether the

[12]https://www.bmvi.de/SharedDocs/EN/Articles/DG/research-programme-on-automation-and-connectivity-in-road-transport.html (Assessed 05/01/2020).

[13]Bundesministerium für Verkehr und digitale Infrastruktur (2016). *Forschungsprogramm zur Automatisierung und Vernetzung im Straßenverkehr*. Berlin, p. 8 (own translation).

[14]https://www.bmvi.de/DE/Themen/Digitales/AVF-Forschungsprogramm/Ueberblick/avf-ueberblick.html (Assessed 12/12/2019) (own translation).

driver rates the time that is gained from the vehicle taking over driving functions as meaningful.

> The transformation of the vehicle to the 'third place' therefore requires the empirical investigation, categorization and further development of knowledge about possible activities that the driver could perform during the automated journey, as well as their effect on and evaluation by the driver. This also includes the fact that the introduction of new automated transport offers can change mobility behavior and thus the transport system as a whole[15].

Even though the interaction with other modes is considered, here the focus is once more private vehicles. Social acceptance is perceived as a means for the 'transformation of the vehicle to the third place', where the driver would be able to use their commuting time efficiently. There is an underlying assumption in the document of the Research Programme that social acceptance will be achieved through replacing one business offer with another; the one of driving with the one that provides productivity and comfort for the driver. This is also assumed to be enough to change mobility behaviour and the entire transport system. It is taken for granted that automated driving would be a solution for multiple mobility problems, and it would undoubtedly benefit the public. However, this approach reduces the notion of social acceptance to technological determinism and market logics, as it does not consider the social characteristics of the citizens, such as income, age, mobility patterns, everyday mobility practices, or their mobility needs in general. Recent research on the public acceptance of automated driving has shown that it is experience and information that will define if and how people will trust and accept automated driving. Therefore, acceptance should be defined more broadly than the mere introduction of technologies to the public (Bjørner, 2017; Fraedrich, 2018; Hancock, Nourbakhsh and Stewart, 2019). The subjects that this policy approach produces are customers, instead of citizens. Customers who are expected to accept, consume and integrate the finished product into their lives. But these customers were not involved in the policymaking process of automated and connected driving. Federal policy assumed a lot about how the public would accept the new technologies, without developing the policy with the public. Finally, there was no explicit elaboration about the usefulness that automated driving would have in urban areas in the document of the Research Programme.

Despite the vagueness of the Research Program regarding urban areas, it was the first time that a federal initiative gave cities the opportunity to apply for federal funding with the objective to explore the potential of implementation of automated driving in urban contexts. This is because the research program opened the ground for funding applications related to complex environments beyond highways, interactions with other modes and integration into the existing transport system. As an interviewee from the Department of the Public Affairs of the City of Munich explained, this development might

[15]Bundesministerium für Verkehr und digitale Infrastruktur (2016). *Forschungsprogramm zur Automatisierung und Vernetzung im Straßenverkehr*. Berlin, p. 16 (own translation).

have had to do with the strong link that certain German cities, including Munich, have to the national level through the Städtetag (the Association of German Cities)[16]. The Städtetag constitutes a mediating policy setting, which provides fertile ground for Munich to get in touch with other German cities, so that they have a regular exchange about automated driving as well as exchange of interests, demands and results. Thus, it is through the Städtetag that cities have a greater voice to influence policymaking at the national level by lobbying (Interview 14, 2018). As a former expert at MVG[17] confirmed in an interview:

> (…) the cities have to explain what they need, because the national government is very reactive on this kind of issues…if you see like with car-sharing in Germany, there was more than 12 years of pressure from bottom-up (…) and this feedback of course goes to the national government and then it's of course a classical lobby work with the Cities Association Städtetag (…) So, that's why I think it's good the national government is funding a number of research projects (Interview 13, 2018, p. 13).

Munich, together with some other German cities, argued for involvement of the local level in the policymaking process for automated driving through federally funded research projects, focused on exploring the potential for implementation of automated driving in cities. Specifically, as the interviewee from the Department of Urban Planning in Munich described, his boss; the former head of the Transport Unit of the Department of Urban Planning has always been attending meetings through the Städtetag with the VDA and the federal Ministry of Transport for mobility policy issues. At those meetings, the former head of the Transport Unit tried to influence the federal policy by pointing out that the discussions at the federal level were only about the technical aspects, and that for cities it is much more interesting to talk about the planning aspects, and how to implement it in the urban transport system (Interview 18, 2018). Through the Städtetag and the involvement in the discussions with the VDA and the Ministry, the federal level got convinced to think about how to implement automated driving in the urban transport system, as well as about the social and planning aspects. Thus, the federal government opened the call for applications in the Research Program to include complex mobility environments with different modes, such as cities. Nevertheless, these two occurrences (i.e. meetings within Städtetag and lobbying with the VDA and the Ministry of Transport through Städtetag) did not only lay the ground for the federal level to include the urban level in Research Program, but they also signified the outset of the policymaking for automated driving of the local level in Munich. Another event, which also happened in

[16] The Association of German Cities-Städtetag is the voice of cities and the national local-authority association of cities which do not belong to a county as well as of most cities and towns within counties. As a community of solidarity of cities, it represents the idea of local self-government to Federal Government, Federal States (Bundesländer), European Union, governmental and non-governmental organisations. The work and services of the Association of German Cities are primarily geared to the needs and interests of the direct member cities and their citizens (Source: http://www.staedtetag.de/englisch/index.html, Assessed 15/12/2019) .

[17] MVG is the public transport authority of Munich and a daughter company of the City of Munich.

2016, was a private initiative focused on setting up a research project on automated driving in Munich, independently from the federal Ministry of Transport. As the interviewee from the Department of Urban Planning imparts:

> One day, my former boss was invited to another initiative, which was a little bit obscure, because it started by someone who was doing private business but wanted to set up an initiative for a research project of automated driving. That person invited our boss and he invited some people from the Technical University of Munich and some people from BMW, because he wanted to start that kind of project. That person tried to start something like a research project, because he did not know that the Ministry of Transport was keen on that subject. But at that meeting, there were people from the Technical University and some people from BMW, that we used to work with for a long time at the Inzell Initiative. And after that meeting we discovered people from BMW didn't like that initiative; they wanted to do their own initiative (…) And I guess BMW is in very good contact with the Ministry of Transport, like all big car-producers, and they have been talking to the Ministry to start that kind of project (…) So, BMW told us '*ok, if we do a project in Munich and if the German Ministry of Transport would like to do a project in Munich, we and the City of Munich have to be in the lead and maybe some other companies, but not some private initiative*' (…) They said '*we are the big car producer and you are the big city, we don't need somebody coming around telling us what to do'*. They wanted to be in charge themselves. (Interview 18, 2018, p.3, 4)

The interviewee's narration clearly shows the dominant role of BMW in the policymaking process not only for automated driving, but also for mobility in general, both at the federal and the local level. In other words, BMW wanted to maintain the leading role in the industry and business realm in Munich. This can be traced historically, as since the 1990s BMW has assumed a crucial role in steering the local mobility governance through the Inzell Initiative, being, more often than not, more progressive than the local politicians and the administration in terms of new mobility concepts and solutions (Hajer and Kesselring, 1999; Kesselring, 2001). As a result, the City of Munich did not move on with the private initiative, but instead they chose to develop a proposal for a federally funded project together with BMW and other local actors, as the following sections will show.

3.2.4. Exploring another 'Tamagotchi'

These three parallel occurrences; the lobbying of the City at the Städtetag, the involvement of the City in the discussions with the VDA and the federal Ministry of Transport, and the private initiative that was overturned by BMW in the backstage, led the local authorities in Munich to start engaging in a local policymaking process for automated driving. The interviewee from the Department of Public Affairs explained that Munich started engaging in a policymaking process for automated driving, not simply because of external global competition, as it would be expected. It was rather 'a tipping

point in time', when different occurrences coincided, without necessarily having one main cause.

> It would be great if I said something like wow Uber or… Apple developed the Apple car, and then we thought now we have to act, but no there was nothing like this. It was more something like…a tipping point in time…I think that it came more and more from…the mobility sector as such; talking more and more about it, the conferences we go…the discussions we have…the calls for abstracts for instance out there…or also the need and demand from regular partners we have was there to talk about that topic or to maybe work on that topic…So, it just came all together and it made us more and more approach the topic actively (…) (Interview 14, 2018, p. 11).

In December 2016, the local authorities in Munich started having regular meetings together with the MVG. Those meetings were initiated by the Department of Labour and Economy of the City of Munich, by inviting only local actors from the public sector, such as the MVG and the Departments Urban Planning and Public Affairs of the City. As an interviewee from the Department of Labour and Economy explained, it is often the case for this Department to give impulse to technical and industry topics and spread initiatives to the other Departments of the City. This is because the Department of Labour and Economy is in direct contact with companies, and it represents industrial interests (Interview 16, 2018). Even though BMW wanted to have a project on automated driving with the City, the Department of Labour and Economy decided to first discuss internally with the other Departments of the City, and make sure that they have a unified opinion on how to discuss the topic with the industry. As the interviewee from the Department of Urban Planning explained:

> There were first some small internal meetings, because the Departments of the City would always like to speak with one voice…Usually we don't, but if you talk to external organisations, you always do some pre-meetings (…) So, we first had some pre-meetings and then we had some bigger meetings with BMW. (Interview 18, 2018, p. 5)

The BWM expert on automated driving described that when BMW started having meetings with the City for the topic of automated driving, the City expressed concerns about the impacts of automated driving on the overall urban traffic and public transport. The City feared that BMW would take over and impose their strategies on the policymaking process. This is because it has happened before that BMW challenged the authority of the City Council and administration through automation visions (Interview 11, 2018). As Hajer and Kesselring (1999) impart, in the 1990s and before the set-up of the Inzell Initiative, BMW published a comprehensive strategy for the re-organisation of traffic in the city. This included a full inner-city pedestrianisation, combined with ten underground multi-storey car parks at the edge of the inner city, which they called 'the blue zone'. The parking system was envisioned as fully automatic and guided by

computers. This initiative by BMW threatened the authority of the City Council, but it set the basis for a discursive and practical change in the way of planning for mobility in Munich. Ever since, as already mentioned in the first section of this chapter, the City of Munich has been following a dual strategy for the last three decades, or as Hajer and Kesselring (1999) phrased it a 'double-track strategy' in terms of mobility policymaking. On the one hand, the City aims to ensure that BMW maintains its position in the local economy, and that municipal policies do not harm BMW's interests. On the other hand, the City must maintain municipal control over urban mobility, in order to ensure a well-functioning public transport system for its citizens and minimise the side-effects of private car use. As the interviewee from the Department of Public Affairs put it:

> So, that is why we don't necessarily always have the same interests as BMW, but the interest that they are feeling well and that they are ok…So, that is why of course we are trying to support approaches, which are very close to what we want to work on. And in this case, automated driving is a kind of interest overlap. They have an interest to further develop the technology and the usage of the technology in business cases, and we want to research on that, on how this technology or this trend autonomous driving can pay into our strategies as a City (Interview 14, 2018, p. 11).

The interviewee referred to automated driving as a technology or a trend, which implies that the City at that point did not perceive automated driving as a real mobility solution. Automated driving resided either in the technical sphere of industry and research or it could be just one more trend, without necessarily being established in urban mobility reality. The same interviewee continued:

> It could be a bubble blast and that nobody is talking about automated driving in ten years…like look at Tamagotchi. I don't want to compare Tamagotchi and automated driving…but we all know trends like that…they can just…explode and they are gone then (Ibid., p. 8).

The metaphors 'trend', 'bubble blast' and 'Tamagotchi' show that even though the City was open to exploring the potential of automated driving in Munich, they did not take its implementation in the urban environment very seriously. Multiple interviewees explained that at that point, automated driving was perceived by the local actors in Munich as a purely technological matter that could facilitate driving on highways, but they had a hard time envisioning its application in their city, even though they were interested in exploring its potential. This is illustrated in practice with the project City2Share, which was a project that came out of the deliberations in Inzell Initiative, funded by the federal government, and coordinated by BMW. The City2Share project started in 2016 and it is still on-going. One of the focus targets of the project was technology, which dealt with the integration of electric mobility, connectivity, car-sharing and automated driving as shaping the concept of tomorrow's mobility. Automated driving was promoted in the context of e-car-sharing. Automated e-car-sharing was phrased as

having the potential to '*increase road transport efficiency and make it accessible to all sections of the population as an affordable means of mobility'*[18]*.* Even though in media statements and on press releases, automated driving seemed to be a major part of the project, reality was different. Several interviewees explained that the only reason that automated driving was part of this project was to make sure that the City will get the funding for the overall project. The federal government required that the City integrated automated driving in their application to show progress on automated driving in local contexts. Ultimately, the City decided to only have a one-day demonstration with an electric highly automated vehicle on a public street, which at the time these lines were written had not taken place yet.

Even though the local authorities were interested in exploring the potential of automated driving in Munich, they could not easily perceive it as more than a technological innovation for private cars. They felt that for the city environment it was just 'another Tamagotchi'; another trend that was hard to imagine whether and how it could fit in the city and the city strategies for future sustainable mobility. The City decided to approach the topic actively because of the overall developments and discussions about automated driving by the federal level, the automotive industry and their mobility partners in general. In parallel, the City wanted to support the automotive industry, but also research what automated driving means for the city itself, so that municipal control would not be overruled by the industry. Overall, automated driving was perceived as a 'nice to have' topic that was worth exploring, yet the conceptual understanding of the local actors was still revolving around the car.

3.2.5. A top-down car-centric policy transfer

From December 2016 (when the first meetings started) until February 2017, the local authorities in Munich had been having internal meetings between the different Departments of the City, the MVG, and with private companies. In February 2017, the topic of automated driving was discussed officially for the first time in Munich as the focus of the 2017 Inzell Initiative Plenary XI, led by the City of Munich and the BMW Executive Board[19]. This was the first time that a larger audience of relevant stakeholders from the industry, local politics, public administration, public transport, as well as research was gathered to discuss the potential of automated driving for Munich in a more coordinated way than before. As a symbolic gesture for showing the commitment of Munich to automated driving, Dieter Reiter, the Mayor of Munich, entered the event hall of the meeting, sitting in the passenger seat of an automated test vehicle. It was at that meeting that the idea of a cooperative project within the scope of the federal Research Program was officially announced. As an interviewee from the Green Party of the City Council, who participated in this meeting, stated:

[18] http://www.city2share.de/city2share.html (Assessed 15/07/2019).
[19] https://www.inzellinitiative.de/stationen.html (Assessed 17/09/2018).

> (…) at this meeting, automated driving started to become a matter for Munich...And there was a willingness for Munich to become one of the most progressive cities in this, and for a big coalition to move forward with the new technology and autonomous driving, so that Munich can be a leading city (Interview 5, 2018, p. 2).

The main aspiration that was articulated by the Lord Mayor Dieter Reiter and BMW at the Inzell meeting was that Munich should become the number one city in automated driving, in order to maintain its competitive position as key industrial location. As multiple interviewees confirmed, this was the focus of the discussions of the meeting, while a secondary goal was that through these innovative technology concepts, the city traffic in Munich will have changed noticeably by 2030-2035 at the latest. However, the potential of automated driving for improving the traffic situation of Munich was not elaborated enough at that meeting. The primary goal remained making Munich a competitive hub for automation technologies. As several interviewees who participated in the meeting mentioned, the main purpose of the meeting was rather to officially introduce the idea of applying to the federal government for piloting automated driving to a wider audience of local mobility stakeholders in Munich.

Eventually, in July 2017, the Department of Urban Planning submitted a first policy proposal to the City Council for the research project on automated driving, that was meant to be submitted for funding at the federal Research Program. The definition of automated driving and connectivity was taken from the definition that was initially included in the federal Strategy for Automated and Connected Driving, and later in the federal Research Program. Based on this definition, automated driving was described in the policy proposal as the further development of assisted driving (e.g. distance control, parking assistance), and was divided into the following three stages: partly automated, highly automated and fully automated. The next stage is autonomous driving, which is perceived as the highest degree of automation and is clearly distinct from automated driving (Figure 2). The distinction referred to automated driving involving interaction between the driver and the vehicle, while with autonomous driving there is a decoupling of vehicle and commuters. This was the first time that this distinction was made at the local level, as up to that point the terms automated and autonomous were used interchangeably in documents and in public statements. Connectivity was about facilitating and supporting the development of automated driving by enabling communication between the vehicles. The focus remained with automation technologies, while digital connectivity technologies were meant to have a supportive role**.** Following the funding priorities of the Research Program, the City of Munich chose to focus on project items related to higher beyond partial automation driving functions.

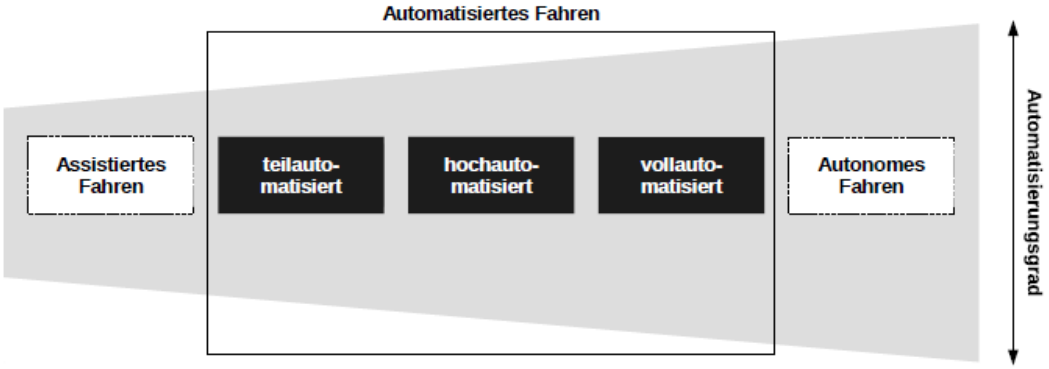

Abbildung 1: Automatisiertes Fahren (BMVI 2016)

Figure 2: The stages of automated driving in the first policy proposal of the Munich research project[20]

In a similar vein, the main objectives of the project were a direct transfer of the objectives of the federal Research Program: *'a safe, environmentally friendly, space efficient mixed operation with conventionally-driven vehicles'*[21]. These objectives of safety, environmental friendliness and space efficiency were once again articulated within the context of the system of automobility, as automated vehicles were meant to be used in mixed operation with 'conventionally-driven' vehicles. This included all kinds of vehicles of road transport, namely private cars, commercial vehicles, sharing fleets, and buses. This suggests that the policy proposal envisioned replacing part of the conventionally driven vehicles. Since there was no further elaboration in the policy proposal, this articulation is rather vague in terms of how these three objectives could be achieved, as it is not clear through which transport modes automated vehicles would operate. It is rather assumed that just replacing drivers with technology would make traffic and mobility safer, more environmentally friendly and more space efficient. In line with Fraedrich, Beaker and Lenz (2015), this reflects a mentality of a technological fix, in the sense that the actors are trying to fix a problem created by previous technologies with another technology.

The expected outcome from the research project was for Munich to develop a framework with scenarios and concepts for the implementation and regulation of automated, autonomous and connected driving. The purpose of this framework appeared to be ambiguous in the draft document. On the one hand, it was stated that the aim was '*to develop a guideline for cities to deal with automated, autonomous and connected vehicles, which can be made available nationwide to the municipalities*. This phrasing indicates a tendency to develop a universal framework for all German cities, which reveals a rather 'one-size-fits-all' approach (Innes and Booher, 1999; Elliott and Lemert, 2006; McClymont, 2011) that is again in line with the approach of the federal level. The phrasing rather assumed that automated driving should fit in the planning and urban

[20] Referat für Stadtplanung und Bauordnung, Beschluss des Ausschusses für Stadtplanung und Bauordnung vom 19.07.2017 (SB), Automatisiertes Fahren und Vernetzung des Straßenverkehrs im städtischen Kontext – Pilotstadt München Sitzungsvorlagen, p. 3.
[21] Ibid., p. 4.

development goals of any city. This shows that automated driving was perceived as what Hajer and Dassen (2014) call a pre-defined technological solution that had to fit in the city, and any other city, neglecting the local particularities of different urban contexts. On the other hand, it was stated that through this framework, Munich would '*significantly shape the development prospects, and position local interests*', and that the main goal was '*to make the embedding of new technologies compatible with the city as part of a holistic approach*'[22]. This phrasing reveals a tendency to shape automated driving from bottom-up and to explore how it fits with the local interests, the mobility needs, and the local context of Munich in general.

Overall, a translation of the federal policy to the local level of what automation means for mobility in Munich had not particularly taken place in the policy proposal. It was rather a transfer of understanding than a translation of understanding. The understanding of automated driving of the City of Munich was similar to that of the federal level; namely evolution of the driving assistant technologies of the private car, which would lead to further automation of the private car, which would in turn solve mobility problems caused by extensive car use in the first place. While, there was a first attempt to shape the technology according to the local context, the ambiguity between the universal and the local in the policy document poses the question whether the research project was aiming at making automated driving fit in the city or the city fit in automated driving.

Abstaining from building new infrastructure for automated driving

Regarding the actors that were meant to be involved in the research project, the City was represented by the Department of Urban Planning as the leading Department and the Department of Public Order. Generally, the Department of Urban Planning is responsible for the transport planning in Munich. The Department of Public Affairs is the road traffic authority, which oversees the entire mobility management and traffic control and steering in Munich. Both these fields are directly or indirectly related to automated driving, so the involvement of these two Departments seems reasonable. However, in most transport and mobility topics in Munich there is another Department which is usually involved; the Department of Construction. This Department, which is responsible for building infrastructure, was not included in the project. On top of that, as the interviewee from the Department of Urban Planning described, it was also Siemens that was not asked to participate in the meetings for the project, even though Siemens is an active member of the Inzell Initiative too. The interviewee explained that this is because Siemens promotes an approach for connectivity infrastructure with signals and traffic lights for automated driving. Siemens's approach is based on the idea that when the software of the vehicles fails, then the infrastructure will have a secondary system to support the vehicles. However, the City of Munich, as many other municipalities (including Stuttgart), would not like to have big investments in infrastructure for automated driving, as they do not have the capacities to cope with the rapid changes in

[22] Ibid., p. 2.

digitalisation, which might require regular updates of the infrastructure (i.e. traffic lights) (Interview 18, 2018). In parallel, BMW, who is one of the main actors of the research project, promised the City that they would only develop technologies inside the vehicles:

> BMW told us they will provide all technologies inside the car (…) Because other companies like Siemens who is not on board in the project, say '*oh, we could provide a lot of technologies for automated vehicles for your infrastructure*'. I think BMW knows that we don't want to…that the cities would not like to have big investments in infrastructure for automated driving. (Interview 18, 2018, p. 12)

As another interviewee from Urban Mobility BMW confirmed:

> (…) our technology concept is that we want to be independent from infrastructure…and that's why the cars can drive basically also today on level 5, but only in a separated area…but they need to understand their environment…and that's the limiting factor at the moment. So, and because we don't want to be held responsible for an accident only because SIEMENS is not able to operate a traffic light…that's not…not our topic. (Interview 7, 2018, p. 8)

Here the strategy of BMW for urban automated mobility becomes clear. The core interest of BMW is technologies that focus on the car and are independent from infrastructure. The above quotes imply that BMW did not want Siemens to participate in the project, because their approach is focused on infrastructure. The form of connectivity that BMW is mostly interested in is the vehicle to vehicle communication (V2V), as the interviewee from Urban Mobility BMW explained. However, the interviewee from Siemens, presented Siemens's point of view differently. He argued that Siemens decided to participate in a similar project in Hamburg, because Hamburg was faster than Munich in setting up a research project on automated driving:

> (…) but we just didn't want another project (…) The Munich project is with many more stakeholders...many many more (…) In Munich they need two years to set up the next meeting, to get all people together (…) if they would ask us now, of course we would join that, because we have now another point or roadmap. So, we have resources now, we have more experience now and know-how. So, that was like a step-by-step going forward decision and that's the only reason (…) I don't want to be arrogant, but Munich is not the centre of the world (…) there are other important projects for a company like that to take part in, so it was like a management decision…in the end. (Interview 6, 2018, p. 14)

As the quote suggests, besides the conflict between BMW and Siemens regarding two distinct technology and business approaches to automated driving, there was also the factor of the long tradition in Munich to include many actors in the policymaking for mobility, which was established by Inzell Initiative. The policy proposal was seen by several interviewees as unique, compared to other cities, exactly because of having a wide range of actors involved. These different actors needed to reach consensus for which

aspects of automated driving would be researched in Munich. Thus, they reached consensus on who would be included in the project and decided that Siemens and infrastructure companies in general as well as the Department of Construction were not included. This raises the question whether the tradition of consensus and long decision-making is inclusive after all or it is geared to serving automotive industry interests. Overall, the avoidance of building new infrastructure for automated driving in the policy proposal was reflected in the actors involved.

Engaging both automotive industry and public transport

The other two main actors of the project were BMW and MVG. MVG was supposed to carry out the project coordination, and work with BMW on fleet management, and testing (see Table 1 below). The interviewees from the City administration explained that as the purpose of the project was to explore the potential of automated driving in urban road transport, they included both the automotive industry and the public transport, to see if they can develop synergies with each other. Despite the policy proposal was generally influenced by the car-centric federal approach, the City was already considering the application of automated driving in public transport already since 2016, as I will show in the next section.

WORK PACKAGES	CONTENT	RESPONSIBILITY
WP1	Objectives and scenarios for urban mobility with automated and connected as well as autonomous vehicles for 2030	Department of Urban Planning
WP2	Macro- and microscopic simulation and potential analysis based on traffic behaviour and the scenarios developed in WP1	University of Armed Forces
WP3	Legal, regulatory and governance framework from a municipal viewpoint	Department of Public Affairs
WP4	Development of fleet intelligence	MVG, BMW
WP5	Piloting and evaluation by testing in urban environment	MVG, BMW
WP6	Technical feasibility and project demonstrations	MVG, BMW

Figure 3: Work packages and actors in the policy proposal for the research project application of Munich[23]

In all three work packages that BMW was involved, they are supposed to work together with MVG, despite the inherent conflict of interests between the two, as automation and digitalisation may lead to a blurring of the boundaries between public transport and private mobility (Interview 18, 2018). The main point that connected both actors is developing fleet intelligence in the form of sharing and ride-pooling concepts. In this sense, the City functions as a mediator between the industry and the public transport,

[23] Ibid., p. 6.

trying to keep a balance between the interests of both. As an interviewee from the Department of Urban Planning explained:

> I think the conflict is…some big car-producers like BMW, they want to get into the market of mobility providers, and the public sector mobility providers need to change their service models too, they both come to the same area, where they compete and that is something like their playground and they don't want to…they both want to get a share of the cake. But the conflict is in some way that…private sector companies say they are obliged to make some profit for the company, and they want to sell their products. On the other hand, the public transport providers are even our company, so they have to provide transport for everybody, while private sector companies maybe would provide transport, but only for anybody who could afford it. That's for us a main difference. So, we always work together with both of them, but we always want to have transport for all (Interview 18, 2018, p. 15).

The University of the federal Armed Forces Munich (UniBW) was set responsible for developing simulations based on the scenarios developed by the Department of Urban Planning. The UniBW have had a long tradition in researching and experimenting on automation technologies since the 1980s, when it participated together with BMW in the project PROMETHEUS, using Munich as a ground for testing technologies for managing traffic flows of private cars (Hajer and Kesselring, 1999). The project is further supported by a wide project network consisting of BMW, MAN (truck and bus manufacturer), PTV (software simulation company), the law firm BBG, the Technical University of Munich (TUM) and several research institutes and universities.

Overall, despite the strong influence of the automotive industry and research, the City tried to counterbalance this dominance by engaging public transport in the project. This perspective contrasted the general tone of the policy proposal, which was mostly influenced by the federal techno-centric approach, focused on the private car. Even though the first policy proposal for the research project was mainly a top-down car-centric policy transfer from the federal level, it left space open for reflecting on how automated driving could be integrated in the urban transport system in Munich, beyond the private car. As far as the local politicians are concerned, there was a consensus of the policy proposal of the City administration without any actual debate in the City Council. Local politicians at that stage were quite passive regarding the topic and relied on the knowledge and the proposals of the City administration (Interview 5, 2018). Against this background, the funding application of the City of Munich for the Research Project on Automated and Connected driving in an urban context was eventually submitted to the federal government in October 2017. The funding application was approved a year later, and an updated policy proposal followed, which had a relatively different focus than the first. The next section analyses, among others, the updated policy proposal within the emergence of an alternative storyline, namely fostering new mobility services, through which the goals of the different actors become more apparent and differentiate from the initial federally driven storyline of fixing the system of automobility.

STORYLINES	ACTORS	NARRATIVES	SETTINGS	PRACTICES	TECHNOLOGIES-ARTEFACTS
Fixing the system of automobility (2010-2017)	Automotive industry, federal government, Research, City administration	Growth of automotive industry, comfort for corporate cars on highways, fixing the technology, transforming car to a 'third place'	R&D, round-tables, project groups, Städtetag, Inzell Initiative	Developing automation technologies, federal strategy for AD, lobbying of the City with industry and federal government, policy proposal for piloting Munich in AD	ADC, electric steering, traffic jam assistant, the car
Fostering mobility services (2016-2019)	City administration, local political parties, public transport, automotive industry	Reversing the trend of urbanisation, space efficiency, optimising the transport system	Perspektive München, City Council	Scenario study, including AD in existing strategies, separating AD from cars and displacing it to other modes, EASYRIDE pilot research project	Automated buses, automated subway, ride pooling

Figure 4: Summary of storylines of case of Munich

3.3. A storyline of fostering new mobility services (2016-2019)

This storyline covers the period between 2016 to 2019. The year 2016 is considered as the starting point of emergence of the storyline for two reasons: 1) It was around that time that the local actors started conceptually reflecting on how automated driving could be implemented in the transport system of Munich in general. This became already apparent in the first policy proposal for the research project application, where the City administration already engaged both public transport and automotive industry, as mentioned in the previous section. 2) The City of Munich conducted a scenario study about the future urban development of Munich, where automated driving was included as a key potential development. This study as a key performative practice that enacted a discursive change from the car-focused approach of policymaking to a more diverse multimodal approach to policymaking; it enacted a dispersion of the topic of automated driving from the system of automobility to the system of multiple mobilities.

For analytical reasons, there is a temporal overlap between the previous storyline of fixing the system of automobility and the current storyline of fostering new mobility concepts. For approximately a year; between 2016 and 2017, the two storylines co-existed, with the local actors from the City of Munich sharing both storylines in an ambiguous fashion. On the one hand, since 2016 the City Departments had already been engaging in a deliberative process of exploring what automated driving means for the mobility system of Munich as a whole. On the other hand, the first policy proposal for the federal funding application in 2017, prepared by the City Departments, was still to a great extent holding up to the federal understanding of automated driving, which was limited to the evolution of the car. This can be interpreted as the City adhering to the federal policy standards to ensure funding for the research project in Munich. Therefore, the first policy proposal was 'federally inspired', but at the same time, the City has already started thinking how automated driving could be integrated in the local transport system in Munich. Therefore, in the background, in 2016 the City started already formulating a more diverse approach, which considers all modes of transport. This alternative approach became apparent in the front stage a year later in 2017, when the local actors realised that at the urban level automated driving could not guarantee a technological fix in the system of automobility. It was this alternative approach that was developed through the storyline of fostering new mobility services. As the next sections show, the new approach does not lack ambiguity. On the contrary, the local actors have been hovering between viewing automated driving as an opportunity to rethink and approach mobility problems anew and using automated driving as a smokescreen to not deal with mobility problems directly and sustain the existing car-protective status quo of policymaking.

3.3.1. Questioning if automated driving can fix the system of automobility

As already mentioned previously, it was only in 2016 that automated driving was taken up as a policy issue by the local authorities in Munich. The local authorities started having internal meetings, in order to define a common communication strategy for dealing with BMW in the face of submitting the proposal for the research project on automated driving to the federal government. In September 2016, a scenario study for the future urban development of Munich by 2040 was completed within the strategic framework of the 'Perspektive München'. The Department of Urban Planning conducted the study in collaboration with the Fraunhofer Institute, which was responsible for developing three scenarios, where automated driving played an important role. The City did not develop or pass a political decision on the topic, rather the purpose of the study was phrased as making statements about possible developments based on real trends, to consciously influence them at an early stage and, if necessary, to be able to counteract them[24]. The issue of lack of space in the city, and the overloaded public transport due to rapid

[24] Perspektive München: Szenarien: Zukunftsschau München 2040+ Ergebnisse eines Szenario-Prozesses, September 2016 (own translation).

population increase were particularly highlighted in the study. In the scenario process, the extent to which automated individual traffic could lead to rebound effects, such as more traffic in the city, in case automated private cars would replace conventional private cars was investigated. One of the overarching conclusions was that automated driving has the greatest potential for the future of mobility and urban development when implemented in sharing concepts and in public transport, and not in private cars. This is line with the findings from other studies on the impacts of automated driving in particular cities, such as the MEGAFON study in Stuttgart (Friedrich and Hartl, 2016) and the Lisbon study (OECD, 2015). The difference in Munich was that the study was not exclusively about automated driving, but automated driving was part of the scenarios for the overall urban development of Munich in 2040. This has to do with the overall tradition in Munich to integrate urban development and transport planning under common policies. Thus, this study was the first attempt to contextualise the topic of automated driving at the local level. As quoted from the study:

> (…) this technology has the potential to completely transform mobility and mobility behavior in public spaces (…) it could produce new mobility concepts, whereby the boundary between public transport and private cars would blur in the medium term. With sharing concepts, traffic would probably decrease, and the city would be given more space. The idea of new mobility concepts could additionally lead to greatly reduced costs for mobility, which could have an impact on the settlement behavior of people. This could reverse the trend towards urbanization as people could use travel time differently. However, this would also lead to an increase in traffic, which brings environmental aspects into the picture (…) Finally, it will be about new intermodal transport concepts, in which public transport will continue to occupy a key position[25].

The above quote illustrates the focus of the study on the potential of automated driving to enable new sharing mobility concepts as a solution for the increasing urbanization and lack of space in the city. Here the strategic framework for urban development Perspektive München functioned as a policy setting that shaped automated driving part of the overall urban context of Munich. Interestingly, while automated driving was discussed simultaneously (in 2016) by the same actors (Departments of the City) within the context of applying for a research project for automated driving as another trend or another 'Tamagotchi', the topic acquired a different meaning when the issue was taken up in the setting of Perspektive München; it got connected to the urban problems in Munich. It was through the study, that the actors deployed automated driving as a new lens of looking into long-existing urban planning issues. As such, the study generated the narrative of automated mobility services contributing to the de-urbanisation and space efficiency, which gradually became key narrative in the second storyline of policymaking in Munich. As the quote denotes, the study concluded that automated driving should be used in new intermodal mobility concepts with public transport having the key role, in order to avoid

[25] Ibid., p. 51.

a laissez-faire approach which might lead to more traffic. Yet, as the next sections show, throughout the play out of the second storyline, it gets ambivalent weather automated mobility services are to be operated only by public transport or whether there will be more mobility providers.

Overall, the study made a statement that automated driving in the form of private car use is not desirable for the future of mobility in Munich. Through the study, the initial federally inspired approach of fixing the technology of the car, in order to deal with the problems, the car has caused, was basically counterargued for. The study argued that a replacement of the private car with automated driving would not fix mobility problems caused by car in the city, it would rather exacerbate them. Therefore, there was a need to diversify the promotion of automated driving, through mobility services. However, the scenario study was not enough to produce a total discursive shift regarding how the potential of automated driving was perceived by the local actors. As the next sub-section shows, the local actors needed to directly question by themselves the potential of automated driving to fix the system of automobility into an actual debate.

'Car traffic does not completely matter'

As explained in the section 3.2.4., the start of the official policymaking of automated driving in Munich was signified at the setting of the Inzell Plenary XI. It was after that meeting that automated driving became a topic of discussion as a future mobility concept in the City Council, while previously it was picked up only by the federal level, the industry and to a lesser extent by the City administration. Automated driving was politically wanted by the City Council, because of its promises for space and traffic flow efficiency, as the interviewee from the Green Party confirmed:

> There was a consensus about automated driving. I think there was no opposition about automated driving (...) because it was declared as good and helpful for the city...and I think it was also declared that we need less cars, less space...so for politicians that sounds good (…) I don' t think it is necessary, but I hope that automated driving is a process to civilize traffic, to have speed, which is regular - 30km - and everybody obeys to this speed. This can be a good progress for the city. (Interview 5, 2018, p. 3,6)

Politically, automated driving was a positive development. However, in practice the objective of policymaking was vague, as it was unclear through which modes and means it would be realised. It was probably this vagueness that enabled consensus among the political parties in the first place. Automated driving was perceived as another technological innovation that promised to solve problems easily, and through which politicians could claim to be progressive, as the interviewee from the Green party further argued (Ibid.). Against this background, in March 2017 the Green Party submitted a proposal to the City Council, where it proposed the renouncement of the planning of three tunnel projects that were meant to cross the city. In their proposal, the Green Party argued that if automated driving has indeed the potential to provide more space in the

city, then the construction of further car tunnels is not necessary. Additional tunnels would be a waste of recourses and time for the City administration, as their construction would start after 2027 at the earliest, while Munich needed reorganisation of traffic by 2030-2035 at the latest[26].

However, the Department of Urban Planning rejected the proposal of the Green Party arguing that it is currently not foreseeable how long it will take to achieve the necessary mobility change through automated driving. The Department further argued that whether these concepts can really affect the number of vehicle journeys was not yet known. Therefore, the potential of automated driving could not be considered as a reliable basis for planning. As a result, the City decided to stick to the planning of the tunnels as the optimum way to meet the goal of transport planning, which was phrased '*to limit the further increase in motorised private transport to the necessary level*'[27]. This phrasing indicates that the Department of Urban Planning assumed that the private car use will increase anyway. This assumption is in line with the projections of the Department of Urban Planning that the daily road capacity will reach its limit by 2030 (Dunkel and Ekchardt, 2018). Based on that, the goal of transport planning appears as rather mediocre; to limit the increase, which means to moderate the pace of the increase, instead of decreasing the motorised private transport. In the best case, this phrasing could be interpreted as keeping the motorised private transport as it is, avoiding further increases. According to the interviewee from the Green Party, it was BMW that put pressure on the governing parties of the City Council SPD and CSU regarding the construction of these tunnels, as they wanted a new connection to the motorway for their employees and logistics (Interview 5, 2018). Thus, the Department of Urban Planning had to plan accordingly. The following quote from an interviewee from BMW Mobility Services illustrates the perception of BMW that tunnels is the most effective solution for dealing with traffic congestion:

> So, it is so hard to steer transport today…I mean you can improve streets, you can improve public transport, but the impact is really small…it doesn't really make a big difference…You build a new tunnel…it is now like the whole traffic is way better than before (Interview 17, 2018, p. 1).

The interviewee from the Department of Public Affairs explained that BMW pays taxes to the City and employs many residents of Munich, thus the City often complies with the requests of BMW, in order to make sure that BMW is satisfied (Interview 14, 2018). With this approach, however, the interests of the City are aligned with the well-being of the industry without the City positioning themselves as a separate democratic entity that represents local citizens. In line with Olesen (2014), this could be interpreted as 'roll-

[26]Antrag Die Grünen Rosa Liste Stadtfraktion München, Verzicht auf neue Autotunnel an der Landshuter Allee, Tegernseer Landstraße und Schleißheimer Straße, München 10.03.2017 (own translation).

[27]Referat für Stadtplanung und Bauordnung, Verzicht auf neue Tunnel an der Landshuter Allee, Tegernseer Landstraße und Schleißheimer Straße, Beschluss des Ausschusses für Stadtplanung und Bauordnung vom 19.07.2017, p. 2 (own translation).

with-it' neoliberalisation of governance, characterised by the normalisation of neoliberal policy practices, in which depoliticisation plays an important role as a preference-shaping instrument in policymaking. Against this background, the planners did not consider the potential of automated driving for the reduction of car-dominance, but they used the old and traditional planning approach for more road tunnels to expand infrastructure, that could relief car traffic in the city. Yet, this approach does not imply a mobility change, it rather implies a continuation of car-dominance, but in a controllable manner. The governing party SPD also supported this approach, which reflects the continuation of the 'two-track' strategy Hajer and Kesselring (1999) were referring to two decades ago. The SPD has been governing Munich for at least seven decades and has been sustaining the two-track strategy in mobility politics since the 90s. As the interviewee from SPD stated:

> The Conservatives are on the one side and the Greens on the other side somehow. I regard our position to be probably a bit more balanced. I believe that the car traffic does not completely matter (…) The most important thing for us is that the MVG; metro - bus - tram, and the S-Bahn work well and are really comfortable and fast also to use. Regarding the car, we do not want to abolish the car in the city now. There are also sometimes reasons to use it, but the roads should be driven as environmentally friendly as possible. (Interview 19, 2018, p. 5)

The above quote confirms that the two-track strategy, namely supporting public transport and alternative modes, but also not hurting the system of automobility, continues to play out. The phrase 'car traffic does not completely matter' indicates that the SPD speaker regards car traffic desirable for the city to a certain extent. In other words, the cars should still be driven, but in a more environmentally friendly and space-efficient manner, while co-existing with public transport. Since automated driving could not guarantee this goal yet, the potential of automated driving of fixing automobility was questioned by the Department of Urban Planning and the governing parties. Thus, in order to ensure that this goal will be sustained, the City administration decided to stick to the old ways of dealing with transport problems (i.e. tunnels). Since the potency of the storyline of fixing the system of automobility was not adequate for translating automated driving into the urban context of Munich, the actors needed to organise themselves around an alternative storyline, namely fostering new mobility services, so that they could explore how automated driving could be integrated in Munich. If automated driving could not ensure that it could fix the unintended consequences of the car in the city, then its promotion and its purpose should be articulated differently.

3.3.2. Exploring mobility services in public transport

Automated buses

In June 2017, one of the district committees[28] of Munich submitted a request to the City Administration about examining the possibility of an offer with autonomous minibuses as a supplement of the public transport service in two areas, because the existing public transport service was not enough. The Lord Mayor, Dieter Reiter instructed the Department of Labor and Economy to answer the request. The Department of Labor and Economy, in turn, asked MVG for an opinion. In October 2017, the MVG answered that in the first place, complex legal and technical questions about automated driving as a regular service of public transport must be clarified, and that the time required for this can unfortunately not be estimated yet at this early stage. The MVG expected that initially there would be limitations in terms of speed (max. 20-25 km/h) and the area covered by the service due to technical and legal immaturity. It would be, therefore, a small-scale development to the nearest public transport stops. As a second step, further requirements would have to be clarified before the introduction of such a transport service, such as creating structural conditions in certain stops and access points[29]. In other words, the MVG perceived automated driving as a regular service of public transport, which would operate under the same legal and regulatory frameworks as public transport using physical stops just like normal public transport buses do.

While the MVG kept exploring the possibility of automated buses as regular public transport, a pilot of automated electric buses to be conducted by the MVG was included in the revised version of the Integrated Action Program for the Promotion of Electric Mobility in Munich (IHFEM) in 2018[30] as an action item for the time period 2018-2020. It was the Department of Labor and Economy that proposed the inclusion of tests with automated electric buses in the first place. In the IHFEM, it was mentioned that the City Council instructed the Department for Labour and Economy to support the MVG in the further electrification and digitization of buses in public transport. Therefore, the Department of Labor and Economy was supposed to work together with MVG to secure funding for the pilot. The additional funds required for testing the automated electric buses were estimated at two million euros, which were meant to be covered by external funding. As it will be shown below, the funding was eventually provided by the federal government within the context of the research project for automated and connected driving in Munich. As quoted from the document of IHFEM:

[28] The City of Munich has 25 district committees, which act as an important link between the citizens and the municipal administration at the sub-city level. (Source: https://muenchenwaehlt.de/en, Assessed: 10/10/2019).

[29] Referat für Arbeit und Wirtschaft, Autonom fahrende Kleinbusse als Nahverkehrsergänzung für den 9. Stadtbezirk prüfen, 16.10.2017 (own translation).

[30] The first version of IHFEM was published in 2015, and the revised version was published in 2018.

> With increasing automation in the vehicle sector, the gradual technical implementation and integration of autonomous electric vehicles into public transport must also be tested (for example, electric bus shuttle). To accompany the development at an early stage, therefore, a pilot for an automated e-vehicle is to be carried out, including a pilot for IT integration of booking/request, reservation and billing of the automated e-vehicle in multimodal applications (such as an App) (…) The topic of automated driving is closely related to electro-mobility and represents a major long-term future task for the City of Munich[31].

The above quote suggests that the City meant to counterbalance the developments in the automotive industry with automation in public transport. In the revised version of IHFEM, it was further mentioned that in the next few years, electric mobility will merge with other topics of the future, such as digitization, connectivity and automated driving. These new technologies were expected to bring about '*new individual mobility in cities*'[32]. This phrase signifies a discursive shift from the dichotomy private transport vs. public transport to a mobility system where the boundaries between the two are blurred. Overall, this was the first attempt of the City to integrate automated driving in existing municipal strategies. However, the conditions under which the pilot would be conducted, where and how were not specified at that point. The framework of implementation of automated electric buses was not defined. Based on this, the interviewee from the Department of Urban Planning contrasted the policymaking of automated driving to the policymaking of electric mobility:

> For us it is just something maybe like electric mobility in 2010 or 2009, when it was just coming up, and you know you have to do some research, you have to do some piloting, some implementation, some testing and you have to think especially how to implement it in the city in the future. But now we just…I guess we will be developing some strategy with that kind of projects when we have results. But now it is too early to do some real strategies. But it is always nice to write some beautiful sentences like '*electric mobility and autonomous driving have to be combined*'. (Interview 18, 2018, p. 13)

The interviewee implied that automated driving is following similar path-dependencies in policymaking as electric mobility in Munich. As previous studies have shown (Servou, 2016; Tschoerner-Budde, 2019), electric mobility was initially approached in a techno-centric way in policymaking, tested and piloted with funding from the federal government, while the context of its implementation at the local level in Munich was not clearly defined. While policymaking for automated driving has been partly following a similar path too, the trajectory of its policymaking also shows opportunities for rethinking urban issues and plurality in mobility options, as the next sections will show.

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[31]Landeshauptstadt München, Referat für Gesundheit und Umwelt (2018). Integriertes Handlungsprogramm zur Förderung der Elektromobilität in München (IHFEM) (own translation).

[32] Ibid., p. 53.

Automated subway

In parallel with the discussions about automated buses, discussions about an automated subway emerged too. In July 2018, the local FDP (Free Democratic Party) requested that the MVG answers whether they have explored the feasibility of operating an automated subway. The argumentation was that the frequency in all lines of the subway in Munich needs to be increased, as the metro is usually overcrowded, and the subway network has reached its capacity. However, the difficulty of finding drivers hinders the increase of frequency. Thus, automation could increase the frequency of the trains without the need of drivers. MVG answered that the use of subways without drivers has been constantly checked, but the technical conditions for infrastructure and vehicles have not reached yet, while the investment and operational costs were evaluated as high so far. Therefore, a prognosis for a driverless operation of the subway could not be given yet[33].

This was not the first time that the idea of a fully automated subway was discussed by the local actors in Munich. In fact, the first time that the term 'automated driving' appeared in the key-word search in policy documents from the City of Munich was in 2008. That was when the first considerations on automated mobility started in the City Council. The MVG has been operating an Automatic Train Operation (ATO) system for many years. ATO enables a completely automatic train journey between the stations, thus enabling the provision of frequent train density in Munich. In case of failure, the driver can intervene directly and continue the operation in the fallback. In 2008, Nürnberg introduced fully automated operation (MTO = Manless Train Operation), which is the next step after ATO. This means that all train functions, the monitoring of the track area in the station area and of the passengers getting in and out are coordinated centrally from an underground operating center[34]. Back then, the local actors in Munich felt that Nürnberg, which also belongs to the federal state of Bavaria, is catching up with public transport automation much faster than Munich. Once again, the MVG answered that a changeover to driverless subway operation was not economically feasible. This was argued for in terms of the high amount of investment costs required for this technical system, and the availability of operating staff with driving authorization to implement the fallback[35]. The topic resurfaced ten years later in 2018, when automated driving had become a legitimate topic in the policymaking arena of Munich. This time, though, it was not only local politicians, but also the Department of Urban Planning that considered an automated subway as a potential development in Munich. The interviewee from the Department of Urban Planning stated:

[33]Bahnen in München umgesetzt werden? Antwort zu Anfrage von FDP-HUT Stadtratsfraktion vom 19.07.2018 (own translation).

[34]https://www.nuernberg.de/internet/digitales_nuernberg/automatische_ubahn_nuernberg.html#4 (Assessed 21/11/2019) (own translation).

[35]Beschluss des Ausschusses für Arbeit und Wirtschaft am 09.12.2008 (SB)/ Fahrerlose U-Bahn – endlich eine Chance für die Nacht U-Bahn Antrag Nr. 08-14 / A 00065 der Stadtratsfraktion der FDP vom 16.06.2008 (own translation).

> I think if you see it as a general objective, we don't want to get urban mass transport cannibalised by lots of small autonomous cars, and even if you think that all autonomous vehicles are shared, we think all the streets and the transport system can't manage all that traffic. So, such a scenario – we feel – would be if there is no public transport anymore, but just small autonomous cars. So, maybe the people would like to work in the car, and they wouldn't care about how much time they need from one place to another or streets will be overcrowded all the time. So, we don't like such a scenario, so we think there should be some kind of big mass transport and that there will be still underground and S-Bahn transport system and that could be autonomous without a driver like it is already in Nürnberg; the metro is driverless. It is easy, you could do it today, in Nürnberg they do it and in a lot of other places. But we think public transport must be still the backbone (…) (Interview 18, 2018, p. 6).

The statements of the interviewee show that even though planners wanted to make sure that the traffic situation in Munich would not deteriorate, they did not see automation as a necessary development to tackling mobility problems, but rather as a development they could not avoid, and therefore they had to be defensive by suggesting automation in mass public transport. It seems as if the planners considered automated subway as a way of managing the risks and rebound effects that come along with automated driving. Eventually, despite the economic and technical hurdles regarding the automation of the subway in Munich, the consideration of a pilot project for a driverless turn at a subway terminal was included in the Green City Masterplan of Munich[36] in July 2018. That was meant to be the first stage for a subsequent further automation and demand control of the subway operation. Overall, these different requests and efforts for including automated driving as a mobility service of public transport in existing municipal strategies were ad hoc, in the sense that they did not emerge from an open debate or a strategic policy document on automated driving. It seemed as if the City was gradually attempting to integrate automated driving in their strategies for public transport to ensure that they maintain relative municipal control over its exploration.

3.3.3. Dealing with space efficiency without blaming the cars

As several interviewees confirmed, the success story of Munich becoming an industrial and research hub has led to humongous population (and number of cars) increase, as many people have been moving for work in Munich. In parallel, the twenty-year old strategy of the City 'compact, dense, green' introduced through the framework

[36] As the permissible annual limit value for nitrogen dioxide (NO2) in 90 German municipalities was exceeded in 2016, the Federal Government initiated the 'Clean Air 2017-2020 Immediate Program' in 2017 to support municipalities in improving air pollution control. A central component of the program is funding Green City Masterplans for municipalities. The aim of these plans is to help municipalities tackle the topic of 'sustainable urban mobility' in a long-term and strategic manner. (Source: https://www.bmvi.de/DE/Themen/Mobilitaet/Sofortprogramm-Saubere-Luft/Masterplaene-Green-City/masterplaene.html, Assessed 15/12/2019).

Perspektive München made the city center so attractive that led to a housing problem, and an overpopulated city center. In addition, the public transport network is monocentric, which means that in many cases one needs to commute to the city center first in order to reach any destination. Thus, there is a need for decongestion of the city center and suburbanization of the city. As the interviewee from the Department of Urban Planning explained:

> I think the strategy 'compact, dense, green' of the Planning Department was and is still very successful the last twenty years. And now I think it's maybe too much or it's even too successful, because we've got a problem with housing and with affordability of flats. So…it is maybe so attractive to go to Munich and to the city centre, and now our strategy was maybe too successful…But I think it always has something to do with sustainability, if the city is getting always denser and denser, it's sometimes maybe not sustainable anymore if there are too many people in a small place and they don't get some green areas, you also have to bring goods to provide the people with food, with everything (…) If you've got some kind of sustainable mode of transport in the more rural areas, it would be a good thing to get in balance again. (Interview 18, 2018, p. 10, 11)

Against this background, in February 2018 the City Council had a public hearing on mobility and the need for mobility change. At that public hearing, the issue of lack of space in general, and the space competition between different modes of transport was particularly highlighted. As quoted from the summary of the public hearing, the Department of Urban Planning stated:

> Good ideas can be proposed, but the space in a city like Munich is finally barely available. Therefore, in principle, only a rededication of space can be used, and this requires rethinking of the extent to which the compatibility of different means of transport is possible and feasible. The focus is not on the restriction or the preference for a type of transport - but the focus must clearly be on promoting emission-free or emission-low mobility. It is about the interplay of space and human. Here, the acceptance and the behavioral analysis of traffic participants play a major role. This should be more often determined by means of transport experiments in order to assess the acceptance and participation of citizens and other actors[37].

In the above quote, despite the City recognises the need for redistribution of space among the different modes of transport, there was no mention about the main mode of transport that causes the lack of space, namely the private cars. Instead, the City rather vaguely referred to rethinking the compatibility of different modes through transport experiments, so that compatibility is evaluated through the social acceptance. The City

[37]Referat für Stadtplanung und Bauordnung, Vom Verkehrsentwicklungsplan zum Mobilitätsplan für München (MobiMUC), Beschluss des Ausschusses für Stadtplanung und Bauordnung vom 11.07.18, p. 13. (own translation).

here rather kept distance from engaging with the problem of space by avoiding deciding which mode(s) of transport is more space efficient and shifting the focus on emission-free mobility.

In parallel, one of the explicit conclusions of the public hearing was that an update of the existing Transport Development Plan is necessary, if new mobility concepts and challenges are to be considered[38]. According to the interviewee from the Green Party, it was the City administration that was pushing for an update of the Transport Development Plan, which was published in 2006, and was considered already too old to deal with the new mobility challenges and concepts. However, the governing political parties, SPD and CSU have not been very eager to update the Plan, in order to work systematically on the issue of mobility, define concrete strategies for reducing the number of cars on the streets, and directly deal with the issue of space. As quoted from the interview with the Green Party:

> I think they don't like this process of thinking about how to deal with the cars in the future, it is better...they think...that we continue as we did, and no change is for the best (…) I think there is a big difference between the staff in the administration and our leading parties SPD and CSU. (Interview 5, 2018, p. 5-6)

The interviewee form the Green Party also critiqued the lack of a concrete vision with measurable goals for the future of mobility in the existing Transport Development Plan:

> (...) there is no vision, because there is lack of a Transport Development Plan - the last one is from 2006. So this is a very old document, which has some visions about modal shift and something like that, but there are no numbers in it, because at this time, there was the Green party governing together with SPD, but SPD was very strong against any modal split share. It was not said: 'we want to have 25% of cycling this year'. It was said, in general, 'we want to have more cycling', but there are no numbers inside. And so, the administration...they want to have another vision, so that people think about the future…what they want to have (…) So, if you want to have this modal shift, it is a big effort, but I think the majority don't do such planning, such visions. (Ibid., p. 7)

The above quotes show that the City administration in general has knowledge of the mobility problems of the city, but it is the political willingness that is missing. As mentioned previously, it was the Department of Urban Planning that rejected the proposal of the Green Party for a renouncement of the building of tunnels and use of automated driving to deal with the lack of space. In this case, it was BMW that put pressure on the governing parties for the building of tunnels, and thus the Department of Urban Planning referred to the mediocre planning goal of limiting the increase of motorised transport.

Eventually, the Department of Urban Planning presented a policy decision to the City Council, aiming to start a consultation process for an update of the existing Transport

[38] Ibid.

Development Plan from 2006 to a new Mobility Plan Munich (MobiMUC). The proposed update was supposed to consider the changed framework conditions and challenges in terms of new mobility concepts (including automated driving), rapid population growth and lack of space. The suggested planning horizon of the Mobility Plan was 2030+. In the policy proposal for the MobiMUC, the role of automated driving in fostering new mobility services was discussed. The policy proposal pointed out that open questions, such as which new mobility offers could result from automated driving, who will be a mobility service provider for such offers in the future, and how this fits into the transport planning goals of Munich need to be answered in the MobiMUC. Automated driving was presented as an element of sustainable mobility. More specifically, the potential of automated driving was discussed as supporting integrated mobility services through Apps and change in preferences of residential locations. Automated driving was mainly articulated as a useful addition to public transport in the form of shuttles and/or ridesharing to connect the less populated and less accessible areas in the suburbs with the city. This could indirectly deal with the lack of space in the city, as people could work in the city, and move to suburban areas, if there was a flexible and comfortable connection to the outskirts. As the interviewee from the Urban Planning Department stated:

> (…) so, it would be maybe even positive if you could live somewhere away, but you use a sustainable automation technology, not your individual car, but those on-demand services. And you say 'ok, I go with the seamless mobility step-by-step, but it is still sustainable' (Interview 18, 2018, p. 10).

Based on the tradition in mobility policymaking in Munich, the City deployed automated driving to rethink urbanization and lack of space, but also to detach the issue of space from the number of private cars. The City saw automated driving as a way of suburbanisation of the city, shifting the focus from directly dealing with the number of cars to changing the residential choice of people. In the policy proposal for MobiMUC, the City avoided formulating and defining the problem of lack of space as explicitly influenced by cars, rather they defined the problem in terms of the residential preference of people, because the city centre is a very attractive place to be. In other words, they considered the overpopulated city centre as the main cause for the lack of space, so if people moved to the suburbs, then there would be more space in the city. To enable that, they considered to implement automated mobility services, which could lead to reduced need for private car use to commute between the suburbs and the city. This implies that automated driving served the purpose of indirectly sustaining the system of automobility through the storyline of fostering new mobility services. In other words, it contributed to developing new mobility options without blaming the private cars. Yet, this approach should not be considered as necessarily negative, as it shows potential for developing alternative solutions for mobility and urban problems through the deployment of automated driving.

3.3.4. The multiple mobilities of the 'sandbox' in the making

When the interviewee from Urban Mobility BMW was asked what the role of the City should be in the policymaking process of automated driving, he answered that BMW expected the City to set the framework for them to operate within, without interfering with technology or public acceptance. As quoted from the interview:

> My message to the City is "don't talk about technologies, don't talk about customer behavior and mobility choices, do what you need to do and don't care about anything else. So, define quality objectives, attach a price to that, that's it. And then you define a sandbox and then let the kids play in the sandbox" (…) then the City can lean back and say "OK, whatever technology comes in, so be it (…) we have defined our sandbox" (…) We don't want a specific regulation for autonomous driving, we just want the regulation for the current mobility problems to be solved. (Interview 7, 2018, p. 4, 8)

When asked what the 'sandbox' should contain, the BMW speaker referred to regulation for land use allocation for the different mobility modes, parking management, traffic flow, road pricing and emission control. This was supposed to be beneficial for the City too, as lack of space, congestion and emission problems need to be solved anyway. When asked if what BMW is expecting from the City with the cooperative Research Project on Automated and Connected Driving (application submitted in 2017) is developing the 'sandbox', he confirmed that this is the case, and that is how BMW tries to influence municipal policymaking for mobility; through the cooperative research project (Interview 7, 2018). The metaphors '*sandbox'* and '*let the kids play in the sandbox'* are powerful signifiers for a value-neutral framework of the City that would allow the industry to develop laissez-faire business cases. These metaphors insinuate that BMW does not want the City to make a concrete decision on how to implement automated driving in Munich. It seems that BMW rather aims for a framework that allows them freedom for experimenting and building new business cases.

The interviewee from the Department of Urban Planning further elaborated on this claim by sharing his reflections on the role of the automotive industry in promoting automation and digital technologies in Munich. He claimed that the whole shift from car-producers to mobility providers, including automation and digital technologies, does not have to do so much with selling their products in Munich or in Germany in general. Rather car companies must make this shift, because they sell most of their cars in Chinese cities, which are much denser and more car-dominated, and they have more urgent mobility problems, especially with smog and congestion. Therefore, the automotive industry needs to test new technologies and mobility concepts in European cities, where the regulatory and physical/infrastructural conditions for testing are more suitable, in order to be prepared to sell them in China (Interview 18, 2018). Several researchers, such as Shulz (2020), argue that mobility services have spread rabidly in China compared to Europe or even the U.S where they were initiated by Uber. In the same line, Attias (2017)

argues that in China customers are more likely to buy equipment for automated driving than in Germany. As quoted from the interview with the Department of Urban Planning:

> I always feel they want to test it, but the big market is not Germany, but China. And they know they have to do something, because if they don't do anything today, the Chinese government will do some regulations, and they can easily do the regulations very top-down without talking with BMW; they can do it from one day to another. So, BMW has to find some solutions before. I think that is the main background in the strategy of companies like BMW. They want to test it in some areas, and they would like to know which regulations could support that (Interview 18, 2018, p. 13).

This indicates that for BMW the promotion of automated driving in Munich was not primarily seen as a direct solution to mobility problems, but rather as a test case for a new market for automated mobility services. BMW might be aiming for making Munich a test field for automation technologies and business cases. Thus, the regulation BMW asks for might be mostly about regulating the existing mobility issues, in order to test how this regulation interplays with automated driving; how automated driving can operate within this regulatory framework.

However, all three interviewees from BMW provided a further explanation on why BMW is interested in exploring new mobility services, such as automated on-demand mobility. That is that increasing traffic congestion has high business costs for them as car producers, as private cars will lose their attractiveness as the main mode of transport in cities. As the interviewee from BMW Urban Mobility stated:

> (…) we are not only addressing the car owners as a strategic target group, we also address the majority of people, not only the ones wishing to own a car. On-demand mobility can be operating in a much better way, because the availability is higher given a certain fleet size…or you can reduce the fleet size for the same availability…And then its operational costs and availability are much better…Then if you combine things, if you really help a city to get rid of congestion, then again we reintroduce or re-establish 'Sheer Driving Pleasure' for those who prefer to drive themselves. So, it's also an indirect benefit for BMW (…) I believe as long as the technology is very expensive, then the on-demand mobility case will be more attractive, so helping the car-ownership case…to survive or to decrease the cost in a fashion that the car-owner will also be able to buy it. (Interview 7, 2018, p. 6, 8)

The interviewee argued that automated on-demand mobility has the potential to reduce congestion by increasing availability and reducing the number of vehicles. This way BMW could 'cure' congestion, which is financially detrimental for the company, through automated on-demand mobility services. Thus, they can reintroduce their core-business of selling cars. This poses the question whether BMW really aims to diversify by offering new automated mobility services, or if at the end these services will be a facilitator for reintroducing the forty-year old principle of 'Sheer Driving Pleasure'.

Whether the internal motive of BMW is finding new markets or reintroducing 'sheer driving pleasure', or both is hard to answer. What is clear is that BMW is interested in testing new mobility services in urban contexts. This logic was included in the updated policy proposal submitted by the Departments of Urban Planning and Public Affairs for the research project on automated and connected driving in October 2018. One further expected result of the research project mentioned in the updated policy proposal, which was not mentioned in the first policy proposal in 2017, was the following: '*how market ramp-up can be organised for services and the development of framework conditions*'. This phrasing resonates with the 'sandbox' logic of BMW mentioned above; the market and industrial interest was to have a safe space (a sandbox) for testing and organising new mobility services.

An opportunity to optimise the entire mobility system

While the research project was expected to start in January 2018, it eventually started one year later in November 2018, because the federal government delayed the approval. For this reason, the duration of the project was limited to two years, instead of two and half, as it was initially planned. The total amount of the project is 10.56 million euros. The project was partly funded with 6.6. million euros by the Ministry of Transport, and the rest was paid by the City of Munich. After the approval from the federal government, the Department of Urban Planning submitted the updated final policy proposal for the project to be approved by the City Council in October 2018, so that the project could officially start in November 2018. In this updated policy proposal, which was published after more than one year from the first policy proposal, the research project was given a name: EASYRIDE. Now the aim of the EASYRIDE project was rephrased as investigating the potential of automated and connected driving to foster sustainable mobility in Munich through developing new integrated automated mobility services[39]. What was different in the updated policy proposal, after one year of discussions within the setting of the City Council, was that the role of mobility services became dominant, diverging from the initial policy transfer of the car-oriented federal approach into the local level. The goal now was to optimise the entire mobility system through fostering new mobility services. If, for BMW, EASYRIDE represented the 'sandbox' for testing their business cases, for the local public actors, this sandbox represented rather a framework for harnessing the potential of automated driving, in order to improve the transport system. As an interviewee from Mobility Management MVG stated:

> Perhaps there is no clear vision, but in the funding application they integrated which steps are to go, and how the potential of automated driving for transport systems can be optimised. The goal is to optimise the whole mobility system with

[39]Beschluss des gemeinsamen Ausschusses für Stadtplanung und Bauordnung und des Kreisverwaltungsausschusses vom 10.10.2018, Automatisiertes Fahren und Vernetzung des Straßenverkehrs im städtischen Kontext Pilotstadt München Teilnahme der Landeshauptstadt München am Kooperativen Forschungsprojekt EASYRIDE im Förderprogramm zur Automatisierung und Vernetzung im Straßenverkehr (own translation).

> automated driving, and to minimize the risk of a new technology, which perhaps decreases mobility itself and the efficiency of the system if the vehicle mile travel increases, and many more cars are driving through the city with no persons inside or with less people inside the car. So that won't be the goal of the City and of our company (Interview 9, 2018, p. 4).

The duality of the local-national remained in the expected results of the updated version. On the one hand, the project aimed at developing Munich as a model region for automated driving and the services it enables in cities. On the other hand, as quoted from the updated policy proposal:

> The EASYRIDE project exemplarily shows how the innovation of automated driving, while maintaining the municipal control function, can be used specifically to optimise the overall transport system without hindering innovation (…)[40].

This new phrasing indicates that the EASYRIDE project attempts to reconcile technological innovation with local mobility needs. Several interviewees used the phrase 'optimise the overall mobility system', when they were asked what the difference between the first policy proposal was in 2017 and the final one in 2018. The first policy proposal was following the federal policy standards and objectives reflecting mainly a car-centric understanding of automated driving. In the updated policy proposal, though, automated driving was seen by the local actors as an opportunity to rethink mobility problems through the integration of new automated mobility services.

Testing mobility services for developing future regulation

The aforementioned goals of the EASYRIDE project were meant to be materially manifested by the following test cases:

- Individualized, automated public transport (highly automated minibus as a feeder to public transport).
- Automated ride-pooling service (fleet intelligence capabilities for on-demand ride-pooling service).

The expected regulatory framework was to be developed as needed from the requirements arising from these test fields. Interestingly, despite the scenarios of EASYRIDE are meant to include the implementation of automated driving in all transport modes (including private cars) and market concepts, the regulations are supposed to arise not from the scenarios, but from the test cases in a bottom-up way. By the end of 2019, the City had come up with four scenarios ranging from automated sharing mobility to automated private cars, and from weaker to stronger regulation in terms of costs and service providers. Three out of four of these scenarios are to be chosen for developing simulations during 2020. Yet, the test cases were already defined before the development of scenarios, and were limited to individualized shared mobility, excluding private car

[40] Ibid., p. 3.

use. Connecting the dots between the policy proposal for the new Mobility Plan Munich (MobiMUC) in July 2018 and the updated policy proposal for EASYRIDE in October 2018, the policy proposal for the MobiMUC had already framed automated driving in the form of shuttles and ridesharing to connect the less accessible suburban areas with the city. Despite the results from EASYRIDE were supposed to be included in the future MobiMUC, the policy proposal for MobiMUC had already set the tone for the preferred mobility modes of automated driving, which excluded the private car and were then taken in the updated policy proposal for EASYRIDE as test cases for mobility services. Furthermore, as mentioned above, a pilot with automated e-buses was included in the updated version of IHFEM. This inclusion of automated driving in the form of shuttle/buses and ride-pooling in already existing mobility policies defined the test cases of EASYRIDE. Thus, it was the test cases that were meant to be used to produce regulation. This further confirms the concept of 'sandbox' as a framework to test new mobility services and regulations.

Against this background, the City of Munich and the MVG announced the test operation of two highly automated electric minibuses of 15 people in the Olympic park in Munich as part of the EASYRIDE project[41]. The MVG had tested an automated electric bus at their private headquarters already in 2017 for a few days, in collaboration with a French manufacturer[42]. But with the trials of EASYRIDE, it will be the first time that automated driving is tested in public operation in urban ground in Munich. The hardware of the minibuses comes from BMW and MAN, while the software is provided by the Karlsruhe company PTV. The minibuses can drive up to 10 hours on two defined test tracks in the Olympic park with pre-defined stations, which means that it will not operate on an on-demand mode yet. While at the beginning, the tests were scheduled for autumn 2019, they were postponed for April 2020. In fact, there will be two phases of testing. In the first phase in April 2020, the minibuses will not be driving in automation mode, but they are meant to only collect anonymized environmental data using the built-in sensor technology[43]. In the second testing phase, which is scheduled for autumn 2020, the minibuses will be running in automation mode using sensor technology to navigate independently. However, a safety driver will be on board to monitor the operation and intervene at any time in case of emergency[44].

[41]Landeshauptstadt München, PROTOKOLL zur Sitzung des BA 11 - Milbertshofen - Am Hart Wahlperiode 2014 – 2020, 27.06.2019 (own translation).

[42]https://www.sueddeutsche.de/muenchen/muenchen-olympiapark-autonome-busse-1.4778145 (Assessed 23/01/2020) (own translation).

[43]https://vision-mobility.de/news/muenchen-mvg-testet-autonome-e-shuttles-22932.html (Assessed 12/12/2019) (own translation)

[44]https://www.stadtmagazin-muenchen24.de/easyride-startet-im-olympiapark-muenchen-tests-mit-automatisierten-kleinbussen-82038 (Assessed 16/01/2020) (own translation).

'Public transport does not need to be the only mobility provider'

MVG seems to have a protagonist role in the testing of the minibuses, as they are branded with its name, and they will also be monitored by the MVG control center with installed cameras inside the buses. At a presentation a spokesperson of MVG gave in mid. 2019, he stated that MVG joined other actors in the EASYRIDE project under the common framework of developing new mobility services for Munich[45], in order to achieve the following goals:

- Traffic reduction of motorised private transport, which is expected to increase occupancy rate (number of commuters per vehicle) in 6-15 persons per shuttle. Occupancy rate in Munich is currently 1.1, and it is one of the main factors of lack of space in the city[46]. Here the goal of MVG is much more explicit regarding the reduction of motorised transport, compared to how the Department of Urban Planning had phrased its planning goal previously.
- Modal shift to environmentally friendly modes of transport by encouraging commuter traffic to switch to public transport at the city border.
- Access of all citizens to public life through making the commuting more convenient and solving the first and last mile problems.
- Gaining knowledge through the field trial for user acceptance. In order to achieve that passengers can commute with and test the minibuses free of charge and without reservation or registration, but instead they will fill out an MVG questionnaire on the feeling of security and their experience in general, while being on board.

However, there is still no clear vision on how these minibuses will be implemented in Munich; will they be an additional service to public transport for less accessible areas in the suburbs, as mentioned in the policy proposal for MobiMUC, or if they will operate differently. As mentioned on the MVG website:

> Automated and potentially autonomous vehicles can serve as part of a wide range of public transport options. In the medium term, they are suitable as a feeder to public transport stops or as a district bus within a defined area[47].

Furthermore, it is not only the mobility concept that is undefined, but also the mobility provider(s). The fact that MVG is in charge for the testing of minibuses, does not necessarily mean that MVG will be the only provider of automated mobility services. In the EASYRIDE project, both MVG and BMW are responsible for the development and testing of fleets. Despite MVG oversees the testing of the minibuses and BMW provides

[45] Landeshauptstadt München, PROTOKOLL zur Sitzung des BA 11 - Milbertshofen - Am Hart Wahlperiode 2014 – 2020, 27.06.2019 (own translation).

[46] https://www.sueddeutsche.de/muenchen/muenchen-mvg-verkehr-autonomes-fahren-shuttle-1.4522412 (Assessed 17/01/2020) (own translation):

[47] https://www.mvg.de/ueber/mvg-projekte/bus/hochautomatisiertes-fahren.html (Assessed 13/11/2019) (own translation).

the hardware. Furthermore, the testing of electric minibuses is only one of the two test projects, with the second one still being undefined. Another development that indicates that the MVG might not be the only mobility provider is the transferring of the project management to the Department of Urban Planning. In the first policy proposal, the Department of Urban Planning was appointed with the coordination of the research project. MVG was supposed to provide project management and expert advice. The argumentation provided in the updated policy proposal regarding the switch of project management from the MVG to the Department of Urban Planning was that in order for the Department of Urban Planning to be able to assume the overall responsibility as a coordinative agency, the responsibilities for expert advice and project management should also be transferred to the Department of Urban Planning. This insinuates that the City wanted to control the expert advice, which if it would come from the MVG, it would be tailored to public transport as the main mobility provider. In addition, it is the Department of Urban Planning that is in close contact with BMW both in the context of the Inzell Initiative but also in general about mobility issues, and not MVG. It is also the Department of Urban Planning that submits policy proposals to the City Council. The interviewee from the Department of Public Affairs further supported this interpretation:

> (…) we see that we could envision more mobility providers, for instance. This a result from what we could envision as a better mobility for all (…) That is why I am saying that it doesn't necessarily mean that the public transport provider is the only mobility provider as such. It could be way more in the future. So, I wouldn't say that the public transport needs to be the one and only. In fact, this…shouldn't be the goal, because you have different target groups. The public transport provider or let's say the public transport always has to be the backbone of urban transport…now and in the future (Interview 14, 2018, p. 8).

What is more, the Lord Mayor of Munich, Dieter Reiter, at one of his statements regarding the project EASYRIDE, made clear that the City should have the last word regarding who will be the mobility provider(s) for automated mobility services. As he stated:

> In order to achieve a traffic-friendly solution that is compatible with the city, it is of utmost importance that, in addition to the vehicle manufacturers and public transport operators, the City administration is also intensively involved in the discussion about future mobility in Munich[48].

The above quote further confirms that the switch of project management from MVG to the Department of Urban Planning means that there was a certain flexibility from the City regarding 'who will be playing in the sandbox'. This approach opens the ground for both the automotive industry and the public transport authority as well as other potential providers to develop and test their mobility services in the urban context. It also seems

[48]https://ru.muenchen.de/2019/119/Muenchen-untersucht-automatisiertes-und-vernetztes-Fahren-85491 (Assessed 15/10/2019) (own translation).

that the role of the Department of Urban Planning becomes ambiguous regarding what kind of future mobility they aim to promote in Munich. The Department has gathered most of the responsibility regarding the promotion of automated driving on behalf of the City administration. Yet, it rather acts as the mediator between public transport and industrial interests.

In a nutshell, the EASYRIDE project has a dual purpose: 1) To facilitate different mobility providers in testing their new mobility services for regulation and acceptance. 2) To allow the City to get an overview of their options on integrating automated driving in planning for sustainable mobility, and to rethink solutions for mobility and urban development issues in Munich anew. The metaphor 'sandbox' signifies the epitome of the storyline of fostering new mobility services. That is a dispersion of automated driving from automobility to experimenting with multiple mobilities; multiple mobility providers, mobility modes and business cases (e.g. minibuses, ride pooling fleets, automated subway) as well as a diversity of urban development issues (i.e. urbanization, lack of space, accessibility) without damaging the local automotive industry. This is how automated driving was translated from a top-down car-centric policy to the local context of diverse issues. Despite this translation indicates opportunities for thinking and solving existing issues anew, the indecisiveness of the local policymaking regarding if, who and how remains, perpetuating the ever-long lasting tradition of ambivalent policymaking for mobility.

3.4. A policymaking of dispersion: opening up new perspectives

This chapter presented a trajectory of dispersion in policymaking of automated driving, as the issue diversified from a federal one-dimensional car-centric approach to multiple mobility options and urban issues. This was traced through the identification of two storylines, namely fixing the system of automobility and fostering new mobility services. This dispersion of the topic of automated driving has been contingent on the location (settings) and the actors of policymaking. In the first storyline, the topic was revolving around the private car and policymaking took place mainly in industrial and federal government settings, which were detached from the urban context. In the second storyline, the topic touched upon several existing urban issues, and it got connected to the overall urban development of Munich, exactly because policymaking took place in municipal settings. Even though there has been a lot of talk and activity about automated driving, there has not been any strategy, policy or action programme for its implementation so far. This validates the hypothesis formulated in the introduction that policymaking of automated driving is not about its implementation. The case of Munich shows that the objective of policymaking has been rather to get relevant actors to rethink and reconceptualise urban problems, such as urbanization, lack of space and limited capacity of the public transport network through the perspective of automated driving. In the case of Munich, it is more about the new perspective for multiple possibilities in decision-making that automated driving provides than about implementation of the technology per se. After contrasting the two storylines and their components, this

concluding chapter discusses how the two storylines interact and the impact of this interaction in policymaking.

Fixing the system of automobility vs fostering new mobility services

The dispersion of automated driving from a car-focused policy to a multi-mobility policy has emerged through a change of scope in policymaking manifested throughout the two storylines. At the beginning of the case study automated driving became relevant for the automotive industry in Munich as incremental innovation enabled mainly by the roll-out of electric steering, which led to more innovations in R&D aiming at developing driving assistance technologies for comfort and productivity. As such, in the early 2010s policymaking was automotive-industry-led and its main objective was the optimisation of the system of automobility for highway driving for the further growth and development of the automotive industry. Initial policies were the outcome of lobbying of the automotive industry at the federal level in several technical working groups and roundtables. As the global competition from the U.S. and China in the field of automated driving became more perceptible by the automotive industry, the policy objective slightly shifted into keeping Germany competitive on a global level in terms of automotive industry. The federal level assumed a more active role by developing initiatives and strategies for integrating ICT technologies into the automotive industry to strengthen and ensure the growth and the competitive advantage of the German automotive industry.

The local level in Munich got involved, first unofficially, in the policymaking through bottom up lobbying with the industry at the federal level, in order to influence the conditions for cities to get a chance to research automated driving with applications in mixed traffic. In the informal meetings between within the City and between the City and the industry, the policy objective was dual: on the one hand BMW to be the leader in automated driving through piloting Munich as a model city and on the other hand the City to explore the trend of automated driving. This objective was officially taken up at the Inzell Plenary XI where the idea of applying for a pilot research project for Munich to the federal government was announced. When the topic of automated was eventually picked up by the City Council and the City administration as a policy proposal, it was a policy transfer from the federal level, detached from the urban context in Munich. Yet, the City already excluded the option of investing in infrastructure for automated driving, something which was in line with the interests of BMW, that is focusing on automation within the car. Social acceptance was reduced to new business and technology offers which would automatically change people's preferences, neglecting the complexity of everyday choices. Overall, the first storyline of fixing the system of automobility focused on incremental automation of the private car mostly as a means for economic growth, and much less as a transport solution.

What triggered a real shift in the policy objective was a scenario study as a key practice, which integrated automated driving into the urban development strategy of Munich and signified the emergence of the storyline of fostering new mobility services. Through this study, the federal approach of fixing the system of automobility was

counter-acted and the option of automated private cars was excluded. On top of that, an ambivalent decision from the Department of Urban Planning to proceed with the construction of more tunnels to relieve traffic in the city was the outcome of questioning the potential of automated private cars to improve traffic flow. This decision separated the issue of automated driving from the issue of car-dominance. These two practices led actors to organise themselves around the storyline of fostering new mobility services. As such, automated driving was linked to the existing policy objectives of suburbanization and space efficiency. Ever since, the local actors took up the topic, which was dispersed in several other policy objectives, namely increasing accessibility of public transport, increasing capacity of the subway as well as industrial objectives of testing regulation for new business cases. One could argue that in the second storyline, actors used automated driving to continue the traditional two-track strategy in policymaking by avoiding dealing with car-dominance directly as a source of many transport problems, while at the same time developing strategies for dealing with these problems without hurting the car industry. Yet, even though this approach ambiguously sustained automobility in the city on the side, the integration of automated driving in existing urban strategies (i.e. IHFEM, Green City Plan, MobiMUC) and policy objectives provided a new ground for rethinking problems and developing strategies anew. In addition, automated driving got indirectly linked to mobility planning objectives. For instance, it was the presence of automated driving on the agenda among others, that mobilized an update of the existing Transport Development Plan, which was inertial to change since 2006, to a new Mobility Plan (MobiMUC). Eventually, the final policy proposal for the EASYRIDE research project was a step to reconcile technological innovation and diverse interests with urban needs. Overall, the second storyline shows how the federal private car approach was diversified in the urban context. Automated driving has been translated from singularity to plurality and from the system of automobility to the system of multi-mobilities.

To sum up, the first storyline was far from conceptualising what automated driving meant for urban mobility and quite straight forward in terms of policy objectives, which had to do with economic growth and competitiveness. The second storyline is much more diverse in terms of policy objectives and discursively richer in new perspectives. Both storylines though, show no indication of actual implementation of automated driving beyond test fields and discursive deliberation. Eventually, in the policymaking arena of Munich, actors have been trying to keep automated driving on the policymaking agenda and looking for ways to legitimize its presence through attaching it to different policy objectives. Even if nothing happens, the analysis shows that automated driving might provide basis for reflexivity and opportunities for developing solutions for long-existing urban problems.

The components of policymaking

The analysis of policymaking of automated driving in Munich showed a diversification of policy objectives from the first storyline to the second. But what led to a shift of scope and objectives between the two storylines? This shift has to do with the components of

policymaking, namely actors, settings, narratives, actions and technologies. In terms of actors, the first storyline was mainly shaped by the triangle industry, research and the federal government. Even though the City Departments got involved at a later stage the meaning of policymaking and the policy objectives did not change significantly. Policymaking was accommodated in technical settings, such as BMW R&D, BASt project group and expert roundtables and informal meetings. These techno-centric settings and actors accordingly produced economic narratives, such as repeating the success story of automobility and the private car as another important place. Even when the topic was officially taken up by the City in the setting of the private-public Inzell Initiative, the narratives remained the economic and technical, such as making Munich a leading city in automated driving. The actions of the first storyline included the market roll-out of driving assistance technologies, projects funded by the federal government, technical reports for defining levels of automation, the setting up of a test field and applications for funding. These actions were in accordance with the overall technical approach that the storyline reflected. Regarding the role of technologies, it was mainly the private car as an artefact that dominated policymaking, while automation and ICT technologies facilitated the evolution of the car and enabled the growth and strengthening of the automotive industry.

The actors that shaped the second storyline of fostering new mobility services were local. Despite there was absence of civil society actors, it was mainly the Departments of the City, the local politicians, and the public transport authority that shaped the second storyline, in collaboration of course with BMW, which has been always involved in mobility policymaking at the local level. The dispersion of the topic of automated driving to multiple issues beyond the car was achieved by the Department of Urban Planning when it published the scenario study and through the ambivalent debate between the Department of Urban Planning and the Green party about the construction of further tunnels, which displaced the topic of automated driving from the sphere of automobility to the sphere of mobility services. Important are the settings too, as it was only when policymaking took place in the urban development framework Perspektive München that the local actors contextualised automated driving and linked it to the existing urban issues of suburbanization and lack of space, while the same actors when deliberating about the first policy proposal for a federally-funded research project in Munich perceived automated driving merely as the further technological development of assisted driving. It was the setting of the Perspektive München that set the tone for making automated driving relevant for Munich. After that, policymaking took place in the City Council, where the main actions revolved around integration of automated driving in key municipal strategies, namely IHFEM, Green City Masterplan and new Mobility Plan (MobiMUC), as well as and testing automated minibuses. Several requests from political parties and a district committee show that automated driving provided an alternative ground for deliberation regarding mobility issues and beyond. Accordingly, these actions generated diverse narratives such as optimising the entire mobility system, capacity increase of subway, suburbanization. Regarding the technologies that shaped the storyline, it was the test cases for automated minibuses, Manless Train Operation and on-

demand ride-pooling through Apps that enabled alternative deliberation beyond the car. It was also the know-how of tunnels and the lack of readiness of automation technologies that displaced automated driving from the sphere of the private car in the first place.

How the storylines interact

As the analysis showed, the local actors in Munich managed to achieve a conceptual shift in the understanding of automated driving and this is exactly what the two storylines identified in the empirical material stand for. Yet, the two storylines are interrelated in the sense that elements of the one exist in the other. This is what makes the case interesting and shows unique opportunities for embracing ambiguity and plurality and acknowledging its productive potential. Even though the first storyline and its components reflect a car-centric approach, the local actors had already tried to bring automated driving down to the urban level and explore its potential through the Städtetag and informal meetings with the industry and the federal level. Even when the local actors at the end of the first storyline took up the topic at the Inzell Initiative and in the deliberation of the first policy proposal for applying for funding at the federal level, they already tried to widen the range of actors, including the public transport authority. These activities of the local level relate to the beginning of the second storyline, which, as already mentioned, co-existed with the first for approximately one year (2016-2017). Chronologically, the local actors started simultaneously (in 2016) engaging through the Städtetag in the first storyline and through the scenario study for the future development of Munich through the Perspektive München in the second storyline. The difference was that the parallel engagements happened in different settings and these settings shaped the narratives and practices the actors produced. In addition, over the course of the second storyline of fostering new mobility services, there was an undertone of the first storyline, as the second storyline indirectly sustained the system of automobility by separating the topic of automated driving from the private car and contextualising it as an alternative perspective for urban mobility and development issues. Even though these urban issues are affected by car dominance, they are dealt with alternatively without directly blaming the car through the storyline of fostering new mobility services.

What does the case of Munich tell about how the institutional void in policymaking is dealt with? The case provides insights about how a trajectory of dispersion of automated driving from the narrow to the wider induces change in problem definitions and ways of dealing with urban issues. According to Hajer (2017), this could be a form of 'ontological expansion', in the sense that deliberation has transformative capacity to change problem definitions and perceptions of the problems at hand and eventually make things happen. This is based on the idea that people are enticed by perspective, and not by facts. The perspective here has to do with an alternative way of dealing with urban issues, while sustaining car use in a controllable manner. Based on that, the case sheds light to the potentials of ambivalence in policymaking. The two-track strategy is an ambivalent approach that has been satisfying the interests of both the local automotive industry and the City of Munich as a win-win condition for many decades. As the capacities of this

strategy reached a degree of saturation due to the rapid growth of Munich and the increasing pressure for new space and more mass transit capacities and accessibility, automated driving came to offer a new perspective for dealing with these issues by replicating the same ambivalent principle of the two-strategy: developing new automated mobility services that would potentially solve the problems while sustaining automobility in a controllable manner. The case study shows that ambivalence can be productive and that the two approaches can co-exist. Instead of creating a dichotomy between one approach or the other (i.e. the car vs public transport), ambivalence revealed the hidden potential that lies in between. It is the in-between that fills in the institutional void by providing perspective and ground for action. Ultimately, the presence of automated driving on the urban agenda provides extra room for reflexivity and opportunities for breaking path-dependencies, regardless whether automated driving will happen or not. Yet, the change of perspective has only been materialised through the integration of automated driving in municipal strategies and planned tests so far and not in the form of regulations. The next case study of Stuttgart analyses how the presence of automated driving on the policy agenda induces more concrete policy changes, such as implementation and new regulation of other policy objectives, but once again without direct implementation of automated driving itself.

4. The case of Stuttgart: what a proxy can do

4.1. Context

The second case study investigates policymaking of automated driving in Stuttgart. The case study provides insights into how automated driving is used as a proxy for legitimizing and regulating other policy objectives. It takes into account policymaking settings of three different administration-political levels, namely the State of Baden-Württemberg (BW), the Region of Stuttgart and the City of Stuttgart, industrial policymaking settings (e.g. Daimler, Bosch) as well as public-private settings, in order to trace and contextualise how automated driving emerged and gained relevance for the urban scale in Stuttgart in the context of multi-level governance. The relevance of these settings was traced with the help of the interviewees, who pointed that policymaking of automated driving in Stuttgart is dependent on multi-level actors and settings. As in the case of Munich, the chapter is organised in four sections. In the first section, a brief overview of the historical, material and governance context and an overview of the storylines in Stuttgart is provided as a basis for the analysis of the case study. The second and third sections analyse the two storylines identified in the empirical material. The fourth section reflects on and discusses the trajectory of policymaking in Stuttgart as relegation as well as the role and the impact of the different components (i.e. actors, settings, narratives, practices, technologies) in policymaking.

Historical and material context of mobility

Stuttgart is the capital of Baden-Wuerttemberg and forms with about 610,000 inhabitants the centre of the Stuttgart Region. It is Europe's strongest region in terms of exports and supports its strength through the automotive and mechanical engineering sectors (Zimmermann, 2018). Stuttgart is home to the automotive giants Daimler and Porsche and the largest automotive supplier Bosch. That is why it is often referred to as the 'cradle of automobile' and as the 'holy ground' of the triangle Daimler-Porsche-Bosch. As such, it is characterised by car-oriented planning history and mobility culture, which was developed after the World War II. After 1945, the city had to be rebuilt, and the city planners back then decided to build a 'car-friendly city' for cars to support the already established automotive industry. From 1960 to 1990, planners focused on improving the hardware infrastructure of the city (road network) along with the public transport network, the first bicycle lanes and pedestrian areas, to minimize the effects caused by extensive car use. Since the 1990s, there has been a shift in transport policymaking focusing more on improving the software of the city, such as investing in electronic signs, digitalisation of public transport and the traffic management centre. The last decade, transport policymaking has been focusing on producing future visions of the 'human-friendly city' with 2030 as a target year, including recovering space for active modes, intermodality, on-demand sharing services and sustainable logistics (Daude, 2019). Despite this shift, the car is still at the core of everyday mobility and remains a crucial policy issue, as the city suffers from congestion, emissions and noise. This is related to the

fact that Stuttgart has a very large Region comprised of a lot of small and middle-sized cities around Stuttgart. The Region has in total 2.7 million inhabitants and employs 1 million people. This is crucial to urban mobility in Stuttgart, as more than 800.000 vehicles commute in and out of the city daily[49]. This high mobility demand is caused mostly by the economy itself, as a lot of people who live in smaller towns in the Region must commute to Stuttgart for work and the other way around. The result is very high traffic volumes, which are difficult to handle (Zimmermann, 2014). These traffic volumes are further intensified by logistics in the city centre, the hilly topography of Stuttgart and the road network itself. In particular, the topography limits the size of the inner-city road network. Since a complete peripheral ring road does not exist, public-transport and road users are forced to share a limited transport infrastructure, resulting in congestion on main arterial roads and negative impacts on noise levels and air quality. All the aforementioned factors have rendered Stuttgart one of the most congested cities in Germany (Daude, 2019). This results in an ambivalent approach in policymaking. The local administration phrases this ambivalent approach as having 'two Stuttgarts'; 'the capital of green' - with 40% of the area under landscape protection - that promotes sustainable mobility, and 'the capital of congestion' that promotes a big automotive economy (Forderer, 2016).

Multi-level policymaking for mobility

The internal policymaking arrangement for mobility of the City of Stuttgart is unusual in Germany. The Department of Sustainable Mobility and Strategic Planning together with the Department of Economic Development function as advisory boards for the Lord Mayor. The Department of Sustainable Mobility coordinates strategies for mobility, and delegates tasks for implementation to the technical bureaus (e.g. Civil Engineering, Urban Planning, Public Affairs). In other words, it provides a framework for the technical bureaus to operate within. The goal of the Department of Sustainable Mobility is to think of mobility as a whole, breaking long governing traditions, which viewed the responsibility for mobility as fragmented responsibilities along different departments and bureaus (Daude, 2019). Both the Department of Sustainable Mobility and the Department of Economic Development work together on certain topics of mobility, especially new mobility concepts, such as electric mobility, shared mobility and automated driving, in order to advice the Lord Mayor and provide the conceptual framework for the technical bureaus. At the same time, since Stuttgart is home to a big automotive sector, there has been a tradition of informal local engagements of the business sector which has led to the development of a neo-corporatist policymaking culture between politicians and businesses (Heinelt and Kübler, 2005). This blurs the boundaries between formal politics (the Mayor and the City Council), administration and business sector creating a more fluid and diverse arrangement of policymaking settings for mobility.

[49] Nahverkehrentwicklungsplan der Landeshauptstadt Stuttgart, 2017 (own translation).

Yet, the City of Stuttgart is not independent in making decisions for mobility issues. Two more levels of policymaking influence urban mobility policymaking in Stuttgart, namely the State of BW and the Region of Stuttgart. The State of BW takes a lot of initiatives in terms of funding projects and pilots at the urban level, something that is not usual in other German federal states. Besides that, the Region of Stuttgart is a layer in between the State of BW and the City of Stuttgart. What is special about the Region of Stuttgart is that it has certain rights, which the State of BW transferred to it. The Region of Stuttgart is the equivalent of a metropolitan region. Usually, the metropolitan areas in Germany are more focused on economic tasks and marketing. The Region of Stuttgart has these tasks too, but it has also some political tasks. As such, it is the only region, which has an inter-municipal network as a regional development association, namely Verband Region Stuttgart[50], which was established in 1994 and has its own directly elected regional parliament (Regierungspräsidium)[51]. The Verband Region Stuttgart has only limited competencies, hardly any executive functions but it has the capacity to initiate and co-fund projects (Heinelt and Kübler, 2005). The most important political tasks of the association are public transport and economic development, which already establishes a strong link between mobility and economic competitiveness in the Region. Although the City of Stuttgart takes care of its own public transport, it is still part of the public transport of the whole Region. Mobility policymaking of the City of Stuttgart must be in line with the overall policymaking of the Region. Occasionally, there are conflicts between the different levels, especially between the Region and the City. This is because of political reasons. A couple of decades ago, all levels; the State, the Region and the City of Stuttgart were all governed by the conservative party (black). As several interviewees put it, since 2016, a 'political-administrative sandwich' has arisen: a green-black coalition government at the State level, a green City of Stuttgart, and a conservative black Region of Stuttgart. As an interviewee from e-mobil[52] Baden-Württemberg phrased it: *'(…) these three different layers are all actually damned to cooperate together'* (Interview 27, 2019, p. 3).

Overall, economic competitiveness of both the State and the Region are at the core of mobility policies, because of the existence of big automotive and ICT players. On top of that, since the City of Stuttgart is one of the main hubs of these industries, the three levels are inextricably related when it comes to policymaking for mobility. That is why in many

[50]The Verband Region Stuttgart (VRS) – Association of the Stuttgart Region is the political entity for the Stuttgart Region. The population of the region decides every five years who will be the delegates in the Regional Assembly, which acts as the "regional parliament". VRS is responsible for coordinating the suburban railway system and regional express public buses in the Region and is also involved in planning for improving the traffic situation (Heinelt and Kübler, 2005).

[51]The Regierungspräsidium is the elected regional parliament of VRS and it is a level under the parliament of the State BW.

[52]e-mobil BW is the innovation agency of BW and it is fully financed only by the state of BW, which is a unique case in Germany, as it is not partly financed by a third party. Its board consists of seven different Ministries; the Ministry of Transport, the Minister of Interior and Digitalisation, the Ministry of Economics, the Ministry of Environment, the Ministry of Science, the Ministry of Finance, and the State Secretariat from the State Ministry. E-mobil functions as a communication channel between the State Government, the industry, research and municipalities, coordinating working groups, studies and projects with the different stakeholders (Interview 27, 2019).

cases they act together for the development of policies, often acting as one actor, such as the State-Region and the City-Region. In general, the Stuttgart Region is competing with other German and European regions in offering locations for enterprises (Fricke, 2020). The expectation is that the Stuttgart Region will act as a catalyst for economic competitiveness and foster the integration of other regions in BW into the European and global economy (Kreukels, 2005). However, after the municipal elections in 2013, when the current mayor of Stuttgart Fritz Kuhn (green party) assumed office, there has been a decrease of the role of the City of Stuttgart in international activities related to economic competitiveness of the State-Region. Ever since, there has been a shift in priorities towards local mobility issues characterised by a strong dependency on local policymaking actors (Fricke, 2020). Therefore, this study integrates the State and regional levels of policymaking and their settings to the extent that they influence the policymaking of automated driving at the local level of Stuttgart.

Overview of storylines

Similar to Munich, the case of Stuttgart spans a period of almost a decade and examines the policymaking process of automated driving between 2010 and 2019. Especially in the initial years of policymaking, the State of Baden-Württemberg (BW)[53] and the Region of Stuttgart play a catalytic role in the process, and they are important for contextualising the sudden relevance of the policy issue in Stuttgart. The case study traces the development of two distinct, yet interrelated storylines in the policymaking of automated driving in Stuttgart; (1) fostering a connected transport system (2010-2019), and (2) supplementing public transport (2016-2019). As in the case of Munich, the two storylines are used as an analytical lens to explain and interpret how the interplay of different actors, narratives, practices, settings and technologies has been shaping the policymaking of automated driving in Stuttgart.

The first storyline of fostering a new connected transport system involves mainly actors from the State and the Region levels as well as the ICT and automotive sector. The main objective is the economic restructuring of the economy of the State-Region by strengthening the ICT sector through the high-tech concept of digital connectivity. This is attempted mainly through developing alliance networks and funding schemes. Urban mobility is rather of secondary importance, without referring to specific ways through which automated driving could be implemented, while the role of the local level in Stuttgart is rather auxiliary. The storyline conveys an abstract approach of 'everything is connected', which is detached from the local everyday mobility in Stuttgart. The second storyline of supplementing public transport signifies a distinct involvement of the local actors in policymaking. While it was triggered as a reaction of the local actors to the first approach, it shows how the abstract concept of a hyper-connected transport system was translated in local realities. The topic of automated driving was taken up by the local actors as an attempt to frame automated driving as an urban mobility issue. A study in 2016 and a policy decision in 2018 defined automated driving as a public transport policy

[53] Baden-Württemberg is one of the 16 federal states in Germany.

in the form of on-demand services. In turn, the City, in order to ensure that on-demand mobility services stay within the spectrum of public transport, enforced new regulations that did not exist before. However, in practice the City did not develop a direct regulation or framework for the implementation of automated driving, they instead regulated on-demand services, which are considered a precursor for automated driving.

In sum, the State-Regional policy for a connected automated system was translated into regulatory policy for on-demand services in the local context after moving to different policy settings. The case study elaborates on how automated driving emerges through visions of hyper connectivity as a policymaking object, and how it is transferred into local settings and translated in urban policymaking realities. Ultimately, the case study shows how the mismatch between an abstract techno-economic approach and urban realities induces a relegation in policymaking of automated driving into a local mobility niche. In the next two chapters, the two storylines identified in the empirical material in chorological order, focusing on specific events, technical developments and institutional practices. Last, the two storylines are contrasted against each other. The similarities and differences are discussed by reflecting on the interplay between the actors, narratives, practices and technologies behind the two storylines, and what this means in practice.

4.2. A storyline of fostering a connected transport system (2010-2019)

The storyline of fostering a connected transport system consists of narratives about the economic restructuring of the State of Baden-Württemberg through ICT technology production. It reflects mostly an economic policy instead of a transport policy. The main stakeholders here are the Ministries of Baden-Württemberg, the Region of Stuttgart, the automotive industry (Daimler-Bosch), the ICT industry (e.g. Deutsche Telecom), while the role of the City of Stuttgart is limited. Practically, it is manifested through the set-up of different networks for the exchange of technological expertise among stakeholders as well as with the public-private partnerships between about implementing 5-G network in Stuttgart (Deutsche Telecom and City-Region of Stuttgart), and pilots on optimisation of the traffic management system (Bosch and City of Stuttgart). This storyline does not make clear in which modes of transport automated driving can be integrated, instead it conveys an abstract vision of 'everything is connected', which shifts the focus from the automotive industry to the ICT industry and from ownership to service. Automated driving was rather considered as a part of an economic strategy for the digital transformation of BW and the Region, instead of a concrete transport solution.

4.2.1. A technological add-on to electric mobility

As multiple interviewees explained, automated driving was first taken up as a topic of discussion at the R&D settings of the State Baden Württemberg (BW) in 2010. The discussions were initiated by the Ministry of Economics of BW. Back then, the focus was on electric mobility, and automated driving was considered a technological add-on to

electric mobility (Interview 26, 2019). More specifically, e-mobil BW, the innovation agency of the State of Baden Württemberg for electric mobility, around the year 2011 started expanding their conceptual and project portfolio focusing on digitalisation and automated driving. The basic idea was '*ok, we electrify first, and then automated driving will come sometime in the late 2020s*' (Interview 27, 2019, p. 11). This was the year (2011) that the State of Baden-Württemberg had elections, and the coalition government changed from CDU (Christian Democratic Union) – FDP (Free Democratic Party) to Alliance '90/the Greens – SDP (Social Democratic Party). The Ministry of Economics was looking for a solution regarding the jobs that could get lost due to the replacement of the combustion engine by electrification. Therefore, software development for automation functions was considered as a compensation for the combustion engine, and it was expected to generate new jobs.

The interview partner from e-mobil BW explained that the first automation technology that was added to electric mobility functions was automatic charging, and it was introduced through the project 'Autoplus'. The aim was to automatize the charging process of electric vehicles in parking lots, in order to make charging more comfortable for the user. Thus, the project team started to think how to add automatic parking to the automatic charging process. The idea was that the driver would just drop off their car at the parking lot, the car would drive in there by itself, and then it would wait for the driver out of the parking lot when the charging process is done. As the interviewee from e-mobil BW stated:

> So, they really automatized this smartly, so that it was really able to drive in a parking lot in Stuttgart. So, it identified the parking lot and then it went up to the sixth floor…went to a charging place. Then they designed a small robot, which took the plug in and the car did it all for itself (Interview 27, 2019, p. 4).

The interviewee further explained that at that point, automated driving was perceived as automated driving functions in the traditional passenger car. These functions were basically 'add-ons' based on today's advanced driver assistance functions and were meant to facilitate the electrification of the car and increase comfort for the driver. Thus, the discussion until 2011 was simply about the (electric) car, but around that time e-mobil BW started referring to 'vehicles' instead of cars in their press releases and policy documents, without making a decision on whether those vehicles should be privately or publicly owned. What really changed discursively was the focus on the connectivity the vehicle has to its environment (Ibid.). While the vehicle as an artefact was still at the core of their perception of an (electric) mobility system, e-mobil BW started attributing importance to the infrastructure and the ICT connectivity around the car.

> (…) automotive is a very large focus in the Region, so we decided to put the car or the vehicle, not the car but the vehicle in the centre. But then of course you need energy, you need infrastructure around it. Since 2011 already we started realizing that with more and more ICT in the vehicles, the vehicle will be connected to homes, cities, to public transport, it will be part of larger fleets…it will have a very

> close connection to the user. So, actually this is two parts: one part around the vehicle is infrastructure and the second is the IT, which is basically infrastructure too, and both are really parts of an environment around it (…) this system around it shows just all the different connections a vehicle has. This vehicle could be shared, could be privately owned…that is an open question (Ibid., p. 3).

However, as the interviewee further explained, at that point nobody spelled out the term 'automated driving' in policy documents or in press releases. It was only later in 2013 that the term automated driving was established officially, after a group of experts (VDA and BASt; see the case of Munich) defined the five levels of automated driving at the federal level. An interviewee from the Ministry of Economics BW added that conceptually, e-mobil and the Ministry of Economics BW wanted, after all, to deploy a combination of electrification and automation technologies to make car use easier and to offer a better product to the customer, because '*all car companies wanted to sell cars also in the future*' (Interview 32, 2017, p. 2). Overall, from 2010 to 2013, policymaking for automated driving took place within R&D settings of electric mobility projects at the State BW level, which defined how automated driving was articulated as an add-on to electric mobility by the e-mobil BW as the main actor, in order to make car use more comfortable and compensate for the loss of jobs due to electrification of combustion engine. In turn, within the context of electrification again, a discursive shift from the car towards the vehicle and the connectivity around it emerged.

4.2.2. Forging networks as new settings for digital connectivity

As the federal level was defining the five levels of automation in 2013, the actors in BW thought that automated driving '*is coming faster than we expected*', as the interviewee from e-mobil BW mentioned (Interview 27, 2019, p. 11). This perception was also influenced by the international competition from Google and Uber in the roll-out of new mobility concepts and technologies (i.e. electric mobility, ride-hailing fleets, automated driving). Thus, the political discussion about the economic restructuring of the State of BW, which had been going on for at least two decades already, was further intensified (Interview 29, 2018). It was about that time that the Region of Stuttgart got actively involved in the discussion about automated driving. As an interviewee from the Verband Region Stuttgart stated:

> The discussion was about how we can deal with this gap between Silicon Valley and the classical car industry here in Stuttgart; combustion engine on the one side and fully electric vehicles on the other side…assistance systems, automated cars at the end of the development maybe. This was the beginning of the discussion, so we can figure out what the gap between Silicon Valley and the Region of Stuttgart is (Interview 33, 2018, p. 5).

The topic of automated driving was officially introduced in the political realm of Baden-Württemberg as a term through the scope of digitalisation in 2013. That was when the

alliance Forward IT was signed between the Ministry of Economics BW and the Ministry of Science BW. Forward IT was an alliance aiming to make Baden-Württemberg an international top location for information and communication technology (ICT) by bringing industry and science together. The alliance was meant to improve the transfer of innovative research knowledge to companies through joint projects. As the Minister of Economics of that time, Nils Schmid stated:

> With its innovative research landscape, its high-performance ICT industry and high-export user industries, such as vehicle and mechanical engineering, Baden-Württemberg has all the prerequisites to be one of the big winners in the digitization of the economy (…) Consistent and comprehensive digitization of industry, also known as Industry 4.0, means a new industrial revolution for our State with its strong manufacturing industry.[54]

Several scholars (Cooke, 1997, 2005; Roper, 2000; Fuchs and Wassermann, 2004) have pointed out previously that despite the success and '*capacity to innovate*' (Cooke, 1997, p. 376) in transport, engines and machine tools, BW was still behind in ICT technologies.

> The large question mark hovering over Baden Württemberg's future is whether the regional innovation system put in place so carefully is adequate to the future growth of informatics, telematics, multimedia, environmental technologies, biotechnologies and financial services (Cooke, 1997, p. 378).

Based on that, the following question arises: how come that Baden-Württemberg started intensively and visibly promoting its economic restructuring only in the 2010's, while the discussions about it started decades earlier? The interviewee from the Ministry of Economics BW explained that BW despite its dominant position in automotive industry in Europe and worldwide, is far behind from the United States and China when it comes to high-tech companies and software developers. Although the German federal government already aimed to actively promote the development of artificial intelligence, BW aspired to independently act towards its rebranding from an automotive state to a high-tech state, in order to catch up with the developments in California and in China. In this case, BW attempted to differentiate itself from Germany and other federal states, in order to compete internationally. Against this background, the Forward IT alliance positioned the ICT sector at the center of the economic restructuring of the State, highlighting the importance of establishing a symbiotic link between production technology and ICT sector. Part of this strategic orientation was the role of automated and connected driving in the future of mobility. It is also noteworthy that automated driving was included in the Forward IT agreement before the Federal Government published the Strategy for Automated and Connected Driving in 2015. It was through this

[54]https://wm.baden-wuerttemberg.de/de/service/presse-und-oeffentlichkeitsarbeit/pressemitteilung/pid/automobildialog-in-stuttgart-minister-schmid-bespricht-mit-unternehmensspitzen-die-zukunft-des-auto-2/ (Assessed 18/10/2019) (own translation).

strategic agreement that the Minister of Economics pushed the topic forward at the federal level. Already in 2014, the Minister of Economics, Nils Schmid stated:

> We support the trend towards connected and automated driving through our 'Forward IT' initiative. However, we also depend on the support of the German Government. That is why together with the other Ministers of Economic Affairs, I asked the federal government for a national roadmap on automated driving, which involves the States at an early stage. In the future, technical and legal standards will have to be developed. This concerns, for example, questions of driving license or liability for occupants of self-steering vehicles.[55]

In parallel, e-mobil BW set up the working group 'Intelligent Move'. The working group was created after requests from research institutes of the State, namely the Fraunhofer Institute in Stuttgart, the Research Centre Informatics in Karslruhe, the Karlsruhe University and the University of Stuttgart as well as from industry partners (e.g. ICT companies, OEMs, T1 suppliers). The municipalities and the Region of Stuttgart were also involved. The purpose of the working group was to give all the relevant stakeholders '*an arena to discuss'* automated and connected driving as well as develop a roadmap and project ideas for BW (Interview 27, 2019, p. 11). As an interview participant from the Ministry of Economics of BW stated:

> There, the Ministry of Economics supported more mobility for people and products in the sense that you could have more mobility opportunities without producing more traffic by having automated driving, robo-taxis, robo-planes etc. On the other hand, the Ministry of Transport and the City wanted to control traffic and wanted less traffic and transport (Interview 26, 2019, p. 2).

This suggests that while the Ministry of Economics aspired to capitalize on more mobility opportunities to ensure competitiveness and the economic restructuring of the State, the Ministry of Transport and the City of Stuttgart feared that more mobility options through automated driving might lead to more traffic, which would be difficult to control. There was a conceptual difference between mobility and traffic for the Ministry of Economics, in the sense that more mobility does not necessarily mean more traffic. This perception, however, did not consider whether policymaking can maintain a balance between mobility and traffic. On the other hand, the Ministry of Transport and the City, which deal with mobility problems in everyday life, perceived increasing mobility as leading to increasing traffic, as the institutional framework to deal with multiple mobility providers did not exist yet. Considering that the efforts of the City to mitigate existing traffic congestion and air pollution are still not adequate, it seems that the laissez-faire visions of the Ministry of Economics could not be translated effectively in the local realities of the city. This was a preliminary indication that there will be a discrepancy between a technical and economic approach of the State BW and the urban mobility realities of the City of Stuttgart.

[55] Ibid.

In 2015, the Region of Stuttgart assumed a more active role in the discussions on how automated and connected driving could be implemented in the Region from a technological and economic point of view. Thus, the Economic Corporation of the Region of Stuttgart (WRS)[56] set up a series of events called 'TecNET connected car' for the automotive and ICT stakeholders of the Region, including the 'Intelligent Move' working group. The focus was on automation and the entire spectrum of connected vehicles (Car-to-Car, Car-to-Cloud and Car-to-X)[57]. During these events, several experts presented their technology, goals and objectives, which range from logistics to vehicle development to connectivity solutions. As an interview partner from the WRS stated: '*In 2015, it was already big enough or important enough for us to say, "ok we need to kind of build a separate network only for the topic"*' (Interview 22, 2018, p. 6). In the Regional Transport Plan of Stuttgart, it was stated that the goal of 'TecNET connected car' was primarily the networking of the actors, whereby both IT and automotive industry in the network jointly overcome the hurdles on the way to a more digitalized vehicle instead of duplicating their developments without knowledge of each other's work. In parallel, the Region started to discuss the necessity of broadband infrastructure as a backbone for automated driving (Interview 29, 2018). The discussions were mainly about planning optical fiber infrastructure to ensure that all municipalities of the Region (including the City of Stuttgart) and their commercial areas have a fast connection to the Internet (Interview 22, 2018). Once more this coincided with the Federal Government's decision to invest four billion euros for the implementation of broadband network in the main city streets and highways all over Germany[58]. Despite the Federal Government already supported the expansion of the broadband network in the unfavourable areas (e.g. rural areas), it seems that the Region of Stuttgart aspired to be competitive not only nationwide, but also within the State. As quoted from the Regional Transport Plan:

> A public support can take place especially by providing necessary infrastructure, but also by promoting the networking of the relevant actors. The Region of Stuttgart is at present in co-operation with the districts, the City of Stuttgart as well as the Economic Development Corporation and the Verband Region Stuttgart, with financial support of the State BW developed a region-wide planning for a broadband network. Intention of the regional participation is the continuous expansion of mobile broadband or mobile communications along the regional

[56]The Economic Corporation of the Region of Stuttgart (Wirtschaftsförderung Region Stuttgart GmbH - WRS) is the central point of contact for investors and companies in the City of Stuttgart and the five surrounding districts. The WRS a publicly owned company, founded in 1995 as a subsidiary of Verband Region Stuttgart. It is responsible for supporting the different companies and bringing them in touch with research institutes, universities and municipal business chambers, etc. Its goal is to promote the development of the Region with numerous projects and offers (Interview 22, 2018).

[57] https://it.region-stuttgart.de/projekte/tecnet-connectedcar/ (Assessed 10/10/2019) (own translation).

[58]https://www.bmvi.de/EN/Topics/Digital-Matters/Broadband-Deployment/Broadband-in-a-nutshell/broadband-in-a-nutshell.html (Assessed 16/10/2019).

main roads. A continuous data transfer over a powerful broadband coverage is essential for future mobility forms, such as automated driving[59].

Overall, all the initiatives that took place between 2013 and 2015 had technical and economic focus, putting great emphasis in digitalisation and connectivity technologies. The main actors here were the Ministry of Economics, the e-mobil BW, the Region of Stuttgart, research and industry (both automotive and ICT). The City of Stuttgart was not really actively involved except for some discussions within the 'Intelligent Move' working group, where they expressed their concerns about a laissez-faire approach with multiple mobility opportunities.

4.2.3. Tendering a test field and the City

One of the products of the working group 'Intelligent Move' was the position paper '*Automated - Connected - Electric: Test Regions in Baden-Württemberg*', which served as the basis for the tendering of a test field for automated and connected driving in BW[60]. As an interview participant from e-mobil BW described:

> And then in the working group, after we had a common idea about automated driving - what we should do - then we were talking with our State Government. And then the State Government said, '*ok we were thinking about test regions, but what do we need for that*'. And then the working group started a hard-working process of several weeks and then…we came up with a position paper. So, this was a description how a test region for automated driving in Baden Württemberg should look like…And based on that, the State Government just started the normal process, they put a funding on it and then they started a competition and the regions could apply for that (Interview 27, 2019, p. 5).

As a result, in January 2016, the Ministry of Finance and Economics of BW published a call for tenders for the construction and implementation of a test field for networked and automated driving in BW. The purpose was to ensure that BW keeps its attractiveness as a mobility and automobile location both in terms of international competition and competition between the federal states. The goal was a closer integration of the vehicle industry with the ICT industry, as it was stated in the document of the call:

> The future of mobility requires new approaches in the technology fields of vehicle, energy, information and communication technologies and production. In mobility, there is currently a paradigm shift from the 'automobile as a product' to 'mobility as a service'. This paradigm shift is also the goal of sustainable mobility. In the future, the focus will no longer be on the car itself, but on satisfying the mobility needs of people and the economy in a sustainable and accessible way. Various

[59] Verband Region Stuttgart, Regionalverkehrsplan Region Stuttgart, Entwurf vom 21.12.2016 (Available: www.region-stuttgart.org) (own translation).
[60] https://www.emobil-sw.de/aktivitaeten/arbeitsgruppen/ag-nutzfahrzeuge-2 (own translation).

> sources of information in and around the vehicle will be linked in the future even more to provide systems for efficient traffic flow control and driver assistance systems for improving road safety. (…) The transport infrastructure and the IT architecture in automobiles need to be expanded and harmonized to connect the information and automation of driving functions[61].

The tendency for moving away from 'the car itself' and focusing on what is around it and how it connects with its environment is apparent in the call. Here the symbiotic link between automotive and ICT for the restructuring of the economy that was initiated through the setting of the Forward IT alliance, is now concretized through the call for a test field as a performative practice. This is line with recent research that suggests that the convergence between the ICT technologies and automation technologies detaches the car from the individual-tailored driving functions and positions it into a new context where everything is connected (Attias, 2017; Mitteregger *et al.*, 2020). This convergence signifies a shift of focus from the automobile as an artefact to mobility as a service: from product to service. In turn, this shift, which is in principle an economic change in production, enacts a meaning for sustainable mobility, namely mobility as a service (MaaS). The arguments used to rationalise why MaaS is sustainable are efficient traffic control and improving road safety.

The call also mentioned that the test field should be open to the public and independent of individual companies. The test field had to cover all relevant road types from inner-street 30-speed zones to motorway sections in real life conditions, and to include applications in public transport. The purpose of the test field was that all stages of automated driving with both private and public vehicles, as well as the new digital infrastructure are tested and further developed. Eligible for application were non-profit universities, non-university business-oriented research institutions as well as municipalities in BW. Commercial enterprises were excluded from the application, but cooperation with companies was permitted. The role of the Ministry of Economics and Finance was to support the conception, planning and construction and setting-up of the test-field with 2.5 million euros. The e-mobil BW took over the project support and was the contact agency for the application process. The test field BW was the first to be subsidized by a State - as all the other test fields in Germany were subsided the Federal Government - and the first test field that included applications on public roads in all traffic situations.

[61]Ministry of Finance and Economics Baden-Württemberg, *Bekanntmachung des Ministeriums für Finanzen und Wirtschaft Baden-Württemberg über die Förderung des Aufbaus und der Implementierung eines Testfelds zum vernetzen und automatisierten Fahren in Baden-Württemberg*, 2016, p. 1-2 (own translation).

The application of Stuttgart

A couple of days after the call was published, a representative from the local CDU party submitted a proposal to the City Council of Stuttgart claiming that Stuttgart had to apply for this tender as the State Capital. This was the first time that the City of Stuttgart picked up officially the topic of automated driving in the setting of City Council. The CDU representative argued:

> It is not just the two car manufacturers Daimler and Porsche that make the automotive industry particularly important for Stuttgart as a business location. To keep it that way, we need to help lay the foundations for forward-looking research and innovation. The future of mobility includes automated and connected driving as a central field (…) Such a test field would be a clear commitment that we want to maintain technological leadership in the automotive industry.[62]

The argument from the local CDU is in a similar line with the argument from the Ministry of Economics of BW; it is an economic argument about business and technological leadership. The difference was that the local CDU did not refer to the regional economic restructuring of the Region in the sense of expanding the focus of production to ICT-based services, but rather the maintenance and strengthening of the role and the image of automotive industry as a socio-cultural identity and brand name of Stuttgart as a city. The proposal of the local CDU mobilized the City Council, which is led by the Green party. Thus, in April 2016, the City of Stuttgart together with the City of Ludwigsburg and the Region of Stuttgart jointly made a project application for the test field (Interview 22, 2018). In the application, it was mentioned that the test field was supposed to enable the City of Stuttgart to position itself as a major automotive and high-tech location and to continue providing top-level research with a platform. The argumentation was supplemented with the positive effects that automated driving could have in traffic flow and reduction of fine dust, but only in a vague way. At that point, there was no specific elaboration about how automated driving could help with the mobility problems of the city.

Before submitting the application, the mayor Fritz Kuhn stated that '*not to be there, would be fatal for us (…). The issue of autonomous driving has huge innovation policy significance'*[63]*.* The leader of the CDU party also stated: '*The car was invented here, then the revolution must also start from here, if now a kind of reinvention of the car takes place*'[64]. The arguments of the local politicians in the City Council for applying for the test field were focusing on the car as the core element of testing. The City Council at that time seemed to perceive automated driving as a reinvention of the passenger private car and as a matter of innovation policy. The City Council as a setting shaped the perception of

[62]Antrag und Anfrage vom 28-01-16, Nr. 20/2016, CDU ‚Stuttgart braucht ein Testfeld für vernetztes und automatisiertes Fahren', p. 1 (own translation).
[63]https://www.stuttgarter-zeitung.de/inhalt.autonomes-fahren-bald-rollen-in-stuttgart-selbstfahrende-autos.2b03bf13-88d3-4a83-819e-ac98f6005928.html (own translation).
[64] Ibid.

local politicians with the car-centric bias towards mobility policymaking, which has been embedded in the City Council for many decades, as Stuttgart is an important automotive location. This perception was different to the one of Baden-Württemberg and the Region, which was about shifting from the car as a product to a service-based connected system. Overall, there were not major objections in the City Council about the application for the test field. Only the left party was officially opposed to the application questioning the potential of automated driving to contribute to a modal shift towards public transport. As an interview participant from the left-wing party of the City of Stuttgart stated:

> (…) The left party opposed to this test field application arguing that automated functions will not bring a modal shift and that it could be a competitor to public transit…We wanted this money for sustainable mobility solutions, not for car industry in general…It is not ok that tax payers give money…a lot of money for this infrastructure (Interview 29, 2018, p. 3).

However, the opposition of the left party did not stop the majority of the City Council from approving the submission of the application. The neighboring municipality Ludwigsburg functioned as an available partner whose streets could be used for mapping, as the traffic situation is less complex than in Stuttgart. In addition, Ludwigsburg also offered the corresponding infrastructure in the field of electric mobility. In coordination with the Regional Council of the Stuttgart Region (Regierungspräsidium), motorway sections outside these two cities were not supposed to be included in the test field. The participants that would participate as associated partners in the project were: The University of Stuttgart, the Fraunhofer Institute, and the Research Institute for Automotive Engineering and Vehicle Engines Stuttgart. In addition, many companies and organisations from the following areas of expertise were integrated: digitalisation of data and maps, communication infrastructure, security, logistics, public transport, automotive, corporate networks.[65]

The submission of the application triggered more discussions in the City Council. In particular, at the end of April 2016, a representative of the political party StadTISTEN[66] pointed out through a proposal to the City Council that while the developments in the industry are progressing rapidly, the impacts on the whole mobility system are not even hinted at by the City. His party proposed that different kinds of experts (i.e. automotive industry, research and academia, sociologists) be confronted with the topic, so that they can illuminate key aspects that will become relevant in the future. These aspects included the continuation of urban and transport planning, the identification of social and employment scenarios (due to potential loss of driver jobs) as well as the impact on public transport, public space, and the environment and energy requirements. As the

[65]Beschlußvorlage 284/2016 'Testfeld für vernetztes und automatisiertes Fahren', 15-04-16 (own translation).

[66]Political party in the City of Stuttgart founded shortly after the heyday of the protests against the project Stuttgart 21.

representative stated: '*Autonomous driving is slowly but surely emerging on the horizon (…) The question is no longer, whether autonomous driving will come, but when'*[67].

As a response to this proposal, the left party of the City Council (SÖS-LINKE-PluS) warned against too much hope regarding automated driving, and pointed out risks, such as manipulation of electronic systems, data privacy, traffic load increase as well as the inadequacy of high tech solutions to solve air pollution problems. The left party stressed that it is necessary for the City to continue working on the vision of a car-free city:

> Stuttgart should support a mobility culture 'away from the car'. An intelligent solution to the traffic problems requires a switch to public transport. This test field should not give the impression that this switch is no longer necessary[68].

The SPD party agreed that only by a strong local public transport Stuttgart could deal with the traffic challenges and claimed that the City Council should set the goal to develop Stuttgart as the public transport capital of Germany. However, the SPD argued that since the topic of automated driving is '*not an illusion but a reality'*, and that except for the risks, this technology also has opportunities (e.g. prevention of parking-search traffic). Thus, the SPD supported the involvement of the City arguing that the City must adapt to the topic and gain experience. The CDU party appeared very confident about the potential of automated driving arguing that '*connected and automated driving is not a panacea and not the only element to make transport in Stuttgart more sustainable, but it is one of the building blocks to get there'*. The Green party (which is the party in power) while acknowledging that automated driving carries risks, argued, in a similar vein with CDU, that it is a building block for traffic reduction and more efficient transport. Therefore, the Greens argued that regulations are required to achieve reduction of trips and to avoid empty journeys[69].

This was the first time that local politicians had an actual debate about automated driving at the City Council as a setting and acknowledged that they needed to engage more with the topic and the several aspects it touches upon. The main debate here seems to be how much priority will be given to the topic, as Stuttgart faces severe problems with traffic congestion and emissions that call for urgent interventions. It is apparent that only the left party had objections regarding Stuttgart becoming the ground of the test field, questioning the importance and relevance of the implementation of automated driving. At this stage, most of the political parties in the City Council considered automated driving as one piece among others in the puzzle of sustainable mobility, but without having a strategic orientation on how and through which modes it would fit into the puzzle. Eventually, in October 2016, the Minister of Transport BW handed over the grant decision for 2.5 million euros to set up the test field not to Stuttgart, but to Karlsruhe.

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[67] Status Antrag 122/2016 political Party Die StadTISTEN 'Autonomes Fahren, Mobilität, Urbanität, Gesellschaft 2020+', 20-04-16, p. 1 (own translation).

[68] Protokoll 'Testfeld für vernetztes und automatisiertes Fahren' - Verwaltungsausschuss, NsNr 145, 27-04-16, p. 2 (own translation).

[69] Ibid., p. 2.

Besides the City-Region of Stuttgart, the other applicant for the test-field was Karlsruhe, which was the successful applicant. As an interview partner from the Department of Economic Development of the City of Stuttgart stated:

> (…) But we didn't win it (…) I think it didn't have to do with our application, but there was some connection between our Ministry and Karlsruhe; in Karlsruhe there are universities and institutes that are very strong in this and I think they wanted to give them more chances…But we didn't understand why Karlsruhe got it and we didn't, because we had a very strong application with many partners from the industry, from universities and so on…many more than Karlsruhe. But I think it was from the beginning clear that they would get it (Interview 25, 2019, p. 11, 12).

The official explanation for selecting Karlsruhe was that the Region is very strong in research for automated driving, as it has many research institutes, which made the Karlsruhe proposal very strong (Interview 22, 2018). However, according to the interviewee from the Ministry of Economics BW, another reason that might explain the failure of Stuttgart is that testing automated driving in public streets in Stuttgart bore the risk of deteriorating the already bad traffic situation in a city with a difficult landscape (Interview 26, 2018). Even if Stuttgart lost the test field to Karlsruhe for whatever reason, the call for applications for the test field was the event that triggered the local level in Stuttgart to engage with the topic of automated driving as a policy topic in the setting of the City Council, and start preliminary deliberations on how automated driving would make sense in a city like Stuttgart.

4.2.4. Positioning automated driving as part of digital connectivity

A couple of months later after granting the test field to Karlsruhe (December 2016), the Minister President of BW and the Minister of the Interior, Digitalisation and Migration presented the cornerstones of a cross-departmental digitalisation strategy called 'digital@bw', which was eventually published in July 2017[70]. Among others, in the published document, it was mentioned that digitalisation plays an enormous role for BW in becoming the number one mobility region. In this context, digitalisation was perceived as the means of making automated driving happen in reality: '*(…) we do not just want to develop automated driving – we also want to get it on the streets as soon as possible'*[71]. Against this background, the Minister of Transport BW at an interview published at the Government Gazette stated:

[70]https://wm.baden-wuerttemberg.de/de/service/presse-und oeffentlichkeitsarbeit/pressemitteilung/pid/landesregierung-bringt-digitalisierungsstrategie-digitalbw-auf-den-weg-2/ (own translation).

[71]Ministerium für Inneres, Digitalisierung und Migration Baden-Württemberg, *Digitalisierungsstrategie der Landesregierung Baden-Württemberg, digital@bw*, Stuttgart 2017, p. 72. (own translation).

> The real challenge for the automotive and mobility industry is: what does the mobility of the future look like and how is a sustainable car? The autonomous car will probably be an element of the digitalisation of mobility as a whole (…) The new digital technologies offer unprecedented opportunities for connecting transport and users (…) The development goes in the direction of connected, digitized, safe and environmentally friendly mobility. But whether fully autonomous vehicles are actually needed, in the end, the car drivers will decide[72].

From this statement, it becomes clear that the central issue is digital connectivity and especially the connection between the user and the transport system. As Attias (2017) wrote, connectivity also takes place through navigation systems; GPS, maps, traffic information, the media, radio, videos, Bluetooth connection, driving aids, rear-view camera, onboard computers, and so on. '*Ultimately, it is the driving itself that will be the subject of this hyper-connectivity and will profoundly change our traffic patterns*' (Attias, 2017, p. 101). This suggests a shift in autonomy (control, responsibility), not just from the driver to the vehicle, but from the driver to the digitally connected transport system. In this case, the vehicle is meant to be mediating between the user and the mobility system. The relationship of the user to the mobility system becomes more direct. Whether there is a driver or not is not so important, as the vehicle will be anyway connected and steered to a great extent by the transport system. Thus, automated driving is positioned by the State of BW as an element of digital connectivity of mobility. Digital connectivity appears to be more important than automated driving per se, and the role of automated driving is rather one of an empty signifier.

A concrete practice of the digitalisation strategy of Baden-Württemberg, a research centre called 'Cyber Valley', located in Stuttgart and in Tübingen, was founded by the State of BW, the Max Planck Institute for Intelligent Systems, the Universities of Stuttgart and Tübingen and other private sector partners, such as Bosch, Daimler, BMW, Porsche and Amazon in December 2016[73]. The selection of the location was strategic, as the Max Planck Institute for Intelligent Systems was established in 2011 at two locations in Stuttgart and Tübingen. In particular, the Institute of Max Planck Society for Intelligent Systems '*aims to do for artificial intelligence what Stanford University did for digital technology, resulting in Silicon Valley*'[74]. Thus, Cyber Valley is modelled after Silicon Valley, aiming to translate findings from basic research into concrete industrial applications. Specifically, research focuses on machine learning, robotics and computer vision. Regarding automated driving, the idea is to develop competitive artificial intelligence solutions to use them later in the automotive sector (among others), so that the Region(s) Stuttgart-Tübingen and Germany in general can cope with the international competition (Interview 27, 2019). As the Bosch CEO said at the Cyber Valley kick-off in Stuttgart:

[72]https://www.baden-wuerttemberg.de/de/service/alle-meldungen/meldung/pid/den-verkehr-sicherer-und-sauberer-machen/ (own translation).
[73]https://cyber-valley.de/.
[74]https://www.ft.com/content/02c89806-b723-11e7-8c12-5661783e5589 (own translation).

> Machine learning and artificial intelligence are key competencies in shaping the connected world (…) In the international competition for innovation, Germany should not sit back and allow major IT companies from abroad to dominate these areas[75].

As the Head of Group Research at Daimler stated:

> Artificial intelligence has the potential to take digitalisation in the automotive industry to a new level, having left the realms of science fiction a long time ago. Progress with respect to automated driving and the many potential applications for development, production, sales or even entirely new mobility services prove this impressively[76].

The State of BW as a setting here seems to have given Stuttgart a different role to that of the Karlsruhe, in order to distribute innovation initiatives between the regions. The Stuttgart Region is now an artificial intelligence research hub, while the Karlsruhe Region is the test ground for automation and ICT technologies. The set-up of Cyber Valley echoes the interests of big players to engage with ICT industries, with start-up companies and learn from them. As the interviewee from WRS explained, at the moment, there are a lot of innovation developments in production technologies, while there is not so much innovation going on in vehicle technology anymore. This includes the uptake of artificial intelligence for developing applications on automated intralogistics' solutions, the use of Apps or higher customisation of products. Generally, artificial intelligence is meant to be used '*to make the production in the industry easier, leaner and better understandable*' in the State-Region (Interview 22, 2018, p. 12).

Overall, it is a commonly held argument that artificial intelligence is necessary for automated driving development in terms of cognitive capacity building of vehicles. Despite artificial intelligence has been developed since the 1950s, it has only become popular the last years. This is because of the huge amount of data that are available today due to digitally connected devices and services (e.g. smart phones, apps). These devices and services collect data in every industry and market, thus fuelling the artificial intelligence revolution. This means that digital connectivity and artificial intelligence are interlinked, enabling each other's functions. Digital connectivity technologies are part of a new data-driven economy of services. The actors at the setting of the BW State assumed that investing in data-driven fast and flexible services though digital connectivity technologies, backed up by automated driving, would make the Stuttgart Region and the State of BW a competitive location in the new global economy. However, this is an abstract economic vision, instead of a mobility vision, while it is still unclear if and how it can be materialised in urban mobility realities.

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[75]https://www.bosch-presse.de/pressportal/de/en/cyber-valley-bosch-establishes-an-endowed-chair-for-machine-learning-82176.html (own translation).

[76]https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-supports-Cyber-Valley-research-initiative-through-endowed-professorship.xhtml?oid=15038990 (own translation).

4.2.5. The ambivalent narrative 'the car as a container'

Despite the State of BW had already decided to invest over 100 million euros in broadband expansion since 2016, the Region of Stuttgart aspired to be the first Region in BW and in Germany to implement 5G network. As mentioned previously, in the Stuttgart Region there had been discussions and planning for optical fiber infrastructure since 2015 to ensure that all 179 municipalities, communities and their commercial areas have a fast connection to the Internet. These discussions led to a public-private partnership between Deutsche Telekom, the Stuttgart Region and the City of Stuttgart for 5G network implementation. Interestingly, the agreement with the Deutsche Telekom for 5G in Stuttgart is a regional agreement where the City is one of the partners, while in Munich and in other German cities 5G implementation comes from the cooperation between the federal government and telecommunication companies. The purpose of the regional agreement is that the Stuttgart Region becomes the first 5G model region in Germany, which among others, would facilitate the roll-out of automated driving. As the broadband representative of the Region put it: '*Stuttgart will be far ahead in the expansion plans of Deutsche Telecom nationwide*'[77]. The mayor of Stuttgart, the district councils and Deutsche Telecom signed a letter of intent in mid-2018 and the agreement was officially signed in May 2019.

The year between the initial letter of intent and the official agreement (2018-2019), there were a lot of objections against the effects of 5G implementation on citizens' health from citizen organisations, but also from the left party of the City Council. The citizens' initiative 'Mobilfunk in Stuttgart'[78] organised several protests against the 5G expansion in Stuttgart. The citizens' initiative argued that this deal is a sell-out of democracy, as the City plans to be equipped with thousands of new 5G technology mobile transmitters for automated driving and the Internet of Things, ignoring the health risks for its citizens and the potential effects on the environmental footprint due to massive energy consumption. The left party argued that as in the case of water, the broadband network, which belongs to the municipal sector, is to be sold to an investor in order '*to implement the digitization of all life processes at full speed*'[79].

However, despite the objections, the City Council of Stuttgart signed the agreement with Deutsche Telekom. High speed internet was perceived as a competitive advantage for the City-Region that would be very crucial to the regional development. As the Managing Director of WRS stated: '*The agreement with Deutsche Telekom is therefore not just a milestone in digitalisation, but more than that, it is a milestone in regional development*'. For the purpose of this collaboration, a coordination organisation was created, called 'Gigabit Region Stuttgart' (GRS). GRS is a joint venture of WRS, the City of Stuttgart and the broadband associations of five districts of the Region. It coordinates the

[77]https://www.stuttgarter-zeitung.de/inhalt.5g-standard-in-stuttgart-region-setzt-auf-pilotprojekt-fuer-neuen-mobilfunk.e27356e2-6eba-45ee-86d0-e16ec6b387c0.html (own translation).

[78] A citizens' initiative against the negative effects of mobile communications, founded in 2016.

[79]https://www.s-oe-s.de/termine/smart-city-stuttgart-und-5-g-e2-80-93-fuer-wen-mit-peter-hensinger-diagnosefunk-bi-mobilfunk-stuttgart-und-juergen-merks-bund/ (own translation).

fiber-optic expansion in the Stuttgart region, manages the cooperation program with Deutsche Telekom and supports smart-region applications. It also provides know-how and a central pool of experts for the districts and municipalities of the region[80]. Overall, GRS signified the development of a new institutional setting, in order to deal with high tech innovations, especially compared to Munich where there has not been any new institutional format to coordinate new technologies.

Assuming the interdependency of automation and 5G connectivity

When the interviewee from WRS was asked what the importance of 5G from a mobility perspective is, he answered that the WRS considers 5G as a prerequisite for a safe transport system with automated vehicles and connected traffic lights that communicate and exchange information with the traffic participants in real time. In particular, he claimed that for the safe roll-out of automated driving, all kinds of connectivity are needed:

> This can only be up and running if there is a stable network, a stable communication system. And as long as we don't have the 5G, we cannot have a safe rollout for everybody…you will go at the beginning with test fleets and small projects, but the entire roll-out will be connected very strongly with the existing infrastructure (…) As a Region of Stuttgart we have a lot of problems with traffic jams. Autonomous cars or vehicles I guess will be easier to guide through the city. So, if you have a traffic guidance system, one big intelligence above the city that supervises traffic; in which areas there is too much traffic at the moment, where the other vehicles go to, where the people head to, then they can kind of manage and control the traffic easier (Interview 22, 2018, p. 3, 4, 5).

The WRS basically argues for what Kitchin (2014) and Elliott (2018) call connectivity 'everywhere and everyware' through connected driving that can be controlled by a '*big intelligence above the city*'. This metaphor reflects the centralisation of responsibility for mobility in cities in one unit, detaching commuters from having control over their mobility choices (e.g. routes, modal choices). It is connected driving that is at the core of this argumentation, instead of automation. The phrase '*autonomous cars or vehicles will be easier to guide through the city*' is ambivalent, as the vehicles cannot be autonomous if they are guided through the city through connectivity. While automation is used in the argumentation, it is not specified how and why connectivity is necessary for automated or even better autonomous vehicles. It is rather taken for granted. In this kind of argumentation, the boundaries between the socio-technical system of automobility and the socio-technical system of ICT get blurred, while the taken-for-granted assumption that connectivity is needed for automated vehicles reflects strong interests of the Region in the convergence between the two systems.

[80] http://www.gigabit-region-stuttgart.de/.

As already mentioned, there is already connectivity going on in urban mobility in Stuttgart. The traffic management centre functions with real time traffic data and are connected to electronic signs with written recommendations about traffic in the city, which direct the commuters to the less congested areas. The difference is that today these are just recommendations and it is up to the commuters to follow them or not. But if we are talking about ubiquitous connectivity that goes beyond the signs and includes traffic lights or road sensors connected with vehicles, which will also be connected with each other, the question is if individual commuters will be able to make a different choice than the one the traffic guidance system tells them. As an interviewee from the Verband Region Stuttgart put it: '*At the moment, the systems to regulate car-traffic are not good enough…they have to be developed so that the connected car is operating all over*' (Interview 33, 2018, p. 8). This means that the Region regards ubiquitous connectivity so important exactly because the most important source of wealth and well-being in the Region so far has been the automotive industry, and there has been a concern that it might lose its importance. As the interview participant from the WRS explained:

> You might remember back in the early times of personal computers, everybody wanted to have an IBM computer or a Hewlett Packard computer. And then five years later, it was important for the consumers to have an Intel sticker inside and then another five years later nobody bothered if it is Intel or AMD or whatever. And as soon as we come to a point where the people don't bother if the car is a Mercedes, a KIA, a Hyundai or whatever, then there will be no need and no reason to buy a Mercedes anymore…If the main value proposition of the car is software and intelligence embedded within and around the car and the rest is only a container, then it will affect a lot the entire Region; social stability, well-being, welfare and so on. So, of course our interest is in keeping as much value development as we can in the Stuttgart Region, and we see automated driving in connected vehicles as a number one trend of the future, we want to enable as much technological development and set-up in our region (Interview 22, 2018, p. 8).

This summarises how the Region of Stuttgart perceives automated driving within the context of digital connectivity. It further reflects the convergence between the automotive industry and the ICT industry, as the software and the online services within the car are gaining increasing importance. The argument of WRS is very much in line with what Canzler and Knie (2016) argue about:

> Manufacturer brands will no longer matter; cars will be downgraded to be mere 'vehicular appliances' and controlled on a digital marketplace, where new actors decide over the use. A proud industry, steeped in tradition, will be ruled by app developers simply because the place where decisions are formed and made has shifted. (Canzler and Knie, 2016, p. 63)

As the interviewee from WRS continued, whether automated driving will be implemented with private vehicles, on-demand individual shuttles or on-demand shared shuttles '*in*

the end the market will decide' (Interview 22, 2018, p. 8). Leaving it to the market further suggests a laissez-faire approach where the automotive industry and the ICT industry would compete for who will become the mobility provider, but this is out of the scope of the connectivity policy. The difference is, according to Canzler and Knie (2016), that the market is more diverse than before, as it is not only the automotive industry that decides; the place where decisions are formed and made has changed. In the case of 5G connectivity, policymaking takes place in a new setting, where the automotive industry is not a main player, yet it is influenced by the decisions. As already mentioned, the Gigabit Region Stuttgart (GRS) was established as a new policy setting where Deutsche Telecom, the Region and the City will steer the implementation of 5G. This setting is an economic public-private partnership that aims at making Stuttgart Region competitive in terms of connectivity, and it is not particularly concerned with mobility per se. The promotion of 5G connectivity is rather part of the overall strategy of the State-Region to strengthen the ICT industry, so that there are two sources of economic development in the area (together with the automotive industry), which also support each other. As the WRS interviewee continued:

> (…) so far the OEMs have the possibility to differentiate by engine, by design, by whatever concepts, all the cars are driver-focused and as soon as no driver is there anymore, it will not depend on whether there is a Mercedes R or BMW image or a nice Porsche car (Interview 22, 2018, p. 11).

From that, it can be deduced that the Region of Stuttgart promotes an economic policy by focusing on the production of ICT technologies that enable mobility services. Even though the 5G expansion was phrased as a necessity for automated driving in the sense of ubiquitous connectivity, it is still unclear whether 5G connectivity is necessary for automated driving. For instance, there are use cases where Wi-fi or DRSC connectivity might be enough[81]. On top of that, as the report of Transportation, Space and Technology Program (RAND) Corporation mentions, from a technical point of view it is still an open question how much and what kind of connectivity is needed and in which situations, namely vehicle to vehicle (V2V), vehicle to network (V2N), vehicle to everything including infrastructure (V2X) (Anderson *et al.*, 2014). Will automated vehicles need back up connectivity or they can solely rely on their own sensors? Which use cases of automated driving are more likely to need connectivity? Currently, there is a widespread idea that is often reproduced by the media and ICT companies that connectivity is a precondition for automated driving. Although some forms of connectivity (V2V and V2N) might be necessary for specific use cases, such as on-demand fleets, so that the user can order the service through an App (CARTRE CAD, 2018), research has not provided any indication that ubiquitous connectivity is a prerequisite so far. Furthermore, it is still unclear if automotive automation follows the progress of ICT, while the increasing integration of electronics in vehicles is not yet complete (Attias, 2017). A researcher from the University

[81] https://www.tu-auto.com/hybrid-connectivity-the-way-forward-for-driverless-cars-says-ericsson/ (Assessed 22/10/2019).

of Stuttgart provided the following example about the imposed vision of interdependency between automation and connectivity by ICT and infrastructure companies:

> (…) it was maybe the year 1992, when mobile phones were not yet around, but…it started working and (…) the telephone boxes we had at the time…we had public telephones…they were all over the place and the big invention was that within a range of 10 meters around that telephone you could connect to a mobile system. So, at that time, the recommendation was to build as many of those locations so that people could make mobile phone calls. Five years later or two years later, it was a joke. So, if you build some type of traffic lights at the moment as a City, because Siemens[82] tells us, it may well turn out to be a joke in ten years from now (Interview 28, 2018, p. 10).

Based on this, in the context of the 5G connectivity promotion, it is assumed by the WRS that automation and digital connectivity technologies enable each other's functionality. In parallel, enabling mobility services is accompanied by a change in the meaning attributed to the car as an artefact. As the interviewee from WRS continued:

> New characteristics will be the most important ones. For example, if the shuttle that I order by phone is on time, it is punctual, it is clean, it is cheap, it is reliable…these will be the characteristics rather than having a nice image, having a powerful engine (Interview 22, 2018, p. 11).

This suggests an assumed shift from owning a car to using a service, which is punctual, safe, reliable and comfortable, and allows them to save time; a shift from ownership to service, from purchasing a car to 'pay as you go' for the service (Canzler and Knie, 2016; Wentland, 2017). This does not mean that this shift is practically happening right now or that it will happen in the urban context of Stuttgart. It is rather reflected in the empirical material as a rationalisation and as a rhetoric from the side of WRS in the context of the economic restructuring of the State-Region through investing in connectivity technologies.

Using automated driving to legitimize investing in connectivity

Against this background, what connectivity enables is the service and not necessarily automated driving per se in the sense of automation functions within the vehicle. While automation and connectivity might potentially develop synergies with each other, the former is not necessarily a prerequisite for the latter and vice versa. Despite 5G connectivity has been phrased as a prerequisite for automated driving by the WRS and the State-Region in general, it is connected driving, which is the core interest. As an interview partner from the Ministry of Transport BW explained, connectivity is a condition for digitalisation, but not necessarily for automated driving. If a car has level 5

[82] Here Siemens was used from the interviewee as an example of a company that is interested in V2X connectivity, as they build traffic lights.

autonomy, it has to be able to react in an apropriate way in any situation, which means it must be fully functional without any car-to-X communication. For example, if the sensor on a road is lacking energy, the vehicle should be able to drive at least up to the point where a traffic light is standing. And if a traffic light is off, the vehicle has to be able to decide if it is allowed to drive or not (Interview 30, 2019). Once again, this shows that the central issue for the State-Region is connectivity and not automated driving per se. While the actors keep automated driving on their agenda, there is no solid indication of how it can be implemented in practice. Actors rather refer to the topic to further legitimize the investments in 5G implementation. Automated driving is rather viewed as something that might come in the future, thus the actors include it in the more tangible strategy for digital connecitivity as a concept that might faclitate digital connectivity.

The City of Stuttgart that signed the agreement to support the regional economy is not willing to change the traffic lights so that they work with 5G. The Departments of the City have been discussing if it is necessary to change the traffic lights, because they do not want to heavily rebuild and reinvest in infrastructure for automated vehicles. As an interviewee from the Economic Department of the City of Stuttgart stated:

> Automated cars will have to take the infrastructure as it is. You can't change the whole world for a new car, but the car has to figure out how it can manage with the infrastructure we have here. And I think in the future it will not be so much that the cities have to rebuild the city for the automated car, but the automated car has to figure out how it can manage in the city. But it is a future we don't exactly know (Interview 25, 2019, p. 6).

The above quote suggests that the City distinguishes between ubiquitous connectivity and automated driving. The City is willing to support the industrial transformation of the Region also in terms of infrastructure, but without implementing radical solutions. As such, they supported the 5G implementation in the City-Region. At a general debate of the City Council about Stuttgart as an economy and innovation city in February 2019, the Mayor of Stuttgart mentioned that the City has the task of not messing around with the digital transformation but helping it with initiatives. He also stated: '*Without digitization, we will not have automated driving in the city*'[83]. However, as the Mayor continued, for the City, 5G means investing in new mobility software. The City would rather use 5G for digital connectivity and App-based and Cloud services rather than vehicle-to-X or vehicle-to-vehicle communication, which would mean investing in hard infrastructure (e.g. road sensors, traffic lights) for automated driving. The approach of the City diverges from the one of the State-Region, who want connectivity in all forms. This shows a discrepancy between the techno-economic approach of ubiquitous connectivity and the local context of Stuttgart. The City of Stuttgart, while it considers some forms of connectivity as necessary for automated driving and mobility in general, they are not in favor of digitalizing hard infrastructure.

[83] Protokoll 'Generaldebatte Stuttgart als Wirtschafts-und Innovationsstadt' NsNr 15, 07-02-19, p. 4 (own translation).

Overall, the storyline of fostering a new connected mobility system shows that all three levels; the State, the Region and the City include automated driving on their policy agendas to back up the argumentation for investing in connectivity technologies, taking for granted that connectivity and automation are interdependent. Yet, this storyline does not specify what exactly is the role of automated driving in mobility. Automated driving is rather used as an item that should be kept on the agenda, but since there is a lot of uncertainty regarding its technologies, synergies and impacts, it rather serves as a means of strengthening the argumentation for investments in digital connectivity. The next chapter shows how the local actors in Stuttgart develop a distinct approach to the one of the State-Region when it comes to the uptake of automated driving in relation to connectivity.

STORYLINES	ACTORS	NARRATIVES	SETTINGS	PRACTICES	TECHNOLOGIES-ARTEFACTS
Fostering a connected transport system (2010-2019)	State of BW, Region of Stuttgart, ICT and automotive industry, research	Restructuring the regional economy, Stuttgart as number one high-tech location, from product to service, the car as a container	ICT & automotive R&D, new alliance networks for ICT and automotive, City Council	AD as part of digitalisation strategy BW, Cyber Valley, 5G implementation agreement	5G connectivity, the car, Artificial Intelligence
Supplementing public transport (2016-2019)	Local politicians, public transport (SSB), automotive industry (moovel)	Protecting public transport, last mile solutions, flexibility	City Council, Public-private cooperation SSB-moovel	MEGAFON scenario study, integrating AD in transport plans, regulation for on-demand services	On-demand algorithmic platforms, on-demand shuttles

Figure 5: Summary of storylines case of Stuttgart

4.3. A storyline of supplementing public transport (2016-2019)

An alternative storyline to the new connected transport system storyline started being produced in 2016 mainly by the local actors in Stuttgart. As mentioned in the previous section, the first discussions in the City Council were triggered by the submission of the application of Stuttgart for hosting the test field of BW together with Ludwigsburg. That was when the first concerns about automated driving threatening public transport were raised, in case it is not appropriately regulated. From 2016 onwards, the Departments of the City of Stuttgart and the public transport company of Stuttgart have started exploring

the potential and the risks of automated driving by engaging in discussions and study projects with the automotive industry. Up to that point, the discussions at the City were mainly about transforming the automotive industry and how automated driving changes the car industry. It was around the year 2016 that the local politicians, the different Departments and the public transport company started discussing how automated driving might change the city and what it means for the citizens. The automotive industry also plays a role in this storyline, but in the form of public-private partnerships with the City. The storyline shows what triggered the development of an alternative storyline and how automated driving has gradually been translated into the urban mobility context of Stuttgart moving across different settings and eventually being relegated from a proxy of ubiquitous connectivity to a proxy of a mobility niche, namely public on-demand mobility.

4.3.1. The performative power of the MEGAFON study

In May 2016, there were elections in Baden-Württemberg and there was a reform and redistribution of tasks among the several ministries. The coalition government changed from a Green/SPD coalition to a Green/CDU coalition. The responsibility of automated driving at the State BW level changed from the Ministry of Economics to the Ministry of Transport (Interview 32, 2017). The three Ministries involved in automated driving policymaking were divided between two political sides: The Ministry of Transport was reformed under the auspice of the Greens, while the Ministry of Economics and the Ministry of Interior and Digitalisation were reformed under the auspice of CDU[84]. It was after the Ministry of Transport took over that the impacts of automated driving on urban mobility started being emphasized as well as the importance of not threatening public transport. As the Minister of Transport stated:

> Our short-term goal is to increase traffic safety. But we also have to pay attention to a positive environmental balance. Automated vehicles should lead to more public transport, not less. Pedestrians and cyclists should feel safer - and not get into the car more often for reasons of comfort[85].

In the statement of the Minister of Transport BW, the relevance of automated driving for urban mobility and public transport is pointed out for the first time. Up to that point, only the economic competitiveness of automated driving and abstract statements about improvement of traffic flow and safety were mentioned, but without any elaboration on how it could be applied in different mobility modes in the city. Even when the local politicians at the City Council had picked up the topic the same year before the elections in the light of the application of Stuttgart for the test field BW, the main arguments were still economic with little opposition coming only from the left party. It was only after the

[84]Koalitionsvertrag zwischen Bündnis 90/Die Grünen Baden-Württemberg und der CDU Baden-Württemberg 2016-2021, *Baden-Württemberg Gestalten: Verlässlich. Nachhaltig. Innovativ.*, 2016 (own translation).
[85]https://vm.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/startschuss-fuer-testfeld-autonomes-fahren/ (own translation).

transfer of responsibility to the Ministry of Transport BW, that the latter funded 100% the MEGAFON study, which was concerned with the potential of automated driving in public transport in the City-Region of Stuttgart. The interested parties in the MEGAFON study were the Association of German Transport Companies (VDV), the Public Transport Authority of Stuttgart (SSB), and the Public Transport Tariff Association of Stuttgart (VVS), and it was conducted by the University of Stuttgart (Friedrich and Hartl, 2016). According to the interviewee from the University of Stuttgart, who was involved in the study, it was the VDV that initiated the process of securing funding for a study in a German city-region that would investigate the synergies of automated driving with public transport, in order to help public transport companies secure that they remain the main mobility providers in cities, instead of private companies (Interview 28, 2018). In the study report, it was mentioned that the Stuttgart Region was selected as a case study, because it represents an example of a monocentric metropolitan area with a well-developed public transport infrastructure and the usual signs of overloading in motorised individual transport and public transport (Friedrich and Hartl, 2016).

The MEGAFON study stood for model-based findings about shared fleets of automated vehicles as a part of public transport, and developed scenarios regarding the integration of automated driving in different modes. The MEGAFON study was based on the approach of a similar study conducted in 2015 by the International Transport Forum of the OECD, which used the city of Lisbon as an example[86] (Friedrich and Hartl, 2016). Similar to the Lisbon study, the MEGAFON study developed eight scenarios, where the trips in motorised traffic are handled to different degrees with either automated carsharing or ridesharing. Interestingly, a laissez-faire scenario, where the technological development without regulating measures as a replacement of the privately-owned car was excluded from the beginning, as it was considered '*obviously negative*', as it is mentioned in the final report of the study (Friedrich and Hartl, 2016, p. 7). In order to simplify, the study did not consider the decision-making process of people, the demand and the potential prices of the services. It just assumed that people use certain modes by setting only the supply and the share of certain modes (e.g. private cars, public buses, carsharing, ridesharing) in the model. As such, the study was not really a forecast of what is going to happen, but rather an extrapolation of potential developments (Interview 28, 2018). The main conclusion of the study was that only the case of automated ridesharing controlled by public transport will decrease traffic volumes, space occupancy and congestion in the city centre, while rail public transport needs to be maintained and strengthened (Friedrich and Hartl, 2016). As the following sections will show, the MEGAFON study has been used as 'authoritative data' (Hajer, 2005b) by the local stakeholders in Stuttgart to legitimize why automated driving services should be part of public transport. It was the MEGAFON study as a performative practice that produced knowledge that could be used in the local policymaking to justify the promotion of automated driving within the context of public transport on-demand services. Ultimately, the MEGAFON study was performed on the

[86] The title of the Lisbon study is: 'Urban Mobility System Upgrade: How shared self-driving cars could change city traffic' (OECD, 2015).

spot drawing inspiration from a similar study in Lisbon, so that public transport can legitimize their role in the debate of who is going to be the mobility service provider of automated driving.

4.3.2. Negotiating the role of the City in steering automated driving

The amendment of the federal Passenger Transport Law (PBefG), effective from January 2013, strengthened the role of the local governments in steering urban transport as well as the function of the Local Transport Plans. In May 2017, after the MEGAFON study was presented in public hearings and conferences, the City of Stuttgart, taking advantage of the modified Passenger Transport Law, included measures regarding new mobility concepts in a Local Transport Development Plan (NVEP), which is meant to be a supplement to the Local Transport Plan (NVP) (published in 2016). The planning depth of the NVEP is limited to a conceptual level. Therefore, the implementation of proposals requires further committee decisions and more investigation in each individual case. The NVEP was the first policy document at the local level that included automated driving. At a City Council meeting about revising the Local Transport Development Plan to its final version, the Green Mayor of Stuttgart Fritz Kuhn started by pointing out that the cities would have to be involved in the discussion about automated driving in good time, and expressed his concerns about the hyper-connected transport system promoted by the industry:

> The visionaries of automated driving saw in it a new transport system, in which the vehicles, so to speak, integrate themselves into a magical line and move in 5 cm distance, car by car, through the city. Such developments and implementation in a transitional period would have a huge impact on cities[87].

The Mayor criticized the abstract vision of the industry by referring to it as a new transport system where everything is connected in a 'magical line'. As a response to the Mayor's critique, the political party StadTISTEN pointed out that considering the high economic attractiveness of Stuttgart with the hundreds of thousands of people commuting in and out of Stuttgart every day, the City Council needs to consider with which means of transport mobility should take place. The StadTISTEN pointed out that with a perspective to 2025, automated buses and logistics as well as the consequences of automated driving in general should be discussed[88].

First open debate on the future of mobility

Almost a year later, the City Council had the first official open debate on the topic of mobility in April 2018. At that public meeting, the Mayor Fritz Kuhn expressed his

[87] Protokoll ‚Nahverkehrsentwicklungsplan (NVEP) - Einbringung – NsNr 215' 30-05-17, p. 4 (own translation).
[88] Aktionsplan, *Nachhaltig mobil in Stuttgart*, 1. Fortschreibung, 18. Juli 2017 (own translation).

skepticism about the plans of the federal government to promote an east bypass with a tunnel (Fildertunnel) in the city as part of Stuttgart 21 project[89]. In particular, he stated:

> As a contribution against air pollution this is almost cynical. Whoever proposes this against air pollution, they somehow did not understand what the law is and what the problems of the people are health-wise. But even as a future concept, it is like now we make another breakthrough in the sense of car-friendly city. I think it is completely absurd. Even the automotive industry in its think tanks thinks very differently about the future. If what they present to us is true. And that is why I believe that we need to focus more on sustainable mobility and, incidentally, on the question of what contribution can automated driving make? I urge the automotive industry to not only come with automated driving forgetting the current environmental problems, but to combine the two questions. Otherwise these are no sustainable answers (…) It will not be the same with 'always as before'[90].

The statements of the Mayor signify the first actual attempt of the City Council to link the potential of automated driving with the local mobility problems of Stuttgart (i.e. air pollution). Instead of tunnels, which is the traditional cost-intensive solution for traffic relief, the Mayor considered the potential of new technologies in solving everyday transport problems in the city. At the same meeting, CDU expressed a more diplomatic point of view about the role of technologies, and particularly automated driving, in the future of mobility. The party claimed that there are many areas that the politics cannot influence, because a lot depends on how technology and research develop, what the companies offer, and what the citizens want:

> We can always only make offers as a policy. And the citizens then decide, and of course the economy, our companies, which of these offers they consider the right one and which they also want to implement. And it is true that, especially in the area of mobility, much more than perhaps in others, we cannot set the decisive framework by ourselves - and maybe it's not bad that we cannot influence everything - because technology is not invented by us[91].

This reflects a hands-off approach from the side of the local politics. The role of policy is perceived by the CDU as making recommendations and not developing regulations, and it is up to the private sector, the technocrats and the voters whether they will adopt them

[89] Stuttgart 21 is a major railway and urban development project in Stuttgart, part of the Stuttgart–Augsburg new and upgraded railway line as well as part of the Magistrale for Europe (Paris—Vienna) in the framework of the Trans-European Networks. Key part of the megaproject is the renewal of Stuttgart Main station and some 57 kilometres of new railways, including some 30 kilometres of tunnels and 25 kilometres of high-speed railway lines. There have been a lot of protests on a broad range of issues, including the relative costs and benefits, geological and environmental concerns, as well as performance issues. (Source: https://www.ipma.world/stuttgart-21-a-mega-project-in-the-heart-of-swabia/, Assessed 17/05/2020).

[90] Protokoll ‚Generaldebatte Mobilität' NsNr 61, 19-04-18, p. 4 (own translation).

[91] Ibid., p. 24.

or not. In turn, this perception reflects the 'institutional void', Hajer (2003b) was referring to, when it comes to accommodating new technologies and change in the setting of City Council. This institutional void is manifested by a tendency to share the responsibility with the private sector and satisfy the demand of the citizens (voters). Bache *et. al.* (2015, p. 65) would call this '*an accountability vacuum*', where politicians create or tolerate a fluid and fuzzy governance arrangement as a rational self-defensive mechanism when faced with complex and intractable socio-technical challenges that require different capacities than what politicians are typically used to. In the case of Stuttgart, CDU traditionally has been in favor of supporting the system of automobility and the car industry, so they would almost always argue for building tunnels and infrastructure to facilitate private cars. Yet, being faced with the uncertainty surrounding automated driving when it comes to its regulation and implementation, the CDU prefers to not be held accountable and share the responsibility.

Responding to CDU, the SPD argued that it is essential that the City be active and establish where and how it wants the offers from the companies and what they mean to the City. The party argued about the opportunities that digitalisation offers in terms of sharing and automated driving as a form of public transport. These services cannot be decided only by the market, because this means that many outskirts will fall out of the sharing offers, as they might not be profitable for the industry. The left party, in a similar line, argued that automated driving should only be an additional system to public transport in the form of stationary vehicle sharing. An interview partner from the left party was quoted as stating:

> 'It's an addition to this system…it's an additional system of public transport, not for private cars… So, in this case, I see a business case for public transport, but we have to say as a City in which way we want to implement this system in our city…we don't want laissez-faire for the industry…not a playground (…) We don't want competitors for the public transport system. Free-floating vehicle systems can be a competitor for public transport. So, we want car-sharing and vehicle-sharing at stations in every area of the city and not as a free-floating system…And we know we have to reach our sustainability goals and that would only work if we reduce cars about 80% by 2050 (Interview 29, 2018, p. 5).

The left party also added that as long as the car is dominating the streets of Stuttgart, the City Council should not wait for '*technological stories*', such as automated driving, to come true. Instead, more urgent and specific interventions, such as driving bans or limited speed measures are required to protect the citizens from air pollution and traffic congestion (Interview 29, 2018). By deploying the metaphor '*technological stories'*, the left party communicated their scepticism regarding the actual potential or even their disbelief in automated driving. Overall, at these two meetings of the City Council; (1) for the revision of the NVEP and (2) open debate for the future of mobility, the City Council integrated automated driving in the local plans and attempted to connect it to everyday transport problems. The majority of the political parties agreed that the City should have

an active role in policymaking of automated driving, while only CDU held back and preferred to not intervene in the interests of the market.

4.3.3. The debate around automated driving as public transport

Eventually, the Local Transport Development Plan (NVEP) was revised to its final version in May 2018. In the document, it is made clear that automated driving is welcomed in the form of on-demand mobility services that need to be controlled by public transport. On top of that, the document provides a regulation guideline regarding potential competition to public transport on-demand mobility offers, which are meant to be eliminated if they arise. This way unwanted effects in traffic can be avoided. On the day it was passed, there was a final meeting at the City Council, in order to approve and pass the Plan. At this meeting, there were several objections about the decision of the City to restrict automated driving to public transport uses. The debate revolved around the following quoted sentences from the revised document:

> The State Capital sees this technology as a suitable approach, especially in connection with new demand-oriented flexible forms of operation. The State Capital attaches great importance to the introduction and operation of such offers as an integral part of public transport via appropriate statutory guidelines, so it can be controlled by public transport authorities. It is important to protect public transport investment as the backbone of urban transport and to further promote its acceptance. Demand-driven transport offers with automated vehicles from private companies are therefore to be interlinked in a suitable manner with public transport or a possible competition is to be counteracted by tariff specifications[92].

First, it was the FDP (Free Democratic Party)[93] party that criticized the new version of the plan as being extremely designed to ensure that any form of movement that can pose competition to public transport is eliminated, and it is best to be banned altogether. The FDP further argued that the City is '*hovering over something like a complete overregulation comparable to the taxi-trade*', and that for a city like Stuttgart is '*a hindrance to future competitors*'. The FDP also stated that '*under no circumstances should this technology be suppressed - especially at the Stuttgart automotive location - by overregulation'*, and it proposed that the above quoted sentences be deleted from the plan.

A representative of VVS, the Public Transport Tariff Association of Stuttgart, responded to FDP by referring to the MEGAFON study, which had also been used in the revised version of the local Public Transport Development Plan. According to the MEGAFON study, if individual traffic changes to automated driving to a great extent, then increases in traffic volumes of up to 40% should be expected in Stuttgart. Since the urban road network cannot cope with this increase, the City has to influence traffic, rather than

[92]Nahverkehrsentwicklungsplan der Landeshauptstadt Stuttgart, 8. Mai 2018, p 44 (own translation).
[93]The Free Democratic Party (FDP) is a liberal political party that supports free markets and privatization and the minimized role of the state.

allow '*a free play of market forces*'[94]. Instead of traffic prohibitions or restrictions, VVS suggested that traffic be regulated with pricing and gate lights.

As a further response to the FDP, the Mayor claimed that he asked Daimler: '*what exactly do you imagine that the City of Stuttgart has to provide in terms of infrastructure for automated driving in five, ten and twenty years? What do you actually mean?*[95]' He continued saying that there is a lot of talk, but the conclusion is still very much floating. The Mayor distinguished between two options for the implementation of automated driving. One option would be automated driving in the form of private cars like today, where one sits in a private vehicle and is driven around autonomously. For this, the City would need no further infrastructure, except ensuring that the cars could enter autonomously without drivers in parking spaces. This could lead to economization of parking spaces in the positive sense. The second option would be automated driving in the form of vehicles *that 'travel very close to each other like a magical line through the city'.* This could lead to regaining more space in the city, because less space would be needed for traffic. The Mayor continues:

> In that case the question is: is automated driving actually still motorised private transport or is it a kind of modification of public transport? What is the relationship to public transport? And of course, as a mayor, I have to ask whoever has such ideas, they have of course to check with the City, because we would have to create infrastructure, because this '*magical line'* cannot be on a normal street. So far, there is no specific announcement from the automotive industry for the second case. But they imagine for the next ten-fifteen years automated driving as driving around like today's cars with drivers. But this discussion is not intended at all. But since we are talking about 2025 and beyond, we as a City have to deal with this question as well[96].

Once more the Mayor referred to the connectivity technology between the vehicles as the '*magical line'*. On the one hand, the metaphor '*magical line'* implies that the local politicians have no knowledge about how connectivity works in practice and what it means for urban mobility. Maasen and Weingart (2005) would call this de-democratization of expertise in the sense that technical knowledge resides within industry and research think-tanks, instead of being shared and presented for confrontation with the public authorities and the citizens. On the other hand, it is also doubtful if the technology experts know more about the impact of connectivity technologies in cities. Thus, the metaphor might reflect the unknown consequences and the unpredictability of combining existing technologies and infrastructure with new connectivity technologies.

The Ministry of Transport BW suggested that automated driving should not only be viewed from the point of view of motorised individual mobility, but also to see the

[94] Protokoll ‚Nahverkehrsentwicklungsplan (NVEP) - Einbringung – NsNr 184' 08_05_18, p. 12 (own translation).
[95] Ibid., p. 28.
[96] Ibid., p. 28.

opportunities for public transport. The Ministry argued that in the rail-bound public transport, automation can be easier to realise than the free-flowing motorised private transport. The State Capital of Stuttgart answered that an automation of the light rail traffic is not urgent, as it is not easy to implement due to the many points of conflict with the motorised individual traffic. In turn, the party StadTISTEN argued that in the NVEP the topic of automated driving is underrepresented. The party referred to the annual report of the SSB, which says that currently they have a daily capacity overload of 11-12%, to rationalise that automated buses on-demand should be highly prioritised as early as possible as a starting point of automated driving.

> I'll put it bluntly; we watch the whole thing and wait until it works in everyday life around us, and then consider whether we might start with it. Actually, I expect a city like Stuttgart, which has automobile companies on site, has suppliers on site, who are active in technology, that they are more active in the role here and not only leave the topic to Karlsruhe, but also act here and not just watching and waiting[97].

The StadTISTEN's argument reflects a tendency for competitiveness between the two regions of Stuttgart and Karlsruhe. Yet, the City did not accept any of the changes proposed. The NVEP was passed as it was revised without deleting any sentences or modifying anything. The final argument of the City before the end of the discussion was the following:

> The automotive industry is undoubtedly of great importance for the City-Region, but no urban development objectives must be subordinated to the industry's product innovations. The MEGAFON study has clearly demonstrated the dangers that conurbations face from automated driving technology. Already today, the precursors of on-demand services reveal in some places that, contrary to the promises of the providers, municipal traffic objectives are being counteracted. Even the coalition agreement of the incumbent federal government provides, despite the liberalization tendencies regarding the federal Passenger Transport Law, improved control possibilities for municipalities[98].

The City for the first time separated the interests of Stuttgart and its citizens from the automotive industry. The premises of the above argument were structured in a way that increases the validity of the claim that urban development should not be subordinated to the industry's product innovations. First, the City used a scientific study to legitimize that there is a real danger for increasing traffic volumes. Then, it referred to the existing experience with on-demand services, and finally to the modified Federal Passenger Transport Law that allows the cities to have increased control over steering of local transport. That was the first policy for automated driving that materialised in the form of

[97] Ibid., p. 22.
[98] Ibid., p. 25.

a policy document at the local level. This policy initiative forged the direction of the local policy for automated driving towards public transport.

4.3.4. Avoiding testing on public streets in Stuttgart

DiaMANT Project

As the MEGAFON study set the tone for relegating automated driving to public transport on-demand mobility services in urban mobility, since January 2018 and until the end of 2020 the Ministry of Transport of BW has been funding the DiaMANT project (Dialogue for Automated, Connected and Electric Mobility: Applications - User Interests - Technology) for automated driving in public transport. The project partners include: the City of Ludwigsburg, the City of Stuttgart, several research institutes, SSB, VDV, Daimler and e-mobil BW. The DiaMANT project's goal was phrased as '*establishing a dialogue between users, operators and manufacturers*', and '*creating technology acceptance for automated, connected and electric driving*'[99]. According to the interviewee from the Ministry of Transport BW, the local authorities in Stuttgart and in Ludwigsburg were disappointed for not being selected for the test field Baden-Württemberg. After persistent negotiations, Ludwigsburg was selected to play a leading role in the DiaMANT project, and the City of Stuttgart was one of the project partners. Once more it was not Stuttgart that got selected as a ground for public tests due to the deteriorating traffic situation. The Ministry of Transport BW was convinced to finance this project, because it deals with testing automated buses in real traffic situations (in Ludwigsburg), and the Ministry is interested in answering specific questions that might lead to actual implementation of automated driving or not (Interview 30, 2019).

The part of the project that was relevant for Stuttgart was testing fully automated buses of SSB at the SSB depot station in Stuttgart. During the night shift, buses were automatically and without a driver driven from their parking position through a washing facility and a refueling facility with an automated tank, and they drove back to their parking position again[100]. This bus testing on a route of automated functions was used to demonstrate the economic optimisation potential of vehicle automation. The goal was that the knowledge gained from these tests will be transferable to other maneuvering trips in other companies in the future[101]. As an interview participant from the Department of Economic Development of the City of Stuttgart put it:

[99] https://vm.baden-wuerttemberg.de/de/politik-zukunft/zukunftskonzepte/autonomes-fahren/ (own translation).
[100] https://www.ifv.kit.edu/forschungsprojekte_973.php (own translation).
[101] https://vm.baden-wuerttemberg.de/de/politik-zukunft/zukunftskonzepte/autonomes-fahren/ (own translation).

> It is cheaper for them (SSB). Cleaning buses automatically will save a lot of money, because you don't need a driver to take the car and drive them to the different locations, but the car itself does that and that is saving money (Interview 25, 2019, p. 11).

Stuttgart was only chosen for testing automated buses at a depot station, which is testing in a closed protected ground. However, Ludwigsburg was chosen for testing automated buses in public streets in real traffic. An automated shuttle bus with up to 15 km/h is to be operated on a supplementary bus line in public street space and in real passenger service in a commercial area of Ludwigsburg.

> (…) they will really start with the operative phase of the project, which will be quite interesting, because it is really like in the normal city…I mean you have a lot of projects concerning shuttles at the moment, but normally they are in a really defined closed area. The idea behind it is to do it really like in a more or less real-life surroundings with all the difficulties you have in doing that (Interview 27, 2019, p. 6).

The purpose of this operation on public ground in Ludwigsburg is on the one hand citizens to come into direct contact with automated driving, in order to increase technology acceptance. On the other hand, it is expected to expand the knowledge and the experience of the public transport operators[102]. Overall, there is an interest from the City of Ludwigsburg in publicly visible initiatives, so that the City could use them for having people experience automation technologies and for their press release. Yet, in Stuttgart the authorities keep avoiding having an open interactive experience with the public, which is both confirmed by choosing to test automated buses at a closed location, such as the depot station. Marres (2018, p. 3) argued regarding on-street testing that '*this kind of 'real-world-testing' cannot be understood in terms of the displacement of technology testing from the laboratory to society*'. The same argument can be transferred also in the case of the testing at the depot station in Stuttgart. Despite the aim of the DiaMANT project was phrased as providing a dialogue between users, operators and manufacturers, the part of the project that took place in Stuttgart was far from of raising awareness of citizens and providing space for public debate and citizen engagement. The setting of the depot station for testing fully automated did not provide opportunities for any interactive deliberation between policymakers and citizens for contributing to everyday mobility issues in Stuttgart, but it rather enabled opportunities for testing economic optimisation for SSB and other companies.

Project Athena

Since 2017, Bosch and Daimler have formed a legal entity to bring level four and level five on the streets while operating as one entity. The outcome of this agreement is the project 'Athena', which is one of the most important projects of the Daimler-Bosch cooperation.

[102] https://www.ifv.kit.edu/forschungsprojekte_973.php (own translation)

The project 'Athena' is about developing and testing robo-taxis in order to catch up with Google's daughter company Waymo in the competition for automated driving. In the second half of 2019, the companies started pilot tests with robo-taxis in a free on-demand ride-hailing service – initially in California and later (in 2020) in Stuttgart. The mobility service is an app-based mobility service and involves self-driving robo-taxis designed for city driving and offering free shuttle service on selected routes. However, the vehicles will have a steering wheel and a safety driver. As part of the cooperation, Bosch provides technology such as sensors, actuators and control units while Daimler provides the vehicles and test facilities. As an interview participant from Daimler Mobility Services described:

> So, we are working together to develop the automated driving kit, the software, the sensor kit, also working on the integration of the vehicle (…) It's about the vehicle…developing the vehicle itself and then what mobility services we use for that vehicle (Interview 24, 2019, p. 5).

For Daimler the most important thing is to develop the IT in the vehicle as fast as possible, so that they do not have to ask Waymo, which is far ahead than Daimler in terms of software technologies as well as mobility services. In this sense, Daimler needs to maintain its independency in terms of both vehicle production and the platform in which the vehicle will be used. According to an expert at Future Mobility Bosch, for Bosch, which is considered a leading manufacturer of radar, ultrasound and lidar sensors without which automated cars cannot drive, this collaboration is mainly an adjacent business (Interview 31, 2018). This is because the competitors of Daimler, including Waymo, also buy their accessories from Bosch. On the contrary, Daimler runs the danger of becoming a mere contract manufacturer for new high-tech companies[103]. Therefore, it is vital for Daimler to be ready for the competition to survive in the new market, and they have already acknowledged that they cannot stand alone.

The City of Stuttgart plays a role in this collaboration too. As a first step, the Bureau of City Planning and City Renewal, the Office of Building Regulations, the Bureau of Public Affairs, and the Department of Economic Development have been discussing with Daimler where the test route should be, what the requirements for the route are (especially for the stops) as well as if there are requirements for traffic lights (Interview 25, 2019). The City, in this case, is in discussions with Daimler-Bosch regarding testing their automated ride-hailing services on public streets. However, it is yet to be seen if, when and where exactly this will happen in public ground in Stuttgart considering the difficult traffic situation in Stuttgart. At the same time, as an interview partner from the Department of Economic Development of the City of Stuttgart the City waits for the Athena project to start in Stuttgart, in order to have an open public discussion about automated driving:

[103] https://www.sueddeutsche.de/wirtschaft/autonomes-fahren-daimler-1.4230184 (own translation).

> I think when we start with the Athena project in Stuttgart, we will have a discussion with our administration, with the citizens, because we have to communicate what we want to do, and we have to inform the public that we start with this project, and I think it will start a discussion how automated cars will transform our society (Interview 25, 2019, p. 7).

This suggests that the City plans to include the citizens in the policymaking process after the decision for testing robo-taxis in public space is made, instead of having an open deliberation process with the citizens in advance. According to the interviewee from the Department of Economic Development City of Stuttgart, there has not been any substantial discussion between the City of Stuttgart and the citizens of Stuttgart so far, with the City arguing that this is because technology is still in an experimentation phase and that is why there have not been any pilot projects or tests on public streets in the city yet (Interview 25, 2019). This implies a tendency to pre-define scenarios and potential outcomes at industrial settings, namely the setting of Daimler-Bosch legal entity, in the first place, rather than including the local citizens in the decision-making from the beginning. The industrial setting in this case excludes a wider range of actors, such as civil society and citizens. Tschoerner (2019) in her study on policymaking of electric mobility in Munich confirms this tendency in policymaking for mobility technologies: '*citizens are recipients of these services (…) and therefore did not play a role in the conceptualisation of the development*' (Tschoerner-Budde, 2019, p. 202). Yet, as an interviewee from WRS mentioned, the City plans to use the results of testing robo-taxis in public space as a trigger for enforcing regulations, '*because nobody wants to see cars driving around all the time using the streets as parking*' (Interview 22, 2018, p. 10). In this sense, the willingness of the City to facilitate automated ride-hailing services of the industry might resonate with the fact that they framed the municipal policy for automated driving towards public transport on-demand ride-hailing in the NVEP. In this case, it is likely that the City has adopted a 'wait-and-see' approach in regards with the availability of technologies and their testing on public streets, and then include them into regulatory framework. As the interviewee from the University of Stuttgart put it: '*the car manufacturers are not asking for anything specifically (…) so what can you do? So, for the City, it is more like lobbying (…)*' (Interview 28, 2018, p. 9). Whether the ride-hailing service of Daimler-Bosch will be eventually tested and under which circumstances remains to be seen.

4.3.5. Automated driving as a proxy for public on-demand mobility

> It is of course a tech race, but it will get connected to local governments and then it will be about who offers the best mobility services[104].

> The only way to differentiate yourself as a company is the mobility service. Of course, you have to have the tech race, but it is the service that makes the difference[105].

In the final version of the NVEP, it was described that an on-demand mobility service with mini-buses called 'SSB-flex' had been developed as a supplement to public transport in Stuttgart. The necessity for SSB-Flex was further rationalised based on one of the main conclusions of the MEGAFON study; that only ridesharing with automated vehicles in combination with high capacity rail public transport will contribute to future sustainable mobility in Stuttgart. Ultimately, as mentioned earlier, the MEGAFON study functioned as 'authoritative data' shaping the direction in which the City should promote automated driving by excluding other options. As Hajer (2005b) argued, this is a way to simplify and control uncertain and ambivalent situations, such as policymaking of automated driving. Against this background, the purpose of the SSB-flex service was framed in the NVEP as achieving the fastest possible and most comfortable overcoming of the last mile. The service was further framed as ideally suited to improving the development of outskirts or topographical special areas with limited accessibility to public transport. SSB-flex became fully operational on the roads of Stuttgart in June 2018. It was perceived as a precursor of automated on-demand services. It was expected that as soon as automated shuttles are available, mobility services of this kind will take a significant boost due to the reduced operational costs (i.e. no need for drivers)[106]. In particular, the argument of the City was that since the technology is not ready yet, the idea is to test on-demand services today using drivers to gather data and information about how the service works in the city. As an interviewee from the Ministry of Transport (Public Transport Unit) BW explained:

> I believe that SSB-flex is kind of, let's say, pre-testing. This can be, let's say, preparation for using automated cars in public transport later to try to find out about the market chances…Since there are no technological solutions right now that are useable for the public transport sector, they are not going into this. For example, if you see the automated cars or buses that are driving around Germany right now, they are usually from two or three companies, have six seats and drive fifteen kilometres per hour. There may be some fields where you can actually use this reasonably…For example, the last mile…this may be a solution for the last

[104] Expert from Institute for Automotive Industry, Workshop '*Challenges of EU Cooperative, Connected and Automated Mobility Systems: Theoretical Models and the Mobilities Paradigm*', 13.05.19 (author's recording).
[105] Expert from Daimler Mobility Services, Workshop '*Challenges of EU Cooperative, Connected and Automated Mobility Systems: Theoretical Models and the Mobilities Paradigm*', 13.05.19 (author's recording).
[106] Nahverkehrsentwicklungsplan der Landeshauptstadt Stuttgart, 8. Mai 2018 (own translation).

> mile; if you have the S-bahn line and you need to have a transport offer for the last four-five kilometres. But within the city we have larger buses, we have larger trains, we have higher speeds and there are no technical solutions for this right now. (Interview 30, 2019, p. 2)

This suggests that the availability of technology currently does not align with the needs of mass public transport in cities, namely speed and large size of vehicles. SSB-flex is a collaboration of SSB[107], with moovel[108] the on-demand service provider of Daimler. moovel's contribution to the partnership is the moovel on-demand platform, which was tested cost-free as 'Flex Pilot' in Stuttgart from December 2017 to May 2018. moovel had been initially testing the service late at night when public transit runs less frequently. Since this first testing was successful, the pilot phase was expanded to two other not very well-connected public transport areas and to the city center business area. After the end of the Flex Pilot, in June 2018, the SSB took over the operation of the service, and SSB flex was launched as a mobility service with minibuses combining routes and bundling passengers' travel requests in the abovementioned operating areas. Since August 2019, SSB Flex is available in the entire city and during the night. At these times, the frequency of public transport decreases in the inner-city area. The SSB-flex functions as a supplementary solution for local public transport during the 'marginal times'[109] enabling additional more flexible journeys in terms of space and time. As a representative of the Technical Board of SSB explained:

> With flexible, customer-friendly solutions, we want to complement the existing range of buses and trains. This allows us to close spatial and temporal supply gaps. The goal is for even more citizens to opt for public transport[110].

The SSB Flex is a unique case of a public-private cooperation between two local mobility providers, and an illustrative example of a new policy setting that allows old (public transport) and new actors (private mobility provider) work together. This cooperation resonates with what Fraedrich, Beiker and Lenz (2015) referred to as the hybridization of individual and public transport through AMOD (Automated Mobility On-Demand). They argued that '*the likelihood of local transport authorities engaging more in cooperation with private mobility providers might lead to renegotiating rules, regulations and access in the public transport arena'* (Fraedrich, Beiker and Lenz, 2015, p. 8). AMOD represent a niche focusing on the development of a completely new way of personal mobility, closely interrelated to the use of ICT, which enables fast access to vehicles or mobility services (Ibid). Currently, there are several pilot deployments of AMOD systems in Switzerland, Singapore, England as well as in the U.S. by new players, such as NAVIA

[107] SSB is 100% daughter company of the City of Stuttgart.
[108] Now moovel became REACH NOW due to the merging of mobility services between Daimler and BMW.
[109] https://media.daimler.com/marsMediaSite/en/instance/ko/Start.xhtml?oid=4836258
[110] https://www.ssb-ag.de/unternehmen/presse/detail/neuer-mobilitaetsdienst-ssb-flex-startet-am-01-juni-2018-in-stuttgart/ (Assessed 04/11/2019) (own translation)

and APTIV[111] (Maurer *et al.*, 2016). Yet, such a direct collaboration with the public transport authorities with the service branded and operating after the public transport provider it not very common. Under the storyline of supplementing public transport and by using metaphors like covering the '*blank spots'*[112]*, 'evening traffic'* and '*closing spatial and temporal gaps'* (Weber, 2018, p. 10), SSB and moovel have aligned their interests to provide people with optimised transport connections and multimodality. Yet, the different goals of each actor are buried within the storyline of supplementing public transport, which they share. In the following, the diverse goals of the two actors are analysed.

Becoming the integrator of mobility services

On the one hand, SSB is the reliable, safe and old public transport provider, which had been taking care of public transport for 150 years. Thus, SSB continues to provide the branding of the service (i.e. SSB-flex) as well as the control centre. In particular, the operator digital dashboard can be seamlessly integrated into the SSB existing traffic control center and was developed by moovel in close collaboration with SSB. SSB also provides the ticketing, as SSB flex is integrated in the VVS (Public Transport Tariff Association Stuttgart) public ticketing system. The contact person for the drivers is also the control center of SSB, while the drivers are SSB drivers. As SSB-flex uses virtual stops, the buses cannot wait for passengers at the pick-up point as in the case of public transport buses or trains. For SSB this on-demand service is a good opportunity to organise themselves for the digital transition as well as be the integrator of multimodal mobility services instead of just a carrier.

Interestingly, SSB Flex is the first on-demand service nationwide, which is operated with a line approval under the federal Passenger Transport Law. This means that normally the Passenger Transport Law only recognises two types of transport services; occasional services (rental car) and regular services (bus/rail transport). An on-demand mobility service is neither occasional nor regular service. The reason is because, according to the Passenger Transport Act, the stops must be there physically in public transport. But if there are virtual stops like in the case of on-demand services, it is not clear if the service is public transport or car rental. So, the legal conditions for on-demand transport are not there yet. Currently, most of the permissions for new mobility services are given through the experimental clause of the Passenger Transport Law and the experimental permission lasts for maximum five years (Interview 30, 2019). However, SSB Flex was the first on-demand service to be approved as a regular service. The Regional Council of Stuttgart (Regierungspräsidium) granted the necessary approval, according to the Passenger Transport Regulations, which also apply to scheduled bus services. The approval as a regular public transport service has been the outcome of SSB lobbying at the national level to include on-demand mobility services under the

[111] https://www.aptiv.com/ (Assessed 15/04/2020)
[112] https://www.moovel.com/en/featured-apps/ssb-flex (Assessed 05/11/2019)

Passenger Transportation Law, so that they can be controlled by public transport. The SSB acted to protect their monopoly as a mobility service provider and make sure that moovel will not be a competitor but an ally. Most importantly, SSB protects public transport from other potential competitors that would be difficult to control by providing the regulatory framework for making this service legal.

Maintaining the contact to the customer

On the other hand, moovel is the new mobility service provider that offers the platform software with a flexible approach living up to the digitalisation requirements. As mentioned above, the role of moovel is providing the algorithm of the on-demand platform behind the SSB Flex app, which bundles the travel requests of the users intelligently (pooling), thus enabling the ridesharing. The moovel on-demand platform is made up of different components. There is the app for the driver, which guides them through the business area by taking the latest traffic information into account. The customers have access to the passenger app, which allows them to find routes and book tickets. The underlying system uses intelligent algorithms to pool journey requests and incorporate and combine different mobility modes (i.e. bus and train). This enables intermodal routing - connecting different modes of public transportation within the city. In other words, moovel offers the software technologies that enable the multimodal mobility service. At the same time, according to the interviewee from Daimler Mobility Services, moovel recognises the complexity of providing mobility in cities. Therefore, they needed a reference framework to operate within. This reference framework is public transport and the regulatory framework around it:

> We know we are depending on how complex the local transportation system is (…) We need policy or regulation regarding existing shared mobility, because that is likely going to be a model for automated mobility as well (…) I think the automated part is just like an add-on to existing modes and by making vehicles automated and connected we will be able to improve concepts we have today. I don't think it will be something fundamentally different from anything we have today in terms of transport modes. Our approach is looking at all use cases we have and see what we can optimise if we make transport automated and connected (Interview 24, 2019, p. 1, 2).

This approach reflects the uncertainty of the automotive industry about the future of mobility in general, and the lack of a concrete vision about the implementation of automated driving mode-wise. Once again, automated driving is not at the core of the argumentation; it is perceived as an add-on to shared services and transport modes. The industry here looks at all use cases trying to figure out the use case that will provide them with certainty and relative stability. In this case, operating within the framework of public transport mitigates the uncertainty, and helps the industry to share the risk and responsibility of providing mobility. What is new for the automotive industry in this case is the notion of service itself. Filkorn and Müller (2011) in their paper 'Selling Mobility

instead of Cars', argue that the car industry has realised that they need to expand their business beyond being a pure car-manufacturer. Thus, the car industry attempts to diversify their business by expanding towards mobility services because of the global competition coming from the ICT industry (e.g. Google, Amazon). Therefore, they need to sell mobility and not only cars, in order to survive. This might explain why some years ago Daimler started with Car-to-Go and moovel. It might also explain why Daimler is now cooperating with BMW on merging their mobility services and on developing automated driving. Another example is that Daimler has developed their own infotainment system called MBUX within the company compared to BMW that bought Alexa from Amazon[113]. According to the interviewee from e-mobil BW, Daimler put a lot of effort in developing their own system as a strategy to keep the connection to the customers within the company. For example, through their own infotainment system, Daimler now offers also services as a provider for restaurants. Thus, for the automotive industry there is now a layer in between, because it is the company that provides mobility that has direct contact to the customer and not the company that sells the vehicle itself. So, the threat for the car manufacturing industry is that they lose the contact to the customer and that translates to a loss of value for them (Interview 27, 2019). From this point of view, it is beneficial for them to cooperate with public transport. As an interview participant from the Ministry of Transport Baden-Württemberg put it:

> If you compare the number of people sitting in the cars in on-demand traffic on average, if you have cooperations usually the number of people sitting in the cars is a bit higher. I believe the reason is that they look at the times when trains arrive or leave. So, you have this connection also, you have a better communication towards the people commuting already with public transport (Interview 30, 2019, p. 12).

Since the traditional mobility providers in cities are the public transport companies, it is not enough for the automotive industry to ally only with other automotive companies, suppliers (e.g. Bosch) or software companies. They need to cooperate with the public transport companies, because they are the only ones who know the complexities of the urban transport system, who have direct contact to the people already using public transport and can also provide the regulatory framework for the services to operate. Especially, in Stuttgart where the hilly landscape, the road network and the traffic congestion might not allow for other use cases (e.g. private automated cars, car platooning), it was probably the safest choice from moovel to cooperate with public transport.

[113] BMW has a different strategy when it comes to the connection to the customer, as it uses Alexa from Amazon, which works very well and it is quite competitive in the field of infotainment systems. So, BMW exchanged giving Amazon the connection to the customer with the certainty of guaranteed quality (Interview 27, 2019).

'It is not so much about the tech; it is about the service'

Coming back to the quotes at the beginning of this section, in the case of the SSB-flex initiative policymaking has been indeed more about the mobility service than the technology of automated driving per se. This suggests that automated driving is not the main objective of policymaking, but rather once again a proxy for another objective, namely on-demand mobility services. As several interviewees pointed out, in terms of mobility as a service, from the user perspective it doesn't matter in the end if there is a driver driving the car or if it is automated, because there is no car ownership and the users are driven back and forth anyway. The local public transport authority (SSB) is rather careful regarding the extent to which they allow private companies with growth strategies to become mobility providers, because they are aware of the risks of taking the ridership from the public transport and worsening the situation on the roads of Stuttgart. As an interview partner from Future Mobility Bosch explained, as the local authorities are already aware of that, they will probably be even more careful in getting automated mobility services to the city (Interview 31, 2018).

While connectivity is still present in the SSB-flex initiative, it seems to somewhat refrain from the ubiquitous connectivity of the first storyline that is disconnected from local realities. There are connectivity elements (i.e. traffic information through App, virtual stops) but more in the sense of multimodality, coordinating the different modes through a digital app. However, there is no connectivity in the sense of 'magical lines' connecting vehicles with each other or connectivity with traffic lights. Connectivity here has to do a lot with developing a service that integrates travel requests and information about different modes (enabling multimodality) and making public transport more attractive. In this sense, it is about optimising the existing connectivity. As an interview participant from the Ministry of Transport BW puts it:

> The connectivity is important to increase attractivity. But we have that already today; we have the integrated control centres for public transport and if your train is delayed for like two or three minutes and there is the risk that you miss your bus, in the best case the bus driver gets the information that they should wait for you. So, that is connectivity, what we already have today; we have connectivity in the travel information systems, in the trains, for example, we can already see our connections. The problem today is that we have a lot of different systems and sometimes you have one information here and the other there and you don't know which is correct. You can find solutions for this, you just need to try to define standards and to increase the connectivity of data flow between these systems, but this is for increasing the attractivity (of public transit) and not necessarily for automated driving (Interview 30, 2019, p. 13, 14).

This is how the 'connected transport system' that was staged mainly from above (State and Region levels) is translated and relegated to an on-demand public-private mobility service where the local public transport is the provider. What is striking once again is that all these initiatives revolve around the niche of public on-demand mobility, while

automated driving is in the background, not in the forefront. The local actors and the media phrased SSB-flex as the precursor of automated driving, but in practice there has been no concrete initiatives taken towards the implementation or testing of automated driving in Stuttgart. Despite there were debates at the local about how automated driving should be promoted in Stuttgart, and it was eventually restricted into the sphere of public transport and on-demand services, automated driving remains a proxy to legitimize other policies, just as in the case of the first storyline.

4.4. A policymaking of relegation: narrowing down the proxy

This chapter presented a trajectory of relegation in policymaking of automated driving as the topic was narrowed down from an abstract economic and technological approach to a specific approach for urban mobility. This played out through two distinct storylines, namely fostering a connected transport system and supplementing public transport. This trajectory is different to the one in Munich, where a narrow approach was diversified into multiple options. The analysis showed that this relegation had a lot to do with the settings and the actors involved in each storyline: in the first storyline policymaking started with a wide range of industrial alliances and networks and governmental levels, while in the second storyline it became a local matter. Practices and narratives on the objective of policymaking were also important. In regards to the hypothesis formulated in the introduction: that the policymaking of automated driving has a different objective than the implementation of automated driving per se, the analysis showed that automated driving has been unfolding as a sub-objective or a proxy in policymaking for legitimizing or backing up other policy objectives, ranging from electric mobility to 5G connectivity to on-demand mobility services. This implies that the objective of policymaking itself has been changing. After summarising the analysis through contrasting the two storylines and their components, this concluding chapter turns towards the insights into policymaking and its impacts through a discussion of how the two storylines interact.

A connected transport system vs. supplementing public transport

One of the most interesting findings of this case study was that actors have been continuously changing the objectives of policymaking in relation to automated driving over time. In the case of Stuttgart, the topic of automated driving gained initial traction in policymaking at the State BW level. In the early 2010s, it was conceived as a purely technological solution to deal with the potential loss of jobs that electric mobility could bring about due to the replacement of the combustion engine. Initially, the State government BW focused on the electric passenger car with some automation functions (i.e. automated parking). Gradually, the policy objective started shifting from the car to the environment around it, placing it in a wider context of a new connected mobility system. Being influenced by the international competition in ICT technologies and data-driven services, the actors in BW and the Region of Stuttgart started forging networks and alliances as new policy settings between different industries, science and public

institutions. The main policy objective was to foster the convergence between automotive production technology and ICT sector. Automated driving was perceived as a part of this digitalisation economic strategy. The politicians in BW had already included automated and connected driving in their strategies for digitalisation before the federal government published the federal Strategy on Automated and Connected Driving, and they lobbied for the development of a roadmap on automated driving at the federal level.

But what was actually the role of automated driving in the economic restructuring of the State-Region? The first storyline of fostering a connected transport system revealed the strong focus of political actors (mainly the State BW Ministry of Economics and the Region of Stuttgart) on fostering technological innovation through automated and connected driving as a boost to the economic restructuring of the State. In practice, automated driving meant a little more than strengthening the economic competitiveness of the State-Region and reinventing the brand name of Stuttgart as a business location. This policy storyline has been present in policymaking for automated driving at all three levels of governance in Stuttgart (i.e. State, Region and City). The topic of automated driving was picked up by the local politicians in Stuttgart only when Stuttgart applied for becoming the test field for automated and connected driving in BW and failed. Practically, the City supported the Region and Deutsche Telecom on enabling the conditions for the expansion and implementation of 5G connectivity through establishing a new policy setting (GRS) for coordination. Yet, the City was not willing to change a lot in existing hardware infrastructure (such as roads and traffic lights) in terms of connectivity, but rather expected that automated vehicles would have to adjust to the city as it is. There was no discussion on including the citizens on the policymaking for automated driving. Initial City Council proposals in Stuttgart, called for expert discussions on automated driving, further research, and the need for regulatory measures. Overall, the storyline of fostering a connected transport system reflects a rather industrial-political top-down vision of restructuring the economy of the State-Region, in which the local actors engaged but did not initiate. This vision represents more of an economic vision rather than a mobility one, while automated driving has never been at the core of policymaking.

One key event and one key practice signified the emergence of an alternative storyline, namely supplementing public transport, which played out mostly at the local level. The key event was transferring responsibility of automated driving from the Ministry of Economy to the Ministry of Transport and the key practice is the MEGAFON study, which was funded by the Ministry of Transport. Faced with the everyday conditions of Stuttgart's mobility, local politicians began to scrutinize what automated driving meant for the local mobility realities. As mentioned earlier in the first part of this chapter (Context), at the local level, which is governed by the Green party since 2013, mobility policymaking has been focusing on solving the local issues and not so much on the internationalization and competitiveness. As such, the City Council started criticizing the abstract visions of the industry for a hyper connected transport system, challenging the automotive industry to be clear about the exact contribution of automated driving in sustainable mobility. The City Council was once more divided. On the one hand, some politicians argued for a laissez-faire approach for automated driving, expecting from the

industry to set the requirements. On the other hand, other members of the City Council argued for a regulatory approach where the City should take control over the implementation of automated driving. Despite the opposition, the results of the MEGAFON study were deployed by the Mayor and the administration of the City of Stuttgart to argue for an implementation of automated driving in the form of on-demand schemes as part of public transport. This resulted to the inclusion of automated driving in the 2018 Local Transport Development Plan as part of on-demand public transport shuttles, arguing that urban development objectives, such as strengthening public transport should not be subordinated to the industry's innovations. That is how the City displaced the topic of automated driving to local public transport. These arguments were not seen in the State-Region policy or in the initial discussion local political actors had on automated driving in Stuttgart. They were thus a result of a reflection on the impact technology-driven policy for a hyper connected system could have on the complex socio-technical context of Stuttgart.

Even though the City demonstrated decisiveness, the topic of automated was dealt with only on a conceptual level. The local authorities in Stuttgart have been avoiding having public tests and having an open debate with the public. Testing automated buses on a private ground at the depot station was all about economic benefits and collecting data from the tasks the buses performed. The City rather dealt with the issue of automated driving indirectly by developing a policy and regulation for on-demand shuttles. It seems that since the local government started steering the policymaking process, automated driving reflected more a process of developing a mobility service than a technological race. Policymaking started refraining from abstract connectivity visions and has been more tailored to the limitations of the context of Stuttgart, filling the gaps of public transport where necessary.

Overall, the first storyline is both discursively and practically unspecific in terms of what automated driving meant for urban mobility and versatile in terms of the objective of policymaking per se. The second storyline is discursively clear and decisive about automated driving being part of public transport. In both storylines though, practically there was ambiguity and hesitance in terms of how automated driving can be implemented. Eventually, in the policymaking arena of Stuttgart, automated driving has never been a policy object itself. Its discursive and practical production rendered it an add-on, shifting from an add-on to electric mobility at the beginning to an add-on to public transport more recently.

The components of policymaking

The two policymaking storylines reflect two distinct sets of components of policymaking, namely actors, settings, technologies, narratives and practices. The connected transport system storyline was shaped by its experts: ICT and automotive industry, research and top-down politics (State-Region). Even though the City Council was somehow present, they did not have a big role in initiating and shaping the policies. Due to the diversity of technical experts and the lack of suitable policy settings for deliberating the complexity

of the new connectivity and automation technologies, new hybrid policy settings were created (such as the Forward IT alliance, the TechNET connected car and the Gigabit Region Stuttgart-GRS), where techno-centric narratives such as the car as a container and connectivity as the backbone for mobility were developed. The governance structures of the triangle State-Region-City demonstrated flexibility in creating new institutional settings for dealing with new technologies. In general, the practices are revolving around automated driving, but not only for automated driving. The times that the topic was taken to the City Council, local politicians saw through the lens of connectivity not so much a policy for sustainable mobility, but a policy for strengthening Stuttgart as a business location through a reinvention of the private car. Regarding the role of technologies, it was the availability of 5G that pushed forward a narrative of 5G as a prerequisite for automated driving, assuming that automation and connectivity are interdependent, even though from a technical point of view it is not clear. The same way it was the unreadiness of machine learning and computer vision that are needed for full automation that rendered automated driving a proxy for 5G connectivity and led to the setup of Cyber Valley as a hub for research.

The actors that produced the second storyline were, contrary to the first storyline, mainly local. The relegation of automated driving from the sphere of ubiquitous connectivity to public transport was mainly achieved by the public transport authority and the Green governing party, while it was also supported by the Ministry of Transport BW, which funded the MEGAFON study. Of course, these actors were present in the previous storyline too, but it was only when the practice of the MEGAFON study was put forward by the Ministry of Transport and the public transport authority that the local politicians saw the mobility aspect in automated driving. Characteristic is the absence of the ICT sector from this storyline. It is only the automotive industry that is still present in this storyline, but only as a service provider under the control of public transport. The practices of the actors reflect a more context-driven approach. Key-practices, such as including automated driving in the Local Public Transport Plan and the regulation guideline of restricting automated driving in public transport applications, and eventually developing a regulation to secure that on-demand services remain under the public transport show that the local actors took precautionary measures against laissez-faire approaches of private mobility providers. Even though the latter regulation was not about automated driving per se, in combination with the regulation guideline for relegating automated driving to public transport, it ensures that the fragile mobility situation in Stuttgart is protected. It is also an indication of how an uncertain and ambiguous policy issue, such as automated driving, can enact new regulation and change the dynamics between actors in policymaking. In this case, the precautionary course of action and the experience gained through lobbying for new regulation at the federal and the regional levels from the side of local government can provide opportunities for being more drastic in solving mobility problems in the future, no matter whether automated driving is implemented or not. The institutional settings in this storyline also played an important role for the development of policies. It was only when the responsibility of automated driving was transferred to the Ministry of Transport that the MEGAFON study

was funded, which in turn was picked up by the politicians to direct policymaking. The most crucial decisions on relegating automated driving to public transport were taken at the City Council. Surprisingly, despite the City Council is a setting with institutional bias in favour of industry, it was able to develop a very clear policy towards prioritizing public transport. Another surprise was the setting of the public-private cooperation between SSB and moovel, which led to new regulation in favour of public transport, even though moovel was part of it. Regarding the technologies that co-shaped the storyline, it was the digital platforms and Apps that blurred the boundaries between public transport and individual mobility and opened up a new arena for new collaborations, such as SSB flex.

How the storylines interact

Policymaking cannot be separated from its context. Both storylines are produced within the context of multi-level governance of Stuttgart. Therefore, as in the case of Munich, it would be false to claim that these two storylines are totally distinct. They have been interacting with each other throughout the case study. As already mentioned, the storyline of fostering a connected transport system emerged from an economic imperative of investing in the ICT sector in the State-Region. As such, the second storyline of supplementing public transport has been developed in relation to the central ideas of the former storyline. It communicates a new more pragmatic perspective of transport connectivity; its application in public transport in the form of on-demand mobility services. While connectivity elements were still there, when the issue went down to the local government, the concept of connectivity meant something different to restructuring the economy; connectivity meant making public transport more attractive in its everyday context and optimising the connectivity that already exists today. Digital connectivity might be useful for many everyday life purposes; education, telematics, traffic information etc. Yet, ubiquitous connectivity in the sense of everything communicates with everything would require big investments in infrastructure (e.g. traffic lights) and would add another level of uncertainty to the local policymakers regarding how this can tackle existing mobility problems. In other words, a hyper-connectivity approach to urban mobility has not managed to be effectively aligned with the urban mobility policy objectives. Thus, an alternative storyline is produced to bring these issues forward and incorporate the elements of connectivity that are relevant to policymaking for urban mobility. As a result, it fostered policies and regulations that protect public transport from competition and secure the leading role of the City in future mobility decisions regarding automation and connectivity. Policymakers through this storyline no longer assumed that a 'magical line' would solve mobility problems in an abstract way. They instead tried to bring automation and connectivity into the realities of the city.

What does the case study of Stuttgart contribute to understanding multi-level policymaking in flux and the institutional void? The case shows that a specific trajectory of multiple translations of automated driving from the abstract to the specific induced policy change. Over the course of the two storylines, automated driving has been 'traveling' across diverse old and new policy settings, engaging a range of public and

private actors, and was eventually relegated into a specific mobility niche at the local level. The relegation of automated driving represents a particular type of movement of policymaking that allows the actors to actively critique and narrow down industrial visions, while in the process they made concrete decisions for the future of mobility technologies in the city. Overall, the inherent uncertainty and ambiguity surrounding the topic of automated driving rendered it a signifier that has been accompanying other policy objectives without being dealt with directly. The impact of this was the creation of new settings for dealing with new technologies, lobbying and eventually developing new regulation in favour of public transport. The recognition of the need for contextualisation and specification of new technologies by the local actors led them to develop new policies. In other words, the case of Stuttgart shows how an ambiguous policy issue, such as automated driving, was used to achieve policy change by touching upon different policy objectives. It shows a productive way of filling up the institutional void.

5. On the impacts of the non-implementation of automated driving

In light of uncertainty and ambivalence, this study has developed an analytics of policymaking of automated driving using storylines, and empirically investigated how automated driving has been discursively and practically produced as well as the practical implications of its production. The analysis showed that the objective of policymaking has not been the implementation of automated driving per se. Instead, automated driving functions as a proxy for the legitimization or rethinking of other issues. The analysis revealed a hybrid policymaking of automated driving characterised by two distinct approaches, which interact; an industry-focused approach and an urban approach as operational discourses that coordinate the actions of policymaking and are also (re)defined by them. These two approaches can also be seen as operational discourses that are different to overarching fundamental discourses, such as neoliberalism or smart cities, in the sense that they reflect how policymaking is approached in practice, instead of which ideational discourses drive the process of policymaking. There are certainly several ideational discourses embedded in the two operational discourses identified in the analysis, but it is beyond the scope and interest of this study to analyse them. Even though the storylines are different in each case depending on the context, they reflect the same approaches for both case studies, Specifically, the storylines of fixing the system of automobility in Munich and fostering a connected transport system in Stuttgart reflect an industry-focused approach, while the storylines of fostering new mobility services in Munich and supplementing public transport in Stuttgart reflect an urban approach to policymaking. It was only when the local actors connected automated driving with the urban realities, that it obtained a meaning beyond economic imperatives and industrial interests. Both case studies have revealed this in different ways. In the case study of Munich, it was when automated driving was treated as a distinct issue from the private car that enabled potentials and alternatives for the future of mobility. In the case of Stuttgart, it was an alternative public transport approach that narrowed down the potential of automated driving and made relevant for urban mobility.

This chapter discusses the two approaches to policymaking as a form of operational discourses identified in both case studies, namely an industry-focused approach and an urban approach. This takes place at a level above each specific case of policymaking and provides a broader discussion on fluid policymaking in uncertainty and ambivalence and the productivity of the institutional void. The chapter considers the three performative dimensions inspired from the performative approach to policy analysis, mentioned in the conceptual framework, through which the two approaches to policymaking are produced: (1) socio-technical scripting: the efforts to determine the characters and the settings of the play (policymaking) and to provide scripts for appropriate behaviour. (2) institutional settings: the physical situation where interactions take place, (3) the staging context where interactions are organised by determining the positioning and roles of actors and the audience. These dimensions and their interplay help to conceptualise and develop a larger picture of the impacts of the production of automated driving through policymaking. After discussing the two approaches and how they interplay, the chapter

will conclude by discussing general insights of this work to policymaking, technology and the institutional void.

5.1. An industry-focused approach to policymaking

Both cases were strongly rooted in an industry-focused approach to policymaking, especially in the first years of the emergence of automated driving in the policy agendas. This comes as no surprise, as especially Munich and Stuttgart and Germany in general are key locations of the automotive industry, which in both cases constitutes a vital pillar of the federal, state, regional and urban economies. A key difference between the two cases is that in Munich automation was seen mainly as an evolution of the system of automobility; an evolution of the car as an artefact and the system that sustains it. For this reason, the technologies deployed in policymaking revolved around incremental innovation to facilitate driving and increase comfort and productivity on highways, while ICT technologies were used at the service of the automotive industry to ensure its growth. On the contrary, in Stuttgart automation was seen at the service of digital connectivity, where the vision of ubiquitous connectivity prevailed as a means of regional and State BW economic competitiveness. Thus, the emphasis was on connectivity technologies, such as 5G, that would render the car a container connected to and controlled by a larger digital system. This approach reflected a seemingly disruptive approach mainly based on ICT, aiming to catch up with global developments from Silicon Valley. Here the automotive industry itself is not the main player, but rather the ICT industry gains increasing importance for the State-Region and is a game changer for the automotive industry.

Overall, one can argue that the industry-focused approach reflects two distinct ways of negotiating the future of automobility; an evolutionary and a disruptive one. The evolutionary way is strongly reflected in the federal policy and in the initial uptake of automated driving at the local level in Munich, and it mainly follows the path-dependencies of the established automotive industry and federal policymaking. The evolutionary way represents a re-articulation of the old promise of the car, where the main focus is to fix the technology within the car (Wentland, 2017), turning the automated vehicle into an improved substitute of the conventional car. Here innovation comes mainly within the automotive industry, reproducing the dominance of what Urry called '*a self-organising autopoietic, non-linear system*' (Urry, 2004, p. 27), which is able to adopt to changing socio-technical conditions. The disruptive way is reflected in the hyper-connectivity visions of the State-Region of BW and partly in the initial uptake of automated driving at the local level in Stuttgart. The disruptive way represents, as Wentland (2017) would put it, finding a new purpose of the system of automobility, which is rooted in the convergence of ICT and automotive and in a shift from product to service, where commuters become passengers instead of drivers. In the same line, Fraedrich, Beiker and Lenz (2015) would call this a revolution of automobile usage, where the key players and settings are established within the system of ICT, while within the system of automobility, they remain institutionally nebulous and unstable.

In a policymaking context dominated by the automotive and ICT sectors and top-down politics (federal government, State BW, Region of Stuttgart), it seemed hard for local policymakers in Munich and in Stuttgart to translate automated driving into urban realities. In Munich, local policymakers initially transferred the federal policy into Munich by conceptualising automated driving as the further development of assisted driving and Munich as a leading city in automated driving. This is further manifested by the strong dependence of the local level on the federal level and the industry to secure funding and support for a research project on automated driving. The only efforts that local actors made towards translating automated driving in the city context was slightly considering the implications of automated driving in city traffic and including the public transport authority in the application for the research project. Similarly, in Stuttgart actors saw automated driving as an opportunity for Stuttgart to become a major high-tech location in ICT and automotive, where the reinvention of the car as a container would take place. Here again, Stuttgart tried to ensure funding from the State of Baden-Württemberg for hosting the test field BW. In addition, the City of Stuttgart supported the decision of the Region to implement 5G as the backbone for automated driving and digitalisation. While there were some objections in the City Council regarding the risks of automated driving and there was a clear decision that the City does not support automated driving in terms of ubiquitous connectivity, especially in traffic lights, these efforts were not enough to specify the relevance of automated driving for the city.

Overall, the industry-focused approach, which is manifested in both cases in two different ways shows a detachment from the urban context, and in both cases reflects a revision of the system of automobility through technology. The different ways this is manifested in the two cases represents the ambivalence between evolution and revolution, which is a crucial debate revolving around automated driving in general. In order to understand how an industry-focused approach is materialised in policymaking and what its impact has been for policymaking in flux more broadly, in the following the two case studies are discussed in three key contextual dimensions through which automated driving has been producing in policymaking in the two cases: socio-technical scripting, institutional settings and the staging context where policymaking has been performed.

The socio-technical scripting of automobility

As already mentioned, both cases reflect ways of renegotiating the system of automobility. This is not a coincidence, as both cities are characterised by a long history of car-centric planning, as it was briefly outlined at the beginning of both case studies (Sections 3.1. and 4.1.). While the actors in the case of Munich aimed at a substitution of some elements of the car as a form of a technological fix, the actors in the case of Stuttgart attempted to break away from the established path-dependency of automobility by broadening the technological vision to ubiquitous connectivity with undefined mobility modes and business cases. Yet, in both cases the main framework of reference was the system of automobility, as it is deeply rooted in the policymaking routines and values of

automobility. The idea of 'car-friendly' city was inscribed in the mobility history and infrastructure of both case studies. After the World War II, the term 'car-friendly' city was coined as a paradigm for economic development and well-being of West Germany. The paradigm of the 'car-friendly' city conceived techno-centrism, functionalism and efficiency as the main principles of the modern city. The car was perceived as a promise for free flow of individuals and goods, success, strength and flexibility among others. To live up to these promises, urban planners started planning for infrastructure to optimise and increase the capacity for private car use, such as wide highways and tunnels (Reichow, 1959). At the same time, for many decades now the automotive industry has been dealing with the unintended consequences of the car through incremental technological fixes within the car. This tendency for incremental innovation within the automotive industry continues to play out until today. In the case of automated driving, the automotive industry combines the tendency for incremental innovation with an attempt to adjust to the challenges and rapid changes that global digitalisation brings about. This is what the example of automated driving in the case of Munich reflects.

Even in the case of a hyper connected transport system in the case of Stuttgart, a lot of the old promises and deterministic rules of the system of automobility are rearticulated. The new belief in big data seems to be the rebirth of the old utopia of free flow of traffic without any congestion and losses of energy and time (Schmucki, 2001). In this rebirth, connectivity is considered as a rule and a backbone for optimisation of traffic assuming that if we have control over where everybody goes through real-time data, we can optimise traffic systems. A good example of the discursive framing of this rebirth is the title of the presentation of a keynote speaker from Siemens at the mobil.TUM conference in 2018: 'Data as fuel of future mobility – AI as its engine'[114]. This framing of data and AI in terms of the car re-enacts the old promise of the automobile for optimisation and efficiency through technological innovation, this time through big data. Yet, engineers and policymakers have never had full control over the dynamics of urban space, as cities are highly complex and ever-changing places. The promise of control through technology has rather been an abstract but very persuasive ideology to generate (perceived) certainties, legitimacy and orientation for policymaking in an increasingly ambivalent and uncertain world (Kesselring, 2016), while it usually served economic purposes beyond improving urban mobility. Accordingly, the promise of automated driving is used through an industry-focused approach to secure and legitimize the economic growth and dominance of the automotive industry as well as to secure a competitive position of the ICT industry.

Even though nowadays it is clear that the system of automobility has a big impact on air and noise pollution, use of space and traffic accidents in urban areas, it seems it is still difficult for policymakers to break away from the core principles of automobility. This socio-technical script influenced policymaking for automated driving in both cases. This explains why through the first storylines of both cases, actors did not manage to specify

[114]https://onedrive.live.com/?authkey=%21APiNvCMZD70cDng&cid=F7E685CFA02B890E&id=F7E685CFA02B890E%21620877&parId=F7E685CFA02B890E%21620786&o=OneUp (Assessed 15/11/2018).

and promote other modes of transport beyond the car; in Munich by directly referring to incremental innovation within the car and in Stuttgart by broadening the technological vision about ubiquitous connectivity around the car. Overall, the industry-focused approach shows that when the production of automated driving takes place through the automobile frame, it obscures the potentials and perspectives that its production through the frame of alternative modes of mobility might bring. Through the industry-focused approach, actors attempt to construct certainties following the path-dependent scripting of automobility anew, which does not seem to align with the challenges and needs of cities. The values and norms of automobility are inscribed in automation and connectivity technologies, producing similar techno-centric perceptions and policies. This can be better understood in contrast to the urban approach (Section 5.2.).

Between old and new institutional settings

In terms of the institutional settings through which automated driving was produced and negotiated, there is rather an interplay between old established institutions and new settings. Traditionally in Germany, the triangle state, automotive industry and research has been steering automobility policies. This triangle has solidified a framework for the organisation for road infrastructure, growing demand of car use and need for traffic flow, in order to capitalize on private car mobility. This stems from a long historical tradition of the state ensuring the well-being and the progress of automotive industry rooted in the belief that technological progress renders Germany a global economic force and a progressive society (Canzler and Knie, 2016; Wentland, 2017). Indeed, both cases revealed that an industry-focused approach to policymaking spans beyond the field of mobility policy. Automated driving was developed as a policy issue for economic competitiveness and investments in digitalisation. In the case of Munich automated driving emerged as incremental innovation at the R&D settings of the automotive industry for its growth, while in Stuttgart it emerged in the form of automated parking as an add-on to electric vehicles at the R&D settings of the State Baden-Württemberg to compensate for the job loss from the electrification of the engine. In both cases, the starting point of emergence of automated driving was the private car. These ideas have been embedded in the traditional organisation of Ministry administrations, the funding frameworks and top-down processes of policymaking. In the case of Munich, the traditional institutional settings of automobility are reflected more clearly. The project groups, roundtables and private meetings were all public-private settings for developing strategies between the automotive industry, research and the federal government with the slight involvement of the ICT industry. Even when the local level started engaging in policymaking through more flexible settings, such as the Städtetag, informal meetings and the Inzell Initiative, it was clear that it adopted the top-down policy guidelines that arose from the deliberation between the federal government and the automotive industry.

In the case of Stuttgart, while the traditional arrangement was still present, the institutional settings were more diverse and new settings were devised due to the

broadened technological vision of connectivity. Furthermore, policymaking did not emerge through the federal government settings, but through the State of Baden-Württemberg, which is often referred to as `the cradle of automobile'; the place where the automobile was born. As such, the local automotive industry is pivotal part of the citizen identity and prosperity in the State-Region, which makes it a matter of regional importance (Mögele and Rau, 2020). As explained at the beginning of the case of Stuttgart, the governance arrangement is different to Munich, in the sense that the State BW, the Region and the City of Stuttgart are inextricably interrelated. Therefore, it happens quite often that the City depends on the State BW and the Region for funding and strategic guidelines for policymaking. Since the State-Region feared that their position as a global location for automobile production is threatened, they decided to restructure the economy through parallel investments in the ICT sector. Thus, inevitably the institutional settings should diversify. These settings, such as IT networks and working groups integrate new powerful actors and visions from the ICT sector, who have been well-established within the system of ICT, but quite marginal and institutionally unstable in the system of automobility until recently. These new settings do not undermine the automotive industry, but they rather aim to develop a symbiotic link between the two sectors. Yet, the automotive industry has not always been present in all settings. For example, the setting of Gigabit Region Stuttgart (GRS), created for coordinating the implementation of 5G, did not include the automotive industry as an actor, yet the automotive industry might be affected by its decisions. It is still unclear how the new settings for digitalisation and connectivity will influence the system of automobility. This is because while the traditional settings have the potential to reinvent the system of automobility in an autopoietic way, the new settings are new locations for policymaking that impose external pressure from new ICT players on the system of automobility. Once again here when the topic was taken up in the local setting of the City Council, the local actors repeated a similar economic rhetoric for Stuttgart as a high-tech location, with the difference that they rejected ubiquitous connectivity and were more focused on the reinvention of the car. Overall, both cases showed that the institutional arrangement of automobility still holds power in steering policies and funding research and development, even though there is external pressure from the ICT sector.

Technical expertise and the social

The settings defined the ways actors were staged to produce an industry-focused approach to policymaking. They define who had the right to make decisions and the power to steer policies, and who was the recipient of these policies. In other words, the settings defined the staging context of policymaking; the different roles and positionality of the actors on stage and the audience. As such, an industry-focused approach is based on the technical expertise of engineers, computer scientists and technically trained administrative officials. This technical expertise defined how they approach policymaking in a technocentric. Therefore, it comes as no surprise that in both cases the first storylines were detached from the urban context and the social. Policy guidelines

were formed by exclusive groups of experts without including citizens or civil society groups. Citizens were rather passive recipients of those policy guidelines; they were the audience. Partially, it was also the local actors who passively accepted or took up the top-down policies. Yet, in both cases there has been some resistance or differentiation in the positioning of the local actors. Specifically, in Munich even though the local actors conceptually followed the federal car-centric policy, they lobbied for being part of policymaking of automated driving, which up to that point was restricted to highway use cases. In Stuttgart, some of the local politicians (e.g. the left party) expressed concerns about the risks and the big promises of automated driving and rejected ubiquitous connectivity. Furthermore, in both cases local actors were clear about their non-willingness to invest in new hardware infrastructure for automated driving, such as traffic lights, arguing that they do not have the capacity to deal with the rapid changes and the uncertainty of ICT technologies. This differentiated positioning of the local level took place in the setting of City Council in both cases. It was through the setting of City Council that ICT and infrastructure actors were kept out of the local policymaking, while the 'traditional actors', such as local politicians, City administration and automotive industry were included. Yet, the analysis showed that mainly in Munich this decision was aligned with the interests of the local automotive industry to focus on technology within the car, which revalidates the expert-driven staging of policymaking.

Overall, the role of the public sector in both cases was to facilitate different kinds of industry, with the local level being more protective of the automotive industry. The public governing entities are assumed to be responsible for providing frameworks for mobility in collaboration with the industry, while citizens have not been engaging in the deliberation of these frameworks and policies. The staging context is thus interrelated with and reflect the socio-technical scripting and the settings of policymaking. Deeply rooted assumptions and infrastructure tailored to automobile have been scripting and producing old and new settings, even the ones that are institutionally unstable due to the emergence of new ICT actors. In turn, these two elements affect the staging of the government, state, region and partially City as responsible for facilitating the industry and providing frameworks for new technologies, while citizens are to receive pre-defined policies. This raises a wider concern of how the social is represented through an industry-focused approach to policymaking. The analysis shows that an industry-focused approach rather assumes that the well-being of society is aligned with the well-being of the economy and technological progress. The technical is rather perceived as fixing the wrongs of the social perpetuating the old hope for societal redemption through technology (Kröger, 2016). This representation of the social, though, is reductive, as it neglects the everyday practices, complexities and needs of urban societies. Yet, even though the production of automated driving within the settings of an industry-focused approach has not provided contextualised policies for cities, it provided a framework of reference for an alternative urban approach to policymaking, where the idea of automated driving and the uncertainty it brings along were deployed to rethink and create urban policies tailored to everyday problems.

	INDUSTRY-FOCUSED APPROACH		URBAN APPROACH	
	Munich	Stuttgart	Munich	Stuttgart
SOCIO-TECHNICAL SCRIPTING	evolutionary: automobility reinventing itself	broadened and seemingly disruptive: data as the new fuel	beyond the car, dispersion of AD to diverse modes and urban issues, open to different providers	beyond the car, relegation of AD to public on-demand buses, public transport as the only provider
INSTITUTIONAL SETTINGS	traditional (federal government, automotive, R&D)	diverse: both traditional and emerging (ICT, automotive, State-Region, research)	re-strengthening of existing policy settings (City Council, Perspektive München)	co-existence of existing and new policy settings (City Council, public-private cooperations), City in the lead
STAGING CONTEXT	technical expertise in power, state facilitating industry, citizens as audience		hybrid forms of expertise (technical and experiential), discursive acknowledgement of citizens as participants but not in practice	

Figure 6: Contrasting performative dimensions of the two approaches to policymaking of automated driving

5.2. An urban approach to policymaking

An urban approach to policymaking was developed in both cases in relation to the first industry-focused approach. The industry-focused approach has been influencing policymaking for mobility for decades, has materialised much of the infrastructure for mobility and has been important for global economy and constant flows of people and goods. Yet, this approach lacks awareness of the specificities of the cities and maintains a narrow perception of the social. Thus, it tends to create generic techno-centric visions that neglect the local particularities of cities. The analysis showed that the industry-focused approach alone could not create the trajectories of dispersion and relegation of automated driving in policymaking, which made an impact in terms of new perspectives

and regulations. Thus, the industry-focused approach reflected the more generic, and to a certain extent, global techno-visions of automated driving and debates on automation and connectivity, evolution and disruption. It was the urban approach that linked automated driving with the needs of the urban space. In addition, as mentioned in the introduction chapter, it is the local micro-interactions that shape the global. Indeed, the analysis showed that it is the cities that foster, modify and hinder the integration and implementation of specific modes of mobility, technologies and the ways this is done. Therefore, an industry-led approach cannot provide a panacea solution to the urban mobility problems.

The two case studies revealed a larger tendency of cities to mitigate existing mobility problems and develop policies for sustainable mobility. This tendency is manifested through a shift to mobility services ranging from on-demand mini-buses to ride-pooling to automated subway. The main difference between the two cases is that Munich was more diverse in the different modes and providers (both private and public) through which mobility services could be introduced, while Stuttgart was more assertive in public transport being in control of mobility services. This focus on mobility services has been referred to by several researchers as transformation of personal mobility meant to create new businesses, such as mobility on-demand for cities, combining personal mobility with public transport (see Fraedrich, Beiker and Lenz, 2015; Greenblatt and Shaheen, 2015; Stocker and Shaheen, 2018). In this sense, the finding that the presence of automated driving on the policymaking agenda can contribute to mitigating urban mobility problems, such as last mile, limited accessibility, urbanization and lack of space is not only specific to Munich and Stuttgart, but it is relevant for other cities too.

Industrial interests are still at play in the urban approach. The difference is that these interests interplay and coexist with the local goals for sustainable mobility and development. In Munich, there was a separation between policies for car use capacities (e.g. tunnels) and the potential of mobility services to solve transport problems. Thus, while the influence of the industry approach is still present in the urban approach creating ambivalence, it is precisely this ambivalence and how the local actors deal with it that gives birth to new ways of dealing with urban mobility issues. For example, in Munich, it was somehow taken for granted that there won't be any radical reduction of car use, so parallel policies focused on mobility services were developed to tackle mobility problems.

Overall, the urban approach through its focus on services instead of products presents a potential for new understandings and practices in urban mobility beyond the private car. Even though the cases presented two very different contexts of policymaking, their similarities have to do with the relevance of automated driving for improving urban mobility, the integration in mobility strategies and their similar potential to present new perspectives, understandings and solutions for mobility issues. They also present some similarities in the practices through which the shift from the industrial to urban approach was achieved. For example, in both cases it was only when the local actors started questioning a purely techno-centric approach through the use of 'authoritative data' from scientific studies that automated driving was integrated in urban strategic documents. As

the analysis showed, no concrete policy or strategy has been developed to implement automated driving per se. None of the two approaches has produced such an outcome. What the urban approach does though is making sense of and translating the industry-focused approach at the local level. In order to clearly show how the impact of this translation is materialised, the next sections discuss the production of an urban approach through the three performative dimensions of scripting, settings, staging, as done in the discussion of the industry-focused approach.

Scripting policymaking beyond the car

The urban approach was produced through a change of scripting against the socio-technical scripting of automobility, meaning changing the conditions, norms and the rules for how actors make decisions. While local actors were part of the industry-focused approach too, the scripting of automobility did not give them an explicit role to perform, so they played along with the pre-defined rules of the other levels (federal, state, region) and the industry. Yet, at the local level the scripting of mobility policymaking is more diverse but also more specific in terms of goals and values for mobility policymaking. This has to do a lot with the scale where the 'real' problems are visible, the landscape, the infrastructure networks that allow or inhibit certain interventions, but also with the more direct involvement of citizens in the local policy issues, even though in the case of automated driving citizens were not involved. Historically, the vision of the car-friendly city has been much more moderate in West German cities compared to the US. This means that cities have been embracing the principles of the system of automobility, but at the same time have been maintaining the liveability of city centres by investing in alternative modes of transport (e.g. cycling, public transport) (Voy, Polster and Thomasberger, 1991). The tendency towards alternative approaches to governing mobility was further enhanced with the environmental movement in the 1970s and 1980s, when both local politicians and citizens started recognising the impact of automobility on the environment. In parallel, the impact of the automobile on traffic congestion and urban space became focus points of the political action for the development of alternative modes of mobility in cities. In the case of automated driving, this tendency for an alternative scripting was further enhanced by the opportunities of digitalisation through new mobility services, which present a transformative potential for cities to combine technological and social innovation and solve problems that private motorised transport has induced.

Yet, this alternative scripting of mobility policymaking has been coexisting with the automobility scripting, to a higher extent in Munich and to a lesser extent in Stuttgart. In Munich, the tendency to develop policies for tackling the lack of space, urbanization and emissions by dispersing automated driving from the private car to a variety of mobility modes (e.g. subway, buses, ride-hailing) while maintaining traffic flows of private motorised transport is evident. In Stuttgart, which suffers from more severe traffic and air pollution problems, the local politicians were more protective of the fragile mobility situation of the city by narrowing down the abstract vision of ubiquitous connectivity and

relegating automated driving exclusively to public transport regulated on-demand buses. Yet, even Stuttgart demonstrated the tendency to facilitate the local industry by discussing the possibility of becoming a test ground for ride-pooling services of the industry (project Athena). This ambivalent scripting was manifested through new policymaking practices, such as integrating automated driving in a wide range of mobility and urban development strategies and developing regulation for recognising on-demand mobility services. Both cases ruled out the possibility of private automated cars in the city by displacing automated driving to other modes of transport. Ultimately, the everyday interaction of actors with local mobility issues and digital technologies developed new approaches to policymaking. These approaches integrate both elements of routinized practices of the past, such as tendencies for investment in public transport, and new dimensions invented on the spot, such as new regulations for public on-demand mobility. Overall, even without directly restricting automobile use, local policymaking shows potential for alternative, more versatile ways of governing mobility.

Strengthening the local settings

These alternative ways of governing mobility in policymaking defined the settings where actors negotiated policies. These settings were mostly local, engaged more local actors and produced contextualised narratives. Even though the local actors engaged in the industry-focused approach through local settings too, the techno-centric scripting did not allow them room for dominant and differentiated engagement. In the urban approach, automated driving was displaced from the settings of the industrial and governmental settings to the local ones. In Munich, this displacement was achieved through the uptake of automated driving at the urban development setting Perspektive München, where it was immediately connected with the sustainable urban development goals through scenarios. The Perspektive München is considered a participatory and inclusive setting, which engages a wide range of actors in decision-making for urban development and it is updated regularly (Zimmermann, 2018; Tschoerner-Budde, 2019). As such, it is dynamic, and reflects 'real-time' collective desires. After automated driving was linked to urban development issues, all interactions and negotiations took place within the settings of City Council, where district councils and local parties submitted proposals for tackling urban mobility issues through automated driving, making the topic even more relevant for the city. Surprisingly, the Inzell Initiative did not comprise a key setting for the urban approach in Munich, while it was the setting where automated driving was officially taken up by local actors in Munich in the industry-focused approach in light of the potential application for federal funding for a research project. While the ambivalent 'two-track' strategy that was established in mobility policymaking through the Inzell Initiative was still present in policymaking, its reproduction in traditional settings, such as the City Council, provided progressive perspectives on mobility without the industry directly leading policymaking, as in the past. While the interests of the industry were of course there, the role of the local planners and politicians was more prominent. In Stuttgart, it was when the responsibility for automated driving at the State BW level was transferred

to the Ministry of Transport, which in turn funded the MEGAFON study, that the urban approach to policymaking was formally introduced. Although this process did not derive from the local level, it produced the framework through which locally driven processes found legitimacy and changed the focus of planning towards public transport. Thus, the local actors built on this framework to argue for why automated driving should be only a public transport matter. While the main setting of local policymaking was once again the City Council, the local actors produced policy in new sub-political public-private settings, such as the SSB-moovel cooperation. Even though the City negotiated automated driving together with the industry in these new settings, it was generally the City leading the policymaking process through developing new regulation for public transport and deliberating what the benefits for Stuttgart could be.

One could argue that the case of Munich demonstrated a re-strengthening of existing policy settings (City Council, Perspektive München), while in the case of Stuttgart there was rather a co-existence between existing policy settings and new ones. Overall, despite their differences, both cases demonstrate that the strengthening of the local institutional settings and frameworks is crucial to developing a new approach to policymaking of automated driving. This strengthening is connected to diverse actors in the local politics, local administration and in hybrid political arenas beyond purely technical expertise. These actors live in the cities and are in contact with everyday problems. They are both policymakers of urban mobility and citizens that experience their own policies. For this reason, they have been able to contextualise new technologies or at least imagine how they could fit in the city and how they could not.

Contextualising expertise

As such, the staging context of an urban approach demonstrates a more diverse constellation of actors that have a more experience-oriented understanding of urban mobility and policymaking. This is maybe one of the most striking differences between an industry-focused approach and an urban approach to policymaking; an industry-focused approach is shaped by technically trained actors, whose expertise derives more than their scientific background, and not so much from their concrete experiences with mobility and urban issues. This of course is interrelated with the institutionalised nature of expertise. Even in contemporary governance, where expertise has lost its former infallible prestige, the tendency of pre-defining decisions in technical think-tanks and expert groups still holds power. Yet, what the urban approach shows is that the industry-focused approach is not as powerful as it used to be when it meets higher complexity. The main assumption of an industry-focused approach is reducing complexity by assuming that technology will automatically fix problems and provide solutions in all contexts. The urban approach shows a more pragmatic aspect of the interplay between technologies and the 'real' complex world, where technologies are negotiated, reshaped and contextualised differently and more diversely than high-tech one-best-way solutions.

Therefore, the main actors of an urban approach operate in a completely different context. Legitimacy of arguments and policies is gained through a practice-driven

understanding of how mobility takes place in the city. This happens through the diversification of the notion of expertise in policymaking. While in both cases scientific expertise was the milestone for the shift from an industry-focused to an urban approach through scenario studies, those studies were tailored to the specific cities and were conducted in collaboration with local actors. For example, in Stuttgart the MEGAFON study was conducted for Stuttgart by the University of Stuttgart in collaboration with the local public transport authority (SSB). Accordingly, in Munich the scenario for the future urban development of Munich was conducted by a research institute in collaboration with the Department of Urban Planning. Thus, knowledge was produced collectively among local actors and research, combining both techno-scientific expertise and knowledge that comes from experience. The knowledge produced through the studies was further reshaped and contextualised by other local actors, such as local politicians and planners in negotiation and deliberation processes for shaping an urban approach to policymaking of automated driving. The following quote from an interviewee from Future Mobility Bosch explains very precisely the need for and the tendency towards collaborative production of knowledge and expertise in contemporary complex world:

> So, I think that is a big challenge in our times; that we have companies having the technologies and the motivation to use these technologies, but on the other hand they have the purely technological view (…) I think there are many cases, where technologies we have in hand today would find completely different applications, if you would have another person who understands the technology a bit and the problem a bit better than the technology expert (…) We always talk about the so-called VUCA world, have you heard of this? Volatile, uncertain, complex and ambiguous world, so everything is getting crazy difficult to understand and this relates to the mobility system if you see all the influencing factors. And this is also something people start to understand; that formerly you could be very excellent in developing smaller transistors to make more powerful processors, but nowadays obviously the problems have grown such complex that people understand that there is this collaboration getting more important. (Interview 31, 2018, p. 13)

This is exactly what the urban approach to policymaking indicates; a hybrid type of knowledge and expertise or as the title of last chapter of the Munich case 'The multiple mobilities of the sandbox in the making' suggests, heterogeneous production of knowledge and legitimacy. The title does not only suggest the diverse modes of mobility beyond the car, but also different ways of mobilizing legitimacy and producing knowledge from multiple sources (e.g. industry, science, public transport, planners, local politicians) compared to the industrial approach. This type of knowledge is more suitable for fluid policymaking aiming to deal with complexity and uncertainty, and it is closer to what Aristotle called as a phronesis, meaning knowledge acquired through experience (Flyvbjerg, 2004), while it widens up the spectrum of what is considered legitimate knowledge. It suggests a less hierarchical positioning of actors and blurs the boundaries between technocrats, the state as facilitator of the industry and the citizens as audience.

Yet, this new hybrid knowledge has not actually been produced together with the citizens in any of the case studies. Even though the intentions of doing so through public testing have been stated in public, there have not been any actual public tests by the time these lines were written. While there was a discursive shift in the role of the citizens from mere consumers to a key factor for the role-out of automated driving in both cases, in practice this is still to be done. In Munich, public tests with automated buses have been scheduled for the autumn 2020, while in Stuttgart automated buses have only been tested at the depot bus station. Taking also into account the influence of the industrial approach which is detached from local particularities, changing perspectives and scope at one level of policymaking (i.e. deliberation and vision-making) might not result in changes at changes in formation of concrete measures and implementation. However, these changes in perspective of dealing with mobility issues and in regulation reveal a growing influence and acceptance of an urban approach in mobility policymaking. They also suggest that even more participatory and flexible governance modes and settings are needed to facilitate collective policymaking of new mobility technologies and concepts in the city.

5.3. On policymaking, technology and the void

The policymaking for automated driving reflects larger governing processes for mobility technologies and mobility in general. One of the main lessons to learn of this work is that policymaking for mobility and its technologies should not be left only to technocrats, as technical approaches to policymaking have not been able to integrate local and social dimensions in the deliberation processes. It needs contextualised forms of networked governance to live up to the challenges of increasing uncertainty and new technologies that add more complexity to the already entangled mobility issues. Based on that, policymaking needs to adjust to contextual socio-material aspects and integrate local actors with experiential knowledge, citizens and civil society as well as new perspectives. This change can be achieved through alternative scripting beyond the car, strengthening local settings and contextualising expertise.

One could argue that the industry-led approach represents the established structures and routines of governing mobility and its technologies, while the urban approach represents the more performative, action-and-context-oriented side of policymaking. Yet, the two distinct approaches to policymaking coexisted in each of the case studies. They existed in different ways and forms over time. Even when one approach dominated in policymaking, there were still elements of the other. Therefore, while the two approaches occasionally contrasted and contradicted each other, they also co-existed in (re)defining and rethinking mobility issues and problems. These two approaches and their impact on policymaking have been produced through the presence of automated driving on policy agendas, but without it being implemented. The very presence of automated driving on the policy agendas represents increasing uncertainty and ambivalence; therefore, it has been an idea or a proxy so far instead of being implemented. As such, the two case studies ultimately showed productive ways of dealing with uncertainty and ambivalence in policymaking. These ways of thinking and doing are enacted without necessarily

compromising what is already there, the previous structures. Uncertainty enacted an interplay of previous structures and performative interaction on the spot. It is ultimately this interplay that can be productive and result in new ways of thinking and doing. This is a form of policy change. This change does not always come due to deep reflection on established norms and values in policymaking, but also due to spontaneous interaction as a defensive response to uncertainty (e.g. pressure from global ICT developments).

The two approaches separately can be considered as two distinct ways of dealing with uncertainty. In the industry-focused approach, avoiding the city context, focusing on highways and developing economic strategies beyond mobility (e.g. 5G connectivity) can be considered as a defensive strategy to deal with the uncertainty that automated driving brings about and as a way of constructing (perceived) certainties from the side of the industry and governmental levels (e.g. federal, State BW, Region). In the urban approach, integrating automated driving on the agendas of the urban level exerts pressure on other policy objectives and urban issues. It provides deliberation and solutions to other 'doable' problems (e.g. regulation for on-demand services in poorly served areas, last-mile solutions for the suburbs to decrease urbanization, etc.) to fill in the institutional void, as the implementation of automated driving per se is at the moment difficult in urban contexts. This suggests that uncertainty and ambivalence of the institutional void can be productive. In other words, the general strategy among the actors to integrate the issue of automated driving in their policy agendas while keeping a 'wait and see' approach regarding its implementation might be a wise strategy. This is because, as the analysis showed, the complexity of automated driving calls for new hybrid types of knowledge and expertise, which need to be further intensified and broadened up to include a more horizontal cooperation between technologists, planners, politicians and civil society. This means that it might take time until this type of expertise can be achieved, as changes in perceptions, settings of policymaking and participatory routines are needed. The urban approach to policymaking presents a promising framework for achieving this kind of expertise, but there is still a lot of room for improvement. Yet, the urban approach is not to be perceived as a concrete solution to be directly implemented in every case, but as an example to learn from, build upon and improve.

In particular, the policymaking of automated driving reflects an ambivalence between automobility and alternative modes of mobility. This work shows that it is more likely that automobility will co-exist with other mobility options signifying a shift from the system of automobility to the system of multiple mobilities, instead of choosing between one or the other. Urban automobility can hardly be sustained through automated driving, as it is too complex and too risky for the functioning of the cities to have private automated cars driving around. Thus, it is more pragmatic that emphasis is given to public transport and other mobility services to protect cities but also to mobilise new solutions for existing problems. Several researchers have talked about the system of automobility, its side-effects and its persistence from a critical point of view (Urry, 2004; Sheller, 2011; Geels, 2012; Schwedes, Kettner and Tiedtke, 2013; Manderscheid, 2014), while others have documented the decline of automobility and the development of its replacement by new mobility modes (Dennis and Urry, 2009; Elliott and Urry, 2010;

Canzler and Knie, 2016). Instead of making claims about futures, this study adopted an alternative stance in favour of the co-existence of different mobilities in a productive way. This does not mean that the critical perspective is absent, but rather that this work attempted to show the opportunities of the pragmatic interplay between the old and the new, instead of being consumed by critique or speculating about potential futures. Thus, it provides a balance between critique against automobility and discovering opportunities arising from the co-existence of automobility with other modes.

Overall, the findings of this work provide an initial research framework for further studying policymaking processes of automated driving and mobility technologies in general. As mentioned in the introduction, research on the production of automated driving in policymaking arenas has been underrepresented so far. Therefore, the value of this work is that it provides an in-depth analysis with thick descriptions of those interactions, negotiations and practices of policymaking of mobility technologies that often remain overlooked and black-boxed in extravagant industry and political press releases and in the media. Thus, future research is needed to investigate whether similar findings are identified in other contexts beyond Germany. Ultimately, the answer to the fundamental question of this dissertation regarding what we can learn about policymaking in uncertainty and ambivalence, is that defensive responses to uncertainty, such as non-implementation of a certain technology, might create a multitude of unexpected potentials, such as enacting new problem definitions, narratives, practices and developing hybrid forms of expertise. While it was not obvious from the beginning of this work, all these impacts and potentials emerged through the non-implementation of automated driving. This finding raises potential for future theoretical developments on the role of policy non-objectives as proxies in filling in the institutional void and in policy change for mobility and beyond. The following concluding chapter will further reflect on the relevance of the findings of this work and discuss potential avenues for future research.

6. Conclusions

Policymaking for automated driving and mobility technologies require new hybrid forms of governance characterised by integrating locally driven urban approaches into the long-established industrial approaches to policymaking. This is one of the key findings of this work. This can be an answer to the increasing uncertainty and ambivalence in policymaking, which cannot be handled anymore only by technical expertise and traditional techno-centrism. The field of policymaking needs to open up and make space for local actors and civil society to cooperate with the technocrats, in order to understand and handle the complexity of urban mobility and new technologies. This hybridity of actors and expertise is what constitutes the institutional void and the potential for its productivity and creativity. What was before separated as the stage and the audience, now needs to be bundled together and create space for improvisation - to put it in dramaturgical terms - where everybody can be an actor (the City and its citizens too). This form of improvisation and experiential knowledge is not just a nice thing to have to demonstrate participatory governance, but it is necessary for making sense of new mobility technologies in cities. A way of making sense of new technologies, when these technologies are too complex and too difficult to decide upon and implement, is using them to exert pressure on existing issues and roll out potential 'doable' novelties (e.g. on-demand mobility services) that are related to the issue at hand (e.g. automated driving). These particular ways of using complex technologies as proxies for solving other issues are locally derived and context-dependent and can only be developed through performative interaction on the spot between technical and non-technical actors. Either this happens through a deliberative way of broadening the perspective to several mobility modes or through a regulatory way of narrowing down to public transport, the transformative potential is there. The analysis showed that both deliberation (Munich) and regulation (Stuttgart) are ways of dealing with uncertainty productively. These are, of course, only two ways derived from these two particular case studies. Future research in other urban contexts might reveal more ways.

How can these findings be relevant for researchers and practitioners though? This concluding chapter answers this question. First, the chapter reflects on the strengths and weaknesses of a combined conceptual approach of policy analysis in the two case studies. After reflecting on the research process, this chapter discusses the insights this work provides for research. Even though this is not the first study that has analysed policy processes of mobility technologies, its uniqueness is that it developed a joint approach to interpret structural developments but also how these emerge and play out. It is useful, because it provides an in-depth analysis of the overlooked and black-boxed interactions and trajectories that ultimately shape policies. In terms of theory, this work contributes to integrating the fields of interpretive research, STS studies and mobilities research and to each field separately.

Next, the chapter discusses the relevance of this work for praxis and policy actors. What is needed to harness the productive potential of the institutional void? Will change come about through new industrial approaches or through the urban approach? As it has

been already argued, the urban approach provides an initial and potential framework for integrating local and context-oriented dimensions in industry-focused policymaking. Even though it is not an 'one-size-fits-all' solution, it provides policymakers and other relevant practitioners with an example of handling complex mobility technologies and their uncertainty productively. At the same time, the industry-focused approach also provides important insights about the barriers of contextualising technologies and understanding their potential. In sum, both approaches reflected in the case studies can help practitioners to reflect on and develop new context-dependent and collaborative solutions for urban mobility.

The chapter closes with some remarks about the relationship between policymaking and technology and directions for future research. The findings showed that finding productive ways to deal with uncertainty requires a new understanding of how mobility is governed. This entails new practices, narratives and forms of expertise. It requires governance processes that embrace uncertainty and require the active efforts of local actors but also citizens. It requires diverse actors that can reflect upon, critique and act to develop new approaches for governing mobility and its technologies. If policymaking is what gathers different components to define what will become of technologies, then, for these technologies to acquire a relevant potential for sustainable urban mobility, an adjustment of policymaking to the void and uncertainty is required.

6.1. Reflecting on the policymaking analysis process

This work contributes to the integration of the fields of interpretive analysis, performative analysis and mobilities research per se. Especially the first two have quite often been referred to as incompatible, because interpretive analysis interprets what is already there (structure), while performative analysis shows how what is there has been produced in the first place (agency). The point of the synthesis of the literatures was not to produce an overarching conceptual framework that would outline a step-by-step means for how research should be conducted in general. Instead, this integration was exploratory, and problem based. There was, of course, a logic in bringing the three literatures together. All three of them focus on the production of developments and processes. This production and the focus on the process has been the key interest of this work and what it aimed to unravel. By drawing on aspects of each of the literatures, this work attempted to balance oversights with insights, complement what is missing from each approach and eventually build an analytical approach that provides a comprehensive account of the production of automated driving in policymaking. After all, the purpose of the approach was to address the challenges of researching broader-local dynamics and structure-agency issues in the policymaking of automated driving.

The primary assumption of this work was that policymaking is dynamic, ever-changing and full of contingencies. Thus, it should be studied beyond dichotomies of structure and agency. This is how the mobilities paradigm served as an ontological basis to conceptualise this fluidity of policymaking. Based on that, it is was assumed that policymaking is a dynamic interplay of multiple social constructs and that is why it should

not be seen as neutral and value-free. Thus, every development and fact had to be produced and meaning and values played a crucial role in that. This was the first step to problematise the ready-made facts and promises regarding automated driving and its potentials. This is how the interpretive-discursive approach was brought in. Yet, it was argued that meanings and discourses are enacted, and are ultimately contingent upon the performative exchanges between actors as well as the material enablers and restrictions of technologies, artefacts and landscapes. In other words, this work did not search for overarching discourses that might inform policymaking, as it assumed that there are multiple. Instead, it traced the narratives and operational discourses that were manifested in the two cases and had a traceable influence on policymaking. This does not mean that existing structures and path-dependencies were overlooked, but rather that these were considered as relatively stable and prone to reproduction and change through interaction with new developments. Thus, even though the analytical approach might have been post-structuralist in orientation, it had a pragmatic stance in revealing the production of automated driving in policymaking.

Overall, this work showed that policy analysis needs to and can overcome the dichotomy of structure-agency by combining an analysis of both structures and agency at the same time and focusing on the meso level of interactions between the two. Therefore, one of the main theoretical lessons of this work is that in order to deeper understand policymaking processes, a combined analysis of both is necessary and possible. The redevelopment of the concept of storyline allowed for this combined analysis by integrating events, actors, their actions, the narratives they produce, settings, technologies and artefacts in one single analysis. Furthermore, the mobilities paradigm functioned as an ontology for the nature of contemporary policymaking and its fluidities (and fixities) and for developing context-specific research.

One could argue that a weakness of this work is to provide a single concrete answer for how to promote automated driving and mobility technologies in general and what is the best strategy for that; deliberation or regulation or something else. The reason is though, that there is not or will ever be a single or a set of straightforward solutions for addressing complex issues in complex situations. This is exactly what this work stands for. Policymaking needs to adjust to the potential of multiple potential structures, solutions and knowledges for handling complexity. Even for the same context or city there might be more than one ways of dealing with a complex issue. Experimentation and improvisation are key factors in unfolding these potential ways. Therefore, this work provides lessons learned for future policymaking in Munich and in Stuttgart, but also for the field of automated driving and other mobility concepts and technologies. These lessons have less to do with the particular strategies that were deployed in each case (e.g. deliberation, regulation), and more with how these strategies were enacted and performed. For example, the integration of automated driving in the urban development framework in Munich opened up deliberation processes for rethinking solutions for urban issues. Using scientific knowledge in political debates in the City Council built the basis for the enactment of new regulation and a hybrid form of expertise in Stuttgart. Thus, it is these particular processes that have been an important condition for dealing

productively with uncertainty. These processes cannot be separated from the context they occur, no matter how much we crave for standardized ways of thinking and doing.

This brings the discussion back to the notion of practices. In the conceptual chapter (Chapter 2), it was argued that the notion of practices was reconceptualised from operational routines to interactive performance. The empirical analysis of the two cases showed that this reconceptualisation is necessary to capture the improvised ways of dealing with uncertainty. This is a contribution of the policy analysis of this work to social science in general and the way it approaches the notion of practice. This work ultimately shows that in order to productively deal with uncertainty, social science needs new conceptualisations of what practice means. The conceptualisation of practice as operational routines implies that practices always refer to established structures. Yet, the analysis showed that while the influence of established structures is still there, there are new ones emerging and practices occur in the 'crossfire' between the old and the new. The two distinct approaches to policymaking, namely the industry-focused approach and the urban approach, and their interdependencies also show how the practices of policymaking of automated driving occur as interactive performance between structure and agency. Ultimately, what might be perceived as the weakness of this work might actually be its strength, in the sense that it provides insights for both research and practice regarding the need for non-routinised forms of policymaking. After all, in a world of ambivalence, dichotomies tend to blur their boundaries, so does the dichotomy of strength-weakness. This dichotomy works in parallel with the dichotomy certainty-uncertainty. In the modern era, certainty used to be perceived as a strength and uncertainty as a weakness. The late modernity, though, calls for embracing uncertainty and ambivalence and producing something out of it. The void would not be productive, if that was not the case. This means that both researchers and practitioners need to question how useful it is to perceive certainties and fixities as strengths in an increasingly complex world. The following two sections, therefore, discuss the relevance of this work for both research and praxis on policymaking of automated driving and beyond.

6.2. Research relevance

This work drew on insights and methods of interpretive policy analysis, Science and Technology Studies (STS) and the mobilities research, in order to study how the institutional void is being filled in. This combination of different literatures is achieved mainly through the redevelopment of the concept of storylines, which originates in Argumentative Discourse Analysis. The concept of storylines allowed for a balance between critical reflexivity of the researcher and an inquiry of how policy objectives came to be through performance. As already mentioned in the previous section, this work contributes to the integration of the three literatures. Yet, it further contributes to several distinct academic fields and traditions. In the following, these contributions are discussed in their intellectual context.

Mobility policymaking literature

First, this work has contributed to the field of mobility policymaking by developing an in-depth and comprehensive analysis of the discursive and performative co-construction of automated driving, instead of focusing only on technical aspects. As such, it highlights the need to step back from measuring and calculating the right kind of policy for mobility with inputs and outputs in a linear way and to consider the wider conditions, complexity and plurality within which contemporary mobility policymaking takes place. The findings show that policymaking and policies need to be connected to the ever-changing and mobile conditions and become flexible, adjustable and networked. Policies and policymaking are not stable, but they reflect the relative stabilisation of certain components which are in turn prone to change due to performative interaction with new conditions. Thus, the approach developed in this work contrasts with more traditional understandings of policymaking as 'policy cycles', because it conceptualises the various dimensions of policymaking in flux. The movement of policymaking and its relation to relative fixities can be seen in the five components studied in the cases: in the actors, their practices, the narratives, the settings and the technologies/artefacts. There are more fixed actors, such as politicians and transport planners, but there are also mobile actors, such as ICT companies or district committees. These mobile actors move in and out of policymaking processes, without being always involved. The policymaking practices are also mobile, as mentioned in the previous section. Even though there are formal policy practices in the form of operational routines, such as City Council meetings, there are also mobile practices, such as public-private agreements and meetings or developing new regulation in a bottom-up manner. The narratives that reflect the industry-focused approach are more stable, such as incremental innovation, while others are more fluid and less definable, such as perspectives on suburbanization. There are settings, which are more stable, such as R&D, but there are also less established settings, such as new coordination organisations (e.g. GRS) and public-private partnerships. Technologies themselves are also mobile in the sense that the focus of policymaking has been shifting across different technologies (e.g. driver assistance, automated subway, on-demand shuttles, 5G) throughout the storylines of the two case studies. These new technologies always relate to established artefacts, such as the car or public transport buses. This further confirms that automated driving as a socio-technical process is not fixed, and it is not clear what its technologies are. These various elements, both the more stable and the more mobile ones, are never really fixed, because they interact with each other and they redefine and recreate each other through policymaking. Ultimately, the very analytical trajectories identified in the two cases, namely dispersion and relegation, show the fluidity of the policymaking.

Thus, the main contribution to mobility policymaking literature is a different ontology for perceiving policymaking as fluid and an analytics to study this fluidity comprehensively. The notion of translation from ANT played an important role in this. While translation was not utilised as a detailed analytical approach as Callon (1986) introduced it, it was used as a methodological insight in the background. If the mobilities

paradigm and the literature on uncertainty provided the ontological basis for understanding policymaking as fluid and mobile, translation has been the guideline that enabled the analytical insights of dispersion and relegation as types of movement of automated driving throughout the policymaking processes. It is the notion of translation that enabled an analysis of the interplay of the different administrative levels and eventually brought down automated driving to the urban level. Other researchers, such as Rutland and Aylett (2008) and Beveridge (2012), have also conducted empirical research through a synthesis of ANT translation and discourse analysis. Rutland and Aylett (2008) conducted two separate analyses of policymaking; one through the lens of governmentality and one through the lens of ANT translation including the agency of non-human actors. Beveridge (2012) conducted a detailed analysis of interactions between actors considering the overarching discourses that informed policymaking, such as neoliberalism. The contribution of this work is that it redeveloped the analytical tool of storylines to accommodate both approaches in one single in-depth analysis without assuming in advance which overarching discourses informed the process. Instead, it traced only the discursive elements that had a practical influence in policymaking. This insight is, of course, relevant not only for mobility policymaking, but for contemporary policymaking in general. Thus, by extension, this work also contributes to post-positivist policy analysis.

Discourse analysis literature

Second, there is a contribution to discourse analysis literature. Instead of focusing on the identification of overarching discourses by starting with already established assumptions and theories that prescribe the influence of discourses, such as neoliberalism and globalisation, this work identified two distinct approaches to policymaking (industry-focused and urban) from the empirical material. In terms of discourse, the term operational discourses was coined to describe these two approaches, offering a middle ground between discursive structures and bottom-up agency. It is these operational discourses that reflect two contextual frameworks through which policymaking of automated driving has been produced, and their ideologies and norms are co-enacted by and co-enact practices. The concept of operational discourses responds to one of the key critiques to traditional discursive analysis. That is; discourses and their ideologies do not just exist on their own, but they are produced through interaction and context. Furthermore, the concept of operational discourses suggests that even overarching discourses with relatively stable narratives, such as digitalisation, are translated and reproduced differently in each context. Based on that, one more insight that this work provides is that policy change is not a matter of replacing one discourse over another, but a matter of co-existence and interaction of several discursive and non-discursive elements over time in policymaking processes. This, in turn, outlines the fluid and mobile nature of policymaking, differentiating this work once again from traditional policy analysis and its linearity.

In addition, the concept of storylines was redeveloped to more comprehensively grasp the performative aspect of the production and enactment of the operational discourses. The key critique of discursive approaches is their tendency to concentrate on the discursive dimension of policymaking at the expense of the actual practices which both shape and are shaped by discourse. On the one hand, the inclination towards the discursive dimension of policymaking is understandable, as the intention of these approaches is to reveal norms and values of governing in policy practices. On the other hand, by doing so, questions remain unanswered regarding the interplay of structure and agency. To what extent do actors shape and enact discourses? How are discourses enacted and produced through actions in local contexts? These questions are not raised to solve the chicken-egg problematic between structure and agency, but to acknowledge that policymaking occurs through their mutual interplay. Therefore, this work did not intend to find answers to these questions, but to develop a pragmatic approach that can incorporate elements of both as much as possible. This was attempted through the concept of storylines. While a storyline is in principle a discursive construction, here it has been used as more than a summarised narrative. A storyline in this work is used as dynamic storytelling of events and developments over time, including detailed interactions of actors, arguments, debates, conflicts, the role of technologies as well as emphasis to the tipping points when the policy issue moves from one setting to another and from one policy objective to another. The two operational discourses (industry-focused approach and urban approach) are, then, reflected through the storylines, which means that they are produced through the contexts of the case study. While they are generic enough to be traced in both cases, they are also specific enough to be produced and enacted differently in each case. For example, the industry-focused operational discourse is enacted through the dominance of the automotive industry in the Munich case, while in the Stuttgart case it is enacted through the interplay of the automotive industry and the ICT industry. This is, of course, merely suggestive of the interplay between structure and agency, thus it should be seen as symptomatic of the difficulty of dealing with one of the main challenges in the social sciences.

Science and Technology Studies

Third, for STS, storylines provide a concept to further elaborate on relational approaches and analysis of technology. While much STS research on 'material semiotics' and ANT has shown the micro details and specific situations of entangling the social and the technical, storylines emphasize the historically emergent processes of co-production of technological policy objects that enable and/or constraint certain entanglements in specific situations, but become relevant beyond these specific situations. Storylines of highly complex socio-technical policy objects, such as automated driving, is a way forward to embracing complexity while summarising it at the same time, especially when it is very unclear what this technology (i.e. automated driving) is. And when it is unclear what technology is, an inquiry of how it emerges and how its potential is perceived sheds light into its becoming. Based on that, storylines as a non-reductionist concept positions

technology not only in technical artefacts, not only in discourse, not only in actors and not only in settings. Instead, storylines analyse technology as a complex and entangled dynamic process made up by diverse elements and connections. Through storylines, thus, we can better understand what and who shapes technology, how technical and non-technical expertise is put into practice and ultimately how to influence technology in the making.

Another contribution to STS is how the performative/dramaturgical dimensions of scripting, settings and staging have been used in this work. One of the main critiques to STS is that it deals in detail with how every micro-interaction between humans and non-humans is scripted and staged in its particular settings without answering the question: so, what? What is the impact of this interaction? What does this interaction mean? Even in Hajer's policy analysis, where these performative dimensions are used to describe the micro-interactions of policymaking processes (Hajer, 2005b, 2005c), they are used separately from an interpretive approach. Instead, this work uses the performative dimensions to show how the two operational discourses reflected in the case studies have been produced in their wider context. They are not used to describe how specific interactions were performed; that was the task of storylines. They are rather used to explain through which cultural, cognitive and material conditions these operational discourses took place. For example, the scripting of automobility in the industry-focused operational discourse shaped the rules of how we should plan for mobility, which in turn shaped the triangle of settings: automotive industry, federal government, research as the primary locations of policymaking. This is turn affected the staging of policymaking by positioning technical experts and expertise as the main actors and the citizens and partly the City as audience. By using the performative dimensions in a wider context, they obtain wider explanatory power in terms of what is the meaning and the impact of performance. This brings STS closer to an interpretive approach. In this sense, STS can benefit regarding how to use the performative dimensions to provide explanations about the impact of performances. At the same time, the interpretive approach can learn from the performative dimensions of STS in terms of reducing over-interpretation of meanings by tracing the meanings in the context of their production.

Policy change literature

Fourth, regarding how policy change occurs, the trajectories of policymaking, namely dispersion and relegation, showed that the displacements of a highly complex and ambivalent issue across settings and policy objectives enable the development of new perspectives and ways of dealing with other sub-problems beyond the implementation of the issue per se. These trajectories and displacements potentially contribute to policy creativity. For example, displacements can contribute to the invitation of new actors, to new opportunities for action, new solutions, persuasion etc. Automated driving 'travelled' across settings over time to legitimize other objectives and to make things happen. Overall, the performative power of the non-implementation of automated driving and its function as a proxy for making other things happen is a contribution to the

literature of policy change. As such, it provides fertile ground for future theoretical and empirical research for rethinking how socio-technical and policy change occurs, the ways it is orchestrated and not orchestrated and the everlasting interplay between the old and the new.

In general, when analysing the question of policy change or the lack of it, the concept of path-dependency (Pierson, 2000) is prevalent in many studies. This concept argues that it is generally difficult to change policies, because institutions are inertial to change, and actors are prone to sustaining the existing regime, even it is not optimal. This is because formal institutions are designed to resist change and encourage policy continuity. This work uses the concept of settings instead of the concept of institutions. In the conceptual chapter, it was argued that the term institution is ambiguous, as while it appears static, it is very much prone to change due to the increasing complexity and multiple sources of legitimacy in contemporary policymaking. The empirical work proved that in several cases policymaking took place beyond formal institutions (e.g. through lobbying, public-private arrangements, etc.), while when it took place in formal institutions, 'wait-and-see' or collaborative strategies with the industry and research were initiated. Therefore, this work while recognising that there are path-dependencies that obscure policy change, it adopted the concept of settings to overcome the rigidity of the concept of institutions. It is especially the movement of the policy issue of automated driving across settings that show the policy change over time. This movement between settings can show how the institutional void is accommodated productively to bring about policy change in unexpected ways that have not been inscribed in formal institutions. Thus, the contribution of this work is that it provides an analytics that can connect the dots and reveal how policy change occurs beyond formal institutions. A relevant key finding is that policy change occurs when the policy issue at hand gets contextualised in local realities and when hybrid forms of expertise are involved. This is something that studies on multi-level and networked governance (see Bevir and Rhodes, 2006; Suškevičs, 2012; Bache *et al.*, 2015) can also learn from in terms of the scale where policy change occurs.

6.3. Praxis relevance

This work also provides an informed conjecture for policymaking praxis. As it was mentioned in the conceptual chapter (Chapter 2), we see new aspects of a problem when someone tells us a story that highlights them. Therefore, it is informed conjectures conveyed through stories that can help policy praxis see opportunities and challenges of a certain policy field or problem anew. Thus, this work offers insights on the role of cities and public authorities in mobility policymaking. These insights have to do with what the opportunities of uncertainty are for mobility policymaking, where policymakers stand, and how they can make use of contingencies. Regardless of how dominant technical and economic imperatives have been, the local authorities played a crucial role in how automated driving was ultimately dealt with in cities. By focusing on industry-led visions, actors have historically failed to include the local particularities of everyday mobility in

policymaking. Focusing on technical and economic aspects, often detached policymaking from the actual urban issues, such as congestion, accessibility or increasing urbanisation. In contrast, when automated driving was integrated into the urban strategies, policymaking seemed to be more productive in addressing existing problems.

Harnessing the potential of complexity and uncertainty requires institutional and structural changes in policymaking. The two cases provide multiple examples for policymakers. For example, a lesson to learn for policymakers is that it is necessary to rethink what is considered as legitimate knowledge and expertise, as both technical and experiential expertise are necessary. There is also a need to reassess what the priorities are for urban mobility. Is it a priority to facilitate the industry in using mobility as a test case for their services and products? Or is it a priority to provide accessible and sustainable mobility options for citizens? Are there opportunities for co-existence of the two options? In which ways? Another key learning for policymakers is that due to the multifaceted nature of problems, the former might need to develop ambivalent strategies that tackle more than one objective. Thus, the key objective of policymaking becomes finding the right balance between multiple policy objectives.

This work also showed the discrepancy between what technical expertise develops and how this is translated into the complex environment of cities. Universal strategies are not a good fit for unrevealing the potential of new mobility technologies in cities. Technologies need to be co-constructed by both technocrats and local actors, in order to have a sustainable impact on cities. In this sense, this work can provide a framework for reflection for policymakers regarding revaluating what is considered as expertise in mobility policymaking, who needs to participate, how technological innovation can be combined with social innovation, and how they can enable, shape or restrict technological implementation. The results of this study are also relevant even for engineers who model scenarios for the implementation of automated driving and other technologies, as they can see how their work is used and translated in real terms, which might be quite different to what they had imagined in the first place. Thus, this work provides an overview of where different actors stand in relation to each other but also in relation to technological developments themselves in processes of policymaking. In turn, this holds the potential for raising awareness, facilitating transparency among technical and non-technical actors. Ultimately, this work calls for intensified collaboration, broadened networks, and exchange of expertise between technocrats, policymakers and citizens, in order to understand and harness the potential of new technologies for both technological and social innovation.

6.4. Final remarks and avenues for further research

This work has dealt with the relationship between policymaking, uncertainty and technology. It has argued that it is policymaking that gives technology a context and it contributes to its *becoming*. The two cases of policymaking of automated driving remind us that technologies cannot simply *become* on purpose, but there are a lot of contingencies and unexpected developments in the process. This fact can be perceived as

both frustrating and empowering. Many elements need to come together over time, and it can take decades until a highly complex technology is implemented. Yet, the process of its becoming can be creative, surprising and highly ambivalent, while it might not necessarily lead to implementation of the technology per se. This can lead to new perspectives and developments in mobility policymaking. The case studies showed that several local actors no longer perceive of everyday mobility in cities as predominately organised around a car. The local policymaking is slowly developing towards alternative modes of mobility, which co-exist with the car. Therefore, the potential for alternative perspectives exists already in policymaking today. The analysis showed that the translation of automated driving from industrial, federal and regional settings to local settings further intensified this potential. Cities and communities start planning tests and pilots with new technologies and mobility concepts. Engineers and transport modelling experts are working together with Cities to develop more integrative solutions for urban mobility. And new narratives such as 'supporting public transport' and 'dealing with lack of space' are reshaping policy objectives, urban strategies and regulation. Even though these new perspectives emerge as a reaction to industry-oriented imperatives and are often part of industrial and economic funding schemes or projects, they still create the potential for shifting policymaking towards locally driven objectives. The question is then, could these inconclusive policymaking processes of the non-implementation of complex technologies offer new opportunities for the democratisation of technology and expertise?

Taking this question as a point of departure, this final section will propose avenues for further research on policymaking of automated driving and beyond. After all, the purpose of this study was not to provide a guide or a model for policymaking of automated driving, but rather a synthetic approach for comprehensively grasping its dynamics and unexpected impacts as well as a framework for reflection for policymakers. Based on this, there is much scope for the further development of such a synthetic approach to policymaking.

Future research avenue 1: Democratisation of technology

A possible direction for further research could be on how the institutional void can provide opportunities for democratisation of technology. The study showed that a productive relationship between policymaking and technology requires hybrid forms of expertise and participation, which occur in an institutional void. The question, then, would be how the institutional void with its hybrid expertise and diverse settings affects the democratic quality of policymaking processes. A possible way to study this could be to focus on how the displacements of the issue of automated driving across settings reframe policy objectives, influence inclusion and exclusion of certain actors and redistribute division of power. The trajectories of dispersion and relegation that emerged through the analysis of this work was a first step towards unfolding the dynamics of displacements of complex technologies. Yet, this was an analytical result that was not obvious from the beginning of the empirical work, therefore no attempt was made to

develop a theoretical understanding of how precisely these displacements can affect participatory processes and creativity in policymaking in the institutional void. This would require further elaboration on the concept of settings as well as building an analytical framework for the democratic evaluation of the displacements from an STS perspective. This framework would have to do with elaborating on the characteristics of the displacements between settings that allow or prohibit participation and transparency as well as enable new opportunities for action, new perspectives and solutions.

Future research avenue 2: The role of expertise, knowledge production and participation

Another possible avenue for research would be the role of expertise in policymaking of new technologies. Once again, the need for hybrid kinds of expertise was an analytical finding of this work. Yet, there is plenty of room for theoretical development on the 'co-production' of new technologies by technocrats, citizens and local actors through policymaking. A future approach to study this could built on the analytical approach developed in this work by incorporating STS approaches on the co-production of knowledge. Jasanoff (2004) has outlined the notion of co-production, which was initially developed in regard to the interdependencies between scientific knowledge and social order (discourses, institutions, etc.). This approach examines how technical knowledge shapes and is reshaped by social practices and norms. It could then be modified and be used to examine how the social (in this case the urban and the local) and the technical expertise co-shape technology and deal with its uncertainty. This has synergies with ANT in the sense that all knowledge is contingent and produced through interaction, but also with discourse analysis in the sense that different types of knowledge (constructivism) shapes governance through meaning exchange. There is, then, a shared perspective in all approaches regarding the plurality of knowledge production and the way in which it produces particular outcomes of policymaking. This could shed light to the black box of 'citizen involvement' and the governance of this involvement. This work showed that through the urban approach, citizens were acknowledged as participants in the policymaking process, but only discursively. However, it did not examine further sub-political groups, such as activist groups, neither it conducted a systematic media research or focus groups with the citizens. Furthermore, since tests with automated buses are scheduled to be conducted in the future (at least in Munich), empirical data could be collected through ethnography, mobile methods or even interviews and focus groups with citizens, in order to elaborate on the citizens' experience and how this co-produces knowledge and expertise. This would be crucial for developing insights for the implementation of future technologies, as this study showed that experiential knowledge is necessary for dealing with complexity.

Future research avenue 3: Theoretical and empirical development of the institutional void

The notion of the institutional void per se could also be further developed. The term was derived from Hajer's work as a trait of networked governance. In economics, institutional voids represent the lack of intermediaries, such as credit card systems, to connect buyers and sellers. Understanding these voids and learning to work with them is considered a key to success. Similarly, in contemporary policymaking, institutional voids represent lack of intermediaries to connect different technologies and industries with City administrations, citizens and other actors. Therefore, less hierarchical and more horizontal forms of governance are required. For this work, the institutional void came to represent the productivity, opportunities and hidden potential of uncertainty and ambivalence. Therefore, a further theoretical development of the concept would benefit from cross-fertilization with theories of reflexive modernisation and mobile risk society (Beck, 1999, 2009; Kesselring, 2008b). Another alternative would be to use this work as an initial framework to develop a wider project for studying how the institutional void plays out in several other urban contexts within and outside Germany, in order to develop a typology of different ways of dealing with uncertainty and filling in the institutional void. This would develop a more theory driven development of the institutional void. The question this wider project would ask is: Are the findings of this research, specifically the two distinct approaches to policymaking present in other policy contexts? Further research would elaborate even more on the dynamics and potentials of these two approaches as well as their interplay for policymaking in various contexts. This would be an empirically driven theory, as stepping too far away from empirical contexts would render theoretical elaboration of the institutional void irrelevant for praxis.

Future research avenue 4: Integrating the three strands of literature more closely

A final future research avenue is to integrate the three strands of literature that have been used to synthesise the analytical approach more closely. The relevance of this integration for policymaking of automated driving has been discussed at multiple points in this work. That is; providing a comprehensive account of the emergence of developments of fluid policymaking over time and the interpretation of these developments. An example of how this could happen is further elaborating on the notion of translation from ANT. As already mentioned, translation here has been used more as a methodological guide for conducting research on policymaking rather than as a detailed analytical concept. The concept could further be applied on policymaking by deploying the four moments of translation developed by Callon (1986); problematisation, interessement, enrolment and mobilisation. These four moments can provide a detailed analytical approach for analysing the micro-interactions of policymaking. It would be an extra supplement to the interpretive approach, as it would reveal the exact extent of translation of a policy issue while it is moving across levels and settings of policymaking. This offers ground for further integrating translation with the mobilities paradigm, as they both tend to conceptualise how policy issues are mobilised and move across different objectives and

settings. Another application of translation, then, would be the one of policy transfer and policy change, which would elaborate on how policies spread, move from one sector and field to another, and in the process, change, and come to mean different things in different contexts. For example, a policy for connectivity might mean different things in the context of economic restructuring of regional economy and different things in the context of mobility.

Overall, other policymaking contexts could benefit from this integration too, such as the energy sector or climate change. The analytical approach developed in this work and its further future elaboration can be useful for studying complex cases of policymaking in general. While the world is getting more and more complex and 'wicked problems' multiply day by day, policy research has not provided enough accounts of contemporary policymaking processes. This is of course a daunting task, which requires time, effort and resources. Therefore, there is a need to provide more detailed, empirical accounts of contemporary policymaking and its contingencies. In particular, in the current context of Covid-19, the further integration of the mobilities paradigm, with interpretive research and STS might become even more important, given the sudden change of everyday life, the collapse of structures that used to matter but not anymore as well as the increasing uncertainty and institutional void of how to tackle an invisible threat. Such an integration could provide useful insights on how different nations, organisations, regions or even cities have been dealing with the collapse of the previous structures of everyday life and how they have been coping with uncertainty as well as what kind of productivity can be identified in these processes. After all, it is in great times of uncertainty that the opportunity for learning and change arises.

As a final remark, this intellectual journey of studying policymaking of automated driving invites us to reflect upon how much effort we have put into ordering and controlling chaos through developing more advanced technology. And yet, the very technology we develop becomes so unpredictable and complex itself that reproduces and reinforces the very same chaos we are trying to avoid. As Latour would put it, the notion of modernity and its idea of separation between nature and technology, humans and things is more a matter of faith than it is pragmatic. The increasing complexity and hybridity of the world is reducing the prospect of keeping technology and society in their separate spheres. Now that the boundaries of dichotomies and categories are becoming evidently blurred, the most promising way forward seems to be acknowledging the multiple connections among technology and society for a broader and fairer understanding of possibility.

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Apendix

Background Interviews

Interview 1: Australian urban planning scholar on automated driving, 29 August 2017

Interview 2: German digitalisation and innovation expert, 29 September 2017

Interview 3: German pioneer in computer vision and driverless cars, 24 May 2018

Interview 4: German professor for philosophy and political theory, 29 January 2019

Munich

Interview 5: Local politician in the Green Party, 5 April 2018

Interview 6: Expert at SIEMENS Mobility, 27 November 2018

Interview 7: Expert at Urban Mobility BMW, 21 June 2018

Interview 8: Expert at MVV (Munich Transport and Tariff Association), 11 September 2018

Interview 9: Expert at Mobility Management MVG (Public Transport Authority Munich), 6 July 2018

Interview 10: Head of Sustainable Mobility BUND Naturschutz Bayern (Nature Conservation Union Bavaria), 10 April 2018

Interview 11: Head of Autonomous Driving Division BMW, 6 June 2018

Interview 12: Head of Automation and Digitalisation ADAC, 18 June 2018

Interview 13: Former director of Strategic Planning MVG (Public Transport Company Munich), 17 May 2018

Interview 14: Project manager at Department of Public Affairs, Division Transport and Mobility Management, City of Munich, 14 May 2018

Interview 15: Two experts at Chamber of Commerce Munich, 5 July 2018

Interview 16: Expert at Department of Labour and Economic Development City of Munich, 22 June 2018

Interview 17: Manager at Mobility Services BMW, 18 April 2018

Interview 18: Planner at Department of Urban Planning and Building Regulations, Transport Planning Unit, 22 November 2018

Interview 19: Local politician SPD party, 9 May 2018

Interview 20: Head of Münchner Forum (Civil Association for Urban Development), 21 March 2019

Interview 21: Head of Mobility Management at Green City NGO, 9 April 2018

Stuttgart

Interview 22: Expert at Cluster Automotive Region Stuttgart at WRS (Economic Corporation of the Region of Stuttgart), 12 December 2018

Interview 23: Expert at Automotive Technology Bosch, 29 November 2018

Interview 24: Expert of City Relations at Mobility Services Daimler, 25 January 2019

Interview 25: Head of the Bureau of Economic Development at City of Stuttgart, 17 January 2019

Interview 26: Expert at Ministry of Economics Baden-Württemberg, Division of Automobile and Production Industry, 14 March 2019

Interview 27: Two experts at e-mobil Baden-Württemberg, 23 April 2019

Interview 28: Senior researcher at the University of Stuttgart, Institute for Road and Traffic Engineering (ISV), 16 November 2018

Interview 29: Two local politicians from the Left Party (SOES LINKE PLuS), 2 July 2018

Interview 30: Expert at Ministry of Transport Baden-Württemberg, Division of Public Transport, 15 February 2019

Interview 31: Senior Expert Future Mobility at Bosch, 7 November 2018

Interview 32: Expert at Ministry of Transport Baden-Württemberg, Division Electric Mobility and Vehicle Innovation, 19 December 2017

Interview 33: Senior Director VRS (Verband Region Stuttgart - Association of the Stuttgart Region), Division Economics and Infrastructure, 5 January 2018