Leveraging shared mobility data for urban development and policymaking: A study of Dutch municipalities' data supply, demand, and challenges & opportunities

Master's Thesis – master Sustainable Business and Innovation

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ABSTRACT

This thesis examines the demand and supply of shared mobility data for urban development and policy-making in Dutch municipalities, additionally focusing on challenges and opportunities in acquiring and using data. It examines how shared mobility providers position themselves in the context of data sharing and how their data is demanded by municipalities for evidence-based decision-making to address policy issues, such as urban densification and sustainability and shared mobility nuisances, working towards the development of smart and sustainable cities.

Using a modified version of Susha et al.'s (2017) taxonomy of data collaborations, which focuses on characteristics of data supply and demand and Diran & van Veenstra's (2020) barriers to data collection and use, this study investigates the research problem centered around the mismatch between the data supply of shared mobility providers and the demand of Dutch municipalities. Utilizing an interpretive research philosophy, this thesis follows an abductive qualitative approach with a multiple case study design, focusing on four major Dutch municipalities: Amsterdam, Rotterdam, The Hague, and Eindhoven. The data was collected based on semi-structured interviews with municipalities, researchers/experts, and shared mobility providers, supplemented with secondary data from policy documents and a literature review. Through thematic analysis, unique insights are discovered regarding shared mobility data sharing. It becomes clear that despite all the benefits that arise when shared mobility data is shared, this data sharing is hindered by challenges such as privacy, legal restrictions, and resistance from private companies.

The findings indicate municipal demand for detailed and preferably dynamic data that includes trip start and end locations, travel times, and usage patterns to improve urban development and policymaking and reduce reliance on private cars. Whereas providers of shared two-wheelers meet this data demand by making it mandatory in the operating permit, providers of shared cars offer more resistance. This research highlights the importance of a clear and thorough data demand in which transparency in data processing and use follow directly from a policy problem/use case.

Furthermore, the thesis emphasizes overcoming challenges such as silo thinking and lack of knowledge and capabilities of Dutch municipalities. A promising initiative that can both facilitate municipalities on their flaws and also facilitate shared mobility providers in providing transparency and a clear goal of municipal data demand is the CDS-M. Further research can delve into this and explore what makes a well-supported data demand.

- Keywords: *Shared Mobility, Data Sharing, Urban Development, Policymaking, Data Supply & Demand, Dutch Municipalities, Smart & Sustainable Cities, New Mobility Services (NMS), Data-driven Decision Making, Business-to-Government (B2G) Data Sharing, Public-Private Partnership, Innovation, Collaboration*

SUMMARY

European cities classified as smart (should) use data in decision-making and urban planning for municipal problem-solving. Nonetheless, data supply and demand often do not align and thus complications may arise in the decision-making process. Therefore, this research aims to understand how Dutch municipalities leverage shared mobility data to inform urban development and policymaking. Specifically, it seeks to explore the supply and demand for shared mobility data within Dutch smart cities, and to identify the challenges and opportunities municipalities face in accessing and utilizing this data, posing the following research question: "What is the supply and demand for shared mobility data within Dutch municipalities to inform (smart) urban development and policymaking, and which access and utilization challenges and opportunities arise in the data sharing process?"

To do so, this research uses an interpretivist philosophy to understand the subjective perspective and experiences of municipalities, researchers/experts, and shared mobility providers. Through an exploratory multiple case study design, this research is enabled to gather in-depth information from the stakeholders involved. Through primary data acquired through semi-structured interviews with 4 different municipalities, 5 different researchers/experts, and 4 industry representatives, this study provides a comprehensive understanding of shared mobility data sharing and its use within municipalities for urban planning and policymaking. Based on a combination of criterion and purposive sampling, 4 relevant Dutch municipalities were selected. The municipalities of Amsterdam, Rotterdam, Eindhoven, and The Hague all qualified having more than 150,000 residents which has a direct relationship with the number of shared mobility providers within the city and the degree of data usage. The acquired data was subjected to thematic coding analysis, which identified predetermined but also new themes. The pre-determined themes were extracted from the modified taxonomy of Susha et al., (2017), which was constructed to represent the supply and demand of data within collaborations. Furthermore, the challenges identified by Diran & van Veenstra, (2020) are taken as a basis and further tested for urban development challenges in the data regime, in this case, shared mobility.

Municipalities see the benefits of shared mobility for addressing urban issues like densification and urbanization, as they aim to reduce private vehicle ownership to free up public space and achieve sustainability goals. However, they are also afraid of ‘a second Uber’ which might disrupt the status quo in the mobility regime within Duch municipalities, asking for regulation. For this, municipalities want to obtain shared mobility data to solve short-term policy problems, but shared mobility providers indicate that municipalities should not do this and should look at the longer term, which directly corresponds to more concrete policy problems and use cases for data. Shared mobility providers, especially car-sharing providers, perceive the data requests of municipalities often as unfounded, asking for excessive data with suboptimal purposes, leading to reluctance from providers to share data. CDS-M and its corresponding program of Natuurlijk Deelmobiliteit are still developing in collaboration with shared mobility providers and municipalities, aiming to address these issues and provide clarity regarding data demand and supply, as well as the methods of data sharing. Essentially this program aims to tackle most of the challenges identified in this research, specifically focusing on matching shared mobility data supply and demand through the development of standardized data sharing and use cases.

Shared mobility data sharing can be done in three ways: mandatory, voluntary, and a combination of both. Two-wheel providers are mandated for data sharing as it is part of their permit to operate within the city. Car-sharing providers, however, are essentially only sharing data voluntarily as they do create

far fewer nuisances and disruption compared to two-wheelers so there is no immediate reason for municipalities to request data. Therefore dynamic data is often shared by two-wheel providers and more static data is shared by car-sharing companies. However, it should be noted that this data sharing is only done after concrete municipal data demand, with clear use cases for the data. Nevertheless, municipalities are increasingly pushing towards mandatory data sharing for all mobility providers. One of the interviewed car-sharing providers even opted for a mandatory data-sharing basis, where additional data can be shared with municipalities voluntarily. Also, some shared mobility providers proactively share data as they see benefits in improving services and infrastructure, enabling mutual benefits. An alternative to data sharing has also arisen: engaging in dialogue with shared mobility providers and municipalities enables mutual learning, meaning that both parties can benefit from collaboration and communication.

However, the data supply is compromised by several factors. Privacy sensitivity remains at the core of concerns in data sharing. Data should not be retractable to individuals or impede the GDPR, therefore data is anonymized and aggregated as much as possible. Additionally, data is valuable and considered intellectual property that requires protection to maintain a competitive advantage. Mobility providers are cautious about sharing data, to avoid compromising their business interests. Also, there is a lack of coherence and centralization in data sharing, which indicates an immediate demand for centralization and handling data sharing ethically. Additionally, the use of shared mobility data is also restricted. Especially, the barriers such as lack of expertise and skills, determining the value and purpose of data, legal limitation/ GDPR, and difficulties in linking, analyzing, and visualizing data are crucial for Dutch municipalities. Although municipalities seem to know the value of data, they lack the expertise and skills to deal with them and often do not address specific purposes of data use. Municipalities are too siloed in their way of thinking and operations. As municipalities often lack the knowledge and technical capabilities to access and analyze data, they often rely on third-party platforms, such as Vianova and CROW. These platforms help integrate and visualize data, though challenges remain, especially with car-sharing data. However dependence on these parties may compromise internal knowledge accumulation.

Ideally, municipalities want to receive as much and as direct data as possible from each mobility provider. Data supply and demand and the various aspects therein are case-specific and therefore difficult to generalize. However, shared two-wheel providers are substantially supplying more data compared to car-sharing providers. But before municipalities can effectively use data at all they should come to clear and transparent data demands and processing and overcome multiple internal challenges.

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LIST OF ABBREVIATIONS

API	Application Programming Interface
AVG	Algemene Verordening Gegevensbescherming
B2G	Business to Government
CBS	Centraal Bureau voor de Statistiek
CDS-M	City Data Specificatie Mobiliteit
CG	Common Ground
CoE-DSC	Centre of Excellence in Data Sharing and Collaboration
CROW	Centrum voor Regelgeving en Onderzoek in de Grond-, Water- en Wegenbouw en Verkeerstechniek
ER	Expert Respondent
ERTRAC	European Road Transport Research Advisory Council
EU	European Uninion
GBFS	General Bikeshare Feed Specification
GDPR	General Data Protection Regulation
GIS	Geographic Information System
GPS	Global Positioning System
IBDS	Inter Bestuurlijke Data Strategie
ICT	Information and Communication Technology
IR	Industry Respondent
ISO	International Organization for Standardization
I&W	Infrastructuur en Waterstaat
MaaS	Mobility as a Service
MDS	Mobility Data Specification
MPC	Multi-party Computation
MR	Municipal Respondent
NAP	National Access Point
NMS	New Mobility Service

NS	Nederlandse Spoorwegen
NTM	Nationaal Toegangspunt Mobiliteitsdata
OMF	Open Mobility Foundation
OUP	Open Urban Platform
SDG	Sustainable Development Goal
STOMP	Stappen, Trappen, Openbaar vervoer, Mobility service, Prive vervoer
TNO	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek
TOMP-API	Transport Operator to Mobility/MaaS Provider Application Programming Interface
UITP	International Association of Public Transport
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
US	United States
VNG	Vereniging van Nederlandse Gemeenten

LIST OF DEFINITIONS

Trip data: information about origins, destinations, travel times, driver behavior, and other statistics, while securing user privacy (Bezerra et al., 2019; Aryandoust et al., 2019; Roy et al., 2020; Ludwig et al., 2023; Neun et al., 2023; Cohen, 2018; Hawken et al., 2020).

NMS: It is recognized that it refers to new actors, new types of ownership and business models, new vehicle types, and new uses of public space (ERTRAC, 2021). Large group access and shared vehicles form the essence according to research from TNO, (2020).

Platform companies: *"Platform companies are marketplaces"* – Martijn Arets (ER3)

Shared mobility providers: *"Shared mobility providers are rental companies with a completely different approach, often with a technology layer"* – Martijn Arets (ER3)

Smart and sustainable city: An innovative city that uses ICT to improve quality of life, efficiency, and competitiveness while meeting the needs of current and future generations in economic, social, environmental, and cultural aspects (UNECE, 2023). In addition, the UN Sustainable Development Goal (SDG) 11, which is widely used across European cities, aligns with smart and sustainable cities, focusing on inclusive and sustainable urbanization, safe and affordable transportation, reducing environmental impacts, and improving disaster resilience (UNEP, 2017).

MaaS: Currently, there is no uniform definition of MaaS. However, it is generally seen as: *"the integration of various forms of transport services into a single mobility service accessible on demand"* (MaaS Alliance, 2017).

Data-driven work: Data-driven work is the practice of operating based on data that arises from actual events in society. This data is analyzed and processed into information, which, when combined with domain knowledge, can be interpreted correctly. This can lead to better-informed decisions with greater value for society (Nijman & Alberts-de Gier, 2023).

1. INTRODUCTION

Between 2014 and 2050 the global population growth is expected to be 32%, with urban environments experiencing a 63% increase (Estevez et al., 2016). As of April 2023, 56% percent of the world's population live in cities. These 4.4 billion people living in cities are expected to double and reach a point where nearly 70% of the world's population lives in cities by 2050 (The World Bank, 2023). This growth is closely linked to globalization (Al-Rodhan & Gérard Stoudmann Director, 2006), which impacts urban planning and development (Dunarintu & Dociu, 2012). The increased population in cities leads to increased commuting and traffic (Grace Dobush, 2019), resulting in social and environmental problems such as increased greenhouse gas emissions, traffic fatalities, transportation and fuel consumption, and air and noise pollution (Kalhor & Mahdisoltani, 2015). For urban development, it is therefore important to have direct insights into the changing behavior of civil society (Friedmann, 2005).

The increasing densification of cities has led to a growing demand for alternative transportation options, such as shared mobility and on-demand services (Butler et al., 2020). The rapid upsurge of platform companies offering products and services that can be shared leads to higher car-driving efficiency and therefore fewer cars in public spaces (Maselli et al., 2016). Additionally, the market of New Mobility Services opens up and is seen as the way forward to counteract urban (development) problems due to increased vehicle use and mobility efficiency (Kamargianni et al., 2016a). Municipalities show that they need a different perspective on mobility to keep cities accessible livable and traffic-safe (Gemeente Den Haag, 2021), but also to meet climate requirements (Gemeente Den Haag, 2020b). A direct consequence of this modal shift takes place in terms of urban design (Hawken et al., 2020).

To address the changing transport and transportation relationships in cities, a long-term vision in urban planning and development is crucial (Bibri & Krogstie, 2017). Smart, sustainable urban planning addresses environmental and social issues and aims for sustainable development (Bibri & Krogstie, 2017). Creating smart and sustainable cities requires a data-informed decision-making approach (Hawken et al., 2020; Paskaleva et al., 2021). As indicated by the United Nations Economic Commission for Europe (UNECE), the use of Information and Communication Technologies (ICTs) is essential in urban innovation and developing smart and sustainable cities (UNECE, 2023). ICTs provide a comprehensive way to collect, analyze, and integrate urban data, such as human mobility, spatiotemporal, traffic flow, environmental, energy, transport, and socio-economic data, into development plans. Europe leads the way in smart city initiatives (Estevez et al., 2016) and Hawken et al. (2020) and Geropanta et al. (2021) acknowledge that European cities are using various technologies and data to develop smart and sustainable cities. However, data demand by urban planners and policymakers is not met with supply (Martin et al., 2018; S. G. Verhulst et al., 2016).

Although local governments are increasingly using trip data (Cohen, 2018), commitment to this method requires data-sharing partnerships (Hawken et al., 2020). However, challenges like data privacy, misuse of data, and different interests arise. Strong governance structures and regulations are needed for effective and efficient data sharing (Benli-Trichet & Kübler, 2022; Zhang, 2019). In this, balancing interests and frameworks to ensure data security, privacy, and usage is essential (Susha et al., 2017; Ruijer, 2021). The central problem, however, is that this (big) data is often owned by private companies that want to keep the data private for innovation and differentiation. This situation is evolving as more externally gathered data opens up the potential for positive societal solutions (Verhulst, 2021). For example, a specific group of private companies collect huge amounts of trip data such as trip origins, destinations, and travel time from its users (Hawken et al., 2020; Ludwig et al.,

2023). Sharing this data with governments can be helpful for urban planning and policymaking. These private companies can provide valuable information on traffic flow and energy usage, enabling initiatives to reduce greenhouse gas emissions and improve energy efficiency (Hudović Kljuno & Krivošić Dizdarević, 2021). This data can also help municipalities make informed and evidence-based decisions for infrastructure and transportation systems development (Mills et al., 2022; Cohen, 2018; Hawken et al., 2020). Although data for public good is still in its early stages (Verhulst, 2021), this data can help urban planners and policymakers incentivize smart and sustainable transportation (Grace Dobush, 2019).

1.1. PROBLEM STATEMENT AND RESEARCH QUESTIONS

Based on the literature, European smart cities (should) use data in decision-making and urban planning (Hawken et al., 2020; Paskaleva et al., 2021). Nonetheless, the literature also shows that data supply and demand often do not align and thus complications may arise in the decision-making process (Verhulst, 2021). Therefore, this research aims to understand how Dutch municipalities (will) leverage shared mobility data to inform urban development and policymaking. Specifically, it seeks to explore the supply and demand for shared mobility data within Dutch smart cities, and to identify the challenges and opportunities municipalities face in accessing and utilizing this data, posing the following research questions:

"What is the supply and demand for shared mobility data within Dutch municipalities to inform (smart) urban development and policymaking, and which access and utilization challenges and opportunities arise in the data sharing process?"

Sub-questions:

1. "How is the Dutch municipalities' shared mobility data demand formed and what data do they need for urban planning and policymaking purposes?"
2. "What is the current state of data-sharing initiatives between shared mobility providers and Dutch municipalities, and how is this data sourced?"
3. "What are the technical and organizational challenges and opportunities experienced by Dutch municipalities in accessing and using data from shared mobility providers active in the Netherlands?"

1.2. AIM OF RESEARCH

The central goal of this research is to investigate the supply and demand of private shared mobility (trip) data within Dutch municipalities. This research aims to understand the supply, demand, and use of such data by Dutch municipalities and how this might affect strategies and policies for developing smarter and more sustainable urban systems in response to urban innovations and changing urban dynamics.

To this end, the three sub-questions are constructed to work toward answering the main question. The first sub-question focuses on Dutch municipal data needs and how these are expressed. This contributes to the understanding of the motivations and objectives in using such data for urban planning and policymaking. The second sub-question explores what data is available to Dutch municipalities and how this data is offered. This opens up the data supply for municipalities and knowing what data they could use in urban planning and policymaking. The third sub-question examines the challenge in practical utilization and acquirement of data within Dutch municipalities to

understand the complications that arise in data sharing as well as urban planning and policy making (based on data).

1.3. RESEARCH RELEVANCE

1.3.1. SCIENTIFIC RELEVANCE

This research addresses the gap between the supply and demand of shared mobility (trip) data in urban planning and policymaking processes within Dutch cities, by investigating the supply and demand of shared mobility data. By providing empirical insights into how Dutch municipalities form their shared mobility data demand and aim to leverage this data, this study contributes to the understanding of data-driven solutions for urban development and policymaking. Specifically, this research provides further focus on the development of smart and sustainable cities and urban mobility, such as research by (Bibri & Krogstie, (2017) and Hawken et al., (2020), which demonstrates the importance of data in urban development and policymaking.

In addition, this research helps identify developments in the field of shared mobility data sharing facilitation and the need for it. By investigating this, it shines light on potential developments and possible mutual accommodations and thus successful data collaborations. This contribution is important for the Sustainable Business & Innovation field, as it provides useful knowledge on how municipalities want to benefit from integrating shared mobility data into their strategic frameworks, which can be inspiring for other municipalities. Moreover, this research contributes to the understanding of how the supply and demand of shared mobility data can be brought closer together.

This research also builds on the theoretical supply and demand underpinnings of Susha et al., (2017), as well as the distinctions between voluntary, compulsory, and intermediate data sharing according to the theories of (Rukanova et al., 2020; Susha, Rukanova, et al., 2019; Klievink, Van Der Voort, et al., 2018; Vigorito, 2022)). Through practical discoveries within shared mobility data sharing, this research demonstrates whether and how these theories are practically relevant within the context of urban development and policymaking. Additionally, this research tests the generalizability of the data acquisition and utilization challenges described by Diran & van Veenstra, (2020) within the urban development and policymaking context.

1.3.2. SOCIETAL RELEVANCE

This research contributes to improving urban development in Dutch municipalities by discovering how shared mobility data can be used in decision-making processes. The insights gained from this study inform urban planners and policymakers about the potential of shared mobility data to facilitate integrated collaboration and evidence-based decision-making. Additionally, this research identifies practical challenges and opportunities in shared mobility data acquisition and utilization by Dutch municipalities, offering lessons learned from large Dutch municipalities.

Shared mobility itself is a form of smart and sustainable mobility, which directly positively influences (urban) climates. By shared mobility providers sharing data, this mobility sector can be improved (due to infrastructural developments or direct stimulation) which increasingly has positive societal effects.

Shared mobility providers, however, can also benefit from the identification of municipal data demand as they could (pro)actively engage with municipalities and share data to increase and improve infrastructures and mobility regulations which enables them to further grow and operate within the built environment.

By specifically focusing on Dutch municipalities this research underscores the importance of shared mobility in the Netherlands and allows findings to be directly relevant and applicable to the Dutch context. Dutch municipalities could use this study to objectively study the supply and demand of shared mobility data and the needed developments to further facilitate and integrate (data sharing) collaboration in urban development and policymaking (in the field of shared mobility).

As this research is highly explorative this research allows researchers and students to further investigate the area of shared mobility and its data sharing specifically in the Netherlands or other countries. This research identifies a large number of developments and challenges which ask for further research.

THESIS OUTLINE

Chapter 2 conducts an extensive state-of-the-art review to establish the current state of knowledge on shared mobility data sharing and urban development and policymaking in the Dutch municipal context. Chapter 3 presents the theoretical framework guiding the study, integrating key theories and concepts to provide a conceptual lens for analysis and for understanding the supply and demand dynamics of shared mobility data. Chapter 4 outlines the research design and explains the rationale behind the chosen methodology and how it aligns with the research objectives. Chapter 5 presents the results derived from the analysis of case studies and other data, offering a detailed presentation and interpretation of empirical findings in relation to the research questions and theoretical framework. This chapter provides insights into the shared mobility data supply, demand, acquisition, and utilization challenges faced by Dutch municipalities. Chapter 6 critically examines the findings, by providing a comprehensive discussion that highlights consistencies and deviations with existing literature. It explores the implications of the findings, addresses the study's limitations, and provides recommendations for future research. Chapter 7 concludes the study by answering the research questions. It reflects on the empirical findings and underscores the current state of shared mobility data sharing among Dutch municipalities and its significance in urban development. Chapter 8 presents a short and concrete overview of recommendations for practitioners, including actionable steps to innovate.

2. BACKGROUND

This chapter delves into the state-of-the-art knowledge necessary to understand how Dutch municipalities are currently positioned toward (smart) urban development and policymaking, digitalization, innovation, data, and data usage. It first looks at the development and status quo (change resistance) in Dutch mobility systems. Then the developments and vision of collaborations are addressed to identify the willingness and recognition of (external) expertise and capabilities. The focus of this chapter is on the development of NMS and its influence on Dutch urban development. After which MaaS and digitalization within urban development are also briefly discussed.

2.1. CLIMATE-NEUTRAL AND SMART CITIES IN EUROPE

The European Commission aims to develop 100 climate-neutral and smart cities by 2030, with Amsterdam, Eindhoven & Helmond, Groningen, Rotterdam, The Hague, and Utrecht selected as development cities in the Netherlands. The Climate City Contracts outline the cities' commitments, involving residents, research institutions, and the private sector (European Commission, 2022). The Dutch Ministry of Infrastructure and Water Management's (I&W) Growth Fund focuses on building a digital infrastructure for data sharing and utilization, facilitating data acquisition, and improving the quantity (Van Schijndel-de Nooij, 2022). The European Green Deal aims to move towards a sustainable future through digitization, with funding provided for digitization projects in urban environments through the Digital Europe program (European Commission, 2023a). Municipalities are translating these goals into concrete mobility master plans, developing strategies to make shared transport a serious alternative to car ownership (Gemeente Eindhoven, 2023).

2.2. STATUS QUO AND RESISTANCE TO CHANGE

Urban development often overemphasizes cars, a dominant non-human entity that shapes people's spatial environment (MR5). However, car' externalities are often overlooked in urban development. Reconsidering this could lead to radically different mobility system principles. To address negative externalities like emissions and traffic congestion, the government is seeking a fully-fledged alternative that seamlessly replaces cars in urban development (ER3). However, changing this approach and mode of transport is considered challenging. Many people still choose to drive, even though other means of transportation might be faster for getting from point A to point B (MR2). Additionally, Jeanette van Eijk from Greenwheels (IR3) is convinced that car usage is specifically high in the Netherlands, saying: *"I believe there is no country in Europe where so many people own so many cars per capita as in the Netherlands. It's quite a sacred cow."*

Municipalities aim to actively address this issue to break the residents' habits and routines, as they often cannot do it themselves (MR2; MR6). To support this, municipalities want to work according to the STOMP (Walking, Biking, Public transport, Mobility service, Private transport) principle. This principle prioritizes modes of transport in a way that minimizes private car use within a city. It starts with walking, followed by cycling, public transport, mobility services, and lastly, private cars (ER1). Municipal respondents suggest adjusting policies and regulations to eliminate the current focus on private cars to successfully reverse the mobility pyramid (MR2; MR6).

2.2.1. RESISTANCE TO CHANGE

In practice, it is difficult to initiate change in the field of urban mobility. Municipalities observe that many people continue to use their cars within the city despite the compact urban design. Consequently, even with the availability of trams and various transport options that might be even

faster than car transport, a significant number of residents prefer driving themselves (MR2). This situation has prompted a focus on encouraging residents to consider faster and more efficient alternatives such as bicycles or other modes of transport, as this leads to less individual dependence on private vehicle use (Gemeente Den Haag, 2020b). The challenge lies in changing established habits and making residents aware of these viable options. In practice, however, shared mobility is primarily considered appealing to those who do not own a car yet or are looking to replace a second car (Gemeente Den Haag, 2020b). This habit is also influenced by governance and politics (MR6; ER2). When a conservative party favoring car use is in power, the development of infrastructure is based on this preference (MR6).

This can be explained using the theory of resistance to change. People are often afraid of the unknown. They know that driving currently works for them despite experiencing problems. However, they do not know what will happen if they take another mode of transportation. They have not yet been able to experience confidence with the alternative and therefore prefer to stay tied to their routines because they are confident (Pardo Del Val & Martínez Fuentes, 2003). The municipality can respond to this by implementing policies that are consistent with promoting facilitation or communicating transportation alternatives such as shared mobility (ER2). As Rik Braams from TNO and the Ministry of I&W (ER2) notes, *"The simplest definition of policymaking is behavior change; you want to effect a change in people's behavior."*

2.3. URBAN TECHNOLOGICAL INNOVATION

Urban innovation is the process of improving urban environments through the development and adoption of new ideas, primarily technological and socio-technical. It involves interactions between stakeholders and involves the use of new technologies to alter collaboration structures and routines in the public domain. By examining the interactions between technological and social changes, it is possible to discover the innovation's associated technologies and social effects (Williams, 1997). In recent years, the driving force and location of (social) innovation in the public sector have shifted from being government-centric to a cooperative approach between government and other actors (Hartley et al., 2013; De Vries et al., 2014). Governments should consider actors capable of implementing public innovation, fostering interactions between companies, governments, knowledge institutions, and citizens to enhance the innovation process and create value for all stakeholders (Hartley et al., 2013). Developers of new technologies need to take into account the adoption capabilities of (government) organizations and citizens (Meijer & Thaens, 2018). Both municipalities and industry representatives indicate that, implementing things such as data standards and working with them costs a lot of money, especially if you are already stuck to routines (MR3; IR3). The integration of new technologies like APIs into existing systems and processes is challenging, necessitating careful consideration of adoption capabilities and financial implications (IR3). In addition, many smart mobility innovations arise within the private sector. By giving space to and facilitating these companies, innovations can continue to develop within the public domain and have a positive effect on the urban area when data and knowledge from these companies is shared with municipalities (Gemeente Den Haag, 2020b).

2.4. COLLABORATION

Policy decisions are initially determined and developed solely by the municipalities, often excluding market parties from the process. From the shared mobility provider's perspective this prevents optimal results (ER5; IR4). Dani Sprecher From MyWheels (IR4) emphasizes this, stating, *"Six months earlier, we should have been at the table commenting on all those turns so that they could decide together which one was the right one."* The goal is to find an overlapping common interest between

mobility users, the government, and mobility providers, as noted by Ferdinand Burgersdijk from the European Commission (ER5). Municipalities also recognize this in their new goals and development strategies. The ultimate target group should be at the heart of development (Maltha et al., 2021). Through collaboration, the municipalities are bringing technological opportunities together with where the need is for practical solutions in public space (Gemeente Amsterdam, 2023).

Within the development of smart cities, collaboration spanning local, regional, and international levels is essential (Liu et al., 2024; Maltha et al., 2021; Gunterman, 2020). Municipalities often acknowledge societal issues and seek solutions, however, the national government fails to take a concrete role in this collaboration and development. The national government should take on the role of coordination and leadership to facilitate innovation and the provision of new mobility options (MR1; MR6; MR7), but should not go too far in this (ER1). As more private sector companies arrive within the public space, municipalities should seek collaboration opportunities with them (ERTRAC, 2021). Governments often overlook the importance of information in decision-making and development plans, resulting in missed collaboration with local governments and stakeholders. More frequent exploration is needed to substantiate choices and include stakeholders in addressing societal issues (Boeije, 2019).

The development of smart cities holds the greatest potential in metropolitan regions that collaborate closely. However, there are many differences between municipalities, which impede development and collaboration. Martijn Arets from Professional Outsider Consultancy (ER3) points out that *"Some municipalities have a vision, while others do not. Some have the resources to think about these issues, while others do not."* The integration of smart city governance into traditional systems may lead to challenges that require sustainable and multi-stakeholder participation strategies (Nesti, 2020). In this development, the use of data is an opportunity for smart and sustainable development (Yigitcanlar et al., 2019). Similarly, D. E. Mills et al. (2021) recognize the importance of authentic collaboration between urban governments, private organizations, and citizens for achieving urban development goals.

By collaborating with and using data of private companies, governments can create win-win scenarios. The joint investment can result in financial gain for private companies and improved urban development for governments, meeting the needs of residents (Ecorys, 2021). Digitalization is crucial for solving societal issues, and collaboration between local governments and stakeholders is essential for sharing data and knowledge. The data strategy within municipalities therefore provides direction and coherence in creating data-driven initiatives (VNG, 2024). Despite the promised benefits of these collaboration initiatives, the associated risks must also be analyzed and mitigated (ERTRAC, 2021).

2.5. POLICY MAKING

Data is needed for short-term policy cycles for traffic regulation and policy adjustments, emphasizing the need for more competent urban planners and policymakers to interpret data and the importance of data for promoting smart and sustainable mobility (Liu & Dijk 2022). Specifically, to achieve traffic adaptation, there is a greater need for real-time traffic and mobility-related data in short-term policy cycles (X. Liu & Dijk, 2022). Leveraging data and integrating it with smart technologies can innovate urban living and management (França et al., 2021; Wang et al., 2021). However, understanding challenges such as data isolation and limited knowledge derivation from data is essential (A. Wang et al., 2021; Sarwat, 2015). Sarwat (2015) and Silva et al. (2018) underscore the importance of data management techniques like IoT to develop effective smart cities that efficiently manage and process large amounts of urban data, leading to a better understanding of urban mobility patterns and more informed urban planning and management. By leveraging the power of big data, cities can make more

informed, timely, and effective decisions, leading to smarter and more sustainable urban environments (Sarwat, 2015; Silva et al., 2018). Oregi et al. (2015) found that the use of ICT tools can significantly improve sustainability performance and facilitate stakeholder communication. However, conflicts and synergies exist between different policy levels, and better policy alignment for sustainable urban mobility still needs to be addressed (Oregi et al., 2015). Ferdinand Burgersdijk from the European Commission (ER5) highlights the complexity of this multi-level regulation: *"If we have regulated it in Europe, then we have to regulate it again nationally and then we have to regulate it again locally, whether provincial or municipal."*

2.6. NEW MOBILITY SERVICES (NMS)

Developments in technology have led to the emergence of new forms of mobility within cities, referred to as New Mobility Services (NMS) (UITP, 2020). According to the European Road Transport Research Advisory Council (ERTRAC), the definition of New Mobility Services (NMS) is not yet complete. However, it is recognized that it refers to new actors, new types of ownership and business models, new vehicle types, and new uses of public space (see Figure 1). This necessitates new regulations to shape the demand, impact, and regulation of these developments (ERTRAC, 2021). Additionally, researchers from TNO state: *''New transport services are defined as car, bike, moped, or scooter sharing, where a fleet of vehicles can be accessed by a large group of users; ridesharing (carpooling or vanpooling), in which rides in a vehicle are shared; and on-demand ridesourcing (pooled or individual), where a driver offers an on-demand ride to a passenger.''* (TNO, 2020). With the changing mobility demand and supply, there is a transition from traditional transportation, often associated with a fixed schedule, to NMS, which are frequently aligned with people's on-demand mobility needs (ER1). These NMS are also characterized by being able to be shared, which facilitates the transition from private (car) ownership to shared mobility (ER1). NMS have the potential to drastically change cities, making it essential to assess the advantages and disadvantages of this innovation (ERTRAC, 2021). NMS is also part of the MaaS development in which municipalities see opportunities to innovate urban mobility. For further information about MaaS see **Appendix C.**

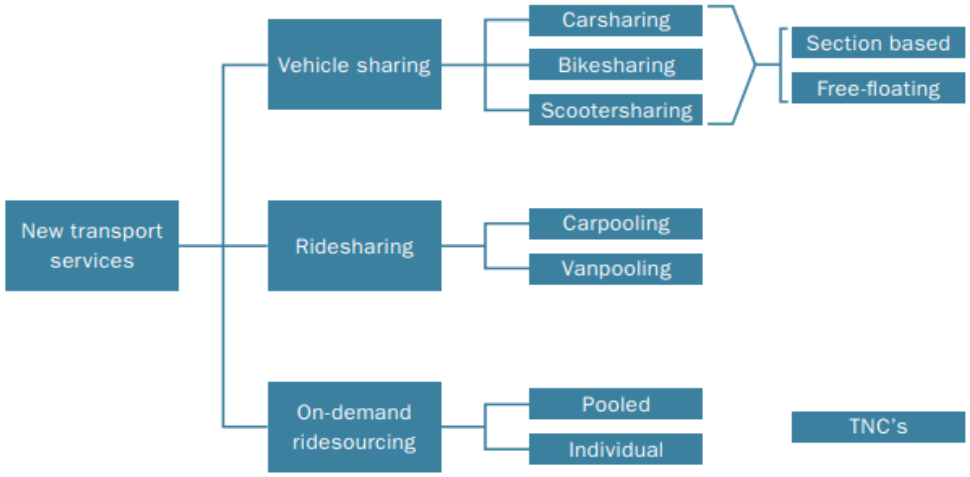

Figure 1 Overview of various New Mobiliy Services (TNO, 2020).

2.6.1. IMPACT OF INNOVATION

This transition aligns with global initiatives such as the United Nations' (UN) Sustainable Development Goals (SDGs). The added value of NMS and particularly shared mobility, is actually that you have a more efficient use of resources (ER5). However, these technological advancements

also lead to unforeseen impacts that are not yet fully understood. Despite the positive promises, there are also concerns and mistrust about the impact of innovation (UITP, 2020). Companies should establish accountability and research is needed to measure the positive impact of their services and products before implementation. This includes making the service accessible to everyone and researching the type of transportation their products replace to gain a broader context of their contribution to sustainable mobility (ER3).

2.6.2. DISRUPTION AND CHANGE

Urban mobility systems are at a turning point, poised for disruption and change (UITP, 2020). Cities want to understand the impact of NMS on travel behavior and calculate where and how they can design mobility in the city and prevent disruption. (Bidasca & de la Quintana, 2020). Rik Braams from TNO and the Ministry of I&W (ER2) notes that within the Ministry of I&W, there is significant concern about disruptive innovations like Uber, which extensively disrupted the taxi domain. *"There is an underlying narrative, a kind of fear of a second Uber. Essentially, there is a risk in not having innovation on the radar in time. This is a major reason for officials at the Ministry of I&W to engage with innovation and maintain contact with the market. It's basically out of a fear that the field will be disrupted, and you won't notice it in time, causing it to take you by surprise,"* explains Rik Braams from TNO and the Ministry of I&W (ER2). Jeanette van Eijk from Greenwheels (IR4) indicates that shared two-wheel providers rushed the urban areas and offered significantly more vehicles than car-sharing providers, suggesting the importance of regulating two-wheel providers, but criticizing the need of car-sharing regulation as it is not disruptive: *"Our entire fleet consists of 2800 cars. (...) So, we never come to cities with an 'I'll just drop 10 cars here' approach. We do have that gradually in some cities, but we are expanding very step-by-step."* In this sense, disruptive innovation refers to innovations where a new market is created by offering different values than the current market. Often this is achieved by being simpler, easier, or cheaper than the competition. Market capitalization is a phenomenon where disruptive innovations start in a niche market and can eventually dominate and replace competition, often criticized by incumbent businesses and stakeholders as undesirable and harmful compared to current practices. Nevertheless, these innovations are often able to evolve and create a new reality in which the industry and user behavior are influenced (O'Reilly III & Tushman, 2021). Ferdinand Burgersdijk from the European Commission (ER5) emphasizes the importance of adaptability in the face of such changes, quoting Charles Darwin: *"It's not the strongest nor the most intelligent of people that survive, but the ones most adaptable to change. We need to adapt to change."*

2.6.3. INFRASTRUCTURAL CHANGES

The availability of NMS depends on the characteristics of the city (MR3; ER3; IR2; IR3). A city with good biking lane infrastructure is better suited for initiatives that offer two-wheelers. Other infrastructural factors also play a role, such as the number of parking spaces, city congestion, and the availability of mobility hubs (MR2; MR3). To integrate NMS into the city, urban planning, and policymaking for the facilitation of NMS in these areas are essential (MR2). Ferdinand Burgersdijk from the European Commission (ER5) underscores the dependency of NMS on public infrastructure: *"The bike rental company can only make money because they can use public amenities."*

Experts suggest that standardizing shared mobility in urban development can improve societal benefits and address the central spatial development issue of urban space utilization (ER3; ER5). This approach increases efficiency by using fewer resources when shared mobility is used more frequently than private cars (ER3), and optimizes urban space (ER5). By offering shared mobility within the city, fewer private cars and parking spaces will be needed, as Jeanette van Eijk from Greenwheels (IR4)

indicates a single shared car can save up to 14 parking spaces. This aligns with municipal goals regarding green spaces and mitigating urban heat stress (IR3).

Over recent years, there has been a shift from private ownership of transportation means to shared transportation. This shift is causing a restructuring of infrastructure within the built environment. One approach gaining traction is the STOMP-procedure, a principle within the mobility sector that is now increasingly being used as a standard for new developments within municipalities (MR6; ER1).

The International Association of Public Transport (UITP) envisions a future where public transport is the backbone of urban mobility systems, with NMS integrated to enhance sustainability and reduce reliance on private cars (UITP, 2020;Kamargianni et al., (2016). As cities grow larger and become more densely populated, it becomes increasingly difficult to further facilitate and expand (public) transportation. Therefore, good cooperation with these transport providers, as well as with users, is needed to identify the right needs. NMS provide solutions by offering transportation within the city as a first/last mile transport provider (ER2; IR1), transportation from peri-urban to inter-urban areas (Bidasca & de la Quintana, 2020). Niels Wiersma from municipality Eindhoven (MR1) explains, *"It is also in our policy of shared mobility and in the larger mobility plans of the municipality that we like to see shared mobility as a very good addition to existing forms of public transport, shaping the solution for the last mile."* A shared two-wheeler industry representative (IR1) adds, *"Our goal is to play in partnerships with public transport, to address the first and last mile."*

2.6.4. MUNICIPAL ROLE

To adapt to digitalization and NMS municipalities need to change their role to manage the urban mobility system effectively (ERTRAC, 2021). Municipalities must all ask themselves what role it has in the city's changing (digital) infrastructure (MR5). A policy officer from municipality Rotterdam (MR6) highlights the need for municipalities to take on a director's role to ensure that the end user benefits from the mobility transition: *"The municipality must take the director's role to ensure that the end user benefits from the mobility transition and that the new forms of mobility are offered in the right way and the right quantity. This is being done on individual subjects, but a coherent whole is not yet being realized."* Despite this, municipalities cannot yet confidently assure residents that they don't need their own cars because suitable alternatives for getting from A to B are available, particularly in urban areas. *"The potential is there, only we don't see the separate innovations converging within the municipality."* adds a policy officer from municipality Rotterdam (MR6).

2.7. DIGITALIZATION

The rapid digitization of infrastructure is transforming traditional cities into socio-physical-digital ones, integrating digital dimensions with social and physical aspects of urban life. This new paradigm creates a triangular relationship in urban functioning, but the central point between these aspects is becoming larger and more integrated in physical reality, potentially leading to different consequences (MR5). Digitization offers governments many opportunities to collaborate with NMS parties, but in practice, it is still insufficiently utilized. This also applies to the use of open data and open information (Boeije, 2019). Collaborating on these challenges is operational, meaning that parties learn about each other's processes and effectively utilize each other's expertise and data for development. For this to happen, governments need to map out the data landscape and ensure that employees understand data and develop digital skills (Keur & Gunterman, 2021).

Data is often seen as a private good, even though it can have a significant impact on societal problems. When data is kept private, its public value cannot be fully realized and socially undesired data

monopolization by (large) private companies will happen (El-Dardiry & Overvest, 2019). The rise in digitality in daily life and urban development makes cities more vulnerable to private companies, raising concerns about government dependency and control, as governments may become captive customers, hindering independent urban infrastructure management (MR5), indicating demand for stringent market regulations (Rijksoverheid, 2021c).

3. THEORETICAL FRAMEWORK

This chapter presents the theoretical framework used to guide the research and give meaning to the results found. The first part of the framework is built upon the framework of Susha et al., (2017). Additionally, the chapter addresses the challenges identified by Diran & van Veenstra, (2020).

To successfully investigate how Dutch municipalities (try to) leverage ride-hailing trip data and what the current supply and demand of this data is within smart cities in the Netherlands, this research needs a suitable theoretical framework. Within the literature, there are several frameworks on smart and sustainable urban planning such as the smart city initiative framework by Ooms et al., (2020), which addresses the different phases and related aspects of smart city development. But also collaboration/co-creation frameworks are often found in the literature. Such as the Quadruple Helix framework by Paskaleva et al., (2021a), which emphasizes the importance of collaboration between multiple stakeholders (government, industry, academia, and citizens) for the success of smart city projects. Or the big data utilization frameworks such as those used by Silva et al., (2018), J. Wang et al., (2017) or Türk et al., (2021). However, there are relatively few practical theories and frameworks on data supply and demand.

Nonetheless, as a starting point for building a theoretical framework for this research, the taxonomy of Susha et al., (2017) is used. This concerns a taxonomy of data collaboratives in which data gets leveraged to address societal challenges. The taxonomy is constructed to represent the supply and demand of data within collaboratives (see Figure 2). However, rapid technological developments may affect the underlying variables of the taxonomy and further research in supply and demand matching infrastructures may discover new issues (Susha et al., 2017).

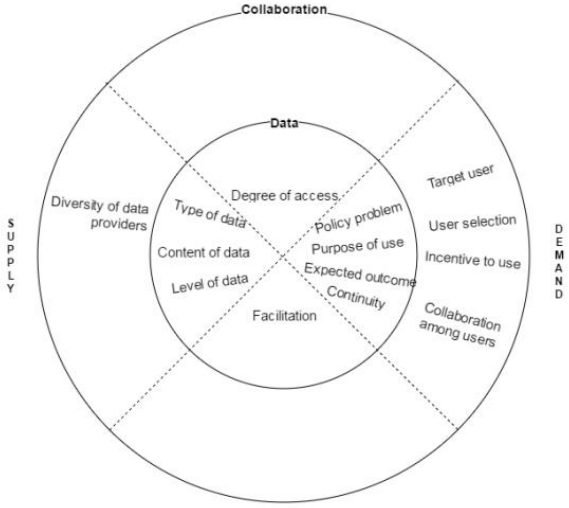

Figure 2 Dimensions of the taxonomy of data collaboratives based on the supply-demand relationship (Susha et al., 2017).

This research will specifically addresses the inner circle, the data layer, from the diagram. This includes dimensions such as **data type**, **data content** and **data level** for the data supply side and **policy problem**, **use purpose**, **expected outcome**, and **continuity** for the demand side. Herein, according to the authors, **data type** is understood as, for example, consumer or user-generated data. The **content of the data** includes, for example, words, locations, behaviors, transactions, and nature. The **level of data** refers to the specificity at administrative levels, and the diversity of data providers. For the demand side, the framework classifies the **policy problem** as unspecified or specified. This refers directly to whether the municipality wants to implement the data purposefully or wants to have the data first and then see what it can be applied for. The **purpose of use** is divided into three groups, being; *primary use*, in which the data is used directly for what it was collected, *secondary use*, in which the data is used for something similar, *tertiary use*, in which the data is used for something else that was initially thought, or *end use*, in which data is processed and the result is used by others. The **expected outcome** of the data collaborative concerns the determination to use the data for policy intervention, data science, or data-driven innovation. Last, **continuity** of collaboration is named in which the influx of data becomes apparent. This can be on-demand, event-based, or continuous (Susha et al., 2017). To match data

supply and demand, the concepts of **facilitation** and **degree of access** are incorporated into the theoretical framework. Here, **facilitation** refers to the support for data collaboration, distinguishing between *direct contact, intermediary contact, or coordinating contact through an intermediary*. **Degree of access** concerns the openness of data, with distinctions between *real-time direct access to raw data, a copy of data, modified/enriched data, outcomes of processed data, or open data*.

However, what is missing within this framework is the way of data sharing, **data sharing mode,** on the supply side. To investigate this, a distinction is made, based on the literature, between *voluntary, compulsory, and intermediate* data sharing (Rukanova et al., 2020; Susha, Rukanova, et al., 2019; Klievink, Van Der Voort, et al., 2018; Vigorito, 2022).

While this adapted framework of Susha et al., (2017) can be used effectively in identifying supply and demand for shared mobility data, it does not directly provide a way to explore the challenges that Dutch smart cities experience in accessing and using data from ride management companies. Despite well-known frameworks by Rukanova et al., (2020) which identify barriers, drivers, and enablers of voluntary B2G data sharing and the governance processes that foster it, and research of Klievink, Van Der Voort, et al., (2018) which adds components such as trust and institutionalization offer some input in this regard, but do not cover the exact challenges. However, Diran & van Veenstra, (2020) do so. They discovered several challenges/barriers to both data collection and data use. Although Diran & van Veenstra, (2020) dedicate their research specifically to heat transition policymaking, these barriers are not expected to differ significantly for policymaking based on shared mobility data, which makes it a suitable starting point for this research. These barriers and challenges are specifically addressed to gathering data from other parties than the municipality itself. See Table 1 below for the identified barriers and challenges.

Table 1 Barriers and challenges in data access and data use by policymakers

Data collection	**Data use**
GDPR and privacy restrictions	Cautious to make decisions based on insights from data
High investments in time and costs	Data lacking quality and consistency
Lack of expertise and skills	Incomplete and missing data
Scattered distribution of data	Data is not always validated
Poor data findability and access	Data lacking detail level
Lacking access rights	Lack of supporting tools
Many formats and standards	Difficult to determine the value and purpose of data
Lack of awareness, trust, and openness in data sharing	Data preparation is resource-intensive
	Difficult to link, analyze, and visualize data
	Resources at the limits to process the quantity of data
	Legal limitations to data use

By combining and adapting these theories, the foundation has been formed for identifying supply, demand, and challenges for the study of how Dutch municipalities (try to) leverage ride-hailing trip data and what the current supply and demand of this data is within smart cities in the Netherlands.

4. RESEARCH METHODOLOGY

This chapter provides an overview of the research methodology used in this study aimed at understanding demand, supply, and use of shared mobility data by Dutch municipalities. It delves into the research philosophy, type, design, sampling strategy, data collection methods, and data analysis procedures. Furthermore, the chapter addresses the research quality indicators, limitations, and ethical considerations, ensuring a robust and transparent methodological approach.

4.1. RESEARCH PHILOSOPHY

This research aims to understand the supply and demand of shared mobility data within Dutch municipalities and how they aim to use this data for urban development and policymaking in response to changing urban dynamics in terms of urbanization and changing work patterns. The interpretivism philosophy is used to understand different subjective perspectives and experiences of stakeholders in urban development and shared mobility data sharing.

The iterative nature of the philosophy allows for exploring the nuanced and context-specific nature of data sharing in the mobility sector. This philosophy enables a holistic approach to understanding qualitative insights on stakeholders' experiences and perspectives on urban development and data data-sharing collaborations and data use practices (Clarck et al., 2021).

4.2. RESEARCH TYPE & DESIGN

This research follows an abductive, qualitative research approach, aligning with the interpretivism philosophy (Clarck et al., 2021). This qualitative approach provides the right opportunities to discover new aspects and explore complex phenomena in shared mobility data sharing through qualitative data collection as well as confirming theoretical aspects. This approach facilitates an in-depth understanding of various stakeholder perspectives, challenges, and opportunities in data sharing, acquisition and utilization for evidence-based decision-making in urban development and policymaking. It allows for the emergence of patterns and themes, revealing the complexity of the subject. The flexibility of the research approach also allowed small adjustments in research strategy and direction based on the acquired data (Clarck et al., 2021). More specifically, this research follows an exploratory multiple case study design, which is a flexible method that allows for in-depth data collection and analysis, which leads to a deeper understanding of the phenomenon and adjusting research questions and directions (Clarck et al., 2021). Conducting multiple case studies has provided opportunities for a comprehensive exploration and understanding of the shared mobility ecosystem and its data sharing with municipalities, effectively identifying patterns and comparing different examples which reinforces the validity of the findings (Eisenhardt, 1989).

4.3. SAMPLING STRATEGY

This research focuses on qualitative data collection through participants who meet specific criteria. For this purpose, the sampling strategy is deployed by a combination of criterion and purposive sampling (Palinkas et al., 2015). This ensures selecting cases that are likely to replicate or extend theory and provide opportunities to provide rich insights and deepen understanding of the shared mobility data sharing phenomenon (Eisenhardt, 1989).

First, criteria were established to identify and select appropriate Dutch cities and participants. In this, the main criterion is the selection of cities with more than 150,000 residents according to the Central Bureau of Statistics (CBS). This condition is tied to the presence of shared mobility companies, which primarily operate in large cities, and the volume of trips made within the city, which strengthens the

quantity of data available (Tao et al., 2019). Additionally, larger cities, as they are more innovative, are more likely to engage more extensively and deeply with data usage, thereby making a more significant contribution to this research (Carlino et al., 2007).

The selection of other stakeholders goes by relevance, availability, and applicability in the selected cities. This purposeful sampling is based on maximizing variation in the experiences and perspectives of key stakeholders in urban development in Dutch municipalities. These key stakeholders are:

1. Urban planners and policymakers who are involved in shared mobility and (sustainable) urban development. They offer valuable insights into decision-making processes and the role of (trip) data in (smart and sustainable) urban development and policymaking. This information can help identify challenges and opportunities for data access and utilization, understanding data needs and supply, and regulations for data collaboration and sharing.
2. Researchers and (Data) experts in the field of (smart) urban development and data collaboration/ utilization. They shape (trip) data collection, supply, and utilization, and provide insights on successful practices related to (smart) urban development, and data collaborations, forming connections between theory and practice. Incorporating their critical perspectives uncovers innovation possibilities and potential solutions for urban development and policymaking based on shared mobility data.
3. Industry representatives of shared mobility, holding (trip) data within the selected municipalities. They offer insights into data supply and the implications of platform-, and shared mobility companies in urban planning and policymaking. Understanding these factors helps identify data sources and collaboration opportunities.

4.4. DATA COLLECTION

This study uses primary and secondary data to understand shared mobility data demand, supply, and use, in smart and sustainable urban development. Primary data has been obtained through in-depth, semi-structured, one-on-one interviews with policymakers/urban planners, researchers/experts, and industry representatives in the field of shared mobility data in Dutch municipalities. The qualitative research technique allows for both anticipated answers and spontaneous discoveries, ensuring participants are not influenced by others or the researcher (Clarck et al., 2021). The conduct of interviews is location-independent for the researcher, using both physical and digital methods, such as Microsoft Teams or telephone. Audio-recorded and transcribed interviews, in agreement with interviewees, are used for thematic analysis in NVivo (Clarck et al., 2021). See Table 2 for the precise list of interview respondents.

Table 2 Interview respondents

Number	Name	Code name	Role	Organization	Duration
		Municipalities			
1	Niels Wiersma	MR1	Data and Platform Strategist	Municipality of Eindhoven	33:42
2	Emma de Wijs	MR2	Policy Advisor Urban Planning	Municipality of The Hague	51:28
3	Undisclosed	MR3	Policy officer	Municipality of The Hague	52:38

4	Antoine Gribnau	MR4	Advisor Geo Information and open data	Municipality of The Hague	21:19
5	Roland van der Heijden	MR5	Program Manager Digital City	Municipality of Rotterdam	38:37
6	Undisclosed	MR6	Policy Officer	Municipality of Rotterdam	42:14
7	Gemma Schepers	MR7	Project manager Smart Mobility	Municipality of Amsterdam	54:23
		Researchers & Experts			
8	Marlous Hovestad & Rosanne Klerx	ER1	Mobility data expert, Community Manager MaaS	Nationaal Toegangspunt Mobiliteitsdata	56:21
9	Rik Braams	ER2	Senior Scientist for Transformative Government/ Innovation Officer Innovation in Mobility	TNO/ Ministry of I&W	36:32
10	Martijn Arets	ER3	International Platform Expert	Professional Outsider Consultancy	44:00
11	Edwin van den Belt	ER4	Software Architect	Dat.mobility & TOMP-API & CDS-M working groups	52:30
12	Ferdinand Burgersdijk	ER5	Data governance, digitalization and mobility expert	European Commission/ FRCB B.V/ UITP	1:17:39
		Industry Representatives			
13	Undisclosed	IR1	Undisclosed	Shared two-wheeler provider	21:26
14	Undisclosed	IR2	Undisclosed	Shared two-wheeler provider	35:11
15	Jeanette van Eijk	IR3	Public Affairs Manager	Greenwheels	1:00:13
16	Dani Sprecher	IR4	Manager Public and Government Affairs/ Co-founder coalitie van Deelauto-aanbieders	MyWheels	42:14

This enumeration lists the four case study cities, each requiring interviews with the municipality. In addition, the research includes interviews with industry representatives (shared mobility providers) and researchers & experts. In this, the municipalities are considered as the data demanding parties as the industry representatives are considered the data-supplying parties. The researchers & experts act as an objective control and explaining group that connects supply and demand and gives context to the

data-sharing phenomenon. The interview guide and questions for each stakeholder can be found in **Appendix H-J**.

To complement primary data, this study uses desk research to gather and analyze secondary data. The study comprehensively reviews and synthesizes existing literature and reports on smart city and data sharing, analyses of data and digitalization strategies, and data sharing initiatives from shared mobility providers. In this way, context is provided, allowing a comprehensive understanding of the topic to be formed. The literature study allows for an understanding of innovations and developments within Dutch municipalities. Starting with secondary data analysis, a data foundation has been formed and research questions and interview questions have been sharpened. Additionally, desk research is used to find policy documents to provide input for municipal case study (thematic) analysis.

The inductive data collection method provides qualitative data while triangulating data collection methods strengthens research validity and reliability (Clarck et al., 2021). The research is iterative, moving between theory and data collection to steer the research but also aims to test the existing framework based on new findings and focus on problem and solution direction, additionally aiming to revise the theoretical framework.

4.5. DATA ANALYSIS

Thematic analysis

To investigate the municipalities as cases (within-case analysis) as well as investigating interviews with industry representatives and researchers/experts, thematic analysis is used. Thematic analysis is a qualitative research method for identifying, analyzing, and reporting themes that emerge within data. It involves reading and re-reading the data to gain a comprehensive understanding and make initial notes to capture context and nuances (Khokhar et al., 2020). The data is then systematically coded using NVivo software. Within the initial coding process, the theoretical framework based on Susha et al., (2017) and Diran & van Veenstra, (2020) is central as this provides the initial codebook (see Table 3). This codebook includes predefined categories facilitating a structured approach for this coding process. This guarantees not only the reliability of the data based on thematic analysis but also contributes to the existing body of knowledge through theory testing (Clarck et al., 2021). This deductive approach to coding ensures alignment with the theoretical constructs and sets the foundation for understanding the data in terms of the established theoretical framework. Additionally, open coding is used to identify new themes within the data. Adding this inductive approach ensures that while the analysis is guided by the theoretical expectations, it remains open to capturing novel insights and deviations from the theory, allowing new themes to be revealed (Clarck et al., 2021). Both deductive and open coding have been done through a combination of in vivo and descriptive coding techniques.

Table 3 Initial codebook (categories derived from theoretical framework

Categories:	**Description:**
Supply:	
Data type	Nature of data collection
Data content	Specific information the data contains
Data level	Specificity or granularity of the data

Data sharing mode	The method through which data is disseminated or made accessible
Supply & demand matching:	
Facilitation	Support mechanisms to aid data collaboration
Degree of access	The extent of data accessibility
Demand:	
Policy problem	Predetermined use case for data
Use purpose	How directly the date serve the initial purpose
Expected outcome	Anticipated result of data use
Continuity	The frequency and regularity of data supply
Data acquisition challenges	Problems faced in collecting data
Data utilization challenges	Difficulties in using collected data effectively

Next, axial coding is applied to discover the relationships between codes and how they refer back to the theoretical constructs in the framework. The next step is selective coding. Here the focus is on refining and selecting core themes that are most relevant to the theoretical framework. To do this, data is synthesized into broader themes to discover the essence of the theoretical constructs and the relationships between them. For each theme, it is reasoned how and why it belongs to the theory or why not (Clarck et al., 2021).

To limit theoretical biases and assumptions regarding the coding process, there is continuous reflection on the process. This iterative process does not follow a chronological approach, allowing for a richer and more detailed representation of complex data (Clarck et al., 2021).

Cross-case analysis

This study shortly engages in cross-case analysis to compare shared mobility data supply, demand, access, and utilization across four Dutch municipalities and shared mobility providers (which are distinguished based on offering cars or offering two-wheelers). By systematically studying themes, derived from thematic analysis based on interviews and documents, within each city, and interviews among shared mobility providers, the analysis facilitates the discovery of patterns, variations, and case-specific insights, enhancing the broader understanding and interpretation of the thematic findings (Clarck et al., 2021; Eisenhardt, 1989). This method not only allows for contrasting and validating themes across different cases but also broadens the perspective by highlighting the complexity and diversity of implementing shared mobility data sharing in various urban contexts.

During the cross-case analysis, themes and content from each city or shared mobility provider are meticulously compared. This comparison leverages the theoretical framework as a tool to examine various aspects of the cities or shared mobility providers but remains flexible to incorporate newly emerging themes and concepts that arise during the analysis. This dynamic approach ensures that the theoretical framework is not only applied but also evaluated for its effectiveness in capturing the nuances of each case.

This research is profoundly explorative, which results in findings (especially from cross-case analysis, as they are based on single interviews, and a limited number of documents) that are preliminary, but suggest directions for further research which includes more extensive data collection.

4.6. OPERATIONALIZATION

Research model

Figure 3 provides a clear visualization of the data collection contribution and process flow. However, the scheme excludes specific literature review topics and documents to maintain clarity. It should be noted that this research model serves as a guideline within the study and is not exclusively adhered to. This allows for deviation from the direct contribution to a topic when a respondent unexpectedly shares relevant information. Additionally, within this model, the direct relationship between thematic analysis and its contribution to the theoretical framework and research questions is omitted to maintain clarity. The thematic analysis for each respondent group was conducted in the same manner, resulting in an integrated view of the supply, demand, and challenges of shared mobility data sharing in Dutch municipalities.

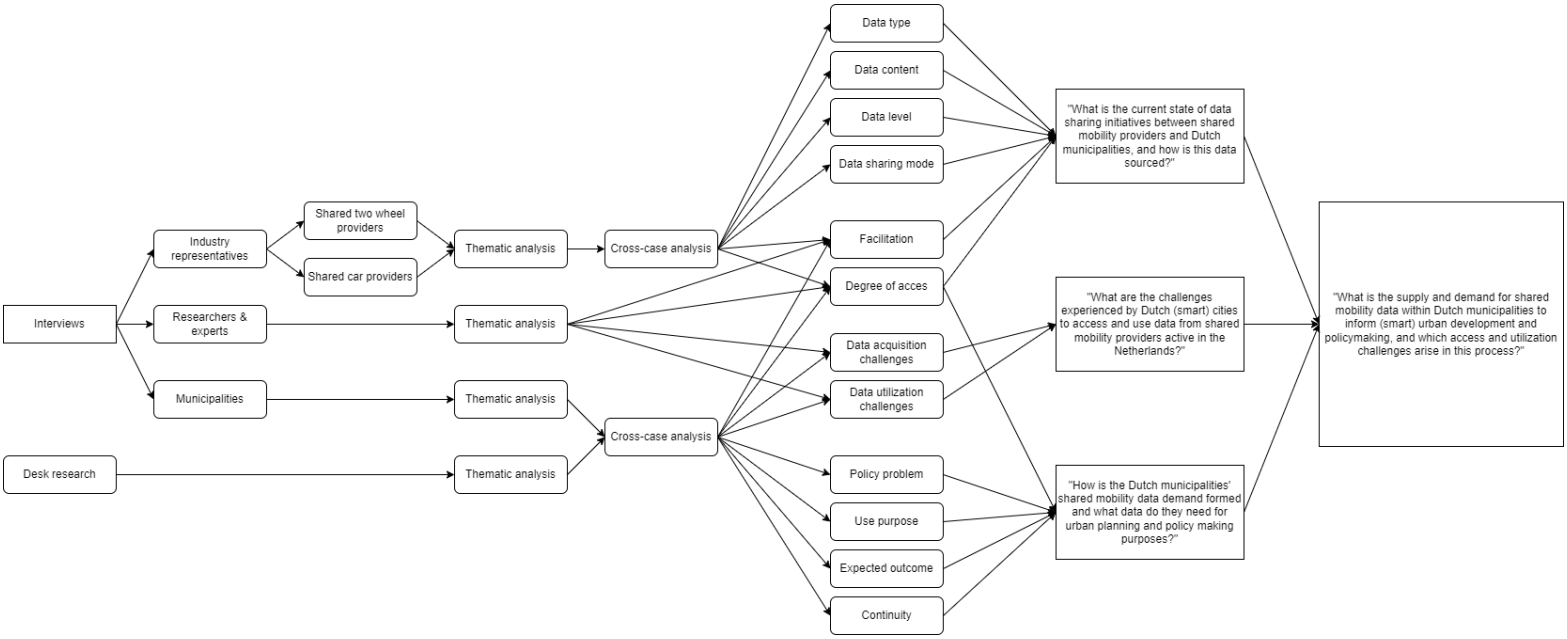

Figure 3 Research design (including data collection, analyses, theoretical framework, and answering research questions)

4.7. RESEARCH QUALITY INDICATORS

Internal reliability

To maintain consistency in data collection, a semi-structured interview guide was created for each stakeholder group (municipalities, researchers & experts, and industry representatives). Before conducting interviews with the respondents, these guides were tested through pilot interviews. Based on the feedback from these pilot interviews, the interview questions were adjusted and refined for clarity and relevance. Additionally, the study was designed and conducted by a single researcher, minimizing differences in interpretation within the study.

External reliability

To ensure trustworthiness and making sure the same results can be obtained by another researcher, the research process includes a transparent methodology, data collection, analysis, and processing strategy, and is built on theoretical frameworks. Although this research is explorative and interpretive it provides clear and transparent findings based on external research, and individual findings and experiences. Additionally, this research clearly states its limitations in the process and results.

Internal validity

To ensure the integrity of the research design, causal relationships are not biased or influenced by external factors. Triangulating data allows findings to be tested and validated against each other. In this study, this is done through interviews from multiple perspectives, integration of policy documents and reports, as well as existing literature and studies. Additionally, feedback was sought from third parties throughout the research process, and the content of the research was discussed with interviewees and the research supervisor from Utrecht University to identify and address potential biases or inconsistencies.

External validity

This research focuses on the development of smart cities in the Netherlands, selecting four municipalities based on sampling criteria. This specification allows for detailed research specifically tailored to the Dutch urban development and policymaking sector. However, the generalizability may be limited due to the specific focus on the Netherlands and the different development visions and cultures of other countries and cities/municipalities.

4.8. DATA ETHICS AND PRIVACY

This research prioritizes data ethics and privacy in data collection, handling, and storage. Informed consent is requested before data acquisition, and participants' processing and use are transparent. Data has been handled accurately and confidentially, with privacy and security guaranteed by storing it on encrypted servers from the University Utrecht and processing it anonymously if desired. See **Appendix E and F** for the informed consent form and information about privacy and confidentiality/ ethical issues.

5. RESULTS

This chapter provides an in-depth examination of the thematic analysis outcomes derived from the interviews with municipalities, researchers & experts, and industry representatives. In addition, these results are supplemented and confirmed by the thematic analysis of policy documents, reports, and articles.

First, the data demand is elaborated according to the terminology provided by Susha et al., (2017). This directly addresses the first sub-question of this research: "How is the Dutch municipalities' shared mobility data demand formed and what data do they need for urban planning and policy-making purposes?" Then the supply of shared mobility data as well as the data acquisition challenges are elaborated according to the continuation of the framework provided by Susha et al., (2017). This also addresses the second sub-question of this research: "What is the current state of data-sharing initiatives between shared mobility providers and Dutch municipalities, and how is this data sourced?" Following the framework of Susha et al., (2017), data facilitation and opportunities are also shown. These are the developments supporting shared mobility data sharing. The data utilization challenges are presented accordingly. Combined, this contributes to answering the third sub-question: "What are the technical and organizational challenges and opportunities experienced by Dutch municipalities in accessing and using data from shared mobility providers active in the Netherlands?"

In the last section, a cross-case analysis is presented. In this section commonalities, differences and exceptions between shared two-wheel providers and car-sharing providers as well as among Dutch municipalities are presented to understand the complexity of the topic.

5.1. DUTCH MUNICIPAL DATA DEMAND

Data is increasingly seen as a valuable resource in urban planning and management (ER5). The specific data demands of municipalities vary significantly based on several factors, including the market share of the provider in the city, the frequency of use, and existing data (MR3). A shared two-wheeler industry representative (IR2) further explains*: "The data requested varies by municipality. Generally, you have standard KPIs like the number of trips made, the duration of those trips, and the average distance of a trip. There are also more detailed questions, such as the start and end points of each trip, where most trips begin, and in which area."* Additionally, the data volume significantly influenced the municipality's data demand, as a policy officer from municipality The Hague (MR3) highlights: *"Look, the amount of data a municipality receives does matter. It also depends on the volume of vehicles in the city. If only 80 drivers are using Bolt cars among a large number of people who have regular cars, the impact is low. Consequently, the need for extensive data and close monitoring is also much lower."*

The approach to data sharing also differs between shared two-wheelers and car-sharing companies. Two-wheeler providers are often required to share data through agreements and licensing, whereas car-sharing providers share less data and are more reserved. A policy officer from municipality The Hague (MR3) notes, *"The shared scooter providers share quite a lot, and the car-sharing providers also share some information. However, this is more on a static basis and less in real-time. They are indeed a bit more reserved."* Municipalities now often include specific data requirements in their permits. A shared two-wheeler industry representative (IR2) states, *"Municipalities now include a fixed list of data points they want to receive from us in the permits."* Gemma Schepers from municipality Amsterdam (MR7) explains the challenges faced by car-sharing providers, particularly those associated with large car brands: *"The car-sharing companies find it very difficult. We've been in discussions with them for about a year and a half or two years now, and they are very resistant. They*

find it quite daunting. This is particularly because some car-sharing companies are part of large car brands, which find data sharing more intimidating."

However, changes are underway. For example, the municipality of Rotterdam is now requiring car-sharing- and shared two-wheeler providers to share specific data as part of their permit conditions (MR6). A policy officer from municipality Rotterdam (MR6) outlines this new approach: *"In the municipality, we have regulations in place, so upfront in the permit conditions, it is stated that providers must share data. This applies to both car-sharing and shared two-wheelers. This is regulated differently. Shared two-wheelers are given specific permits to operate. They may be allowed a certain number of vehicles per vehicle or as a provider. However, this system is being revised and optimized. The policy regulation specifies that this optimization applies to car-sharing. The implementation decision outlines the conditions they must meet. This is how it is organized."*

According to shared mobility providers, municipalities must articulate a clear purpose for the requested data and ensure they operate within legal boundaries to motivate private companies to share their data (IR3; IR4). Dani Sprecher From MyWheels (IR4) highlights the importance of understanding these frameworks: *"The government, cities, and data requesters—such as urban officials, ministries, but primarily cities—are all different. It may sound a bit generalizing, but they must clearly understand the frameworks within which they are actually allowed to request information."*

When municipalities request data without a clear societal value or legal grounding, it can lead to tensions. Especially car-sharing providers do not appreciate unclear or even, from their perspective, illegal data demands. Dani Sprecher From MyWheels (IR4) further explains, *"At some point, you encounter things where you can say, 'Okay, but this no longer relates to the concept of whether it has societal added value or not.' It's really about whether we run our business one way or another. These are business economic choices that municipalities should not be interfering with at all."* He adds that municipalities should avoid requesting data for short-term issues*: "At its core, data sharing should be about long-term matters. So, you shouldn't request data for things that are not related to the short term."* Jeanette van Eijk from Greenwheels (IR3) thinks that municipalities often overreach in their data demands: *"We have come to realize that, in my opinion, much more is being requested than is actually allowed, at least from us. Let me put it this way: we do not comply with that."* Dani Sprecher From MyWheels (IR4) confirms by mentioning a municipal data request requesting useless things such as car color, car action radius, etc. This suggests a need for municipalities to better align their data requests with legal and practical constraints. However, municipalities find it challenging to obtain a legal basis for requesting this data. As Niels Wiersma from municipality Eindhoven (MR1) points out: *"You really need a legal foundation to obtain personal information. For such an application, it is indeed quite complicated unless you have a very specific purpose."*

Industry representatives suggest municipalities sometimes exhibit a shortsighted approach when imposing data demands on shared mobility providers. Dani Sprecher From MyWheels (IR4) recounts an instance of this mindset where a policy officer said: *"Your cars are in public spaces, so you must share all your data.' That was his way of thinking. He genuinely believed that."* Says Dani Sprecher From MyWheels (IR4). Jeanette van Eijk from Greenwheels (IR3) also observed a tendency for rushed data demands without sufficient justification: *"What we noticed was a tendency to quickly assume, 'Just arrange this,' or 'Just share that.' In fact, we were the first among the shared mobility providers to ask: 'Why do you want this information, and what is the logic behind it?' It's not that we don't want to share; we've actually shared quite a bit of information by now."*

5.1.1. POLICY PROBLEM

Municipalities often face difficulties regarding densification and urbanization, prompting them to seek innovative solutions within the city (MR1; MR2; MR7). Shared mobility emerges as a key component in addressing these challenges. According to a policy officer from municipality The Hague (MR3), shared mobility is viewed as a promising solution in the mobility transition, especially as cities grapple with overcrowded conditions and limited space. *"Cities are overcrowded with cars, and there's insufficient space while more people are moving in. We need a solution. This solution involves encouraging more people to walk, cycle, use public transport, and also utilize shared mobility,"* the policy officer from municipality The Hague (MR3) explains.

In rapidly growing cities, densification is particularly pressing due to the influx of new residents and limited land availability for new construction. Niels Wiersma from municipality Eindhoven (MR1) points out that Eindhoven's rapid growth, fueled partly by companies like ASML, necessitates significant densification, especially in the city center. This increasing urban population results in less public space, demanding careful decisions on its usage. Gemma Schepers from municipality Amsterdam (MR7) emphasizes, *"More and more people are moving into the city, resulting in less public space. Therefore, we must make very careful decisions about how we use the public space we have."* This sentiment is echoed by a policy officer from municipality Rotterdam (MR6), who notes that the integration of various urban ambitions converges in the public space, presenting a complex challenge. To address the lack of urban space, municipalities recognize the potential and necessity of shared mobility, particularly shared two-wheelers. They anticipate these innovations will take up a significant share of mobility, facilitating continued urban development. As Gemma Schepers from municipality Amsterdam (MR7) predicts, *"Bicycles, scooters, and small vehicles will take up a much larger share of public space in the city, and this trend will continue."*

Municipalities have set goals often framed as policy problems. These policy problems are the practical use cases behind the data demand, such as **spatial planning, nuisance prevention, and sustainability** (MR1; MR2; MR3; MR4; MR7). Shared mobility offers an alternative to private vehicle ownership, contributing to municipal spatial development plans and sustainability goals. A policy officer from municipality The Hague (MR3) explains, *"As a municipality, you need to have insight into the mobility within your city to manage it effectively, whether something goes wrong, you want to enhance something, or you aim to expand certain aspects."* Gemma Schepers from municipality Amsterdam (MR7) adds that gaining insight into how people use shared mobility allows for better management and public space design. *"For example, if an area sees high usage, you might need to allocate more space for parking,"* she says. Niels Wiersma from municipality Eindhoven (MR1) explains that this is possible using data regarding the start and ending points of shared mobility. This approach helps municipalities optimize the physical public space effectively (MR7).

Reducing private vehicle ownership also leads to fewer vehicles in public spaces and reduced greenhouse gas emissions. Rik Braams from TNO and the Ministry of I&W (ER2) highlights the policy shift towards shared transport to achieve these environmental goals from the Ministry of I&W perspective, stating, *"They say that personal transport is not always the best solution everywhere, so we need to look at shared transport. This shared transport should provide the same convenience and seamlessness, which essentially requires Mobility as a Service (MaaS)."* Every municipality aims to transition to sustainable and smart mobility, reducing private car use in favor of public transportation and shared mobility alternatives. A policy officer from municipality Rotterdam (MR6) advocates for this direction, suggesting that funding for shared transport should be considered alongside public transport funding to supplement the overall mobility system.

However, municipalities also face challenges related to the nuisances caused by shared mobility. For example, Martijn Arets from Professional Outsider Consultancy (ER3) notes that in The Hague, shared scooters often cause disturbances when large numbers of them move to popular destinations like Scheveningen. To address parking issues, Gemma Schepers from municipality Amsterdam (MR7) explains that digital zones within apps now restrict scooter parking to designated areas, reducing disorganized parking, and indicating the direct application of shared mobility data. Additionally, a shared two-wheeler industry representative (IR2) indicates that Idle vehicles are almost synonymous with nuisance. "*Therefore, it's our responsibility to use the data we collect to allocate our fleet across the service area in a way that ensures an optimal occupancy rate at all times."*

Despite these efforts, municipalities experience more nuisances with two-wheelers than with car-sharing providers (MR2; ER3; IR4). Dani Sprecher From MyWheels (IR4) argues that while scooters cause disturbances justifying certain data requests, cars do not present the same issues. *"Officials had a specific basis for their concerns with scooters since they caused disturbances, prompting them to seek certain information. You might think this could also apply to cars, but cars do not cause the same disturbances,"* he explains. Jeanette van Eijk from Greenwheels (IR3) points out that car-sharing providers and shared two-wheeler providers are often grouped under the same term, despite significant differences between them. *"Shared mobility often becomes an umbrella term that includes car-sharing, which then also applies to data sharing requirements (…)Then it became a copy-paste situation: 'We also want to know this information from the car-sharing providers,'"* Jeanette van Eijk from Greenwheels (IR3) says. This is in line with the municipality's perspective as they only mention nuisance concerning shared two-wheelers and do not mention any nuisance from shared cars (MR3; MR6; MR7).

To facilitate shared mobility and reduce nuisance and inconveniences, both municipalities and mobility providers are exploring the establishment of mobility hubs within cities. These hubs are designated locations where various modes of transportation are offered centrally (MR2; MR3; IR2). A shared two-wheeler industry representative (IR2) notes success in working with municipalities to create specific hubs for bikes, while a policy officer from municipality The Hague (MR3) mentions ongoing efforts to establish more hubs for shared scooters. *"Mobility hubs are the places where this could happen, bringing various modes of transportation together. We are still working on linking different data to our data tool to visualize space requirements and determine the square footage needed for such a mobility hub. Where could we realize this within the city?"* Emma de Wijs from municipality The Hague (MR2) explains.

5.1.2. USE PURPOSE & EXPECTED OUTCOME

The concrete use or purpose for demanding and using data is a crucial issue within shared mobility data sharing especially from car-sharing provider's perspectives. Shared two-wheel providers are generally already open to data sharing (MR3; MR6; MR7; ER3), but car-sharing providers tend to open up to municipalities when municipalities have a specific and unambiguous use case (IR3; IR4). This cooperative attitude stems from the clear identification of objectives in consultation with policymakers. As Gemma Schepers from municipality Amsterdam (MR7) points out, *"It's quite challenging because everyone thinks, 'I just want parking data,' but the question is, why?"* Car-sharing providers note that when municipalities articulate their data needs clearly, it facilitates cooperation. Dani Sprecher From MyWheels (IR4) illustrates this with an example: *"So you need to state, 'Okay, by 2025, we want only electric cars in the city. Therefore, we need to know if your car is electric or runs on gasoline.' Clear and well-founded. Here's my data. It's that simple."*

However, collecting data without a justified interest is problematic. As Ferdinand Burgersdijk from the European Commission (ER5) emphasizes the need for municipalities to ask better questions and understand legal and technological constraints: *"Collecting data for the sake of collecting is not a justified interest. I want municipalities to ask themselves better questions without being fed the answers. This means adopting a more critical stance, which involves, first, understanding and applying the law better, and second, having a better grasp of technology."*

According to interviewed shared mobility providers, such as Amber Mobility (now MyWheels), they have shown openness to collaborative agreements that ensure privacy-sensitive and commercially sensitive information is protected. Niels Wiersma from municipality Eindhoven (MR1) explains their approach: *"From the beginning, we stated that this would be a collaborative agreement where we would jointly determine what needs to be shared. From our side, we wanted to ensure that no privacy-sensitive information was shared, and from their side, we understood that no commercially sensitive information would be disclosed."*

However, shared mobility providers perceive that they often encounter unwarranted and legally conflicting data demands from municipalities (IR3; IR4). Requests for personal customer characteristics, which providers are not permitted to collect, are an issue according to shared mobility providers. A shared two-wheeler industry representative (IR2) notes, *"Yes, municipalities often request personal characteristics of customers. This is data we simply do not collect from our customers, as we are not permitted to collect it. We do collect that through surveys."* Dani Sprecher From MyWheels (IR4) adds: *"They not only oversimplify by lumping concepts together, but they also consistently take a lax approach to legal matters. They often think, 'We think it's a good idea, so it must be allowed.' When we point out their legal authority, they generally don't appreciate it."* This signals that shared mobility providers perceive municipal data requests as disproportionate. At the same time, according to interviewed municipalities, as well as experts, they are aware of the need for municipalities to formulate clear, legally sound data requests where the municipality needs to think deeply about what the actual problem of the city is to formulate a very good questions and provide a legal rationale for determining the necessary data variables (MR7; ER5).

Indiscriminate data requests are problematic and legally questionable from the shared mobility providers' perspective (IR2; IR3; IR4). Dani Sprecher From MyWheels (IR4) criticizes this approach, explaining that he is 99% sure that it is not permitted under administrative law: *"In legal terms, this is called a 'fishing expedition': requesting all data indiscriminately and then searching for something useful to form policies with. This is not allowed."* This is undesirable for the mobility provider as they do not want to be burdened with ineffective data sharing and certainly not with potential confrontation on business practices based on their own supplied data. As a result, mobility providers are often reluctant to address specific data requests, especially those that are or may be tied to privacy or business-related content (IR2, IR3, IR4). Dani Sprecher From MyWheels (IR4) explains, *"Look, our data has value. We are happy to share it freely with the municipality, but I do not agree to another commercial party making money from our data."*

5.1.3. CONTINUITY

The degree of data sharing depends significantly on the conditions established in agreements between municipalities and shared mobility providers (MR1; MR7; IR2; IR3; ER5) While live, automated data sharing is ideal for municipalities (MR1), this often involves extensive lobbying and negotiation. Gemma Schepers from municipality Amsterdam (MR7) notes, *"Shared mobility providers are willing*

to share data, but they also want a place in the city and the necessary permits. However, the municipality imposes various requirements."

According to shared two-wheel providers, municipalities typically include fixed lists of data points in permits, with the frequency of data sharing varying by municipality (IR1; IR2). A shared two-wheeler industry representative (IR2) states, *"Municipalities now include a fixed list of data points they want to receive from us in the permits. The frequency varies by municipality; some request it monthly, while others want it every six months."*

Shared mobility providers also vary in their data-sharing practices. Some have continuous agreements (shared two-wheel providers), while others share data only when requested by municipalities (car-sharing providers) or proactively by shared mobility providers in specific cases (essentially only shared two-wheel providers) (IR1; IR2; IR3; IR4). A shared two-wheeler industry representative (IR2) explains, *"We share data purposefully with municipalities where we are active. Sometimes, we also share data with municipalities where we are not yet active but want to contribute to decision-making. Primarily, we share data in municipalities where we are active, and this has become a standard part of our permits with municipalities."*

A notable difference exists in the continuity of data sharing between shared two-wheelers and car-sharing companies. Two-wheeler providers are often required to share data as part of their permits, whereas car-sharing providers are less consistent (MR3; MR6; ER3; IR2; IR3; IR4). Dani Sprecher From MyWheels (IR4) highlights this discrepancy, noting the significant variation among car-sharing providers compared to the more regulated shared two-wheelers. Niels Wiersma from municipality Eindhoven (MR1) explains, *"In recent years, we have made agreements with all mobility providers. If they receive a permit to operate shared mobility in the city, they are required to exchange data and make it available according to the established standard."* However, according to the shared mobility providers, the continuity of data sharing depends on the municipality's requests and the level of detail required. Dani Sprecher From MyWheels (IR4) observes that issues arise when the questions become more detailed. Initially, municipalities just wanted to know what was happening with the vehicles, so providers gave them averages, but this changed when shared two-wheel providers arrived in the city. Jeanette van Eijk from Greenwheels (IR3) explains, *"Initially, they just wanted to know what was happening with our vehicles. So we gave them averages. However, we now notice that more and more municipalities want to know exactly what is happening with each vehicle."* This is in line with an explanation from a policy officer from municipality The Hague (MR3), which indicates that municipalities increasingly want to be closer to the data and are transitioning to being obligating actors, which means that it will be putting more pressure on mandatory data sharing. However, as municipalities increasingly seek to mandate data sharing, they must balance their demands to avoid driving providers away. A policy officer from municipality The Hague (MR3) articulates this balance: *"On one hand, you want to have the data to create good policies and improve mobility in the city. On the other hand, you don't want to drive providers away with too many obligations and regulations."* A policy officer from municipality Rotterdam (MR6) adds that municipalities should see shared mobility as a collective provision and a collective mobility, which indicates that municipalities should be careful with being too strict with shared mobility providers. Understanding the business operations of shared mobility providers is critical. Gemma Schepers from municipality Amsterdam (MR7) highlights that municipalities sometimes impose unrealistic data demands on young companies with slim margins, expecting them to be available for municipal purposes. *"We sometimes impose too many unrealistic demands on their growth business model, especially since they are still young with very slim margins, yet we want them available throughout the city. We need to listen to them more, and I*

think we, as a city, sometimes fail to do that," says Gemma Schepers from municipality Amsterdam (MR7)

5.2. SUPPLY OF SHARED MOBILITY DATA (AND ITS CHALLENGES)

5.2.1. DATA COLLECTION BY PRIVATE COMPANIES

Mobility providers note that they regularly receive data that might be privacy-sensitive. However, they tend to limit privacy-sensitive data collection, especially if it doesn't serve a specific use case, as they then tangle with legally established privacy restrictions (IR2; IR3). Jeanette van Eijk from Greenwheels (IR3) indicates that they do not track their users' destinations or refueling stops: *"We currently do not know where our users go or where they stop to refuel. We do not track that at all. Only if something goes seriously wrong do we investigate, but we are very conscious of the information we request from people. We handle it with great care."* A shared two-wheeler industry representative (IR2) explains that they do not collect personal data at all, so they cannot share it: *"Municipalities sometimes request personal characteristics such as age or gender, but we are not allowed to collect this information due to General Data Protection Regulation (GDPR) regulations."* A shared two-wheeler industry representative (IR2) further elaborates, *"We are not allowed to collect personal data that is irrelevant to our work. In some cities, showing a driver's license is mandatory, but those details are processed and deleted in a GDPR-compliant manner."* Often, this is also outsourced to a third party for better and more secure processing (IR2).

5.2.2. DATA AS INTELLECTUAL PROPERTY

Big data is more than just the collection of data; it also encompasses its analysis. In essence, big data has the typical characteristics of intangible properties. It requires a significant amount of time, energy, money, and effort to generate (Zhang & Xu, 2023). This results in the high value of data, and therefore it must be protected by the owner to maintain a competitive advantage over competitors (Teixeira & Ferreira, 2019). Therefore, shared mobility providers are generally cautious about sharing data because they consider it an essential resource for their business and necessary to compete with other mobility providers. It is crucial for capturing market share in users and winning contracts through tender processes. Additionally, privacy is one of the biggest concerns for these providers. Much of the data contains personal details or is in some way retraceable to an individual. Due to General Data Protection Regulation (GDPR) legislation, this data cannot be shared (CoE-DSC, 2023).

Dani Sprecher From MyWheels (IR4) emphasizes the value of private shared mobility data, stating, *"Look, our data is valuable. We are happy to share it freely with the municipality, but I do not agree to another commercial party profiting from our data. That would be completely unacceptable."* Dani Sprecher From MyWheels (IR4) further explains the internal views on data sharing, noting that not everyone within the company or in other companies thinks the same way about this issue. *"I lean towards transparency, but conceptually, the line is drawn at information that is highly competitive and could be used by competitors. We are all colleagues, but if you have a small advantage, you want to maintain it. If things are going poorly, not everyone needs to know that."* A shared two-wheeler industry representative (IR2) confirms and indicates that it will happily share commercially sensitive data with municipalities but need to be careful for the competition getting too much data, saying: *"Because you also need to understand that there is a lot of commercially sensitive information. Information that we would like to share with cities because it can help them in decision-making. At the same time, we do not want to give our competitors too much information. This could help them build a business case for a particular city where we are active."* This indicates that shared mobility providers

are essentially not against data sharing but against competition gaining an competitive advantage using the data of others, and are therefore careful about what they share and are demanding transparency from municipalities.

5.2.3. DATA TYPE & CONTENT

To address the issue of translating policy problems to data demand, municipalities need to engage in dialogue with shared mobility providers and remain open to learning from them (MR7; IR4) Rosanne Klerx from the NTM (ER1) emphasizes the importance of specifying data requirements in permits: *"In your permit issuance to a shared mobility provider, you need a paragraph or a few sentences specifying what data must be shared so that I, as a municipality, can have a certain insight."* A collaborative approach in policy-making, as suggested by Dani Sprecher From MyWheels (IR4), involves engaging in non-binding discussions with providers. For instance, municipalities might ask: *'Can you tell us more about this?' We, as a city, want to achieve the goal of reducing the number of cars driving through this street. What could we do to achieve this?"* This approach fosters a cooperative relationship where shared goals can be more easily achieved.

All the shared mobility providers are generally open to sharing data and see it as beneficial for policymaking. Dani Sprecher From MyWheels (IR4) underscores this willingness: *"Municipalities need to realize that we are highly positive about sharing data with them. They shouldn't think that we are unwilling to do so. Sharing data can be incredibly useful, and we are eager to contribute to policymaking."* A Shared two-wheeler industry representative (IR1) adds by stating: *"We want to be the responsible operator and collaborate with cities."*

Both municipalities and shared mobility providers indicate that specific data requested by municipalities can vary. However, the typical type of data shared with municipalities includes trip data and related information. It includes standard KPIs such as the number of trips, trip duration, and average distance (IR2). (Car-sharing) providers may also share additional data if municipalities present a compelling reason (MR7; IR3; IR4) Niels Wiersma from municipality Eindhoven (MR1) provides an example: *"We asked them to share the time when a trip started in one area and the time when it ended in another area. This way, we could see how many trips started and ended in each area. However, we removed the direct relationships between origins and destinations to avoid privacy concerns."* Shared two-wheeler industry representative (IR2) notes, *"There are also more detailed questions, like the start and end points of each trip. Complaints are, of course, an important aspect. However, there is actually much more underlying data".* A shared two-wheeler industry representative (IR1) explains the general approach to data sharing: *"We share the start and end locations if the city requests it. Of course, we have legal agreements in place ensuring that this information is anonymized."* Additionally, some providers share road quality data along with aggregated trip data (IR1). This indicates that there is a significant need for a balanced approach that respects mobility providers' business cases while ensuring municipal data needs fulfillment. This mutual understanding and collaboration could then lead to more sustainable and effective urban development and policymaking, resulting in better shared mobility solutions.

The content and detail of data shared differ between car-sharing providers and shared two-wheel providers. Both provide data on trips and fleet availability, including average trip distance, fleet numbers, start and end locations, vehicle locations, and trip counts. However, two-wheeler providers generally share more comprehensive data, excluding only privacy and business-sensitive information (IR1). As a shared two-wheeler industry representative (IR1) states, *"Any information that's not related to user or commercial information that you could see on our app"*. In contrast, car-sharing

providers are more reserved. Jeanette van Eijk from Greenwheels (IR3) explains the cautious approach of car-sharing providers: "*We currently do not know where our users go. We handle it very carefully.*"

However, car-sharing providers are often more willing to share data if there is a clear, long-term use case from the municipality (IR3; IR4). Jeanette van Eijk from Greenwheels (IR3) states, *"But we always talk about averages, not, or rarely, about specific vehicles."* Dani Sprecher From MyWheels (IR4) advocates for sharing aggregated data rather than specific details: *"Aggregated areas instead of specific locations. So, not this car but this neighborhood. The larger the area, the better."* This approach helps avoid micromanaging and ensures the data is used effectively for policy-making, according to Dani Sprecher From MyWheels (IR4). The variability in data-sharing practices also depends on how each municipality arranges data use and its contribution to decision-making as, a shared two-wheeler industry representative (IR2) points out, *"Because a lot of data is shared, and often it's unclear how that data is used and how it contributes to decision-making."*

5.2.4. DATA LEVEL

Municipalities receive data at varying levels of specificity from shared mobility providers (IR2; ER1. While some providers supply raw data, others offer only general insights and averages (MR1; MR7; ER1; IR1; IR3). Additionally, there is a distinction between dynamic data, often provided by shared two-wheel companies, and static data, typically provided by car-sharing companies (MR3; IR1; IR3) A policy officer from municipality The Hague (MR3) explains that data from shared scooter providers is dynamic and received almost in real-time, within about 24 hours, which contrasts with the more static and slower data from car-sharing providers.

A shared two-wheeler industry representative (IR1) indicates that municipalities might either receive raw API data to handle as they wish or use platforms that gather and display data from all operators in a territory via a dashboard (IR1). However, some municipalities request detailed data tracking of each vehicle individually, which can be problematic for some providers as noted by the car-sharing providers (IR3; IR4). Jeanette van Eijk from Greenwheels (IR3) notes, *"It is really just an average overview, which is different from what many municipalities now ask from us. They often want to track each vehicle individually. For that, I say, maybe in the future, but first we need to set it up properly."* In contrast, a policy officer from municipality The Hague (MR3) notes that it can exactly see where shared tow-wheelers are standing, indicating that these companies do share the live locations of their vehicles. However, it is not noted that individual vehicles could also be tracked while in use.

Despite their efforts to provide data, shared mobility providers are often cautious about the details they share. Car-sharing providers, in particular, struggle with sharing detailed data due to privacy concerns. Dani Sprecher From MyWheels (IR4) emphasizes that the more detailed the data, the more privacy issues arise. Jeanette van Eijk from Greenwheels (IR3) recalls providing a detailed overview to the G5, the five largest cities in the Netherlands, highlighting the number of new vehicles and the social impact of their service, such as saved space, as a way to thank municipalities for their collaboration. However, she stresses the complexity of complying with requests for very specific data: *"Do you really want to know this explicitly per vehicle? Then we'll set it up properly, so I know I won't be the only one complying"* (IR3).

Privacy concerns and the risk of data leakage are significant barriers to data sharing. In smaller markets, data can be easily traced back to the provider, which is problematic (IR3; IR4). Jeanette van Eijk from Greenwheels (IR3) recounts an incident where their data was shared with researchers without consent, leading to a halt in data sharing. A shared two-wheeler industry representative (IR2) adds, *"If you know a few key data points, like the number of trips and their duration, you can almost*

calculate revenue figures. That's highly confidential information that we don't want to make public." However, municipalities often find that abstract data can be very informative, even without privacy-sensitive information (MR1; MR5; MR7). Niels Wiersma from municipality Eindhoven (MR1) explains that simple data, like the number of trips starting and stopping at each location per hour, can effectively meet policy goals (MR1). Gemma Schepers from municipality Amsterdam (MR7) adds, *"With a set of, I think, eight variables or even fewer, you can answer almost all your policy questions."*

Despite this, experts often state that data only delivers its value when it can be combined with other data (ER2; ER4; ER5). Ferdinand Burgersdijk from the European Commission (ER5) notes that a single piece of data doesn't say much on its own but becomes significant when placed in context and cross-referenced with other data. However, combining data can pose privacy risks. Gemma Schepers from municipality Amsterdam (MR7) expresses concerns about future data collection, emphasizing the need for thorough privacy assessments to prevent identifying individuals. In addition, Niels Wiersma from municipality Eindhoven (MR1) highlights the importance of Privacy Impact Assessments for any data processing involving personal data (MR1). To protect user privacy, providers say they ensure that no one can identify users from the data shared. For example, scooter ID numbers and start and end locations are hidden to prevent user identification (IR1). According to Dani Sprecher From MyWheels (IR4) linking shared data to other government-held information could potentially identify users, which is not allowed (IR4). In some cases, shared mobility providers therefore might use the GDPR as a shield in sharing data with municipalities. As indicated by CDS-M and TOMP-API expert Edwin van den Belt (ER4): *"Often, the GDPR or AVG (Algemene Verordening Gegevensbescherming) is cited, saying, 'Guys, data sharing isn't fully possible because it's personal data.'"*

All municipalities indicate that, in essence, receiving raw data is often preferred, but can be hindered by poor agreements, provider reluctance, or the municipality's ability to process and analyze the data. Roland van der Heijden from municipality Rotterdam (MR5) points out that without well-defined contractual agreements, underlying data might not be accessible when needed: *We don't have much visibility into all the underlying data that goes into generating that information. Sometimes things go wrong, and if you then need the underlying data and it's not contractually well-defined, you won't get that data."*

5.2.5. DATA SHARING MODE

In data sharing between municipalities and shared mobility providers, three distinct forms have emerged: compulsory data sharing, voluntary data sharing, and a hybrid model. However, municipalities are increasingly pushing towards mandatory data sharing, particularly aiming to include car-sharing companies (MR3). Over recent years, the market has seen a shift towards regulated data sharing through licenses or tenders. As a shared two-wheeler industry representative (IR1) explains, *"In these licenses and tenders, there are increasing requirements to share data in a specific way. This shows us how the city wants it. We then discuss with the city their preferences and the standards they want. It's an ongoing discussion that we can adjust anytime."* A policy officer from municipality The Hague (MR3) observes this move towards a more mandatory approach, noting the necessity of shared mobility in the urban mobility transition: *"We need a solution. As a municipality, you can essentially say that if you don't provide data, we can revoke your permit. So, you must provide some data."*

Mandatory data sharing is common for two-wheel sharing companies, which must share data as part of their operating permits (MR3; MR6; IR1; IR2). The extent and nature of data shared can vary significantly. As Jeanette van Eijk from Greenwheels (IR3) points out, *"The two-wheelers needed*

permits, so they had to comply. It was explicitly stated in certain permit conditions." This gets confirmed by a shared two-wheeler industry representative (IR2) stating: *"Primarily, we share data in municipalities where we are active. This has become a standard part of our permits with municipalities."* In contrast, car-sharing companies are less subject to mandatory data sharing. They tend to be more resistant to such requirements, as Gemma Schepers from municipality Amsterdam (MR7) notes: *"The car-sharing companies find it very difficult. We've been in discussions with them for about a year and a half or two now, and they are very resistant."* Roland van der Heijden from municipality Rotterdam (MR5) adds that traditional companies are worried about compromising competitive advantage when sharing data: *"Companies in traditional sectors are often hesitant to adopt new digital practices because they are concerned about data security, privacy and loss of control over their data. They may be reluctant to share data unless they are sure that it will not compromise their competitive advantage".*

Voluntary data sharing is a phenomenon affecting both two-wheel and car-sharing companies. Car-sharing providers, particularly those affiliated with large car brands, are often more cautious about data sharing and less keen on mandatory data sharing. Gemma Schepers from municipality Amsterdam (MR7) explains, *"Some car-sharing companies are part of large car brands, which find data sharing more intimidating. In contrast, the shared scooter companies, which often start as small start-ups, have no problem sharing data."* Dani Sprecher From MyWheels (IR4) elaborates on the differing attitudes towards data sharing: *"The shared scooter companies come to the city with something new and ask for permission to operate. In contrast, car companies have been around for a long time and have been operating under certain regulations for years. Suddenly, they are asked to open up their databases."* Car-sharing companies prefer to share data voluntarily and want to contribute to municipal goals and development plans in this manner. Dani Sprecher From MyWheels (IR4) emphasizes the importance of constructive dialogue over obligations: *"You can still engage in policy-making by discussing and requesting data in a non-legally binding manner, like asking, 'Can you tell us more about this? We want to achieve the goal of reducing the number of cars on this street. What could we do to accomplish that?'"*

A hybrid approach, involving a combination of mandatory and voluntary data sharing, is seen as beneficial by car-sharing providers (IR4). Dani Sprecher From MyWheels (IR4) suggests that municipalities set a minimum mandatory requirement for essential data while fostering collaboration for additional data sharing: *"It would help if municipalities saw mandatory requirements as a basic foundation and approached the rest through constructive collaboration."*

Both car-sharing and two-wheel companies can engage in proactive data sharing or respond to municipality's data demands. However, Jeanette van Eijk from Greenwheels (IR3) states, *"The only reason we would share data is because a municipality requests it from us."* Meanwhile, a shared two-wheeler industry representative (IR2) notes the benefits of proactive data sharing: *"We also proactively share data in areas where we believe we have a mutual interest and where it can improve our services."* These attitudes align with the cautious nature of older companies and their leadership styles. As indicated by a policy officer from the municipality of The Hague (MR3), shared two-wheel providers are generally led by younger people who are more technically capable and collaborative by nature. Speculatively this could also be explained as shared two-wheel companies might benefit more from the municipalities' idealistic changes in infrastructure aimed at reducing cars in public spaces and promoting sustainable mobility, therefore aiming at mutual benefits. This allows them to directly benefit from data sharing, which can be used to make the infrastructure less car-dependent.

5.2.5.1. DATA SHARING MOTIVATION

Following proactive data sharing, shared mobility (two-wheeler) providers see direct benefits in sharing data, often aligning with common interests such as service improvements and infrastructure enhancements (IR1; IR2). Shared mobility providers emphasize the proactive sharing of data to improve services and address gaps in supply (IR2). They also share data on missed demand, which highlights areas where potential customers open the app but do not find available vehicles, leading to actionable insights for better service placement. For example, *"In the station area, we are not allowed to offer bikes, but that's where the highest demand for bikes is. This insight has helped us get permission in some municipalities to offer our bikes in specific areas"* (IR2).

Shared mobility providers acknowledge their use of municipal infrastructure and feel a responsibility to give back to the municipalities. Jeanette van Eijk from Greenwheels (IR3) mentions, *"We should be grateful for the opportunity to operate here, and we should be willing to give something back in return."* By sharing data, both municipalities and mobility providers can gain insights that lead to infrastructure improvements, expansions, or changes (IR1; IR2; ER2). A shared two-wheeler industry representative (IR1) notes, *"We want to help cities build more bike lanes, make it easier for people to bike, take a scooter, walk, etc."* The data shared shows aggregated travel patterns, which can inform infrastructure development decisions. For instance, *"We can say, 'Look, many people bike through this district every day, but there's a large lane for cars and no bike lane. Maybe in a few years, you should consider building new infrastructure there'"* (IR1).

Despite the potential monetary value of the data they collect, shared mobility providers convincingly state they do not sell it for profit (IR1; IR3). A shared two-wheeler industry representative (IR1) stresses that there is no financial motivation behind it: *"We don't monetize our data"* (IR1).

5.2.6. DEGREE OF ACCESS

As essentially every stakeholder indicates, the extent to which municipalities have access to specific data varies greatly depending on the case. In some instances, municipalities obtain all requested data, including raw and real-time data. In other cases, the data is first processed or shared with a third party (see next paragraph).

A policy officer from municipality Rotterdam (MR6) explains that while for shared mobility providers some data is easy to share, other data can be highly competitive and privacy-intrusive. Gemma Schepers from municipality Amsterdam (MR7) adds that municipalities can receive data dumps, allowing them to process and analyze the data themselves. However, to access this data, municipalities must have a clear policy question and legal justification (MR7; IR4). Sometimes, additional information not included in API data variables could be requested separately and received in Excel files (MR7).

Municipalities often believe they own data generated within their boundaries, while companies see themselves as the rightful owners (MR5). Users also believe that data generated by individuals should belong to them, which makes the question of data ownership complex. As Gemma Schepers from municipality Amsterdam (MR7) notes, *"Whose data is it? Sometimes it belongs to the government because it oversees public spaces. Sometimes it belongs to the provider. Sometimes it belongs to the owner."* Ferdinand Burgersdijk from the European Commission (ER5) argues that data generated by users, such as bike usage data, should belong to the user. He criticizes the idea of bike-sharing companies sharing this data with municipalities without user consent, stating, *"What I do with that bike is none of their business."* Extending on this, municipalities have faced resistance from companies

over data ownership. Roland van der Heijden from municipality Rotterdam (MR5) recalls an incident where a company asserted ownership over the data, saying, *"Yes, that's great, but the data isn't yours; it's ours"*.

The degree of data access also depends on agreements between mobility providers and municipalities and the specific data (MR1; MR7; IR2; IR3; ER5). Dani Sprecher From MyWheels (IR4) emphasizes that legal obligations must be met by mobility providers, and municipalities must respect data demand limits. Disagreements can lead to legal disputes. However, non-obligatory data demand and learning from shared mobility providers through constructive dialogue also form an alternative according to Dani Sprecher From MyWheels (IR4). Ferdinand Burgersdijk from the European Commission (ER5) points out that European and Dutch legislation requires municipalities to regulate data requests within their legal frameworks. Dani Sprecher From MyWheels (IR4) recounts a situation where a municipality demanded all data for cars in public spaces, leading to a potential court case: *"'Your cars are in public spaces, so you must share all your data.' That's how he thought about it. I responded, 'Okay, then we'll see each other in court.'"*

Data sharing and access are rarely straightforward. Roland van der Heijden from municipality Rotterdam (MR5) notes that it's almost always about the circumstances under which data can be shared (MR5). Building trustful relationships is crucial for effective data sharing. Martijn Arets from Professional Outsider Consultancy (ER3) emphasizes the importance of being mutually reliable partners in making agreements, and Rosanne Klerx from the NTM (ER1) adds that trust is essential before exchanging data.

Sharing data is a big task for many market participants (Royal HaskoningDHV, 2017). They see data as an asset that (potentially) provides a competitive advantage. As a result, they want to limit access to it significantly and keep it mostly for themselves (IR2; IR3; IR4). However, when the data's purposes and usage are clear, transparent, and secure, shared (car) mobility providers are more willing to share (some) data for public benefits (ER5; IR3; IR4).

5.2.7. FACILITATION

When municipalities lack the technical capability to read or collect data themselves, they often turn to third parties for assistance. They use data dashboards provided by organizations like Vianova and CROW. This approach has proven effective for shared bicycles but remains challenging for car-sharing (MR3; MR6; MR7). *"The CROW shared mobility dashboard is super useful for us as a municipality,"* notes a policy officer from municipality The Hague (MR3). These dashboards help municipalities analyze data effectively, especially when responding to council questions, as highlighted by a policy officer from municipality Rotterdam (MR6): *"Often, specific data is used in an ad-hoc manner. For example, when there are council questions, you can use the shared mobility dashboard, which really proves its value."* Gemma Schepers from municipality Amsterdam (MR7) explains, *"We are not technically capable of accessing that data ourselves, so we work with third parties like Vianova or CROW. They have the APIs to access the data and display it on a dashboard, giving us access."* The goal is to integrate shared mobility data into these dashboards. While this integration works well for shared two-wheelers, it remains a challenge for car-sharing. *"For shared two-wheelers, everything is included and functional. However, for car-sharing, it is still quite a challenge,"* states a policy officer from municipality Rotterdam (MR6). There is a desire to include car-sharing data in these dashboards, as noted by a policy officer from municipality The Hague (MR3): *"Ideally, we would like to have a dashboard that includes the car-sharing providers as well."*

For data dashboards to be effective, they need a sufficient data supply to provide value and reduce concerns about data tracing back to individual providers (MR5; IR4). Public and essentially open data platforms can act as barriers to data sharing. Roland van der Heijden from municipality Rotterdam (MR5) explains, *"An open data platform uses open standards, and anyone can connect. However, it doesn't mean all data is open. Companies decide under what conditions someone gets access to their data."* When data is open, it is freely accessible and therefore a concern for private companies because of their business case (Geonovum & Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2021).

Car-sharing providers indicate their hesitance to supply data due to concerns about data handling and competition. Dani Sprecher From MyWheels (IR4) notes, *"The relationship that Vianova currently has with the municipality of Utrecht and the data from the providers is not okay. They are given too much freedom with it."* He also highlights the competitive risk: *"Greenwheels knows its data, so if they pull their data from the dashboard, they also get ours. You have to be realistic about that."* To mitigate these issues, some mobility providers offer their own dashboards and analyses (IR2; IR4). However, not all municipalities trust the reliability of these proprietary surveys and data presentations. Jeanette van Eijk from Greenwheels (IR3) mentions, *"We also conduct research with our own users. This type of information is included in the research, but some people don't fully believe it."*

5.3. DIGITALIZATION AND DATA SHARING DEVELOPMENTS AND OPPORTUNITIES IN THE NETHERLANDS

5.3.1. LEGAL AGREEMENTS AND TRUST DEVELOPMENT

Municipalities embrace new mobility solutions, but mutual agreements should be made (Gemeente Den Haag, 2020b). For municipalities and shared mobility providers to have a mutual understanding of expectations, establishing clear conditions is essential. These conditions must address what data will be shared, how privacy and security are managed, and who owns the data, ensuring that consent is always obtained (Maltha et al., 2021). From a municipal perspective, flexibility in current policies is beneficial for implementing innovations. Niels Wiersma from municipality Eindhoven (MR1) notes the advantage of having an experimental clause in the parking ordinance that allowed for flexible data-sharing agreements. Martijn Arets from Professional Outsider Consultancy (ER3) adds that agreements should include buffers for changes to manage risks effectively.

Jeanette van Eijk from Greenwheels (IR3) highlights the need for clarity in governance and liability: *"How is cybersecurity managed? Also, how is governance arranged? When I share data, who owns it? And if something goes wrong, who is liable? These are things that are still not clearly and precisely regulated."* This illustrates the current state of data sharing and the need for further development in regulation and standardization to increase trust within data sharing and handling. Jeanette van Eijk from Greenwheels (IR3) explains that harmonizing and understanding data is acceptable as long as it is properly set up and standardized. This ensures that data sharing is less risky and more manageable.

Both municipalities and shared mobility providers must take considered risks and agree to changes which takes trust, *"Ultimately, it is about being a mutually reliable partner,"* notes Martijn Arets from Professional Outsider Consultancy (ER3). Gemma Schepers from municipality Amsterdam (MR7) emphasizes the need for municipalities to be consistent and reliable partners, citing the example of Amsterdam's inconsistency with scooter permits, where certain partners were banned from operating within the city even though they complied with every demand from the municipality, compromising trust. Rosanne Klerx from the NTM (ER1) underscores the necessity of informing each other about

changes to maintain this trust, stating: *"Parties are realizing more and more that they can't do everything themselves. I don't know everything, and I don't have all the data, so I gladly use your data. But I want to know that it's reliable and that you won't change it without notice. You'll see that trust will play a bigger role in this. This can be addressed by making mutual agreements. Under what conditions and how will we handle changes?"* Transparency in data sharing and utilization lowers barriers and fosters collaboration for shared (car) mobility providers. Jeanette van Eijk from Greenwheels (IR3) states, *"If you keep it transparent and clearly specify what you want from whom, it becomes a solid foundation to build on. And yes, trust is the key in this."* Ferdinand Burgersdijk from the European Commission (ER5) adds that compliance with laws and regulations, combined with transparent operations, ensures trustworthiness.

Understanding each other's interests and expectations is fundamental. Jeanette van Eijk from Greenwheels (IR3) asks municipalities, *"Why do you want this data? And why should I share it?"* highlighting the need for clarity and mutual understanding. Roland van der Heijden from municipality Rotterdam (MR5) warns that the lack of transparency and accountability is a significant concern. Gemma Schepers from municipality Amsterdam (MR7) concludes that careful consideration is needed when sharing data via technical APIs, including defining roles and responsibilities clearly to remain trustworthy.

5.3.1.1. DIGITAL WALLET

Starting in 2025, a European digital wallet will be introduced for citizens, enhancing transparency in data sharing and ownership. This initiative aims to help users better understand what data they are sharing and ensure that data sharing is limited to clear, justified use cases (ER4). Gemma Schepers from municipality Amsterdam (MR7) highlights that the digital wallet system will improve transparency, allowing users to specify which data they wish to share. The digital wallet will enable minimal identification and allow citizens to manage the information they share. CDS-M and TOMP-API expert Edwin van den Belt (ER4) explains, *"For example, if you want to rent a scooter in Rome, you can use your Digital Wallet to easily share your name and bank account details with the rental organization to sign up and use the scooter."* This system simplifies the data-sharing process while maintaining user control. Companies will still be able to set conditions for using their products, but these must be legally justified. CDS-M and TOMP-API expert Edwin van den Belt (ER4) emphasizes, *"They may only request information necessary for their operation, such as verifying the validity of a driver's license."* However, since data ownership is expected to be put at the individual user level, data acquisition from a municipal perspective might be compromised. Municipalities might need to get data from way too many individual digital wallets. Therefore there might arise opportunities for data collection initiatives where individuals directly allow municipalities to handle their data and therefore supplement municipal data demand (ER4).

5.3.2. DIGITAL CAPACITIES & INFRASTRUCTURE

The national and local government acknowledges that digital skills are becoming increasingly important for businesses and urban projects (Rijksoverheid, 2021b). The municipality of Rotterdam acknowledges the challenges of digitizing existing departments and modifying internal processes, while new departments can be easily adapted and set up in a non-traditional way, aiming to work data-driven and encourage integration with other departments and stakeholders (de Lange, 2020).

5.3.2.1. VNG COMMON GROUND INITIATIVE

The adoption and implementation of IT systems within municipalities are exceptionally slow, and meeting privacy legislation requirements is highly challenging. A critical aspect of this issue is the complexity of combining and sharing data across different domains. Since each IT system is often slightly different from the next, and data standards are not yet widely adopted, IT is frequently seen as a barrier rather than an enabler (Keur, 2020). A policy officer from municipality Rotterdam (MR6) describes the situation vividly: *"ICT systems are almost like tectonic plates that continuously rub against each other. If one decides to slide open, then another one goes in the opposite direction. That's very complicated."* This analogy highlights the lack of synchronization between various IT systems, making effective data sharing and implementation of IT solutions particularly difficult.

Therefore, the Common Ground (CG) vision was developed. Through CG, municipalities can handle data easier, faster, and smarter and comply with privacy legislation. CG is a movement in which municipalities work together with the VNG, chain partners, market parties, and the state (VNG, 2020). The goal is to discover and organize a new way of working (using ICT and data). Despite a strong willingness among municipalities to realize CG, breaking away from the status quo is difficult (Keur, 2020). Antoine Gribnau from municipality The Hague (MR4) notes that the theoretical promises do not always match practical experiences: *"Theoretically, I completely agree, but that just means a lot of agreements have to be made with all sorts of parties."*

The VNG roadmap clarifies how municipalities can achieve collaborations to realize decision-making and developments (Keur, 2020). Most large municipalities are actively participating in the CG initiative, intending to convince smaller parties and municipalities to join through practical success stories, with the VNG indicating opportunities for innovation (VNG, 2020). The technology to achieve all of this is already available, however, the significant challenge lies in establishing the right collaborations with chain partners and market parties (Keur, 2020). Additionally, Antoine Gribnau from municipality The Hague (MR4) points out that the usual problem-solving culture involves short-term thinking: *"My strategy is to focus on the short term. What do my clients want? I will arrange that for them. Then we will see if we can integrate that into a system."* This contrasts with what car-sharing providers believe is necessary for shared mobility data sharing, which is a long-term perspective (IR4). In this respect, Common Ground is essential to extend the internal short-term problem-solving culture within municipalities and reduce the individual demand on shared mobility providers, as data can be better shared within and among municipalities (VNG, 2020).

5.3.3. STANDARDIZED DATA SHARING PROCEDURE

Currently, many municipalities do not know how to handle data responsibly and often improvise, which can lead them to not comply with EU law and regulation (Berretta, 2023; European Commission, 2023c). This uncertainty makes shared mobility providers reluctant to share data. Dani Sprecher From MyWheels (IR4) highlights this issue, noting that misinterpretation of data can lead to incorrect policy decisions: *"If they just request a lot of data and start looking at it, yes, it's going to go wrong."* Different interpretations of data values are common, and proper data interpretation requires understanding the context in which the data was collected. Jeanette van Eijk from Greenwheels (IR3) argues that data generation and analysis are best performed by the same party or at least using the same standards. A standardized data protocol is a solution to facilitate interoperability between the different parties and solve the current problems (Borsboom-Van Beurden et al., 2021).

Jeanette van Eijk from Greenwheels (IR3) illustrates the need for this standardization: *"If an organization wants to analyze all the offerings in a city and says, 'I get one sheet from Greenwheels*

and another from a different provider, and I can't combine them. I want to harmonize and understand the data,' I understand that but we need to set it up properly and ensure that we're all doing it in the same way." Inconsistent definitions and calculations further complicate data sharing. Jeanette van Eijk from Greenwheels (IR3) points out that terms like occupancy rate can be defined differently by various providers, affecting how data is interpreted: *"How do you calculate the occupancy rate of a car? That very much depends on how you set it up in your system."*

In the view of Dani Sprecher From MyWheels (IR4) officials often oversimplify data sharing without understanding its complexities. According to Jeanette van Eijk from Greenwheels (IR3, governments are also often unaware of how private mobility providers operate. Jeanette van Eijk from Greenwheels (IR3) recalls finding basic data requirements in local ordinances, such as respecting user privacy, which providers already prioritize: *"I have to laugh a little bit at that because I look at that and think; yes, but we already have much more respect for our users in the first place than you do right now."* This illustrates the critical view form car-sharing providers on municipalities and the distrust in them handling data correctly, which hampers their data sharing.

Conversely, shared mobility providers can also learn from the municipality's perspective. Gemma Schepers from municipality Amsterdam (MR7) stresses the importance of mutual learning and collaboration*: "If I talk to Check, for example, they tell me things I never thought about because I'm not in their business. And when I talk to them, I provide the city's perspective, which they might not know. Continuous consultation is very important."* A policy officer from municipality The Hague (MR3), confirms and recognizes that visions from younger people (among shared mobility providers) can enhance municipal knowledge, *"You notice that these shared scooter companies were often, generally speaking, started by young guys. They also had a lot of knowledge about how to do all of this technically very quickly. So, that's perfect for us as a municipality."*

5.3.3.1. CDS-M

To integrate shared mobility into urban development the Netherlands is developing a national program called 'Natuurlijk Deelmobiliteit'. A key component of this program is the CDS-M, a standardized data-sharing method (MR7). *"We have ensured that data sharing is standardized in the Netherlands through the 'Natuurlijk Deelmobiliteit' program. As part of this standardization, we have also specified technical APIs,"* explains Gemma Schepers from municipality Amsterdam (MR7). The program is a collaborative effort, promoting the use of shared transportation and CDS-M (Curzon-Butler, 2022; ER4). Using European grant to share mobility data, the CDS-M was initiated in 2019 (Berretta, 2023; European Commission, 2023c). The TO-MP working group, Ministry of I&W, and the five largest Dutch cities are currently collaborating to further develop this initiative (Nijhof, 2020). CDS-M is a data-sharing manual that enables municipalities to analyze data responsibly while safeguarding user privacy (Berretta, 2023; European Commission, 2023c). The CDS-M program recognizes that shared mobility, partly driven by growing sustainability movements, is increasingly being adopted and utilized in cities (Berretta, 2023; European Commission, 2023c). Governments benefit from CDS-M by gaining better insights from shared mobility in the urban environment, allowing for better policy development, urban development, and identifying social problems (Gemeente Amsterdam, 2024). The model is based on GDPR and includes a step-by-step explanation of how municipalities can learn from use cases (Berretta, 2023; European Commission, 2023c).

Municipalities start by identifying a policy problem, referred to as a use case in CDS-M terms. These use cases are often set by policymakers in consultation with shared mobility providers (Beckers & Aurup Poolsem, 2022). *"The goals are actually set by policymakers in consultation with the shared mobility providers"* says Gemma Schepers from municipality Amsterdam (MR7). Data requests must

be substantiated with a clear use case, as unsubstantiated data requests are prohibited. *"The GDPR and AVG legislation prescribe data minimization. If you start exchanging trip data without a substantiated question, that's not allowed,"* explains CDS-M and TOMP-API expert Edwin van den Belt (ER4). Ultimately, this creates a centralized and unified data query that meets all privacy requirements, which makes for easier collaboration between governments and mobility providers (Gemeente Amsterdam, 2024). Gemma Schepers from municipality Amsterdam (MR7) notes, *"What's very nice about that is that it's very easy for cities because they don't have to think about how to share data anymore."*

"CDS-M's goal was not to develop a separate standard, but to use existing standards to answer policy questions in a privacy-compliant way," says Niels Wiersma from municipality Eindhoven (MR1), noting that it is an improvement to establish a data link between carriers and cities. This standardization is welcomed by both municipalities and mobility providers, facilitating fair and structured data exchange (MR1; MR3; MR7; ER4; IR3; IR4). *"For the shared mobility providers, it is very nice because they have to install an API once, and then they are done. The basic data is always just unlocked via an API,"* explains Gemma Schepers from municipality Amsterdam (MR7). Jeanette van Eijk from Greenwheels (IR3) emphasizes the importance of setting up this data sharing correctly: *"I understand that the municipality wants to know what happens here. We are using public space after all. But we need to set it up right. So we are really working with CDS-M to harmonize data sharing and arrange it as best we can."*

Most of the current work regarding CDS-M focuses on car-sharing companies, but efforts are expanding to include two-wheelers. *"We are now working to include the two-wheelers as well. For that, we are at the table with Amsterdam, Rotterdam, and Eindhoven,"* says CDS-M and TOMP-API expert Edwin van den Belt (ER4). The CDS-M procedure has been tested in 2021 through several pilots in which the use cases have been worked out. However, laws and regulations still have to be adapted to the CDS-M procedure and the standards within the mobility sector. To this end, a plan of action is being developed for the Netherlands, as well as ambitions have been put out for international cooperation and implementation (Beckers & Aurup Poolsem, 2022).

5.3.4. DATA STANDARD

Standardized data sharing within the CDS-M program is facilitated through an API, ensuring interoperability between mobility providers, municipalities, and other stakeholders. As is illustrated in Figure 4 and explained by a policy officer from municipality The Hague (MR3): *"With data sharing between those parties, that magic word of interoperability always comes up. That means communication between technical systems. So that can be helped with an API."*

Figure 4 Display of API function (Gemeente Amsterdam, 2021a)

Niels Wiersma from municipality Eindhoven (MR1) discusses the evolution of data standards: *"The first standard that we have tested quite thoroughly and that is reasonably used is GBFS. It's an old bike-sharing standard that only reports status changes, resulting in inaccurate start and end times and*

making it difficult to track the availability of bikes and such. Then we adopted MDS, which was originally an American standard. It provides a much more continuous data stream." A policy officer from municipality The Hague (MR3) confirms, *"In the beginning, there were various APIs in the MaaS world. We started with GBFS, then moved to GBFS+, and finally to the TOMP API."* The TOMP API, imposed after negative experiences with shared bicycles in Dutch cities (MR3), is an open-source code that facilitates data exchange among all parties (Nijhof, 2020). Multiple data standards are necessary to address specific aspects and fulfill various purposes. Rosanne Klerx from the NTM (ER1) emphasizes, *"I have come to realize that having multiple standards, each addressing specific aspects, is essential. Otherwise, you end up with a single, overly broad standard that does not adequately meet the local and individual needs of parties, users, or governments."*

Integrating data standards can be challenging due to technical issues and legal obligations regarding data standardization and sharing. For example, U.S. data standards required adjustments to comply with European regulations. CDS-M and TOMP-API expert Edwin van den Belt (ER4) recalls, *"We did push back against OMF for a while because it wasn't fully GDPR compliant. We looked into it thoroughly and made various adjustments for the European market."*

Shared mobility providers are technically capable of making necessary adjustments to comply with these standards. However, they require clarity about the intended outcomes and the course of action, as these changes can be costly (IR3; IR4). Jeanette van Eijk from Greenwheels (IR3) notes, *"Technically, a lot is possible, but many other aspects still need to be properly arranged."* Dani Sprecher From MyWheels (IR4) adds, *"We did have a TOMP-API, which we developed a long time ago. We acquired Amber Mobility, a much younger and newer car-sharing company that had developed such a TOMP-API but it also cost a lot of money."*

5.3.5. NEUTRAL DATA FACILITATOR

Governments are looking for opportunities to acquire all kinds of data, but are limited by their capacities to form collaborations and guarantee data quality (MR4). Additionally, new laws and regulations need to be incorporated into the CDS-M procedure, and cooperation in the domain of mobility must be expanded. For this, besides frontrunners, a central governing body is also necessary to monitor and encourage data exchange (Beckers & Aurup Poolsem, 2022). Also, a comprehensive solution is needed to address concerns among private parties about competition, privacy, and mistrust when data is made public. Neutral parties must develop solutions and establish pre-set regulations to alleviate these concerns and facilitate data sharing and collaboration (ER1).

Governmental bodies can potentially serve as neutral actors in managing shared data because they typically have no vested interest in private companies. Rik Braams from TNO and the Ministry of I&W (ER2) suggests, *"A government could do that because a government has no interest in a private company. You would say a government is a neutral actor."* However, it is essential to recognize that even governmental bodies can be influenced by political streams and their effects (ER2).

Although a neutral data facilitator is not interested in the individuals behind the data but solely in the transport movements and associated data, a major impediment for a mobility data hub is the GDPR, which ensures the privacy of personal data. Therefore, an adjustment to the rules on purpose limitation is necessary. Both government and market parties should be able to share data and be a source of innovation (Geonovum & Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2021).

5.3.5.1. NATIONAL ACCESS POINT (NAP)

Within Europe, every member state must have a National Access Point (NAP) for mobility data. In the Netherlands, this is the National Access Point for Mobility Data (NTM) (ER1). It serves as a connecting hub between various parties in shared mobility data sharing. It establishes and ensures standardization and interoperability in data sharing and brings public and private entities closer together (NTM, 2023a). The NAP's core mission lies in making mobility data discoverable and linking different data together to form a chain connection. It recognizes data can provide a lot of value, but is also associated with risks. Therefore, good cooperation between all stakeholders is essential (ER1). Additionally, Gemma Schepers from municipality Amsterdam (MR7) notes the multiple functions of the NTM as follows: *"The NTM is also going to determine, throughout the data chain, who has what role and what responsibility? So who is the owner, who is the controller, who invents it, who tests it if you want to exchange data? Because that is also not yet sufficiently described."*

The ultimate goal is to have the NAPs of each member state working together to create an international platform that facilitates international transportation (ER1). Data must not only be known but also accessible, functional, reliable, and interoperable, which is why NTM focuses on various MaaS standards such as TOMP-API and CDS-M data sharing procedure (NTM, 2023b). As Rosanne Klerx from the NTM (ER1) explains, data must be shared in a manner that transforms it into useful information and knowledge. Data must be accessible so that not only the transporter but also the municipality that issued the permit can see it. NTM focuses on the data aspect, while the dashboards communicates the knowledge derived from it. Thus, several steps are involved in this process (ER1).

5.4. CHALLENGES AND OPPORTUNITIES IN UTILIZATION OF AND LEVERAGING DATA IN URBAN PLANNING AND POLICYMAKING

5.4.1. SILO THINKING AND INDIVIDUAL EXPECTATIONS

Urban planning is complicated by shrinking available space and differing interests within public space as indicated by most municipalities. Municipalities and shared mobility providers both indicate they must reach concessions in expectation management to share data and develop public space effectively. Municipalities should seek overlapping goals among municipalities, mobility providers, and citizens (ER5). A policy officer from municipality Rotterdam (MR6) notes, *"The public space and the spatial integration of all ambitions we have as a city is becoming an increasingly important and difficult question. There are so many ambitions, and everyone is on their own island, but how does it all come together?"* This issue is compounded by mismatched expectations between municipalities and providers. *"There is continuously a mismatch between the expectations we have from a policy perspective and what providers can or want to deliver,"* says a policy officer from municipality Rotterdam (MR6). Ferdinand Burgersdijk from the European Commission (ER5) describes the relationship as a triangle in which an overlap of common interests should be identified between government, private companies, and citizens.

In addition, there is often too little collaboration within municipalities. Operational departments are too individualistic, making it difficult to achieve cohesive results. *"It is already difficult enough for many municipalities to get collaborations done within their own organization,"* observes Antoine Gribnau from municipality The Hague (MR4). Technical systems may differ from one department to another, making it more difficult for employees to adjust (MR4; MR6). In addition, data sharing between municipalities is also still perceived as difficult, despite promising great potential (MR4). For municipalities to make a successful decision, it is incredibly important to drive together from the same reality. Different views and results should be examined to understand how they came about (MR5).

Mobility is too often approached from a silo, resulting in limited interdisciplinary collaboration (ER3; MR5). To create unity and promote cooperation, direction, and control from a higher level of government are needed to bridge gaps between different municipalities (ER1). *"What strikes me is that people often think in isolated themes,"* notes Roland van der Heijden from municipality Rotterdam (MR5). *"However, as a government, we often buy data and applications from companies, which end up as silo solutions within our organization,"* he adds.

This silo thinking creates non-optimal results, as external scenarios are not included. Strengthening intra-municipal cooperation creates opportunities for data (models) to interact and provide closer-to-reality insights (MR5). Roland van der Heijden from municipality Rotterdam (MR5) finds this particularly interesting but challenging: *"In Rotterdam, we have a fantastic mobility model that calculates road capacity and flow rates. We also have a great water model that shows flood scenarios. However, integrating these models to understand road capacity during a flood is very difficult because everyone works in silos."* Currently each tool is only focused on one goal and needs only limited data to do so. This data must be combined for both tools to get the same result and thus better present reality (MR5). This illustrates the need for all kinds of data including shared mobility data to create a holistic and integral simulation of reality. However, these intra-municipal collaborations are limited by differences in technical state and infrastructure, leading to problems regarding interoperability and human knowledge. A policy officer from municipality Rotterdam (MR6) reflects on these silo approaches: *"Everything changes so often. We have experiments with mapping structures. The mobility department still uses them, while the sustainability department operates through Teams and SharePoint."*

5.4.2. MUNICIPAL KNOWLEDGE AND CAPABILITIES

To work with data and collaborate with others, urban planners and policymakers must be (digitally) proficient and have the right facilities to analyze and process data into policy and urban development decisions (Maltha et al., 2021). Staff must be knowledgeable about processing as well as gathering data to deal with the complexities and deliver value within the public sector (Rijksoverheid, 2019b). In practice, most civil servants have too little knowledge and/or (technical) capacity to accurately analyze data. In addition, they need to be able to translate this analysis into policy and decision-making, which also requires a lot of knowledge, capabilities, and capacities (Maltha et al., 2021). Most civil servants do not have these capacities as Gemma Schepers from municipality Amsterdam (MR7) observes, *"The average official doesn't understand what to do. And then you get that every civil servant is going to make up his own mind and that's not very efficient."* Dani Sprecher From MyWheels (IR4) adds his view on policymaking when civil servants are not (digitally) capable of making decisions, *"If you draw the wrong conclusion, you are also going to make the wrong policy."*

A shared two-wheel providers (IR2) mentions that while a lot of data is shared with municipalities, the main challenge is the municipalities' capacity to use that data effectively for decision-making. Dani Sprecher From MyWheels (IR4) further explains, *"Certainly, the substantial knowledge is still lacking to work with the data. Even if the data analysis is done, translating that into policy and making decisions is something most civil servants cannot do."* This illustrates the critical shared mobility providers' perspective on municipalities and sharing data with them, suggesting data provision is not the essence of the problem, but being able to cope with them is.

When municipalities lack the knowledge and capacities, they seek it from external parties. Larger municipalities often have more internal knowledge and capacities, while smaller municipalities are highly dependent on consultants (ER2). Rik Braams from TNO and the Ministry of I&W (ER2) notes

that smaller municipalities and regions often struggle with knowledge building, contrasting with larger teams like Amsterdam. However, Gemma Schepers from municipality Amsterdam (MR7) indicates that they also often do not have the capacity and capabilities to work with certain data, *"We often can't do it ourselves, so we hire agencies. For example, we use third parties like Vianova or CROW to handle data through APIs and provide dashboards for us to access the data."* Gemma Schepers from municipality Amsterdam (MR7) continues, "*I think a city like Eindhoven or Rotterdam are better at this because they are more technical." "A lot of expertise is hired by governments, and it leaves with the consultants, risking the buildup of internal knowledge,"* Rik Braams from TNO and the Ministry of I&W (ER2) concludes.

In addition, the lack of expertise and knowledge can also lead to incorrect handling and interpretation of data. *It's really about how many people are on your digital team and whether those people understand data and have time to dive into it,"* explains a shared two-wheeler industry representative (IR2). Gemma Schepers from municipality Amsterdam (MR7) agrees in this, *"We can't do it as a municipality because we're not technically capable of unlocking the data."* To address these challenges, the Natuurlijk Deelmobiliteit/CDS-M program is being set up in the Netherlands (MR7).

5.4.3. DATA STANDARDS AND INTEROPERABILITY

If as many municipalities as possible draw up a common vision and ground rules for the digital infrastructure, such as the use of IoT and data, innovation and developments can be safer and faster, as cities can learn from each other's experiences (Depla & Ollongren, 2017). In addition, an integral vision for the design of public space, in which cooperation with the state, municipalities, the business community, and (knowledge) institutions is central, is also a way to develop further (Depla & Ollongren, 2017).

To work together, central data standards must be developed and integrated into business operations and municipal infrastructure. In doing so, it is important that data can be read by the recipient and used for policy development (Royal HaskoningDHV, 2017). A policy officer from municipality The Hague (MR3) acknowledges the challenges in adopting a central data standard: *"There are still major challenges in getting those inter parties to work together, especially within a central platform where they are forced to adopt the same data standards. That makes the private parties nervous."* Additionally, Roland van der Heijden from municipality Rotterdam (MR5) highlights a practical issue with proprietary data formats: *"At one point, we had the data, but I couldn't do anything with it because it was in a language only that one company understood. It wasn't an open standard; it was written in a company-specific standard. I needed the codebook, which I could only get if I paid for it."* This lack of data standards, open data formats, and protocols creates barriers to city development (van Beurden, 2017).

5.4.4. DATA RESPONSIBILITY AND PRIVACY & SECURITY

"Even though there is no law prohibiting a certain action, it doesn't mean it should be done without careful consideration," says Roland van der Heijden from municipality Rotterdam (MR5). He further emphasizes the importance of being responsible, prudent, and transparent in decision-making: *"We must always consider whether it is responsible, good, and smart, and we should always be transparent about it. As a government, we often fail in this regard."* Niels Wiersma from municipality Eindhoven (MR1) underscores the importance of good governance in data sharing, especially when addressing new questions or adding new aspects to area development: *"It's crucial to organize governance around data sharing properly. Nationally, the first steps have been taken, but there is still room for*

improvement." Niels Wiersma from municipality Eindhoven (MR1) also acknowledges the challenge of transparency in data collection and usage by government institutions: "*This is tricky because it could involve a long list of data. People might comply, but we must question whether such practices are transparent enough for a governmental institution."*

Within mobility providers, opinions on openness differ. While companies can be transparent about many things, sharing competition-sensitive information is a different matter. Dani Sprecher From MyWheels (IR4) explains, *"If you have a small lead, you want to keep it. If things are going badly somewhere, then not everyone needs to know."* This highlights the delicate balance between transparency and maintaining a competitive edge, emphasizing the need for thoughtful governance and ethical considerations in data sharing. Additionally this underlines the importance of addressing privacy and security concerns proactively and ensuring transparency in data handling to maintain public trust (IR4).

Antoine Gribnau from municipality The Hague (MR4) highlights the need for balance in data management, stating, "We live in such a society that everything has to be buttoned up with all kinds of contracts. It must be *necessary, but there has to be a balance somewhere between having everything tightly framed and having everything open."* This emphasizes the challenge of finding a middle ground between stringent data protection measures and the openness required for innovation and effective data sharing.

5.4.5. COMMAND AND CONTROL

The government's role in managing technological advancements has often been minimal, with a tendency to leave it to big tech companies, particularly from the U.S. A policy officer from municipality Rotterdam (MR6) questions this approach: *"We've mostly let big tech handle it all for us, but the question is whether that's wise."* Roland van der Heijden from municipality Rotterdam (MR5) highlights the ethical implications of this passive stance: *"You see that this position is becoming increasingly untenable. You see that the whole ethical aspect is becoming more and more unsustainable. This is a development we are very much involved in, and we find it very important that companies understand this. But we are working very hard on it."* The municipality itself is very aware of the excessive data collection of large corporations and therefore appointed a philosopher to incorporate data ethics into the digitization program (de Lange, 2020).

Entering the technological world where the rules are not yet established, makes it very challenging for both the government and market players to determine the boundaries within which they operate (ER1). In recent years, various municipalities have primarily left the market in charge, giving the market free rein to develop and innovate in the area of shared transportation (MR6). This also applies to other digital developments. Municipalities have allowed these advancements to progress with little oversight and have shown little initiative, resulting in them now lagging (MR5).

Shared mobility apps collect data from every trip, which can be valuable for identifying issues, opportunities, and solutions in the urban domain (Berretta, 2023; European Commission, 2023c). Often, big tech companies have a better understanding of how certain urban aspects function and how to address related issues. Additionally, more physical infrastructure data is being discovered and processed by private companies. While they often gather this data to assist municipalities directly, they can also charge for this service. This situation, however, makes cities directly dependent on these companies, which is both democratically and economically undesirable (MR5). Initially, the municipality might be able to cover the financial costs, but as their dependence on the data grows, private companies have the freedom to increase their prices (MR5). Roland van der Heijden from

municipality Rotterdam (MR5) warns, "If *we continue down the current path, you could say that we will end up as a government, as a customer in our own city."* CDS-M and TOMP-API expert Edwin van den Belt (ER4) provides an example of a situation which could happen when municipalities become too dependent on a certain saying, *"We tried to ensure that agreements are made to prevent companies like Apple and Google from having the opportunity to, say, independently contract with an organization like NS. Towards the end of the contract term, these companies might say, 'Hey NS, we see that about 70% of your revenue flows through our platform. We want a bit extra for that.'"*

Municipalities must be vigilant about entering into data delivery contracts with (large and dominant) private parties (ER2). They must have clear terms to avoid the tendency to vendor lock-in and ensure that they are not overly dependent on specific data standards or providers (Veronelli, 2016; (Bagheri, 2024; Maltha et al., 2021). Especially when companies have a monopoly position, they have the ability and freedom to set conditions for the use of data, which can deprive municipalities of access, restrict it, or essentially become blackmailed when the municipalities depend on it directly (Gemeente Amsterdam, 2021b; Bagheri, n.d.). Municipalities should contractually establish ownership of source data to avoid later problems (Meerman, 2023; ER4), such as indicated by Roland van der Heijden from municipality Rotterdam (MR5) where it has not been able to receive underlying raw data from a certain data provider (for free).

5.4.5.1. HIGHER-LEVEL GOVERNANCE

Currently, municipalities often struggle with the balance between autonomy and centralization, as well as unity within decision-making and problem-solving (Keur. Peter-August, 2019). Rik Braams from TNO and the Ministry of I&W (ER2) notes, *"It's very difficult to speak about one vision because I don't think it exists."* A policy officer from municipality Rotterdam (MR6) emphasizes the need for stronger interaction between national and local governments: *"The interaction between the national government and municipalities should be much stronger."* Niels Wiersma from municipality Eindhoven (MR1) adds that having a national legal framework would simplify coordination: *"If there were a national legal guideline or framework, it would be much easier to regulate centrally."* According to the Masterplan Mobiliteit 2050 of municipality Eindhoven shared mobility is something that goes beyond municipal barriers and therefore should be regulated in cooperation with regional authorities (Gemeente Eindhoven, 2023). These are all indications that municipalities can not effectively innovate and integrate shared mobility alone. Central regulation and cooperation is needed to provide fair and transparent collaboration between municipalities and shared mobility providers.

Gemma Schepers from municipality Amsterdam (MR7) suggests more centralized steering through national programs like Natuurlijk Deelmobiliteit (including CDS-M) to ensure uniformity in data sharing: *"We have now a national program, Natuurlijk Deelmobiliteit, which ensures uniformity in data sharing and defines technical APIs."* In which Gemma Schepers from municipality Amsterdam (MR7) praises the national collaboration, *"It's very good that we have organized this nationally, so not every city comes up with something different."*

Contrarily, policies are often developed from another or higher government position to be implemented by others. In practice, however, this is much more difficult than previously estimated by the higher government. They often lack concreteness about the practice and implementation of policies. As a policy officer from municipality Rotterdam (MR6) says: *"A legion of optimistic technicians who are eager to play the innovation card. There is a great need for assistance in a lagging field like mobility. The thinking is, if we just do this now, you'll quickly see how fast we can grow into a beautiful new mobility system. Many things that are not fulfilled but are often initially embraced by politicians."*

5.4.6. COMMUNICATION AND COLLABORATION

Cities often find it challenging to engage in meaningful dialogue with businesses. It is crucial to listen to the experiences of these parties, as they possess intricate knowledge of their operations. Engaging with them allows for a better understanding and more effective collaboration (MR7). Gemma Schepers from municipality Amsterdam (MR7) highlights this, stating, *"For instance, during discussions with Check, they share insights that are novel to me due to my different perspective. Conversely, I provide them with the city's viewpoint, which they might not be fully aware of."*

This continuous exchange of information ensures mutual awareness and fosters collaboration, which is also indicated by Dani Sprecher From MyWheels (IR4), noting that entering into dialog with shared mobility providers opens up opportunities to learn from each other and fosters collaboration. However, this process can be difficult, and the ease of communication can vary from one city to another (MR7). Gemma Schepers from municipality Amsterdam (MR7) notes that trust is essential for effective collaboration: *"Without trust, collaboration would not be possible" (MR4).* Moreover, including representatives of frequent users of shared mobility solutions or even regular residents can add a valuable perspective to these discussions, as they view these solutions differently (MR1). Niels Wiersma from municipality Eindhoven (MR1) emphasizes the importance of incorporating these perspectives to enrich the dialogue and improve outcomes.

5.5. MUNICIPALITY AND SHARED MOBILITY PROVIDER COMPARISON

Although many aspects in this section are already described in previous sections it is developed to give a quick insight into the differences, similarities, and exceptions among shared mobility providers and Dutch municipalities. Based on initial codes and thematic analysis this section provides a cross-case analysis of the results found between car-sharing and shared two-wheel providers as well as Dutch municipalities. In doing so, this comparison contributes to the degree of generalizability of the results and the interpretations given to them. For substantiation and direct thematic coding results see **Appendix E**.

5.5.1. SHARED MOBILITY DATA SUPPLY COMPARISON

During the research, it became clear that within shared mobility data sharing a distinction can and should be made between shared two-wheel providers and car-sharing providers to form a clear picture of the shared mobility data supply. By looking at these parties individually, municipalities can get a better understanding of the companies and their vision for data sharing and build better policies and frameworks accordingly.

In essence, the type of data shared by both parties is similar. Both parties primarily share trip data, but in some cases also include aspects such as usage, complaints, and potential initiatives regarding road quality. A two-wheeler provider also mentioned proactively sharing mismatch data. This data covers the time and location when someone opens the app but cannot find a shared vehicle within reach. This data can be beneficial for both municipalities and shared mobility providers. However, the specific content of shared data significantly differs between two-wheeler and car-sharing companies.

Both parties indicate that data sharing heavily depends on agreements with different municipalities. What municipalities request and what providers are willing to offer can vary greatly. Generally, it can be concluded that shared two-wheeler providers are more willing and able to share extensive data with municipalities, partly because they are bound by legal agreements and permits. On the other hand, car-sharing providers prefer not to go into detail when sharing data with municipalities. They believe that

municipalities can manage with less specific data, thus they prefer to share annual averages rather than direct data about individual vehicles. The level of specificity is the main difference between the two parties.

Despite both parties recognizing the benefits of data sharing for urban development and policy-making, they are both extremely cautious about privacy and business-sensitive information. An important example of maintaining privacy is only sharing start and end locations instead of the entire trip, or anonymizing and lightly editing data before sharing it.

While shared two-wheel providers have already agreed to mandatory data sharing, car-sharing providers are not in favor of this and indicate that they are only willing to share very limited data on a mandatory basis. They suggest that much more is possible if municipalities engage in dialogue with the provider and the provider shares data voluntarily. Both parties can and want to proactively share data with municipalities to contribute to urban development and policymaking and to give something back to the municipality. Shared two-wheel companies explicitly mention creating win-win scenarios through proactive data sharing, where the provider shares data to improve public spaces and infrastructure, potentially tailored for (two-wheel) shared mobility.

Both parties, however, see the risks of open data and are therefore cautious about what they share and how it is used and presented in practice. To facilitate this data sharing, there are various initiatives in place. Two-wheel sharing companies do not explicitly mention third parties or facilitators. However, car-sharing providers frequently mention CROW and Vianova as third-party data dashboards for municipalities. It is noted that this can be challenging in practice because there are too few different providers in an area, making it too easy to trace data back to a specific provider. In addition to data dashboards, car-sharing providers state that they want to operate according to the CDS-M data-sharing model from the program Natuurlijk Deelmobiliteit. While shared two-wheel providers do not mention this, car-sharing providers see it as the core of (potential) data sharing.

The extent to which municipalities have access to the providers' data depends on legal agreements and the attitude of the provider. While shared two-wheel providers sometimes even share data proactively with municipalities where they do not operate, car-sharing providers typically only share data in response to municipal requests.

5.5.2. MUNICIPAL DATA DEMAND COMPARISON

To realize data sharing, municipalities emphasize that communication with shared mobility providers is essential. Both parties need to know and understand each other's perspectives to establish good and clear agreements. Within these agreements, the use of APIs is crucial to read the data. Several municipalities also indicate that they use third parties to read data. Specifically, the Municipality of Rotterdam and the Municipality of The Hague mention the Open Urban Platform. This platform aims to facilitate data sharing from various parties by offering a data marketplace.

Most municipalities state that data should be open and accessible to everyone. In practice, various municipalities acknowledge that while they possess a lot of data, specific (external) data is often not acquired yet. The Municipality of Rotterdam cites a specific case where it sought access to the underlying raw data of an application but was denied access by the data owner.

All municipalities focus on using data for better decision-making, public tasks, and improving the quality of life. Several municipalities specifically mention their efforts to manage urban growth, public space, and especially mobility. The Municipality of Amsterdam notably highlights the use of data to

reduce the nuisance caused by shared mobility. Similarly, the Municipality of The Hague also indicates a desire to use data to facilitate mobility hubs to mitigate nuisance.

All municipalities recognize that they should not request data from shared mobility providers unless they have a direct use purpose. Additionally, most municipalities indicate that mobility data can be used for multiple purposes beyond just mobility-related questions. In some cases, new, unexpected results can be obtained based on mobility data. Some municipalities also directly state that personal data has no use purpose and is therefore not important in their data requests. Various municipalities acknowledge that data leads to opportunities that have not yet been identified.

The continuity of data sharing varies between municipalities and depends on permits and other agreements with shared mobility providers. Municipalities seek automated data sharing where as much data as possible is shared, but in many cases, data is only shared periodically and in a less specific manner.

Acquiring data from shared mobility providers requires effort. However, many municipalities lack the capacity for this effort and often do not know what to do to obtain the data or which data they need, as mentioned by the Municipality of Rotterdam. In contrast, the Municipalities of Eindhoven and The Hague state that there are few obstacles and that data acquisition is generally proceeding well. The Municipalities of Rotterdam and The Hague note that the challenge mainly lies in the organizational capabilities of the parties rather than technical difficulties. On the other hand, the Municipality of Amsterdam states that technology is still a challenge within the municipality.

For data utilization, many municipalities often do not have the right capacities and capabilities to analyze data and integrate it into policy decisions and urban development. Additionally, a central theme among the municipalities is ensuring the privacy and security of the data. The Municipality of Amsterdam points out that there are frequent changes in the market, which complicate data usage. The Municipality of Rotterdam has a unique perspective on the mismatch in data utilization. The Municipalities of Rotterdam and The Hague also acknowledge that data application must be done at various levels and within different municipal departments.

6. DISCUSSION

This chapter critically examines the results of this study by putting it into contrast with existing literature, again distinguishing between data demand, supply, and challenges found through a systematic literature study which can be found in **Appendix D**. In addition, the limitations of the study are acknowledged and the significant contributions of the study are named. Lastly, recommendations for further studies are made based on the limitations and results of the study.

6.1. EMPIRICAL FINDINGS AND IMPLICATIONS

In addition to the deductive coding strategy using an initial codebook, this research also employed inductive open coding. Many of the initially divergent themes align with the challenges identified by Diran & van Veenstra, (2020). Examples include: 'Data ownership', which corresponds to 'lacking access rights and scattered distribution of data'; 'market dependence', which aligns with 'cautious to make decisions based on insights from data'; and 'resistance to change', which corresponds to 'lack of awareness, trust, and openness in data sharing.' Emergent themes, however, include 'central vision,' 'role division,' and 'higher level governance,' all of which suggest a new theme described as '(central) governance and role division' in data sharing. Additionally, other themes pertain to specific aspects of the urban development and policymaking sector.

6.1.1. DATA DEMAND

Although little literature exists on the specific research topic, there is a literature base in the area of data sharing for public benefits and urban planning & policymaking. X. Liu & Dijk, (2022) indicate that there is a data need for real-time traffic and mobility-related data. This is important in short-term policy development. This research is in line with this in terms of data demand. Municipalities often want to obtain shared mobility data to solve short-term policy problems, but shared mobility providers indicate that municipalities should not do this and should look at the longer term, which directly corresponds to more concrete policy problems and use cases for data. According to the mobility providers, this is the main reason why shared mobility providers would be reluctant to provide data, and therefore supply and demand do not match. A tension is seen in this since if mobility providers are continuously asked to provide data it incurs more costs and can thus lead to even less willingness of companies to share data. Therefore data demand standardization is desired from both parties, but need close cooperation in establishing it.

Leveraging data and integrating it with smart technologies can revolutionize urban living and management (França et al., 2021; Wang et al., 2021). By harnessing the power of big data, cities can make more informed, timely, and effective decisions, leading to more sustainable and efficient urban environments. Borghys et al. (2020); Hawken et al. (2020); Susha et al. (2019), highlight the benefits of data collaboration in city developments, including improved decision-making, increased process efficiency, and innovation. Businesses could contribute to the development of smart and sustainable cities (Hudović Kljuno & Krivošić Dizdarević, 2021). This research connects to this and provides specific insights into shared mobility and its data in Dutch cities. Municipalities see direct benefits of shared mobility for addressing urban issues like densification and urbanization. Additionally, they aim to reduce private vehicle ownership to free up public space and achieve sustainability goals. This often drives municipalities to request data from shared mobility providers to see where and how demand for this modality is currently established and might transition in the future. This aligns with the literature by França et al., (2021) and Borghys et al. (2020) emphasizing the critical role of data in smart city initiatives, noting that data-driven approaches can significantly improve urban infrastructure

management and sustainability efforts. The demand for data is also influenced by increasing digitization and the need for municipalities to adapt to rapid technological changes (França et al., 2021). This is also confirmed by this research, noting that municipalities are afraid of 'a second Uber' which might disrupt the status quo in the mobility regime within Duch municipalities. This indicates that the municipal data needs to regulate NMS initiatives.

Hawken et al., (2020) and Verhulst, (2021) emphasize that while private companies collect vast amounts of valuable data, sharing this data with municipalities is still in the early stages. This is partly confirmed by this research. Shared two-wheel providers are often already sharing data and comply with municipal data demand due to obligation through permits, which aligns with the reason noted by Klievink, Van Der Voort, et al., (2018). However, currently, shared mobility providers perceive the data requests of municipalities often as unfounded, asking for excessive data with suboptimal purposes, leading to reluctance from providers to share data. Shared mobility providers, especially car-sharing providers, indicate that municipalities must avoid unjustified data demands, also called 'fishing expeditions,' which are legally questionable. Providers are open to data sharing if municipalities have specific, justified use cases, which are termed policy problems according to CDS-M terms. CDS-M and its corresponding program of Natuurlijk Deelmobiliteit are still developing in collaboration with shared mobility providers and municipalities. However, municipalities express mixed opinions about these statements. Some municipalities admit that they do not always fully understand what data they need, and therefore cannot issue clear data demands to the shared mobility providers. On the other hand, municipalities assert that they have a right to certain data and should receive it from the shared mobility providers. The right to and ownership of data remains a significant point of discussion. CDS-M aims to address these issues and provide clarity regarding data demand and supply, as well as the methods of data sharing. Essentially this program aims to tackle most of the challenges identified in this research, specifically focusing on matching shared mobility data supply and demand through the development of standardized data sharing and use cases.

The need for clear, actionable data demands supports the conclusions of Verhulst, (2021), who identifies the gap between data supply and demand as a major challenge in data-driven urban planning. More and more Dutch municipalities are trying to incorporate data demand into permits for shared mobility providers. While this has been successful for most shared two-wheeler providers, the goal is to organize this for car-sharing providers as well. The data requirements municipalities include in these conditions, or their data demand in general, vary greatly between municipalities but also depend on the shared mobility provider. The larger the provider, the greater its influence, and the larger the data demand from the municipality. This also affects the continuity of data sharing. Ideally, municipalities want to receive as much and as direct data as possible from each provider, but often, static, less frequent data sharing is already sufficient for municipalities. Municipalities also recognize the need to be cautious with the data-sharing conditions they include in permits because they depend on the availability of shared transport and do not want to drive providers away from the city.

6.1.2. DATA SUPPLY

Vigorito, (2022) emphasizes that data sharing presents risks such as privacy, and security. Several studies point out the challenges of data sharing to municipalities. For example, Zhang, (2019) and Benli-Trichet & Kübler, (2022) discuss the need for strong governance structures and regulations to keep disrupting initiatives under control. The issues of data privacy and the legal constraints imposed are significant barriers, as noted by (França et al., 2021) and further supported by this study's findings. Shared mobility providers are vigilant about collecting privacy-sensitive data. European legislation (GDPR) limits the collection of personal data, and mobility providers generally avoid collecting

privacy-sensitive data unless necessary for specific use cases. However, in some cases, this is not yet fully understood by municipalities. The data request is then not only not wanted but also impossible. Additionally, the competitive landscape plays a significant role in data-sharing practices. Data is valuable and considered intellectual property that requires protection to maintain a competitive advantage. Mobility providers are cautious about sharing data, especially with commercial parties, to avoid compromising their business interests. Privacy sensitivity remains at the core of concerns in data sharing. To mitigate privacy risks, data is anonymized and aggregated as much as possible. Ensuring individual user privacy is a central responsibility of mobility providers. This is in line with (Klievink, Janssen, et al., (2018), which note that companies must be cautious of over-compliance with information-sharing regulations, as this can lead to unintended consequences. Striking a balance between compliance and value creation is crucial (Klievink, Janssen, et al., 2018)

(Hawken et al., (2020) indicate that big internet businesses use vast amounts of geospatial data to improve their functioning and financial growth, but they often overlook the potential public benefits of their data. Additionally, governments are slow to recognize that cities might have ownership of this data or could integrate this data into their development. According to this study's findings, it is shown that there are roughly 3 perspectives on data ownership. These are the data generator- often the transport user, the data collector- often the transport provider, and the municipality that facilitates the infrastructure. Throughout the research it is indicated that data ownership is extremely hard to determine and most respondents did not want to explicitly state who should or would be the rightful owner of data generated through mobility usage. Even though sometimes it is said that the individual data generator should be the owner one needs to address to complexities of access and storage of this data, which individuals find hard to accomplish. In addition, municipalities often do not know which data they need for a specific policy question. Engaging in dialogue with shared mobility providers allows municipalities to learn from the market's expertise. However, this dialogue and learning are mutual, meaning that both parties can benefit from collaboration and communication.

As for the level of specificity and specific types and content of data, it depends on the case. Some municipalities demand more and other data than others and some shared mobility providers provide more or other data than others, with some municipalities receiving raw data and others only general insights. Generally speaking, there is a lack of coherence and centralization in data sharing, which indicates an immediate demand for centralization and handling data sharing ethically. This is in line with research from (Estevez et al., (2016) indicating that technological solutions should not neglect legal, social, and ethical impacts. This is also what directly influences the differences between car-sharing and shared two-wheel providers. Whereas the two-wheel providers are the disruptive innovator and therefore need permits to operate within the city and car-sharing providers are the incumbent firm which is already settled within the city. On top of that, these companies create far fewer nuisances so there is no immediate reason for municipalities to request data, whereas two-wheelers do. Therefore dynamic data is often shared by two-wheel providers and more static data is shared by car-sharing companies. However, shared mobility providers become more cautious when data requests become more specific, privacy-sensitive, or business-critical. Shared mobility providers primarily share trip data, such as start and end points, trip duration, and aggregated information to protect privacy. However, there is a clear distinction between car-sharing and two-wheel providers, with the latter often sharing more comprehensive data. Car-sharing companies typically wait for municipalities to present a substantiated data demand and specific use case for the data.

Throughout the literature, most practical evidence has been found for voluntary B2G data sharing and win-win scenarios (Rukanova et al., 2020; Susha, Rukanova, et al., 2019; Klievink, Van Der Voort, et al., 2018; Vigorito, 2022). Within the shared mobility domain, in principle, all parties are willing to

share data voluntarily. However, mandatory data sharing is currently only in place for shared two-wheel providers. Share car providers often only share data voluntarily because they are not (yet) subject to licensing requirements. However, it should be noted that this data sharing is only done after concrete municipal data demand, with clear use cases for the data. Car-sharing providers are generally a lot older and mature and therefore already often present within cities before data-sharing demand emerged and shared two-wheel providers began to integrate within the urban public space. Shared two-wheel providers were taken hand in hand with nuisance, causing municipalities to implement direct regulation through permits and therein also data sharing. This does not go up for car-sharing providers, as they do not cause the same amount of nuisance and disruption. However, municipalities are increasingly pushing towards mandatory data sharing for all mobility providers.

However, this study indicates that that shared mobility data sharing could be both on voluntary or mandatory basis. Although voluntary data sharing is also confirmed by this study as it indicates that shared mobility providers are sharing data to potentially increase municipal infrastructure and even specific mobility hubs for the providers, it also provides evidence for successful mandatory data sharing, confirming with Rukanova et al., (2020) and Vigorito, (2022). One of the interviewed car-sharing providers even opted for a mandatory data-sharing basis, where additional data can be shared with municipalities voluntarily. This could contain data that municipalities regularly need to confirm shared mobility providers operate according to the given permit (such as operating vehicles and frequency of use) and for other use cases/ policy problems, municipalities could come to a dialog with shared mobility providers to provide additional information voluntarily. This way shared mobility providers are given the opportunity to understand the municipal problem, and allow them to find the appropriate data to share to solve this problem. This is consistent with the findings of Vigorito, (2022), which indicates that in many cases an optimum of data sharing can be achieved when both methods are combined. In addition, shared mobility providers feel a responsibility to contribute to municipal goals and infrastructure improvements. By proactively sharing data, they often see benefits in the form of improving services and infrastructure, therefore enabling mutual benefits.

6.1.3. DATA ACQUISITION AND UTILIZATION CHALLENGES

This research started with an expectation of problems using the theory of Diran & van Veenstra, (2020). Although they specifically dedicate their research to heat transition policymaking, the barriers they are mentioning were not expected to differ significantly for policymaking based on shared mobility data. This expectation was right. This research has confirmed almost all the problems experienced by Diran & van Veenstra, (2020). Especially, the barriers such as lack of expertise and skills, determining the value and purpose of data, legal limitation/ GDPR, and difficulties in linking, analyzing, and visualizing data are dominant throughout the research. Although municipalities seem to know the value of data, they lack the expertise and skills to deal with them and often do not address specific purposes of data use. This also refers to the effect that municipalities find it difficult to analyze data, and make connections. In this study, this is mainly referred to as "silo thinking. Municipalities are often too individualistic, limiting collaboration, connections, and mutual learning opportunities. It has also been shown that data, especially from car-sharing providers, often do not meet the municipalities' intended level of detail. However, shared mobility providers often think that detailed data is often not necessary to share. This also ties in with the legal limitations of data use and privacy laws. Shared mobility providers in some cases hide behind this legislation to share as little data as possible with municipalities. Municipalities must also comply with the legal frameworks and powers in not only the data demand, but also its use.

As municipalities often lack the knowledge and technical capabilities to access and analyze data, they often rely on third-party platforms, such as Vianova and CROW. These platforms help integrate and visualize data, though challenges remain, especially with car-sharing data. However, dependence on these parties may compromise internal knowledge accumulation, which is a unique challenge identified in this study. This dependence is not extensively discussed in the literature, which often assumes internal capabilities.

This research highlights the mismatch of expectations between policymakers and shared mobility providers. There is a significant challenge due to different expectations and perceptions of the usefulness of data between policymakers and providers as well as divided perspectives on providing a clear use purpose for the data demand. This aspect is indicated by Diran & van Veenstra, (2020), but receives a lot more body within this research. Meanwhile, this study found no significant indication that data was scattered distributed, or untraceable by municipalities. Only when looking at shared mobility as a whole one can speak of scattered distribution. In practice, each provider has its own data, over which the municipality can express its need. Municipalities actually do know where to find data. However, the degree of access is significantly dependent on agreements and the willingness of the shared mobility provider to share data. Also, it should again be noted that data often gets demanded from single municipal departments without other departments knowing. This indicates that data might be demanded redundantly and is scattered among municipal departments, asking for central data points within municipalities.

6.2. LIMITATIONS

This research contains several limitations. The first limitation is the specific focus on medium to large-sized cities in the Netherlands. The findings may not be generalizable to smaller cities or cities in other countries with different urban dynamics and regulatory environments. In addition, the four municipalities each have at least one interview, with some being examined more thoroughly. The limited and varying number of interviews means that the findings may not fully capture the complexities and variations within each category. This limitation reduces the depth and reliability of the insights and hampers the identification of consistent patterns and themes across municipalities. The comparative findings are preliminary and should be seen as indicative rather than definitive.

The second limitation is the large focus on only municipalities, shared mobility providers, and experts/researchers on the research topic. Residents and/or shared mobility users are not included in the research, which can lead to a biased understanding of the data usage and its implications. However, it is indicated from different angles that also the vision of these stakeholders can contribute to the development of data sharing and that the interests of these stakeholders should be included in the discussion about data ownership and the purposes of use.

Third, this research is primarily limited only to the collaboration and interaction of data sharing between municipalities and shared mobility providers. However, the research also revealed that NMS contains more modalities, and MaaS is a direct extension of this data sharing. The MaaS platforms are another (often (semi) private) party that needs data from shared mobility providers.

Fourth, the research topic is very current so there is still much changing in the field of shared mobility within cities, but even more so in the data they collect and share with municipalities. Following this, the much-discussed policy program "Natuurlijk Deelmobliteit" was released on 30/05/2024, so it was not possible to include it in this research.

Lastly, this research is based on qualitative information, which introduces subjectivity in data interpretation by the researcher. In this researchers' preferences or background could have influenced the interpretation and direction of the research. Focusing on qualitative data provides a brought and deep understanding of the phenomenon of mobility data sharing, but hinders statistical presence and underpinning for generalizability. One should consider this study indicative and exploratory rather than definitive and exclusive.

6.3. CONTRIBUTIONS AND FUTURE DIRECTIONS

This research supports existing knowledge on sharing data for evidence-based decision-making. By providing empirical insights into the demand, supply, and challenges in acquiring and using shared mobility data, this research highlights critical aspects, differences, and conditions to effectively use data for smart and sustainable urban development and policy making, potentially improving sustainability and urban space, and reducing (mobility) nuisance. However, future research should explore best practices for data collaboration and integration, focusing on case studies of successful implementations to provide practical guidelines for municipalities and mobility providers. According to some respondents, the municipality of Utrecht is currently working with shared mobility providers, especially car-sharing providers, to reach data-sharing agreements.

This research is one of the first substantial movements in capturing supply and demand from shared mobility data. The qualitative approach has provided a broad exploration of the current situation, but could better demonstrate its value when statistical and quantitative underpinnings are given to the specific supply and demand variables needed for urban planning and policymaking.

This research demonstrates that shared mobility providers have a significant need for a well-substantiated and clear use case and data handling framework when municipalities request data sharing. However, this study has not fully clarified what constitutes a clear and justified use case and interest that would persuade shared mobility providers to share data. Further research should delve into both municipal and shared mobility providers' perspectives on creating this use case and data handling framework.

This research also shows that there are many issues involved besides sharing data, such as who should provide the data, data ownership, why it is sometimes not readily available or used, and any potential repercussions and solution. However, this provides opportunities for further research into data collaboration (in urban development) in which certain aspects can be explored in greater depth.

This research provides a comprehensive approach to the supply and demand of shared mobility data from the municipal demand perspective. However, the research also shows that MaaS is a movement that requires shared mobility data. Municipalities also see potential in this and are looking for ways to take advantage of it. Further research can provide its value when focusing on data sharing between shared mobility providers and Maas operators. This allows for triangulation between the three stakeholders, in which an optimum mutual state (of collaboration) could be identified, facilitating all stakeholders' ambitions.

This research provides a comprehensive approach to the current state of data sharing between shared mobility providers and municipalities, however, mobility crosses national borders. Besides improving quality and supporting the reliability of the results, it is interesting to investigate the current state of affairs in other (European) countries. This can provide valuable insights into differences and similarities, which can contribute to the discovery of best practices, centralization in data sharing, and further interoperability in data sharing and usage.

In closing, the research shows that a significant hope for central control, interoperability, and reliability in the area of shared mobility data sharing is placed on the CDS-M procedure, which is part of the Natuurlijk Deelmobiliteit program. Further research can delve into this particular program to provide guidance on the quality of the program and potentially suggest improvements. In addition, this can also be drawn to other countries, as the CDS-M method has ambitions to roll out further within the EU.

7. CONCLUSION

This research aimed to understand how Dutch municipalities (could) leverage shared mobility data in municipalities in the Netherlands. Therefore the research focused on three sub-questions: understanding the shared mobility data supply, understanding the data needs of Dutch municipalities, and examining the challenges and opportunities in data acquisition and utilization faced by Dutch municipalities. The framework of Susha et al., 2017) has been adapted to structure this research around supply and demand. However to identify the data sharing mode, this study included the distinction of data sharing mode based on theory from (Rukanova et al., 2020; Susha, Rukanova, et al., 2019; Klievink, Van Der Voort, et al., 2018; Vigorito, 2022). Additionally, to structure the challenges in data acquisition and utilization in the urban development context, the theory of Diran & van Veenstra, (2020) has been adopted. Following this theoretical framework and by conducting interviews with multiple Dutch municipalities, researchers and experts in the field of shared mobility data sharing and urban planning, and shared mobility providers, primary data has been gathered to identify the core of the problem as well as the (potential) solutions for the shared mobility data supply and demand mismatch. Additionally, document and literature reviews have provided context on the issue, clarifying the advantages and disadvantages of shared mobility data sharing, its operational mechanisms, and ways to improve it. Together, this has led to an answer to the main question: "*What is the supply and demand for shared mobility data within Dutch municipalities to inform (smart) urban development and policymaking, and which access and utilization challenges and opportunities arise in the data sharing process?"* The answer to this central research question is elaborated in this chapter based on the 3 sub-questions.

Sub-questions:

1. "How is the Dutch municipalities' shared mobility data demand formed and what data do they need for urban planning and policymaking purposes?"

Dutch municipalities acknowledge they often cannot innovate on their own and want to keep control over (possible) disruptive innovation. For municipalities to answer their policy questions and solve problems, they are looking for opportunities to collaborate with and acquire data from shared mobility providers as they note their positive potential to reduce car usage, fix space shortage, and stimulate sustainability. However, especially shared two-wheel providers lead to problems within urban areas, resulting in municipalities integrating data sharing as a condition in operating permits for shared two-wheel providers. Municipalities are seeking collaboration opportunities with private shared mobility providers to gather data on vehicle usage and trips, aiming to inform urban development and policymaking.

The Dutch municipal shared mobility data demand is a combination of legal, practical, and policy-driven factors. The data demand is mainly fueled by the will to overcome challenges related to urbanization, densification, and sustainable mobility. To request this data, municipalities must take into account legal restrictions and need to clearly articulate their needs and establish a legal basis for their requests to increase the willingness to share data from the perspective of shared (car) mobility providers.

The specific content of municipal shared mobility data demand varies and depends on factors such as market share, frequency of use, and data already acquired. The approach to data sharing also differs between shared two-wheeler and car-sharing companies, with the former often needing to share more data through licensing agreements and the latter tend to be more hesitant about data sharing. Clear communication and legally sound data requests facilitate collaboration, while indiscriminate data

requests and handling can even lead to conflict and ineffective data sharing. To ensure continuity of data sharing, municipalities, and shared-mobility providers must establish robust agreements that balance municipal data needs with providers' operational interests. This includes establishing clear standards for data sharing, understanding technological and legal constraints, and fostering collaborative approaches that benefit both parties.

2. "What is the current state of data-sharing initiatives between shared mobility providers and Dutch municipalities, and how is this data sourced?"

Shared mobility data provision involves a complicated mix of legal, operational, and collaborative dynamics and aspects. While shared mobility providers collect a lot of data on vehicle trips and usage patterns, they are bound by privacy regulations such as GDPR, which prohibits them from collecting and sharing personal information. This limitation means that while municipalities often seek detailed information, providers note they often can and will only share anonymized and aggregated data. Providers also protect their data as intellectual property to achieve a competitive advantage, essential for maintaining market share and winning contracts and licenses from municipalities.

Shared two-wheeler providers generally share more data, often in real-time or near real-time, while car-sharing providers are more cautious. Municipalities need to come up with better cooperation strategies, as they cannot directly apply their strategy of data obligations for shared two-wheeler providers to car-sharing providers, as this strategy was mainly based on obtaining data to prevent nuisance. Shared cars often do not cause nuisances, eliminating the municipal legal basis for data collection.

Data sharing between municipalities and mobility providers can be mandatory, voluntary, or a combination of both. Mandatory data sharing is more common for shared two-wheelers and is often included in city operating permits. However, car-sharing companies often resist mandatory data sharing due to competition and privacy concerns. Voluntary data sharing is often driven by mutual interests, such as improving services and infrastructure, and is seen as a way of increasing cooperation and flexibility. This indicates that there are opportunities for municipalities to directly encourage shared mobility providers to provide data, as they can mutually benefit. However, car-sharing providers advocate for a centralized approach to data sharing that clearly states the purpose for which the data is used and how it is processed, interpreted, and handled, meaning transparency in the whole data sharing and utilization process, leading to trust.

As most municipalities lack technical capabilities, shared mobility data could also be shared through the use of third-party dashboards. However, shared mobility providers also question the transparency of parties such as CROW, raising concerns about data handling and competitive risks.

3. "What are the technical and organizational challenges and opportunities experienced by Dutch municipalities in accessing and using data from shared mobility providers active in the Netherlands?"

Additionally, shared mobility providers are cautious about sharing data that could compromise user privacy or their competitive advantage and market positioning. This value of data makes providers protective of their datasets, especially when there is a risk of sharing sensitive information with competitors or third parties. However, the threshold for data sharing depends on the obligation of data sharing, but it also relies on the internal organizational structure and leadership. Shared two-wheel providers are often a lot younger as well as their teams when compared to car-sharing providers which

directly affects the willingness to share data. Therefore, municipalities are often sufficiently supplied with data from shared two-wheel providers but lack access to data from car-sharing providers.

For successful data sharing, trust is at the core of collaboration. Constructive dialogue and mutual respect are crucial for fostering cooperative data-sharing agreements. Municipalities and providers must both be transparent, prudent, and ethical in their handling of data. Ensuring that data-sharing agreements are clear, legally sound, and aligned with the public interest to maintain public trust and achieve (sustainable) urban development. However, there are still many obstacles to conquer for municipalities to translate the data into evidence and make policy and urban development decisions. Municipalities often lack the technical expertise and capacity to effectively analyze and utilize the data they receive. Many municipalities rely on third-party platforms like Vianova and CROW to access, process, and visualize shared mobility data. However, municipalities should be careful and limit dependence on these platforms as internal (technical) knowledge and capacity development might be at risk. Municipalities must invest in building their technical capacities or continue to leverage third-party platforms to manage and utilize the data effectively.

Urban planning and policymaking are often hindered by silo thinking and mismatched expectations between municipalities and providers as well as municipalities with higher-level government and internal departments. Breaking down these silos, higher-level governance, and a more centralized approach to data regulation and standards can help address these challenges. This also has great potential to solve the lack of standardized data formats and interoperability. Proprietary data formats and siloed data systems further complicate data sharing. Therefore, the centralized and currently developed CDS-M procedure should be used to come to concessions and stimulate mutual benefits between municipalities and shared mobility providers. This procedure ensures interoperability, guarantees equal data interpretation and standardizes data sharing which increases data availability for municipalities and decreases stress on shared mobility providers as transparent data handling and clear policy problems are presented as uses cases.

Overall, this research illustrates the current state of supply and demand in shared mobility data sharing. It enables municipalities to identify problems and opportunities in this area and potentially learn from the perspectives of shared mobility providers to reach better agreements. The research highlights the key aspects of shared mobility data sharing, most of which can be addressed by the CDS-M program. Additionally, the research provides valuable insights for shared mobility providers, allowing them to learn from the perspectives of municipalities to reach joint solutions and mutual benefits, and actively contribute to the further development of the CDS-M program.

8. RECOMMENDATIONS FOR PRACTITIONERS

To form clarity for municipalities on what they can do to strengthen data sharing between them and shared mobility providers, some clear points are briefly identified below.

4. **Establish clear data-sharing agreements**
   Municipalities should establish a standardized way of data-sharing based on agreements with shared mobility providers. Within these agreements it should be clearly defined which data types and content municipalities need and at which frequency. For this, the municipalities should make clear what they need the data for, as demonstrated within the CDS-M data-sharing method. This will help in building trust and ensuring compliance with privacy regulations.
5. **Strengthen collaborations with shared mobility providers.**
   Municipalities can start the conversation with shared mobility providers, as well as establish new communications and collaborative platforms. In doing so, it facilitates ongoing dialogue to solve problems and further innovate in the field of shared mobility. By facilitating public-private partnerships, both parties can better collaborate, understand and learn from each other, which can have the direct result of making data easier or earlier to share.
6. **Promote voluntary data sharing**
   Municipalities can stimulate and encourage shared mobility providers to share data voluntarily by demonstrating mutual benefits. This can be done by showing best practices in which data sharing has contributed to urban planning and mobility solutions benefiting shared mobility providers.
7. **Invest in data and digital infrastructure and human capabilities**
   Municipalities need to invest in solid data and digital infrastructure to be able to analyze, manage, and use (shared mobility) data. This includes setting up proper, secure data storage systems, employing data analytics tools, commitment to interoperable data standards, and above all, bringing technically savvy employees in-house through, for example, more and better employee training.
8. **Ensure data trust and privacy**
   Municipalities must ensure that it is clear what data is used for, but also in what way and how it is handled. Again, having data standards is essential, but the method of reading data must also be consistent. Municipalities must demonstrate compliance with privacy laws and regulations and protect the interests of both mobility providers and user. This builds mutual trust and alleviates privacy concerns.

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11. APPENDIX A – (DATA AND DIGITALIZATION STRATEGY)

Based on the rapidly growing amount of data generated by both private and public institutions, Europe aims to become a leader in the data economy. Recognizing the untapped value and potential of data Europe aims to use its technologies, skills, industry, and vision to become a frontrunner in data sharing and create a society empowered by data (European commission, 2020).

Therefore the European Data Strategy (EDS) has been developed. It indicates the creation of data spaces where data is freely available to everyone, whether public or private, start-up or giant. The European Union (EU) acknowledges that creating incentives for data sharing and establishing practical, fair, and clear rules on data access and use, which comply with European values and rights such as personal data protection, consumer protection, and competition rules, is necessary. Furthermore, the strategy highlights the importance of making public sector data more accessible by opening up valuable datasets across the EU for reuse, thereby paving the way for innovation (European Commission, 2024a). To fully exploit the opportunities of data sharing, the European Commission wants to improve the development of technologies and infrastructure. The Commission will also work to further narrow the digital skills gap among Europeans and explore how to give citizens better control over who can access their machine-generated data (European commission, 2020).

Through policy development and investments, B2G data sharing is facilitated within the EU (European Commission, 2020a). Each country is expected to cooperate in setting up governance structures and data stewards. Transparency is also seen as very important, with citizens at the heart of acceptance and provision of data. Also, the technological and information aspects is of great importance in the development of efficient and effective B2G data sharing. The (mutual) benefits need to be discovered and explained, and support is needed for urban development based on data and digital infrastructure (European Commission, 2020c).

To achieve the goals of the EDS, the Data Governance Act (DGA), Digital Markets Act (DMA) and Digital Service Act (DSA), among others, were drafted. The DGA aims to promote data sharing mechanisms and trust in the availability and use of data and aims to facilitate the exchange of data between different sectors, including through data intermediaries, with the AVG (GDPR) at its core when it comes to personal data. It also deploys safeguards to strengthen trust in the exchange and use of data, thereby promoting the availability of data in the market. The DMA aims to regulate and set requirements for interoperability, trust, transparency, and market position of online platforms. The DSA ensures a level playing field for innovation, growth, and competition. All are designed to protect the interests and rights of citizens while encouraging industrial and technological development (European Commission, 2020b).

The Data Act aims to make data clear and visible for both users and other parties. By applying central formats to data and providing access to it, evidence-based decisions can be made. Moreover, the transparency of the process potentially allows users better insight into the potential of their data in enhancing urban planning and policymaking. Additionally, the Act focuses on updated contracts to facilitate data access, sharing, and use, and to counteract market dominance by large companies. This is achieved by making data sharing easier and more secure through fair, reasonable, and non-discriminatory terms. This ensures not only better innovation and economic growth but also preserves the rights of companies and stimulates a competitive market. The Data Act ensures that the compensation for data access does not exceed the costs directly associated with making the data available. This consideration supports the innovation ecosystem by enabling smaller players to more

fully participate in the data economy, promoting diversity and competition (European Parliament & Council of the European Union, 2023).

In 2023, the Data Governance Act went into effect, which aims to build trust in data sharing, and data availability and break technical barriers (European Commission, 2024b). In addition, the AI Act and the Data Act are under development. The AI Act assesses risks associated with the use of algorithms to generate trust in this development (European Commission, 2023b). The Data Act aims to facilitate the collection of data by private parties and access to the data by those from whom it has been collected (European commission, 2022)

Dutch digitalization strategy

The Dutch Digitization Strategy describes the increasing reliance on collaborations among various stakeholders such as businesses, governments, knowledge institutions, and societal organizations to optimize opportunities (Ministerie van Economische Zaken en Klimaat, 2018). It creates space for companies to deploy and test innovations that can address Dutch societal problems and maintain the Netherlands' position as a digital frontrunner in Europe. Here, it emphasizes trust, which further translates into security, privacy protection, and fairness in digital data (Ministerie van Economische Zaken en Klimaat, 2018).

Echoing the European data and digitalization strategy, in 2018, the Dutch government published the Digitalization Strategy (DS). To map out digitalization across various public sector levels, the Digital Government Agenda (DGA) was established. This agenda also mentions the Data Agenda Government (DAG). In this agenda, the Dutch government indicates that it is looking for opportunities to optimally utilize data for policy-making and providing solutions to social issues (Rijksoverheid, 2019b). This agenda highlights the opportunities for new technologies and innovations to contribute to data-driven action. Implementing this is the responsibility of both national and local governments, such as municipalities (Rijksoverheid, 2020b). In 2021, the Dutch government released an update to this strategy that makes it clear that the government is using digital resources for development, solving societal problems, and improved government services (Rijksoverheid, 2021a). In addition to the DAG, the individual vision of each municipality is also important. The Association of Netherlands Municipalities (VNG) is responsible for developing data-driven development goals and visions of municipalities in the Netherlands (Rijksoverheid, 2019b).

Within the Netherlands, since 2019, The Ministry of the Interior and Kingdom Relations and the VNG are responsible for the approved use of data coming from the public domain and for taking stock of the complications in the use of this data. The VNG should also come up with solutions to these complications based on the inventory of the different municipalities (Rijksoverheid, 2019b). In addition, the Ministry of Economic Affairs and Climate Policy developed the Dutch vision on data sharing between companies. This document, unlike Data Agenda Government, is aimed purely at the business sector (Rijksoverheid, 2019a).

For using digital tools and data to enhance urban environments and the development of smart cities, the "NL DIGIbeter 2020" program has been developed. Through Public-Private Partnerships (PPPs), the Dutch government aims to promote innovation in smart city projects. These partnerships involve sharing data and insights to enable more informed decision-making and to develop holistic solutions that meet the needs of various stakeholders (Rijksoverheid, 2020a). To get to optimal use of digitization to achieve economic and societal goals the Data Sharing Coalition was officially launched in the Netherlands in 2020 (Brakema, 2020). To ensure ownership of data and conditions for data use by the respective party, the Data Sharing Coalition is actively engaged in establishing general

agreements for data sharing, testing the use of data in practical cases, and supporting data sharing development and initiatives (Nederland Digitaal, 2021).

Dutch data strategy

The Inter-Governmental Data Strategy (IBDS) is a policy that aims to use data responsibly to solve societal problems and contributes to the "Work on Implementation" (WoI) and the "Value-Driven Digitalization" work agenda. Since 2023, an inter-governmental multi-year plan has been established to work responsibly with data within the government based on use cases with societal value. Through cooperation, data can be utilized from various perspectives to influence the four central pillars: What is Allowed, What is Possible, What Helps, and What Inspires (NL DIGITAAL: Interbestuurlijke Datastrategie Nederland, 2021; van den Berg et al., 2023). In the multi-year approach of the IBDS 2024, there is an effort to follow up on innovations and new developments concerning data and to identify needs within the context of data sharing and data usage. This should collectively lead to leveraging and guiding innovations to create a solid trust framework for data sharing. To this end, it focuses on increased use of data and data usage in consultation with public values (Rijksoverheid, 2023).

12. APPENDIX B – (LAW AND REGULATIONS IN DATA-DRIVEN DECISION-MAKING)

The EU promotes but limits data-driven decision-making at the same time. To begin with, the EU is promoting the Digital Single Market for Europe, which aims to ensure that the economy, business, and society in Europe take full advantage of the new digital era. Unity between different stakeholders on different policy/geographic levels in the field of digital processes, technologies, and data use aims to innovate and increase acceptance of change (Ratcliff et al., 2023). Additionally, the EU Commission has developed the Public Sector Information (PSI) guideline, which is also known as the directive on open data, with a specific focus on open data from public enterprises to make data more accessible and further used for development. The directive aims to prescribe a transparent process for public-private data sharing to avoid risks such as data lock-in. Thus, it seeks to remove barriers in the reuse of public sector information and includes scopes for obtaining and understanding dynamic data to facilitate real-time services. These high-value datasets include geospatial, environmental, meteorological, statistical, mobility, and business datasets because they have great potential commercial value. Obtaining data is partly done by engaging especially SMEs in data sharing through financial incentives and organizing EU data spaces to stimulate access and interoperability and bring about data-driven innovation (European Commission, n.d.).

City Deal

The City Deal focuses on creating smart, sustainable, and democratic cities in the Netherlands, rooted in a community of practice framework. A broad coalition of partners collaborates to seize opportunities related to digitalization and technology, with a strong emphasis on ethical principles and democratic decision-making. Innovation in digitalization and technology is leveraged to address significant societal challenges, including housing shortages, mobility pressures, energy transition, climate change, and nitrogen issues. Furthermore, the City Deal serves as a platform for collaboration, knowledge sharing, and innovation, providing smart city solutions(Wesselink, 2024; Wesselink, n.d.).

Gemeentewet

The Municipal Law forms the foundation for municipal government, facilitating decentralization from the national government to local municipalities. This autonomy allows local governments to make individual choices for urban development and respond to local needs. The law stipulates that the municipal council establishes the frameworks for urban planners and policymakers, and accomplishes zoning plans, budget allocations, and project approvals. Urban planners and policymakers are required to work closely with the executive board (mayor and aldermen) to implement plans and operate within these frameworks. The Municipal Law encourages citizen participation and involvement in the planning and decision-making process. Plans must address not only technical and social aspects but also financial feasibility within the municipality and provide accountability for this.

Although the Municipal Law does not directly address decision-making based on data from private parties, it does imply certain uses of data within the legal framework. The decentralized autonomy of municipalities allows them to form their policies and decisions and to determine how they collect, analyze, and apply data for urban development (within legal constraints). The principles of transparency and accountability from the law also apply to the use of data in decision-making processes. Collaboration with citizens in the realm of data and transparency can enhance the acceptance of policies among residents.

The openness of the law enables the formation of collaborations with various stakeholders for project implementation, as well as data-driven partnerships with private entities. However, the conditions

within these collaborations must be transparent and serve the public interest (Rijksoverheid, 2016; VNG, n.d.).

Handreiking Data-gedreven werken VNG

Data-driven work leads to opportunities for reliability and quality in policy development, but public values and digital civil rights must be respected. The Association of Dutch Municipalities (VNG) emphasizes the achievement of goals for 2030 in its guidance on Data-Driven Working. These goals include responsible data use and municipal participation in the VNG Knowledge Network for Data & Society. The aim is to share effective information and experiences based on practical cases among municipalities to identify successful processes and optimize various policy processes. By gathering information from different municipalities, the VNG can build on datasets, knowledge, and experiences to map the impact of national laws and regulations, centralizing the interests of the municipalities (Nijman & Alberts-de Gier, 2023).

GDPR

However, the Dutch government acknowledges complications in data-sharing processes (Rijksoverheid, 2019b). The main data sharing limiting regulation is the General Data Protection Regulation (GDPR), which exists to protect the individual rights of people and to simplify and standardize data use within the EU. It focuses on giving individuals control over their data. This approach not only aims to modernize data handling practices but also to foster consumer trust through reduced bureaucracy and enhanced privacy measures. Both companies and governments are required to handle user and resident data carefully by complying with safety and privacy requirements. The GDPR sets innovation as a goal of data use and emphasizes the realization of privacy by design, which means that privacy is the starting point of every good and service (European Commission, 2016; European Commission, n.d.-a). Since governments are not the only actors and stakeholders in the public domain, it is necessary to set certain boundaries regarding the collection and use of data in agreement with society and businesses (Rijksoverheid, 2019b)

Decentralization and data sovereignty

In addition, the Future Exploration of Digitalization 2030 identifies 11 trends within digitalization in the Netherlands. Among these, the development of Mega Ecosystems, also known as multifunctional apps by large tech companies, raises concerns about centralization, privacy, and security. For this reason, there is a surge in technological decentralization, allowing data, finance, and applications to operate without direct control by a central (technological) power.

Data sovereignty is a growing trend where citizens, companies, and governments are becoming more aware of their data and its sharing, particularly with the rise of Artificial Intelligence (AI). This has raised concerns about data responsibility, especially as AI is increasingly integrated into daily tasks. Digitalization and smarter technology enable people to group digitally and transmit information through platforms, resulting in less direct government oversight. Humans are increasingly dependent on technology for optimization and economic growth, but this has led to increased vulnerabilities on various levels, from individuals to society as powers aim to spread ideas and stimulate technology development (Rijksoverheid, 2021c).

13. APPENDIX C – (MAAS FINDINGS)

Although the rise of micro-mobility is often prohibited by the Dutch government to date, MaaS is seen as an opportunity to use new mobility options to achieve public social goals. New Mobility Services have increasingly been added to the Dutch transportation system, and new modalities have been integrated into travel planner apps. The number of stakeholders involved in MaaS is significantly large, and the diverse nature of these stakeholders makes collaboration complex but essential for urban development. Although most public transport companies are exploring MaaS options, governments often do not provide MaaS services directly but collaborate with private players and encourage growth (TNO, 2020). The difficulty lies in the separate silos in which MaaS is conceived and developed (ER1; ER4). Rik Braams from TNO and the Ministry of I&W (ER2) highlights the challenge of this integration: *"Imagine if you could bring all those apps and all those mobility providers together on one platform; that would be quite a challenge."* Furthermore, Emma de Wijs from municipality The Hague (MR2) emphasizes the environmental benefits, stating, *"Clean transportation in the city is an important task in which Mobility as a Service can be key and connects to the goals of the municipality."*

MaaS was presented as the solution for traveling from A to B, regardless of the modes of transportation used (Van De Wiel, 2023). As Emma de Wijs from municipality The Hague (MR2) notes: *"You have one way to travel, but how you get there can be with different providers.''* The generated travel data from the MaaS trip would be immediately analyzed to contribute to sustainability goals, solve traffic congestion issues, and reduce pressure on public transport and accessibility. However, complications arose during its development. It turned out to be more challenging than anticipated, usage was lower than expected, and the concept resolved fewer problems than anticipated. Even when shared mobility providers were already integrated with MaaS, they withdrew because it did not work as promised and caused more problems (Van De Wiel, 2023). Table 4 below adds a comprehensive overview of current challenges and findings about MaaS and its integration into the Dutch mobility system.

Table 4 MaaS challenges

A MaaS app might be financially challenging for providers	Connection to MaaS is difficult for car-sharing providers
Maas cannot be developed by a single party	Planning ahead and making reservations makes MaaS integration more difficult
Concession boundaries	MaaS has privacy issues
MaaS takes hurdles with downloading, onboarding etc.	MaaS is not really needed
Integrating standards other than their mobility providers' own technological development in MaaS and shared transportation costs too much money	The answer for facilitating and developing MaaS has not yet been found
MaaS experiences struggles with integration of many different mobility providers	The municipality is not really sure yet how it wants to facilitate or drive MaaS
MaaS is only a small share of total mobility	MaaS is not yet successful as it has high fees
MaaS is still too often in separate silos	MaaS is difficult for a government to market

Most people are not yet familiar with MaaS	MaaS lacks in operationable scale
Maas development takes collaboration	The accountability aspect is a major barrier to MaaS
Native apps are better than MaaS apps	The challenge of MaaS is organizational
People want mulitple apps instead of one central MaaS app	The impact of MaaS is uncertain
MaaS apps are only used to book a ride to a limited extent	

The user experience through a MaaS app is always inferior and less reliable than in the native app. Developments in the providers' own apps could only be made available later in the MaaS app, causing them to quickly fall behind the competition. The development costs for MaaS are high, and if no added value is delivered, partnerships quickly dissolve (Van De Wiel, 2023). Gemma Schepers from municipality Amsterdam (MR7) notes: *"Most people download an app from the provider anyway, so the Check app, or the Felix app, or the Greenwheels app and don't book the trip through MaaS, because it's a bit cumbersome anyway. It doesn't work that well yet."*

The expectation is that MaaS can contribute to urban developments when challenges regarding data use and privacy are addressed, but therefore is a need for both public and private data. The Netherlands directly targets achieving MaaS level 4, which means that data from public-private partnerships is used to guide policy objectives and regulations that have been developed for MaaS (see Figure 5) (Bollars et al., 2021).

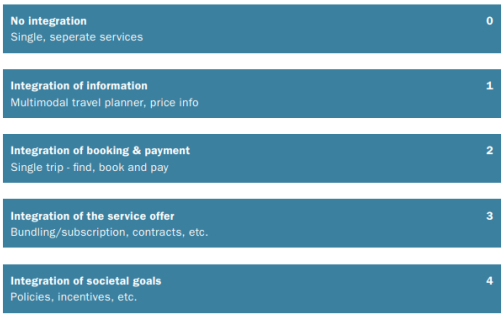

Figure 5 Levels of MaaS (TNO, 2020)

On the other hand, MaaS apps are effective for facilitating billing, integrating with administrative systems, and registering and deregistering users. Based on data, the app serves excellently as a map or travel planner in which mobility supply and demand are efficiently and effectively structured (CoE-DSC, 2023), but users prefer the ability to compare different mobility providers. This was confirmed by Jeanette van Eijk from Greenwheels (IR3), noting: *"Identifying those vehicles is going well, but when it comes to reporting damage, indicating where someone has parked the car, or wanting to know how much fuel is in the car or the battery level if it's electric, it would be convenient if we could show that in our own app and continue to develop it further.''* Additionally, the app must be at least as easy to use as the native apps (ER2). The high level of required personal data also creates a barrier to usage (Van De Wiel, 2023). Therefore, behavioral change is needed in various ways. If people are willing and able to travel more flexibly, it could significantly impact MaaS usage. The responsibility for the functioning of MaaS lies with the service provider, who must ensure it meets the needs of the intended audience (Van De Wiel, 2023). Additional use purposes and Maas opportunities as posed in Table 5.

Table 5 MaaS use purposes

Municipalities	**Industry representatives**	**Researchers & experts**

MaaS as a route planner	As a map of current vehicles	A solution for the first and last mile of a journey.
MaaS as a solution for space constraints	To facilitate the customer	Facilitating international transport
MaaS as an opportunity for clean transportation		Facilitating payments
MaaS for vulnerable groups		Facilitating seamlessness for stimulating shared mobility use
MaaS in non-urban areas can be a solution for the lack of train and metro services.		Identifying accessible vehicles and modalities
MaaS is a way to offer transportation to various groups in an intelligent manner.		Solution for an unplanned trip
MaaS to achieve sustainability goals		Tailored travel advice
People need an incentive to use MaaS.		
First and last mile transport is from the city outskirts to the center and vice versa.		
A complete MaaS trip consists of small segments before and after transport, integrated with public transit.		

MaaS in practice

In 2017, a whitepaper was published by the Ministry of Infrastructure and Water Management (Ministry of IenW), outlining the definitions and models of MaaS. Simultaneously, Dutch governments collectively set up the MaaS program, showing public-private cooperation for 7 pilot initiatives to understand the impact of MaaS in urban environments. In 2018, budgets for these initiatives were set, with co-financing totaling 20 million euros. This involves municipalities imposing strict regulations on new and shared mobility based on fair competition and protection of consumer interests. Private parties must contribute 50% of the capital needed themselves and to present a business model that aims to be (financially) self-sustaining within 2 years. Additionally, the use of the data string, collaboration, and as much use as possible of the Transport Operator to Mobility/MaaS Provider API (TOMP-API) is mandatory. The data enters an open ecosystem to explore insights from practice and develop proper regulations (TNO, 2020).

14. APPENDIX D – (INITIAL LITERATURE REVIEW)

To fit the research within the larger context of existing knowledge and literature, this chapter describes the current state of the literature through a systematic review. In this way, literature gaps can be identified and important theories and concepts can be incorporated into the theoretical framework. This literature was found based on keywords entered in the Scopus database. Here, the time criteria were set on 10 years of research, from 2014 until 2024. However, as this research has been built in response to the Uber Movement Initiative, the literature search has been specified for Keywords mentioning “Uber” to exclude the timeframe in which Uber Movement was not yet available and thus may lead to different research findings about Uber as a ride-hailing company in the city. The search term for the development of cities is additionally framed in the Netherlands, where the goal is to gather specific insights into the development plans of Dutch cities.

Table 6 shows the main concepts and corresponding search code. It also explains why these concepts are important to the study and how many results were found and selected in the literature review. After this, the full and elaborated literature review is presented in which the main concepts for understanding the research topic become clear and research gaps are being identified.

Table 6 Search keywords and results

Main concepts	Search code	Reasoning of use	Search results	Selected
Urban mobility	TITLE-ABS-KEY ("urban mobility" AND "dutch" AND data)	To examine current practices regarding movements of people within urban environments in Dutch cities and lay a foundation for applying data in urban mobility.	2	2
Smart and sustainable cities in the Netherlands	TITLE-ABS-KEY ("smart cities" AND "netherlands" AND "sustainability")	To discover the intersections and connections between smart cities and sustainability in the Netherlands and understand how Dutch cities use technology and data for efficient urban development.	23	8
Sustainable urban planning	TITLE-ABS-KEY ("sustainable urban planning" AND dutch OR netherlands)	To understand the broader Dutch urban planning framework and discover environmental and social sustainability in urban planning.	6	1
Platform/ride-hailing data	TITLE-ABS-KEY ("ride-hailing data" OR "platform data" AND "urban transportation" OR mobility	To find out how platform/ride-hailing data influences urban planning transportation and mobility.	24	4
Data collaborative in the city	TITLE-ABS-KEY ("DATA COLLABORATIVE") AND CITY	To discover which and how data collaboratives are currently taking place in cities.	32	6

Data partnership	TITLE-ABS-KEY ("DATA PARTNERSHIP")	To discover which and how data partnerships are currently taking place in cities.	26	3
Business to government data sharing	TITLE-ABS-KEY ("BUSINESS TO GOVERNMENT DATA SHARING") TITLE-ABS-KEY (B2G OR BUSINESS-TO-GOVERNMENT AND "DATA SHARING")	To explore how data sharing between businesses and government is formed and what is involved.	4 / 16	3 / 8
Urban planning and policymaking	TITLE-ABS-KEY ("urban planning" OR policymaking AND "data analytics" AND transportation OR mobility)	To explore the use of data analytics in urban planning and policymaking, specifically focused on the transportation and mobility sector.	39	4
Platform/ride-haling policymaking and urban planning	TITLE-ABS-KEY ("transportation" OR mobility AND policy OR planning AND "ride-hailing" OR platform AND municipality)	To explore the ways in which municipalities involve platform-based services in urban planning or policymaking developments.	28	2
Data driven urban planning and policymaking	TITLE-ABS-KEY ("data-driven" AND "urban planning" OR policymaking AND "netherlands")	To explore the role of data in urban planning and policymaking processes in the Netherlands.	8	2
Uber Movement	TITLE-ABS-KEY ("UBER MOVEMENT")	To uncover how ride-hailing companies can potentially share data, as Uber Movement is seen as the largest and most successful data sharing innitiative	22	6
Uber and local governments	TITLE-ABS-KEY (UBER " LOCAL GOVERNMENTS") TITLE-ABS-KEY (UBER AND PLANNING AND DATA AND CITY OR URBAN)	To discover how Uber, by being the largest ride-hailing company, is being taken on by local governments	15 / 54	9 / 10

Smart and Sustainable Cities in the Netherlands

The integration of smart city governance into traditional systems may lead to challenges that require sustainable and multi-stakeholder participation strategies (Nesti, 2020). The changes in governance structures provide opportunities for collaboration and inclusive approaches in which stakeholders can

contribute to city developments. In this development, the use of data is an opportunity for smart and sustainable development (Yigitcanlar et al., 2019). Similarly, D. E. Mills et al. (2021) recognize the importance of authentic collaboration between urban governments, private organizations and citizens for achieving urban development goals. (Paskaleva et al., 2021b) add academia as a fourth stakeholder and suggest that co-production with diverse perspectives leads to more holistic solutions and could be the key to effectively leveraging data for urban planning and policy making, using the Quadruple Helix model to analyze projects in cities such as Manchester, Eindhoven and Stavanger.

Research by Tomor (2019) introduces the concept of "Citipreneurship" in which traditional public sector management is combined with strategies in smart city contexts. The unique position of these entrepreneurs can provide a link between civil society, the market, and the state to create public value by using smart technologies (Tomor, 2019). Based on four different smart city models in different urban contexts, focusing on socio-cultural and organizational processes in urban development, Lee et al. (2023) add the role of integrated platforms in facilitating collaborative governance in local contexts.

The evolution of governance structures within smart city projects can be divided into several stages (Ooms et al., 2020). In the initiative stage, factors such as leadership, strategy, and community building are crucial. As development continues, it enters the growth phase. In which the focus shifts to managing larger numbers of participants and increasing competition, with an emphasis on collaboration and co-creation strategies. In the maturity phase, ecosystem management returns to orchestration, but with a focus on control and value appropriation (Ooms et al., 2020).

To assess compliance with Sustainable Development Goal 11 (SDG 11), (Parra-Domínguez et al. (2023) introduced a fuzzy logic-based model. This includes data availability and data quality challenges, highlighting the potential of this model for a better understanding of urban smart and sustainability performance. The findings suggest that this fuzzy logic approach can effectively capture the complexity of urban sustainability and provide insight into areas where cities need improvement. However, the research has limitations, such as the potential impact of missing data on assessment results and the subjectivity involved in designing membership functions (Parra-Domínguez et al., 2023).

Urban Mobility

The complex policy mixes within governments, specifically in the context of sustainable urban mobility transitions in Dutch cities have been examined by Liu et al., (2024). The authors acknowledge the importance of cooperation between different levels of government and other stakeholders and the need for European funding for local initiatives. Based on case studies in Maastricht and Groningen, Liu & Dijk (2022) highlight the importance of using data in short-term policy cycles for traffic regulation and policy adjustments, emphasizing the need for more competent urban planners and policymakers to interpret data and the importance of data for promoting smart and sustainable mobility. Specifically, to achieve traffic adaptation, there is a greater need for real-time traffic and mobility-related data in short-term policy cycles (X. Liu & Dijk, 2022).

Urban Planning and Policymaking

França et al. (2021) and Wang et al. (2021) emphasize the role of interconnected and data-driven systems in enhancing urban transportation systems. They highlight how leveraging data and integrating it with smart technologies can innovate urban living and management. However, understanding challenges such as data isolation and limited knowledge derivation from data is essential (A. Wang et al., 2021; Sarwat, 2015). Sarwat (2015) and Silva et al. (2018) underscore the

importance of data management techniques like IoT to develop effective smart cities that efficiently manage and process large amounts of urban data, leading to a better understanding of urban mobility patterns and more informed urban planning and management. By leveraging the power of big data, cities can make more informed, timely, and effective decisions, leading to smarter and more sustainable urban environments (Sarwat, 2015; Silva et al., 2018).

Sustainable Urban Planning

The application of Information and Communication Technology (ICT) tools in urban planning for sustainable energy integration is investigated by Oregi et al. (2015). Based on a city expansion plan in Nijmegen, The Netherlands, the authors found that the use of ICT tools can significantly improve sustainability performance and facilitate stakeholder communication. However, conflicts and synergies exist between different policy levels, and better policy alignment for sustainable urban mobility still needs to be addressed (Oregi et al., 2015).

Data collaboration

Data partnerships enable urban planners and policymakers to access more data and expertise, allowing them to make evidence-based decisions to improve transparency, accountability, and effectiveness (Hawken et al., 2020). The integration of data-driven approaches is essential in developing smart and sustainable cities (Hudović Kljuno & Krivošić Dizdarević, 2021). Different datasets offer insights into urban challenges, enabling more effective policy formulations and help address urban challenges and stimulate innovation and economic growth, especially in developing countries (Hawken et al., 2020). Evidence-based decision-making allows for appropriate responses to emergencies, transportation, and environmental management (Susha et al., 2017). New data promotes direct decisions and democratic decision-making through increased citizen engagement (Muñoz & Bolívar, 2021).

Although Klievink, Van Der Voort, et al., (2018) do not directly address collaboration structures in urban environments, they do indicate that successful data collaboratives involve trustful collaborations and active stakeholder engagement. Better collaboration between users and data providers enhances the positive impact of data and trust, enhancing the legitimacy of this practice (Verhulst, 2021). These partnerships improve decision-making, optimize services, and enhance efficiency (Rasche et al., 2021; Hawken et al., 2020; Susha et al., 2019). By providing access to new data and resources, these collaborations help the decision-making process and integrate public participation (Rasche et al., 2021; Bednarska-Olejniczak et al., 2019). Public-Private Partnership (PPP) and the Quadruple Helix model are examples of collaborations that combine joint efforts to achieve urban development goals (Brinkerhoff & Brinkerhoff, 2011; Paskaleva et al., 2021).

Data collaborations also present challenges like data privacy and changing governance frameworks (Swofford, 2020; Borghys et al., 2020). Here, citizen engagement, public participation, and inclusivity are essential (Muñoz & Bolívar, 2021; Bednarska-Olejniczak et al., 2019). Strong political leadership in city governance, stakeholder collaboration, and enough funding can lead to data-informed decision-making (Hawken et al., 2020; Paskaleva et al., 2021). Hudović Kljuno & Krivošić Dizdarević, (2021) and Zhang, (2019) indicate that challenges in this process are associated with financial difficulties, administrative complexities, and data privacy concerns. To overcome these challenges, Paskaleva et al., (2021) indicate that innovation and ethical technology usage need support from regulatory frameworks.

<u>Types of Data in City Data Collaborations</u>

Evidence-based decision-making relies on data collaboration, including transportation, environmental, energy, and social data (Hawken et al., 2020). This data covers city functions like traffic, utilities,

water supply, waste management, and community services (Hudović Kljuno & Krivošić Dizdarević, 2021). E-participation initiatives help understand civic needs and preferences through social media and citizen feedback (Muñoz & Bolívar, 2021). Data on citizen well-being also plays a role in data collaborations, analyzing the impact of urban environments on mental and physical well-being (Geropanta et al., 2021).

Benefits and Risks of Data Sharing

B2G data sharing benefits public authorities by improving the quality and quantity of data (Vigorito, 2022; Rasche et al., 2021). According to Borghys et al., (2020); Hawken et al., (2020); Susha et al., (2019), the benefits of data collaboration in city developments can be seen in improved decision-making, overall increased process efficiency, enhanced citizen engagement, and innovation. Data collaboration in city developments can influence situational awareness, analyze causes, problems, and effects, and make connections. By combining different data sets, a global overview of a case can be provided, ensuring that those responsible for the solution have insights into the causes of problems they need to solve. Data can also improve predictive capability by analyzing previously unavailable data sets, enabling institutions to proactively respond to potential changes and crises. Finally, data can reflect the actual impact of policies and interventions, allowing for evidence-based development of policies and services through an iterative process and experimental methodology (Verhulst, 2021).

Data sharing is a crucial aspect of reducing social and economic disparities (Vigorito, 2022), but it also presents risks such as privacy, security, and potential increased social and economic disparities. Clear governance frameworks and regulatory frameworks are necessary to guide data sharing and achieve a balance between public and private sector interests (Zhang, 2019; Ruijer, 2021; Hawken et al., 2020; Susha et al., 2017). Strong leadership, stakeholder engagement, and adequate resources are essential for reducing inequalities (Hawken et al., 2020; Zhang, 2019). Companies must be cautious of over-compliance with information-sharing regulations, as this can lead to unintended consequences. Striking a balance between compliance and value creation is crucial (Klievink, Janssen, et al., 2018). The primary issue is the mismatch between data supply and demand, which can be addressed through data collaboratives (Verhulst et al., 2016). By ensuring the right institutions and individuals can analyze and use data, new innovative social solutions can be discovered (Verhulst, 2021).

Business-to-Government Data Sharing

Businesses could contribute to the development of smart and sustainable cities (Hudović Kljuno & Krivošić Dizdarević, 2021). However, this does not exist without risks for the companies. Privacy and potential misuse of data could damage trust in private businesses by consumers (Burns & Andrucki, 2021). For this reason, there is an immediate demand for strong governance frameworks to handle data sharing ethically (Bian, 2023).

Collaborative success relies on a shared vision, commitment, and mutual trust among stakeholders (Susha et al., 2022; Hawken et al., 2020). However, challenges include effective governance structures, transparency, financial resources, and administrative complexity (Bednarska-Olejniczak et al., 2019; Hudović Kljuno & Krivošić Dizdarević, 2021). Burns & Andrucki, (2021) indicate that citizen engagement and social inclusivity are crucial for successful partnerships, but more research is needed. Ethical issues like data ownership, privacy, and security pose significant obstacles in data collaborations, necessitating further research (Ruijer, 2021).

Private businesses can benefit from data sharing with government agencies when they align their interests with societal needs. This can be achieved by balancing government leadership with businesses' interests (Susha et al., 2022; George et al., 2020). However, data philanthropy requires

significant control over complementary assets like data expertise (George et al., 2020). Businesses must carefully consider the information they want to share, the conditions for sharing, and how to add value while considering the pros and cons of data sharing (Klievink, Janssen, et al., 2018).

Platform/Ride-Hailing Data

Despite only focusing on Toronto, Canada, Loa et al. (2020) reveal that ride-hailing and public transit demand are more complementary than substitutive and suggest that the demand for one service tends to increase the demand for the other. Yang et al. (2022) propose an innovative approach to utilizing diverse mobility data sources, including ride-hailing data, which can potentially significantly improve urban planning and policy-making. Through a multi-source data-driven methodology for delineating Traffic Analysis Zones (TAZs), Yang et al. (2022) propose a way to offer valuable insights into urban transportation planning. However, its specific application to Beijing highlights potential limitations in different urban contexts.

Big data can also forecast demand for on-demand ride services. Through data from DiDi's platform in Hangzhou, China, J. Liu et al. (2017) examine the effectiveness of the random forest model in predicting ride service demand. This approach aligns with the dynamic nature of urban transportation and could be instrumental for real-time policy decisions in cities. Also, Romano (2021) explores the role of platform data in understanding changes in mobility patterns during and after lockdowns, highlighting the critical role of such data in managing urban mobility during crises. However, due to its focus on pandemic-related mobility patterns, it may not fully represent regular conditions.

Platform/ride-hailing policymaking and urban planning

Fiore et al. (2019) show how advanced data management and analytics can contribute to smart city development, specifically focusing on transportation management. By using cloud-based big data platforms and a mix of technologies, focusing on data privacy, data quality and the integration of different data sources, more informed decisions and efficient urban mobility planning can be achieved. Another way to use big data analytics in urban traffic management has been explored by Bakri et al. (2022). By developing a smart transportation platform that uses big data to address transportation challenges in historic megacities, the authors highlight the potential of big data analytics to provide real-time insights into traffic conditions, enabling more efficient and responsive traffic management. However, the study's specific focus on historic megacities may limit its applicability to other urban contexts.

Data-Driven Urban Planning and Policymaking

Diran et al. (2022) examine the adoption of data-driven approaches in local policymaking, focusing on local energy transitions within four Dutch municipalities: Amsterdam, Rotterdam, The Hague, and Utrecht. They identify a significant gap between the potential applications of data-driven methods and current practices, underlined by challenges related to data availability, technical capabilities, and readiness of institutions. Despite the value of data-driven approaches, barriers such as the integration of these methods into local policymaking persist. Dutch municipalities should navigate these challenges to harness data effectively for urban planning and policymaking. For this, the authors advocate for future research to delve into integrated and actionable strategies for the adoption of data-driven applications (Diran et al., 2022). Complementing this perspective, Diran & van Veenstra (2020) explore the specific challenges encountered by Dutch cities in implementing data-driven policymaking for urban heat transition. Their findings, based on eight Dutch cities, illuminate barriers including GDPR (General Data Protection Regulation) and privacy concerns, the substantial investment of time and resources, scattered data distribution, and data processing and analysis challenges. This detailed

examination of challenges and barriers contributes to a broader understanding of the impediments to data-driven policymaking in urban settings.

Uber and Local Governments

Big internet businesses use vast amounts of geospatial data to improve their functioning and financial growth. However, public benefits are often overlooked, and governments are slow to recognize the city's ownership of this data (Hawken et al., 2020). To address global challenges, new guidelines and rationales need to be established for data sharing between governments and companies (Mayer-Schoneberger and Ramge 2018). Mayer-Schoneberger and Ramge (2018) argue that large companies should pay taxes through data sharing, rather than monetary taxation, to work together and address global challenges (Hawken et al., 2020).

Route planning relies heavily on time-dependent traffic speeds, but many OpenStreetMap (OSM) platforms lack real-time or historical data. One reason for this is that commercial companies like Google and Here own these global traffic speed data. However, combining different data sets is challenging due to different data system structures. Uber Movement, released by Uber, is the most promising open data set for open-source routing systems so far (Ludwig et al., 2023).

Understanding Uber Movement Data

Uber Movement Data is an initiative that releases anonymized GPS data from millions of Uber trips and users worldwide, providing insights into transportation patterns across major cities through information about trip origins, destinations, travel times, and other statistics while securing user privacy (Sun et al., 2020; Bezerra et al., 2019; Aryandoust et al., 2019; Roy et al., 2020; Perlman & Roy, 2021; Ludwig et al., 2023; Neun et al., 2023). The initiative was created to support urban planners and policymakers in making informed decisions about transportation, infrastructure development, and urban planning (Bezerra et al., 2019; Aryandoust et al., 2019; Roy et al., 2020). While the literature on Uber's data provision is sparse, several articles suggest that Uber reveals valuable information about commute times, job accessibility measurements, traffic patterns, and congestion spots, which are valuable to urban planners (Gerte et al., 2018; Sun et al., 2020; Aryandoust et al., 2019; Roy et al., 2020; Perlman & Roy, 2021).This data helps local governments improve transportation planning, enforce regulations, and make evidence-based decisions about urban development initiatives for creating smart and sustainable cities (Cohen, 2018; Hawken et al., 2020).

Local Governments' Engagement with (Uber) Data

Uber's data is being used by local governments to improve urban planning and policymaking. This includes understanding urban mobility and analyzing driver behavior to tailor regulations (Cohen, 2018). Data-sharing partnerships are essential to illuminate traffic patterns, congestion spots, and regulation compliance (Hawken et al., 2020). The data is used to create parking density maps, assess socio-demographic influences, and inform Uber's service connectivity in different regions (Aryandoust et al., 2019; Perlman & Roy, 2021). Understanding the spatiotemporal distribution of Uber trips can improve public transportation options, reduce traffic congestion, and identify areas for economic growth and development (Roy et al., 2020; Sun et al., 2020). Additionally, data optimization of road networks, parking pricing, and overall transportation efficiency is being considered (Aryandoust et al., 2019).

The relationship between Uber and local governments is complex, with concerns about data privacy, security, balancing business innovation and worker protection, and conflicts of interest between Uber and city authorities (Benli-Trichet & Kübler, 2022). Uber's disruptive innovation strategies can challenge traditional governance, but its data can provide valuable insights into city transportation

dynamics. This presents both challenges and opportunities for urban planning and policymaking from local governments' perspectives (Cohen, 2018; Hawken et al., 2020). However, the risk of limiting citizens in urban decision-making through smart engagement is acknowledged, emphasizing the need to balance private interests with community needs (Bednarska-Olejniczak et al., 2019). The use of data for the public good is still in its early stages, and the optimal way to optimize data collaboratives is yet to be discovered (Verhulst, 2021).

Conclusion

The rise of gig economy platforms has led to the collection of (trip) data. However, the release of this data is often restricted due to concerns about privacy and ownership (Cohen, 2018; Burns & Andrucki, 2021). Despite this, urban planners and policymakers are increasingly requesting trip data to inform their plans, aligning to develop smart and sustainable cities (Hawken et al., 2020; Geropanta et al., 2021). This data can be used to make evidence-based decisions in urban planning and policymaking, providing insights into efficient, smart, and sustainable cities. However, challenges like data privacy and public-private partnerships limit its application (Susha et al., 2017; Hudović Kljuno & Krivošić Dizdarević, 2021). To effectively use (trip) data, a balance must be struck between innovation, privacy, and public interest (Hawken et al., 2020; Rasche et al., 2021), where data demand is met with supply (Martin et al., 2018; S. G. Verhulst et al., 2016).

Literature gaps

The literature indicates that urban planning and policymaking are increasingly dependent on data, and while data sharing and public-private partnerships are frequently mentioned, little in-depth research has been done on the challenges, opportunities, and outcomes of these partnerships as well as the specific supply and demand of ride-hailing and shared mobility trip data in the context of smart/sustainable urban development. Especially, the combined perspective and effort of private companies, governments, academia, and citizens in smart urban development may lead to effective outcomes.

15. APPENDIX E – (CROSS-CASE ANALYSIS FOUNDATION)

Table 7 Shared mobility comparison matrix

Categories:	**Twowheelers**	**Car-sharing**
Supply:		
Data type	9. Road quality (IR1) 10. Commercially sensitive data (IR2) 11. Mis-match data (IR2)	
Data content	12. Depends on agreements (IR1) 13. Everything except privacy and business data (IR1) 14. Average trip distance (IR2) 15. Local road intensity (IR2) 16. Number of trips (IR2) 17. Start- and end location (IR2) 18. Trip duration (IR2)	19. Annual averages (IR3) 20. Vehicle averages (IR3) 21. How are the cars being used (IR4) 22. How many cars does the provider have (IR4) 23. How many hours per day does the car drive (IR4) 24. How many people use the car (IR4) 25. Location of cars (IR4) 26. What distance does the car ride (IR4)
Data level	27. Aggregated data (IR1) 28. Only start and end locations instead of the entire trip is shared (IR1) 29. Raw API (IR1) 30. Data level varies per municipality (IR2)	31. As much as possible (IR3) 32. The company does not look at specific vehicles (IR3) 33. Data gets mostly generated outside the municipal borders (IR3) 34. Number of customers per municipality (IR3) 35. Data can easily be retraceable in small markets (IR4) 36. The company has more data than it is willing to share (IR4)
Data sharing mode	37. API (IR1) 38. Dashboard platform (IR1) 39. Depends on communication and agreement (IR1) 40. License to operate (IR1) 41. Mobility provider analyses (IR1) 42. As part of the license to operate (IR2) 43. Proactive data sharing (IR2) 44. Same as Uber Movement, but not public (IR2) 45. Standard KPI (IR2)	46. Proactive (IR3) 47. Voluntarily (IR3) 48. The company has its own data dashboard (IR4) 49. Free data sharing (IR4) 50. Obligated data demand as a basis and other data demand through constructive collaboration (IR4) 51. Voluntary data sharing instead of obligation is way easier and better (IR4) 52. Voluntary data sharing is fine (IR4)

Supply & demand matching		
Facilitation	53. Subcontract a data collector (IR1) 54. Mobility provider has data sharing with a third party to enhance and facilitate transportation offerings (IR1)	55. CDS-M as technical approaach of programma Natuurlijk Deelmobiliteit (IR4) 56. Company does not use an external dashboard (IR4) 57. CROW and Vianova as data dashboard (IR4) 58. Data dashboard for municipalities to access aggragate data (IR4) 59. Data dashboards only possible when there are many providers (IR4) 60. Natuurlijk Deelmobiliteit as technical solution and legal basis (IR4) 61. Programma Natuurlijk Deelmobiliteit to facilitate fair data sharing (IR4)
Degree of access	62. Depends on legal agreements (IR1) 63. Aimed at specific municipalities (IR2) 64. Data sharing in active municipality (IR2) 65. Data sharing in passive municipality (IR2)	66. After municipal demand (IR3) 67. Shared mobility provider may not even share live data with municipalities (IR3) 68. Awaiting judge's decision on data sharing (IR4) 69. Companies must react on municipal data-sharing obligations (IR4) 70. One of my main concerns is how we handle the data requests from the municipality (IR4)

Table 8 Municipality comparison matrix

Categories:	**Municipality Amsterdam**	**Municipality Rotterdam**	**Municipality The Hague**	**Municipality Eindhoven**
Supply & demand matching:				
Facilitation	- Communication between part mobility provider and municipality is	- Regional platform for knowledge sharing (Gemeente	- Open Urban Platform (OUP) (Luk, 2022)	

	essential to understand each other's perspective (MR7) - Data sharing leads to better dialogue between provider and city (MR7) - Dital Wallets may strengthen TOMP API (MR7) - Technical connection between supply and demand is through an API (MR7) - The municipality uses third parties to read data (MR7)	Rotterdam, 2021) - Facilitating data exchange to improve the efficiency and effectiveness of city processes and services (Bagheri, 2024) - Knowledge institutes help municipalities innovate and use data (Maltha et al., 2021) - Appstore (MR5) - Outsourcing tasks (MR6)		
Degree of access	- Should be independent from third party facilitators (Gemeente Amsterdam, 2023) - Open data (Royal HaskoningDHV, 2017) - Lack of external sources (Gemeente Amsterdam, 2021b)	- Data should be open to everyone (Meerman, 2023) - Big difference in sharing different data types (MR6) - Depends on use purpose (MR6) - No access to raw data (MR5)	- External stakeholders (MR5; MR6) - Open data (MR5) - Real-time (MR6)	- Many initiatives (Elstgeest, 2022) - Municipalities poses many data (Elstgeest, 2022) - Regional data (Elstgeest, 2022) - The municipality understands that no commercially sensitive data

	- Ownership of data is an endless discussion. (MR7)			would be shared (MR1)
Demand:				
Policy problem	- Inclusive society (Gemeente Amsterdam, 2021b) - Better decision making (Gemeente Amsterdam, 2023) - For identifying people's behavior and profile (Royal HaskoningDHV, 2017) - Improving quality of life (Gemeente Amsterdam, 2023) - For performing public tasks (Gemeente Amsterdam, 2021b) - Determining parking zones (MR7) - Managing physical public space (MR7) - Using data to reduce nuisance. (MR7)		- Data for accessibility (Gemeente Den Haag, 2020a) - Evidence-based decision making (Luk, 2022) - Data for gaining insights into urban mobility (Gemeente Den Haag, 2020b) - Data for infrastructure status (Gemeente Den Haag, 2020b) - Data for public objectives (Luk, 2022) - Data to create value (Gemeente Den Haag, 2020a) - Data to help citizens (Luk, 2022) - To inform traveler and citizens (Gemeente	- Road safety (Gemeente Eindhoven, 2023) - Decision-making and regulation (Meijer, 2020) - Public tasks (Meijer, 2020) - Insight in modal split (Meijer, 2020) - Impact assessment (Gemeente Eindhoven, 2023) - All policy problems (MR1) - Location of shared mobility use (MR1) - Sustainability (MR1)

			Den Haag, 2020b) - To make smart apps (Gemeente Den Haag, 2020b) - Urban growth and densification (Gemeente Den Haag, 2020b) - Urban space (Gemeente Den Haag, 2020b) - To allow mobility management (MR2) - To collaborate with others (MR4) - To facilitate shared mobility (MR3) - To show mobility hub locations (MR3) - To steer urban development (MR3; MR4)	
Use purpose	- Data basis (Royal HaskoningDHV, 2017) - Public value (Gemeente Amsterdam, 2021b) - Data sharing can also lead	- Don’t invest in data acquisition if you don’t have a goal (Maltha et al., 2021) - Issues as the purpose, ownership, and governance of	- Data sharing for availability and capacity insights (Gemeente Den Haag, 2020b) - End goal is essential in	- No personal data for area development if you don't have a specific purpose (MR1) - No use for personal data (MR1

	to unexpected insights or objectives. (MR7) - Use case and data query reasoning is often still challenging. (MR7)	the platform; development costs and financing; and data sharing and privacy for Open Urban Platform (Bagheri, 2024) - More than just mobility purposes (MR5) - To create a relevant end product (MR6)	data demand (Luk, 2022) - Only use data for what you want to achieve (Luk, 2022) - Specific questions and clear use cases are sporadic (MR4) - To identify urban area utilization (MR2) - To increase effectiveness (MR4)	- To identify shared mobility use (MR1) - To understand city dynamics (MR1)
Expected outcome	- In the future, vehicle speeds should also be adjustable based on zones. (MR7)		- Connection between current practices and data demand (Luk, 2022) - Mismatch between data and permits (MR3)	- Data allows for opportunities (Elstgeest, 2022)
Continuity	- Based on terms and conditions agreements (MR7)		- Closed (Gemeente Den Haag, 2024) - Open (Gemeente Den Haag, 2024) - Shared (Gemeente Den Haag, 2024)	- Automatization (MR1) - Eindhoven municipality has ongoing data sharing (MR1) - Periodically (MR1)
Data acquisition	- Comming to consensus (Gemeente	- Appropriate governance (Bagheri, 2024)	- Balancing data aquisition strategy with shared	- Municipal capacities (Elstgeest, 2022)

challenges	Amsterdam, 2023) - Gathering data is expensive (Gemeente Amsterdam, 2021b) - Private companies are reluctant in data sharing (Royal HaskoningDHV, 2017) - Security and privacy issues (Royal HaskoningDHV, 2017) - Agreements (MR7) - Differences between USA and EU (MR7) - Municipalities lack knowledge and capacity (MR7) - Municipality lacks data (MR7) - Technical API's (MR7)	- Citizen engagement (Bagheri, 2024) - Collective ambitions (Bagheri, 2024) - Cost of data platforms (Bagheri, 2024) - Ethical use (Maltha et al., 2021; Meerman, 2023) - Identifying supply (Maltha et al., 2021) - Lack in capacity and capabilities (Maltha et al., 2021; Bagheri, n.d.) - No technical barriers (de Lange, 2020) - Privacy (Meerman, 2023) - Transparancy (Meerman, 2023) - Trust (Bagheri, 2024) - Costs (MR5) - Data dependency (MR5) - Data sharing depends on conditions (MR5) - Data sharing takes effort (MR6) - Getting to a central stake (MR6)	mobility facilitation (MR3) - Many municipal departments (MR3) - No data from ride-hailing companies (MR3) - Not that many difficluties (MR3) - Organization ally difficult (MR4) - Takes effort (MR3)	- Around data there are not so many obstacles, everything is running pretty well (MR1) - Need for a legal basis (MR1) - Need for a specific goal (MR1)

Data utilization challenges	- Ethicality (Gemeente Amsterdam, 2021b) - Technical capacity (Gemeente Amsterdam, 2021b) - Data analysis to policy making (MR7) - Lack of municipal technical capacity (MR7) - Often changes in market development (MR7) - Too much data (MR7)	- Ethical use (Meerman, 2023) - Hard to recognize data utilization possibilities (Maltha et al., 2021) - Lack in capacity and capabilities (Maltha et al., 2021) - Long term vision (de Lange, 2020) - Only analyzing data is not sufficient (de Lange, 2020) - Privacy (Meerman, 2023) - Transparency (Meerman, 2023) - Applications are independent from data (MR5) - Data readability (MR5) - Mismatch in expectations (MR6)	- Data integration and combination (MR4; MR2) - Data standardization (MR3)	- Municipal capacities (Elstgeest, 2022)

Informed consent form (interview)

In this study, I want to learn about the role of Mobility as a Service/New Mobility Service data in urban planning and policymaking. Participation in this interview is voluntary and you can quit the interview at any time without giving a reason and without penalty. Your answers to the questions will be used by me specifically. I will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act). Please respond to the questions honestly and feel free to say or write anything you like.

[In case of anonymous handling: Everything you say or write will be confidential, and anonymous. This means that I do not ask for your name, and no one will know which respondent said what.]

I confirm that:

- I am satisfied with the received information about the research;
- I have no further questions about the research at this moment;
- I had the opportunity to think carefully about participating in the study;
- I will give an honest answer to the questions asked.

I agree that:

- the data to be collected will be obtained and stored for scientific purposes;
- the collected, completely anonymous, research data can be shared and reused by scientists to answer other research questions;

I understand that:

- I have the right to see the research report afterwards.

Do you agree to participate? o Yes o No

Information Sheet (interview)

Introduction

You are invited to take part in this study on data sharing and collaboration for evidence-based decision-making in urban developments. The purpose of the study is to learn about the role of Mobility as a Service/New Mobility Service data in urban planning and policymaking, specifically in the context of smart and sustainable developments in Dutch municipalities.

The study is conducted by Floris van den Dool who is a student in the MSc program Sustainable Business and Innovation at the Department of Sustainable Development, Utrecht University. The study is supervised by Iryna Shusha.

Participation

Your participation in this interview is completely voluntary. You can quit at any time without providing any reason and without any penalty. Your contribution to the study is very valuable to me and I greatly appreciate the time taken to complete this interview. I estimate that it will take approximately 40-50 minutes to complete the interview. The questions will be read out to you by the interviewer. Some of the questions require little time to complete, while other questions might need more careful consideration. Please feel free to skip questions you do not feel comfortable answering. You can also ask the interviewer to clarify or explain questions you find unclear before providing an answer. Your answers will be noted by the interviewer in an answer template. The data you provide will be used for writing a Master thesis report and may be used for other scientific purposes such as a publication in a scientific journal or presentation at academic conferences.

Data protection

The interview is also audio-taped for transcription purposes. The audio recordings will be available to me, the Master's student, and academic supervisors. I will process your data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

[In case audio recordings will be deleted: Audio recordings will be deleted when data collection is finalized and all interviews have been transcribed.]

In case audio recordings will not be deleted: Audio recordings will only be stored on a secured and encrypted server of Utrecht University]

[In case of an anonymous interview: Everything you say in this interview will be confidential and completely anonymous. This means that I will not ask for your name, date of birth, or other personal information that can be traced to you by the University or a third party]. I will process your data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act)]

17. APPENDIX G – (DESCRIPTION ETHICAL ISSUES)

The acquisition of data, especially primary data, should be done carefully. The rights and privacy of interviewees must be assured in order to conduct a thorough and ethical research. For this reason, this research focuses on informed consent of data subjects, data confidentiality and anonymity, data security and storage, and transparency.

Informed consent

Before acquiring primary data (e.g., through an interview), the subject and purpose of the study is explained. The procedures for data processing and publication are explained, but the importance of acquiring information and the potential benefits of this data are also directly addressed. Through the prepared consent form (Appendix B), data subjects can indicate their understanding and acceptance of the rights and conditions. Data subjects are given the space and possibility to withdraw at any time and have the opportunity to ask for clarification.

Data confidentiality and anonymity

To ensure data confidentiality and anonymity, it is ensured that data is anonymized immediately and there is no possibility of tracing the data back to the interviewee if the respondent preferred to be anonymous. The data is encrypted and the identifying information is securely stored separately from the interview data. In addition, participants have the right to request that the initial interview data will be deleted immediately after data processing.

Data security and storage

The data is only directly accessible to the researcher and the first supervisor. The data is processed confidentially according to the General Data Protection Regulation and Personal Data Act. The data is stored solely on secured and encrypted servers of Utrecht University.

Transparency

Throughout the research, there will be open communication with participants about the research process and progress. Regular updates on data processing will be given and questions and other interests of participants will be included in the research process.

18. APPENDIX H – (INTERVIEW GUIDE MUNICIPALITIES)

Thank you very much for agreeing to participate in this interview. My name is Floris van den Dool, and I am conducting research for my master's thesis for the University of Utrecht's Sustainable Business and Innovation program. This research delves into public-private collaboration in urban planning and policymaking, with a specific focus on the role of Mobility as a Service (MaaS)/New Mobility Service (NMS) data. This includes companies and services that are reshaping urban mobility, such as ride-sharing platforms, electric scooter rentals, and ride-hailing platforms. I'm interested in how their data on usage patterns, service demand, operational challenges, etc. can support more informed urban planning and policy decisions.

Today, we'll discuss the supply, demand, and usage of data for smart urban development within the Dutch context, paying special attention to data held by the private sector. Given the transformative potential of MaaS and NMS in shaping our urban environments, it's crucial to understand how data from providers like Uber, Bolt, and local vehicle-sharing services can inform smarter city planning and policy decisions.

This conversation should take about 40-50 minutes, and with your permission, it will be recorded. I understand the sensitivity of information, especially when it comes to unpublished data or internal insights. Please let me know your preference for confidentiality regarding our discussion. Would you be comfortable with your organization or role being mentioned, or do you prefer a higher degree of anonymity? You will also have the opportunity to review a transcript of this interview to ensure accuracy and comfort with the shared information.

Before we begin, do you have any questions?

Introduction

1. "Can you share your relevant work experience concerning the research topic, especially your role in partnerships with mobility providers and access to their data?

Public Problems

2. "How does MaaS/New Mobility Services fit into the vision of smart and sustainable city development in your municipality?"
3. "What are the current public (policy) problems within your municipality where you see a potential for NMS data to provide solutions?"

Data Supply, Types, Sources, and Collaboration

4. "How is this data shared with your municipality by New Mobility Service providers?"
    a. "Can you give any specific examples of initiatives/collaborations/practices?"
        i. "How successful are they and what have been the challenges to get access to the data?"
        ii. "Was/ is data continuously demanded/ supplied?"
5. "What specific types of MaaS/NMS (trip) data are you interested in?"
    a. "Can you give examples of the data content, such as geographic information, user behaviors, or service demand patterns?"

Demand and Utilization of Data

6. "What does the municipality desire to accomplish with Maas/ NMS (trip) data and how is it integrated into urban planning and policy-making?"
7. "Can you provide examples of how this data has influenced policy decisions or urban development projects in your municipality?"
    a. "How and with which data provider was this collaboration formed?"

Challenges in Data Access and Utilization

8. "In your experience, what barriers exist in terms of data collaboration and sharing between municipalities and private companies?"
9. "What challenges have you faced in accessing and utilizing data from private MaaS/NMS companies?"

Improving Data Collaboration:

10. "From your perspective, how can data-sharing initiatives between new mobility service providers and local governments be improved to better support smart city development?"
    a. What policies/frameworks/tools are needed for that?"

Ending/Conclusion

These were all the questions regarding the research.

11. "Is there anything else you think is important regarding the supply, demand, and/or usage of NMS (trip) data in evidence-based decision-making for (smart and sustainable) urban development?"
12. "Do you have any questions for me or any aspects of the study you'd like to discuss further?"

This concludes the interview. Once again, thank you very much for your time and insights. Your contribution is invaluable to this research. Please remember that everything discussed will be treated confidentially, and I'm more than happy to share a transcript of our conversation with you. If you have any further thoughts or questions in the future, please feel free to contact me.

19. APPENDIX I – (INTERVIEW GUIDE RESEARCHERS/EXPERTS)

Thank you very much for agreeing to participate in this interview. My name is Floris van den Dool, and I am conducting research for my master's thesis for the University of Utrecht's Sustainable Business and Innovation program. This research delves into the role of Mobility as a Service (MaaS)/New Mobility Service (NMS) data in urban planning and policymaking. This includes companies and services that are reshaping urban mobility, such as ride-sharing platforms, electric scooter rentals, and ride-hailing platforms. I'm interested in how their data on usage patterns, service demand, operational challenges, etc. can support more informed urban planning and policy decisions.

Today, we'll discuss the supply, demand, and usage of data for smart urban development within Dutch municipalities, paying special attention to data held by the private sector. Given the transformative potential of MaaS and NMS in shaping our urban environments, it's crucial to understand how data from providers like Uber, Bolt, and local vehicle-sharing services can inform smarter city planning and policy decisions.

This conversation should take about 50-60 minutes, and with your permission, it will be recorded. I understand the sensitivity of information, especially when it comes to unpublished data or internal insights. Please let me know your preference for confidentiality regarding our discussion. Would you be comfortable with your organization or role being mentioned, or do you prefer a higher degree of anonymity? You will also have the opportunity to review a transcript of this interview to ensure accuracy and comfort with the shared information.

Before we begin, do you have any questions?

Introduction

1. "Given your background and experience, what questions should local governments be asking given the growth of New Mobility Service providers in Dutch cities?"

Data Collection and Sharing

2. "In your view, how should local governments go about the fact that NMS providers collect a lot of data that can be valuable for policy making?"
3. "In your view, what is the state of play in terms of data access and data sharing initiatives between government and NMS providers in Dutch cities?"
    a. "Do you know of any concrete examples?"

Data Demand and Utilization

4. "From your point of view, what is the added value of evidence-based decision-making within Dutch municipalities?"
    a. "What type of data is much needed and how should/can this data be shared and accessed?"
5. "Reflecting on your experience, to what extent are local governments making good use of the data available from NMS providers?"

a. "How could this be improved?"

Public Good vs Private Interests

6. "What are the overarching challenges in balancing public good and private interests in data sharing for urban development?

Challenges

7. "What are key challenges you see in data sharing and evidence-based decision making?"

8. "From your experience, can you discuss any (potential) gaps between theoretical and practical implementations of (NMS) data usage/?"

Data Collaboration Stimulation and Innovation

9. "How could data sharing and collaboration between NMS and municipalities be improved?"

    a. "Can you discuss any models or frameworks that (could) facilitate effective data sharing and collaboration among these stakeholders?"

10. "How can data-driven approaches within municipalities be optimized to enhance urban development?"

Future Perspectives

11. "Looking ahead, can you envision any innovative approaches or potential breakthroughs that could significantly impact the future of data-driven urban development?

    a. How might these innovations reshape the interaction between municipalities and data providers?"

Ending/Conclusion

12. "Is there anything else you believe is crucial for understanding the supply, demand, and utilization of trip data in evidence-based decision-making for developing smart and sustainable cities?"

13. "Do you have any questions or comments that you would like to add?"

This concludes the interview. Once again, thank you very much for your time and insights. Your contribution is incredibly important to my research. I'll ensure the information you've shared is used responsibly and with respect to your anonymity. If you have any further questions or wish to discuss any aspect of the study further, please don't hesitate to contact me.

20. APPENDIX J – (INTERVIEW GUIDE INDUSTRY REPRESENTATIVES)

Thank you very much for agreeing to participate in this interview. My name is Floris van den Dool, and I am conducting research for my master's thesis for the University of Utrecht's Sustainable Business and Innovation program. This research delves into public-private collaboration in urban planning and policymaking, with a specific focus on the role of Mobility as a Service (MaaS)/New Mobility Service (NMS) data. This includes companies and services that are reshaping urban mobility, such as ride-sharing platforms, electric scooter rentals, and ride-hailing platforms. I'm interested in how their data on usage patterns, service demand, operational challenges, etc. can support more informed urban planning and policy decisions.

Today, given the transformative potential of MaaS and NMS in shaping our urban environments, we'll discuss the perspectives of NMS companies on data sharing, collaboration, and their impact on urban development.

This conversation should take about 30-40 minutes, and with your permission, it will be recorded. I understand the sensitivity of information, especially when it comes to unpublished data or internal insights. Please let me know your preference for confidentiality regarding our discussion. Would you be comfortable with your organization or role being mentioned, or do you prefer a higher degree of anonymity? You will also have the opportunity to review a transcript of this interview to ensure accuracy and comfort with the shared information.

Before we begin, do you have any questions?

Introduction

1. "Could you briefly describe your work position in NMS, especially concerning data sharing and urban planning?"

Impact on Urban Planning

2. "From your perspective, how do NMS companies like yours impact Dutch city's mobility? "
    a. What role does data play in this impact?"

Data Sharing and Utilization in Practice

3. "Can you describe any existing collaborations involving data sharing between your company and urban planners or government bodies?
4. "What are the key challenges your company faces when sharing data with public parties?"
    a. "How are these challenges being addressed, and what improvements do you envision could facilitate better collaboration?"
    b. How does business interest perform against public good?

Data Demand

5. "How is data demand from municipalities identified, and how is data shared with these demanding parties?
    a. Does your company share data proactively, or is it driven by specific requests?"

Collaboration, demand, and Integration

6. "What type of data is your company currently sharing or willing to share with governmental bodies, and what considerations play a role in what you might be willing to share?"
7. What data are municipalities demanding from your company?
    a. Does your company share data proactively, or is it driven by specific requests?
8. "Could you elaborate on what this data entails?"
    a. "Has this data been processed or analyzed before sharing?
        i. If so, how?"

Value of Data Sharing

9. "How do you perceive the value of these data for both your company and governmental bodies?"
    a. "Are there specific benefits or outcomes you aim to achieve through data sharing?"
    b. Why are specific data types being shared?

Ending

10. "Is there anything else you think is particularly important regarding the supply, demand, and/or usage of trip data in evidence-based decision-making for urban development?"
11. "Do you have any questions for me, or is there anything you'd like to add that we haven't covered?"

This concludes the interview. Once again, thank you very much for your time and valuable insights. Your contribution is essential to understanding the complexities of data sharing between NMS companies and municipalities in the context of urban planning and development. Please remember that everything discussed will be treated confidentially, and I'm more than happy to share a transcript of our conversation with you. If you have any further thoughts or questions in the future, please feel free to contact me.