"Data-Driven Governance: Linking Data Information and Regional Mobility Hubs in Eastern Netherlands"

A single case study on the integration of data in policy governance of the regional mobility hub in the city of Geldermalsen

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Abbreviation	Definition
IAD-framework	Institutionalized Actors and Development Framework
PSM	Problem Solving Model
Ministry of IWM	Ministry of Infrastructure and Water Management
Ministry of BZK	Ministry of the Interior and Kingdom Relations
Ministry of EZK	Ministry of Economic Affairs and Climate
KIM	Kennisinstituut voor Mobiliteitsbeleid
CROW	Centrum voor Regelgeving en Onderzoek in Grond-, Water- en Wegenbouw en de Verkeerstechniek
ROCOV	Reizigers Overleg Consumentenbelangen Openbaar Vervoer
ROVER	Vereniging Reizigers Openbaar Vervoer
MaaS	Mobility-as-a-Service
P&R	Park and Ride
OV	Openbaar Vervoer
PBL	Planbureau voor de Leefomgeving
NS	Nationale Spoorwegen
CBS	Centraal Bureau voor Statistiek
KCBR	Kenniscentrum voor Beleid en Regelgeving
TOD	Transit Oriented Development
IR-systems	Information Retrieval systems

1. Introduction to research

1.1 Research Problem Statement

In the Dutch national governmental agreement in 2023, plans were made to invest 7.5 billion euro's in solving mobility problems throughout the country. Of this, 7 million was set aside for the gathering of knowledge about shared mobility hubs (Ministry of Infrastructure and Water Management, 2023). Other money was invested by the Ministry of Infrastructure and Water Management (IWM) to financially support the development of larger urban areas such as Eindhoven and Leiden, including the redesign of train stations with the purpose of increasing the accessibility for passengers. In addition to larger projects of the national government, other governmental layers as provinces subsidize the redevelopment of smaller train stations. Railway stations, such as Station Geldermalsen (AD, 2024), have received millions to redesign their train station. The general objective of improving the station area is linked to the investment in mobility hubs. In various mobility policies across the Netherlands, mobility hubs are one of the key objectives. The Dutch report of the Ministry of IWM defines mobility hubs as a physical key point between travel modes which, besides their mobility function, can serve as concentration point for spatial development (Witte et al., 2021). One of the characteristics of hubs is their multimodality, pointing out the diversity of transport modes converging in one node. The presence of more modalities often relates to a bigger sized hub. The categorization of train stations into a type of hub is based on the number of modes of transport at the location (Rongen et al., 2022). Smaller, local hubs to bigger, international hubs are identifiable.

According to Witte et al. (2021), governmental policy makers tend to include mobility hubs in mobility policies to combine objectives as overcoming population decline, promoting sustainability and more healthy transport into a single policy instrument. To integrate multiple objectives effectively, mobility hubs connect insights from various stakeholders, such as ministries and municipalities, private companies, academic institutions, travelers, and transport companies (Rongen et al., 2022). Besides the input of a broad scale of stakeholders, mobility hubs act in between a moving political landscape of governance arrangements (Kask et al., 2022), diverse interests and differing powers of stakeholders (Lunardon et al., 2023) and changing roles of data information in mobility policies (Liu and Dijk, 2022). Various kinds of factors affect the implementation of mobility hubs in public policies (Rongen et al., 2022). One of the factors, data information, can be identified as:

- "Data are units or morsels of information that in aggregate form the bedrock of modern policy decisions by government and non-governmental authorities." (Gitelman, 2013, p. 1)

Data information serves as evidence to inform policymaking. Mays et al. (2005) discuss how different forms of evidence are present, such as qualitative and quantitative approaches. Approaches vary per policy development, which means stakeholders in policy making can use diverse strategies with diverse types of data. The Dutch National Government initiated multiple mobility policies, where aspects as timing and coordination of government investments influenced the policy making (Rongen et al., 2022). Adding to this, other research show issues governmental organizations experience managing huge amounts of mobility data of travellers influencing policy making (Bokolo, 2023). Liu and Dijk (2022) connect environmental data, spatial data and research data to mobility policy making. Based on these studies, the 'themes' of data in this research are chosen.

Linking research on data information and how data is perceived in policy making, the concept of data governance emerges. The definition of data governance is as follows:

- "The power relations between all the actors affected by, or having an effect on, the way data is accessed, controlled, shared and used, the various socio-technical arrangements set in place to generate value from data, and how such value is redistributed between actors" (Micheli et al., 2020)

Notably, Michele et al. show that data governance and the attached actors are interwoven (2020). Therefore, considering the power distribution in policy design and the focus of actor's goals are part of the research. Data governance does not focus on how to get data, but it focuses on data benefits and who controls it or has the access to it (Micheli et al., 2020). In this research, this definition of data governance helps to understand the data governance of mobility hubs. The research incorporates the Institutionalized Actors and Development Framework (IAD-framework) of Ostrom and the Problem Solving Model of Wilson (PSM) to understand the policy and decision making in the data governance of mobility hubs.

The frameworks integrate a diversity of elements to understand policy and decision making that are researched in this study.

In the scientific field, research exists on the relation between mobility hubs and data governance. Liu and Dijk (2022) discuss the role of data in mobility policy making. Due to the academic scope of their research, Liu and Dijk ask for more practical knowledge on the use of data in policy making. Empirical information on data usage is under researched (Liu & Dijk, 2022). For example, pointing out constraints of data usages and innovative solutions for new data types in mobility policy making can be the focus of new research.

1.2 Research aim and research questions

To address this gap, two aims of this research are identified. Firstly, the research aims to add knowledge on the lack of empirical information by providing insight into the experiences of policy makers in the field of data use and governance. Secondly, the research aims to understand data governance in creating mobility policies affecting the mobility hub in the rural town of Geldermalsen, the Netherlands.

For the first aim, the research tries to provide policy makers with insight into the experiences of other policy makers to make funded future choices in the field of mobility hubs. For the second aim, the study tries to use the experiences of data governance in Geldermalsen to inform other municipalities and provinces on more empirical knowledge. The research uses the IAD-framework and the PSM as theoretical foundation to set out what data governances exist in policy making concerning hubs. To try to understand the data governance, the policy making is split into the phases of policy formulation and decision making. Because there can be an interaction between actors in policy formulation and actors in decision making, a third place of data governance is present. In other words, data governance exists in three places: policy formulation, decision making and the interaction between the phases. This research uses the following topic question to combat the problem statement:

- What is the data governance in policy formulation and decision making of the regional mobility hub Geldermalsen, the Netherlands?

The research is divided in two elements. The first element of the study explores existing Dutch policies affecting the mobility hub of Geldermalsen. Then, a document analysis tries to outline the key stakeholders participating in the policy formulation and decision making. The document analysis focuses on the role of the stakeholders in the policy making process and it aims to understand the integrated types of data information in the existing mobility policies. Therefore, the following sub question is created:

1. Who are the key stakeholders involved in policy governance of mobility hubs, and what roles do they play?

The results of the document analysis are the foundation of the second part of the research. In this part, a descriptive examination aims to determine which characteristics belong to the data governance of mobility hub concerning the case of Geldermalsen. By exploring the policy making phases including the scope of this research is on power relations, communication dynamics and the types of data used. Additionally, data governance is the focus point in researching the phases of policy making and the interaction between them. To align with the research objective of this research, the following research questions are formulated:

2. In what way is data governed in the policy formulation phase, focusing on power relations, communication and types of data?
3. In what way is data governed in the decision making phase, focusing on power relations, communication and types of data?
4. In what way is data governed in the interaction between the policy formulation phase and the decision making phase, focusing on power relations, communication and types of data?

1.3 Scientific and societal relevance

This research understands the concept of relevance as the extent to which scientific research impacts the social world. Furthermore, the connection between scientific research and its scientific relevance is explained within the context of this study. This section first discusses the societal relevance of the research, followed by its scientific relevance.

Societal relevance

As stated by Rongen et al. (2022) and Witte et al. (2021), mobility hubs can connect various policy goals into one policy solution. Hubs are viewed as "panacea" for addressing transport issues (Rongen et al., 2022, p. 1). The potential of hubs varies from problems as congestion and limited space to societal objectives, such as an increase in the accessibility of rural areas (Witte et al., 2021). The concept of mobility hubs is implemented by governmental institutions in urban and rural areas across the Netherlands. Roles of governmental institutions differ, in which the national government can play a financing, directing, and launching role (Witte et al., 2021). On a smaller scale, municipalities can play a more coordinating role in mobility hub projects and the affecting flanking policies. According to Witte et al. (2021), instruments of the national government effect projects on a local scale. Examples as introducing national standards for sharing transport data and stimulating sustainable opportunities of mobility are described in there. The national government needs to focus on an efficient use of transport data and other forms of integrated data in policy making (Witte et al., 2021). Sharing information, evaluating data, and connecting data are example which are researched. This research can help governmental institutions to understand the role of data inside mobility hub policies and implementing hubs in practice. Kask et al. (2022) suggest that sharing success and failure experiences of hubs can shape future projects. This also includes sharing data information experiences, which is part of this research. However, a descriptive overview of data governance of mobility policies is not enough. The Knowledge Center for Policy and Regulations (KCBR) (2024) is a knowledge institution which provides guidelines for Dutch organizations. It shows how to optimize 'evidence informed' policy forming. One of the key points is to analyze when to implement data in the policy design. Stakeholders in policy making can integrate information from different sorts of overviews to get the right information needed to make the right policy choice (KCBR, 2024). However, presenting another research on 'evidence' or data-driven policy making by giving an overview does not match the needs (Oliver et al., 2014). This study shows that researchers often only produce knowledge for their specific scientific field. That is why this research focuses on implementing diverse layers of governments and other policy makers. This is done by interviewing their needs and by sharing the outcomes of this research. The research tries to connect insights of policy formulators, decision makers and the academic world to understand the data governance in mobility hubs policy making.

Scientific relevance

As mentioned in the problem statement, mobility hubs come in varied sizes. Larger hubs function as network nodes where multiple modes converge (Arnold et al., 2022). Smaller hubs in more rural areas often have fewer modes coming together. The mobility hub data integration framework (Tran & Dreager, 2021) enables the opportunity to identify types of mobility hubs using all sorts of data information. The framework identifies data sources in for instance timetables, lay-outs, and transport data. The data-driven framework provides policy makers a helping hand, but it does not discuss the implementation of the framework (Tran & Dreager, 2021). The existing gap is researched using elements of this framework to understand policy governance of mobility hubs better.

The mobility hub data integration framework (Tran & Dreager, 2021) focuses on the metropolitan area of Los Angeles, where the focus of this research is on the Netherlands. Earlier research investigated the typology of mobility hubs in the Netherlands (Weustenenk & Mingardo, 2023) or studied the historical implementation of mobility hubs in the Netherlands (Rongen et al., 2022). According to Rongen et al., (2022), the implementation of mobility hubs in Dutch areas faces major problems, such as the lack of a variety of modes in rural hubs. Limited research in the policy governance of implementation of rural hubs has been done. When looking at policy governance in the Netherlands, research focused on different topics. Blad et al. (2022) studied the allocation of regional shared mobility hubs. Meurs et al. (2020) researched the alliance formation of Mobility-as-a-service. Other research of

Kask et al. (2022) specified which factors stimulate mobility hub governance, where knowledge sharing plays a significant role. Witte et al. (2021, p. 59) discuss how the complexity of "hub development" is a process of "learning-by-doing". The research recommends for future research to connect the usage of hubs to other policy instruments. This type of information of other policy instrument is part of the knowledge policy makers have in the creation process. The role of information, knowledge and data in policy making is the topic of the research of Liu and Dijk (2022). The academic papers that are reviewed in their research lack the policy practice. The recommendation is for future research to aim for a better understanding "of the use of state-of-the-art of data in practice" (Liu & Dijk, 2022, p. 15). This research jumps into this gap, where data governance is discussed concerning a regional mobility hub of Geldermalsen in the Netherlands.

2. Literature review and theoretical framework

To answer the main research question, it is necessary to intensively review all interrelated issues. This thesis critically reviews the current academic debate focusing on theoretical frameworks, and the creation of a conceptual model. Furthermore, a systematic review is done to look at the used connected theories.

2.1 Critical review of academic literature

In the critical review, an analysis is done to look at the broader academic debate on the topic of mobility hubs and data governance. This helps to better understand how hubs are defined, what obstacles there are and what current research focuses on. Thereafter, the definition of data information is explained, types of data are discussed and domains of data are introduced. Then, data governance is introduced, including its definition and the link to key types of power relations. In chapter 2.2, the link between theoretical frameworks, the scientific world and the notion of data information, data governance and mobility hubs is made.

2.1.1 Mobility hubs

This research focuses the mobility hub of Geldermalsen, located in the eastern province of Gelderland in the Netherlands. To understand the concept of mobility hubs, a definition is needed. Mobility hubs are transport hubs that focus on reducing the use of cars and reducing emissions (Aono, 2018). This is done through the integration of private and public transportation options, such as active transportation. The definition of hubs used in this research is as follows:

- "A mobility hub is a recognizable place with a range of diverse and interconnected modes of transport, complemented by enhanced facilities and information to attract and benefit the traveler." (CoMoUK, 2019).

Aono (2018) and CoMoUK (2019) indicate that multiple modes of transport need to come together in one place. It serves as a hub in a larger transportation network ((Aydin et al., 2022; Witte et al., 2021). Objectives related to hubs aim to lower long waits and travel uncertainties at train and bus stations (Aydin et al., 2022). Hubs should provide new opportunities for commuters to travel in a smart, safe, clean, and sustainable way (Miramontes et al., 2017). Finally, hubs should improve the quality of life in the areas around (MaaS, 2020). This can happen on the level of the city, region or country (Arnold et al., 2022). More local railway stations are often served by fewer modes of transportation. This results in less diverse first and last mile trips to and from the hub. However, the trips regarding larger hubs are more focused on public transportation and other options of sustainable transport (Arnold et al., 2022).

The concept of mobility hubs first appeared in the early 2000s in Bremen, Germany (Arnold et al., 2023). It was part of a transportation policy as a location where sustainable transportation was connected to key locations in the city. While the first mobility hubs were being implemented, academics and practitioners tried to define them in words (Aono, 2018; CoMeUK, 2019, Arnold et al., 2023). In the early years, Bertolini (2008) discussed that station areas were becoming hubs in transport networks. He discussed how stations had the opportunity to use the network function to become economically stronger. Innovative projects such as high-speed rail help to improve the position of urban station areas

(Bertolini, 2008). Transit Oriented Development (TOD) is part of this, focusing on the improvement of public transport compared to the car (Rongen et al., 2022). Along with the inclusion of micromobility and shared mobility, TOD results in more diverse modes of transportation, which is a key condition to be called a mobility hub (Arnold et al., 2023).

International objectives of mobility hubs

Internationally, mobility hubs have key objectives that are more common in some regions than others. The North American and European regions have concentrated on environmental reasons for implementing hubs in their policies (Arnold et al., 2022). Mobility hubs became a tool in policies to combat carbon emissions. In the European continent, environmental reasoning influenced the European Union to subsidize the Mobi-Mix project with the Interreg 2 Sea program to investigate how mobility hubs lead to more sustainable transport (Hachette and L'Hostis, 2023). Practices in the cities of Norfolk, England, and Valenciennes, France, show that mobility hubs are a useful method to promote mobility hubs in policies to achieve sustainability goals. In the United States, San Diego identified an improved station area as the key objective to implement mobility hubs in planning policies, where this would also lead to less traffic congestion (Arnold et al., 2022). This is evident in the United Kingdom, where the introduction of mobility hubs has reduced congestion. In Nottingham, shared mobility was integrated into the hub, which improved the local station area (Arnold et al., 2022).

Adding to less traffic congestion as objective, other practices, such as in Vienna, Italy, showed how the combination of the traveller experience at the hub and improved mode switching leads to lower carbon emissions (Arnold et al., 2022). In addition to shared mobility and traveller experience, active mobility is a key objective of cities worldwide for mobility hubs. It benefits sustainability reasons, but also social elements (Arnold et al., 2022). In Seoul, for example, mobility hubs are used to promote healthier modes of transportation (Ku et al., 2022). Concluding, mobility hubs are part of mobility policies due to a diversity of goals that vary from place to place, city to city, and country to country.

Mobility hubs in the Netherlands

Rongen et al. (2022) show how the Dutch mobility hub concept has evolved in policies. Initially, park and ride (P&R) hubs were the first to be included in the policy. P&Rs near railway stations would increase public transport (Roukouni et al., 2023). A "transferium" is introduced as a hub where car drivers switch to trains to travel to other cities (Rongen et al., 2022, p. 4). First and last mile trips are included, where the focus of the car also shifts to walking, cycling and other public transport. In addition to TOD, P&R hubs are integrated to aim for reduced congestion. Bundling transportation modes was not new, but it was also necessary to address emissions. When mobility hubs are introduced, emissions and vehicle congestion are not the only objectives for adding hubs to the policy (Rongen et al., 2022). Mobility hubs serve as a catalyst for the transformation of station areas, which also improves the character of the area (Roukouni et al., 2023). At a local level in the Netherlands, hubs try to focus on short-distance destinations and shorter travel times (Van Lierop et al., 2016). Shared mobility, mobility-as-a-service, electrification, and demand-responsive transport are part of the area around the station, as in Amsterdam (Roukouni et al., 2023). These services are only possible with the right mix of supportive policies, from national to local. Therefore, cooperation between private and public authorities is important. In Dutch policy making, hubs are seen as center of economic development (Weustenenk and Mingardo, 2023). Productivity is higher in these locations due to high accessibility and available facilities. Growing mobility hubs also leads to a better position in regional networks (Weustenenk and Mingardo, 2023). Additionally, changing the mode shift to more sustainable types of transport is possible due to high car use in rural areas of the Netherlands (Wiersma et al., 2015).

Weustenenk and Mingardo (2023) and Blad et al. (2022) have attempted to develop a typology of regional mobility hubs. Railway stations in rural areas of the Netherlands that bring together shared mobility, park and ride, and public transport are referred to as "regional shared mobility hubs" (Blad et al., 2022). This type of hub differs from regular regional rail hubs in that it, for example, incorporates shared mobility modes and intelligent passenger information systems. In the end, this type of regional mobility hub corresponds with the chosen case study Geldermalsen. This is explained in chapter 3.

2.1.2 Datasets and domains of data

To understand datasets and domains of data, different researchers have tried to define the concept of data. One of them is Gitelman:

> "Data are units or morsels of information that in aggregate form the bedrock of modern policy decisions by government and non-governmental authorities" (Gitelman, 2013, p. 1)

The definition explains how data exists everywhere, where data forms the bases for all kinds of investments, policies and frameworks (Gitelman, 2013). Gitelman explains that policy makers and scientists experience difficulties with expanding datasets available as big data. Big data is introduced in an era in which big volumes, variety and exhaustivity play important roles (Ye & He, 2016). Big data in urban policies includes 'transactional, transportation monitoring and social media that are geographically and temporally referenced' (Ye & He, 2016). The policy makers can use big data to optimize city planning. Big data can create opportunities in analyzing societal networks, but the need for recording individual behavior can help to link spatial and temporal information (Ye & He, 2016). This can be understood using 'small data', which focuses on the 'active solicitation' of data collection (Chen et al., 2016). This active collection includes common surveys to understand specific phenomena. The passive collection of big data is done for general studies on human movement. Collecting big data can potentially be used in research and small data is collected specifically for one research (Chen et al., 2016). Policy related decisions and small versus big data must be researched. Human movement is researched by new datasets as phone data, which provides new tools for policy formulation (Shi et al., 2016).

Data, information and knowledge

As mentioned before, mobility policies integrate data in the process of policy making. Adding to this, the typology of mobility hubs is partly done by using varying information which determines in which type of hub existing and new mobility hubs fit. This chapter clarifies the definition of data or information that is used in this research. Second, this chapter explains what datasets and domains of data are integrated. The identification of datasets and domains of data is used in the resulting part to understand the process of mobility policy making in the case study of Geldermalsen.

Data, knowledge and information are conceptual elements of information sciences (Zins, 2007). The "fundamental building blocks" are examined because of changing perceptions on the definition and positioning (Zins, 2007, p. 479). According to this overview, researchers across the world vary in insights towards the definitions. The universal understanding would be that data form are "sets of signs that represent empirical stimuli or responses" (p. 487). Zins explains information as a "set of signs, which represent empirical knowledge" (p. 487). Lastly, knowledge "is a set of signs that represent the meaning … of thoughts that the individual justifiably believes that are true" (p. 487). As difference is clear with "documented propositions and meanings" (Zins, 2007, p. 487). In the end, knowledge is the total set of signs, data on one side and information on the other. Because of the fact that meaning cannot be sensed by individuals themselves, set of signs are the only perceivable entity (Zins, 2007), According the research, when doing a study related to data, information and knowledge, the scope is on the "set of signs", which varies in each of the terms.

Concluding, in this research the terms of information, data and knowledge are used to refer to a set of signs. The concepts are in a way interchangeable, because it is about a set of signs which is used in policy making.

Identification of datasets

By doing a systematic overview on existing research on mobility policy making, the following datasets are discussed: Surveys, Pilot study, Formal documents, Evaluation forms, Experts Panels, Data Reports and Dashboards. Survey data is seen as "dominant data" in the policy cycle in mobility practices (Liu & Dijk, 2022, p. 12). Surveying the travel behaviour highlights mobility problems and could embrace new opportunities. This research shows that small data as surveys is still done in policy evaluation (Liu & Dijk, 2022). That is why surveys are investigated in the mobility policy making. Second, Arain et al. (2010) have showed that pilot studies are often done for testing hypothesis or as randomization procedure. Pilot studies are often not considered for publication, but it can provide an full understanding of "qualitative research project" (Malmqvist et al., 2019). In other words, pilot studies can help the

policy formulation because of the broad scale of information of certain topics. Third, Sutton (1999) highlights how policy documents are an unnegotiable base for new policy formulation, because existing documents describe what has to be done and what cannot be escaped from. Current mobility policies are part of new policy cycles, which makes it a dataset for policy and decision makers in this research. Fourth, evaluation data integrates monitoring of existing urban mobility practices (Liu & Dijk, 2022). It highlights limitations in actors' resources and power, which can open opportunities in new policy making processes. This research includes the evaluation of policy documents, but also relies on evaluation of residents. Fifth, in policy making experts are often used to collect insightful knowledge on mobility issues (Liu & Dijk, 2022). Experts provide in-depth data to put scientific data into policies. Expert knowledge is positioned in between citizens and politics, where questions come up if expert knowledge might be superior to knowledge (Bäckstrand, 2003). In other words, expert data is not weighted in this research, but compared to other sorts of datasets. Thereafter, Liu & Dijk (2022, p. 6) introduce statistical data, which includes information "for understanding and quantifying impacts of political decisions". These reports of data help to understand the mobility situation in a specific area. In other words, data reports as statistics can play a role in policy making. Finally, big data can play a key role in mobility policy making. Big data on online platforms can influence choice and decision making in empirical experiments (Kourtit & Nijkamp, 2018). Dashboards are tools for supporting policy making by integrating complex big data bases (Kourtit & Nijkamp, 2018).

As concluding remarks, the datasets in policy making are varying from surveys to policy documents. Each of the datasets can influence policy making in their own way. Following this relation, this research integrates the focus on datasets to understand the policy making process around hubs.

Integrated domains of data

In this research, domains of data are investigated in mobility hub policy making. This research uses existing studies to find domains of data that are proven to be part of mobility policy making. The following domains are explored: demographic data, economic data, environmental data, geospatial data, political data, empirical data and transportation data.

First, Cao et al. (2008) show that demographic data can influence the frequency of trips made by travellers. The demographic background of commuters is shown to have an effect on the travel behaviour (Cao et al., 2008). Knowing the demographics of a population in a specific area, transport mobilities can be adapted to the respective population. Second, the research of Liu & Dijk (2022) explains how financial issues in urban planning can be measured. For example, limitations in financial capacities can affect urban practices (Liu & Dijk, 2022). Cost-benefit analyses show what economic thoughts are integrated in policy making (Hanley, 2001). In other words, the economic data in policy making is important to research. Third, environmental data in policy design is discussed by Feuilette et al., 2015). Environmental data can affect the economic costs or wins of specific policy instruments (Feuillette et al., 2015). Social costs and benefits of mandatory environmental policies are calculated in new projects. Fourth, the research of Liu & Dijk (2022) also discusses how existing mobility policies have integrated Geographical Information Systems as data in mobility policy making. Road networks, maps and traffic information provide evidence in decision making and policy formulation, as stated by Liu & Dijk (2022). By integrating the geospatial data, the spatial context becomes clearer. Fifth, political data is part of policy making, where it includes the element of narratives (Sutton, 1999). Policy makers use a specific story in which they formulate and decide on new policies. The aligns with the political discourse. Adding to this, empirical techniques are integrated in policy making to connect scientific methods (Liu et al., 2023). Laboratory tests, experiments and trials are examples of certain empirical data types. Certain methodologies are input for policies to implement scientific research or data (Liu et al., 2023). Finally, Park et al. (2023) discuss how transport data, such as travel patterns, can be part of policy making. By recognizing travel patterns, the travellers' journey is better understood (Park et al., 2023). Also, big data including mobile phone movements explain the transport network better. Bringing technological transport big data and travel data collected in surveys (Liu & Dijk, 2022) together, this can be an opportunity for new mobility policy making.

Concluding, the domains of data vary from transport data to political data. Transport data are set of signs with information. However, the political data includes the subjective sets of signs of discourses, which can be seen as political information. The domains of data are discussed in the resulting part.

2.1.3 Data Governance

In this subchapter, the role of data governance is explained to understand how the mentioned datasets are used in mobility policy making in Geldermalsen, the Netherlands. First, multi-level governance is introduced, whereafter the link to the usage of information or data in policy making is outlined. Then, data governance in the scientific field is related to mobility practices across the world. This forms the bases for explaining the data governance in current mobility policy making. Comparing the scientific field on mobility policy making and data governance has resulted in the operationalized theme of power relations, which is part of data governance.

Multi-level governance and data governance

In policy making the concept of governance is introduced to understand the process of implementation new policies. Governance covers the "consequences for the way the object of implementation" of new policies (Hill & Hupe, 2003, p. 15). It refers to how societal choices affect the world and how they are reproduced in the process (Hill & Hope, 2003). The linkage between societal choices and policy processes are better understood by modelling governance into diverse types (Hooghe & Marks, 2001). European governance processes have focused on 'state-centric' and 'multi-level governance', both explaining the role of national governments in the policy process (Hooghe & Marks, 2001). On one hand, in state-centric models, the national government has all the power to decide in policy making, where smaller subnational actors have smaller, limited power. On the other hand, multi-level governance divides governmental layers into respectable arenas. For example, national governments are positioned in national arenas of policy making and subnational governments can participate in subnational arenas (Hooghe & Marks, 2001). Multi-level governance implies that the national power is not endless, which provides the opportunity for other stakeholder groups in policy design. This results in collective decision making in which national governments have less control than in state-centric models (Hooghe & Marks, 2001). Adding to this, policy and decision making are influenced by multiple actors acting in their own arena, but also interfere in other political arenas. Subnational actors can be influenced by each other but can also interfere with national arenas (Hooghe & Marks, 2001). Elements that are part of this multi-level governance are the multitude of actors which lead to combined decision making. This places actors in a diversity of risks, complexities and uncertainties (Van Asselt & Renn, 2011). In other words, a diversity of actors is connected to a multitude of personal backgrounds. The various so called subgroups of actors can act as 'horizontal' structures where state and non-state actors can interfere with each other in policy making (Micheli et al., 2020). The variety of connections between actors can be understood by focusing on datafication processes, which can help to understand how personal data of actors can be governed. Datafication can be explained as: "The growing presence, use and impact of data in social processes" (Heeks & Shekhar, 2019, p. 1). Datafication is linked to governance in the way that in governance practices, new forms of data are introduced with differing volumes and varieties. Data infrastructure and data politics help to orientate the datafication in governance practices (Micheli et al., 2020). Research on data infrastructure identifies the concept as a:

- "Ecosystem with a plurality of actors having multiple interests, agenda, goals and strategies, and interacting with an array of tools, mechanisms, systems, interfaces and devices for governing data." (Micheli et al., 2020)

Where data infrastructure explains the actors positioning in datafication, data politics focus on the "performative power of data" (Micheli et al., 2020). Data collection imbalances the power distribution between connected actors in datafication. Data infrastructure, data politics and datafication are part of the 'data governance' in policy making:

- 'The power relations between all the actors affected by, or having an effect on, the way data is accessed, controlled, shared and used, the various socio-technical arrangements set in place to generate value from data, and how such value is redistributed between actors.' (Micheli et al., 2020)

This definition of data governance focuses on decisions made over data, who makes them, who has access and who controls it (Micheli et al., 2020). Where data governance is applicable for social sciences, data governance is also usable in mobility policy making. In this research, data governance in mobility hub policy making is studied. To identify the governance structures in mobility policy making,

existing research is discussed to highlight power relations to operationalize the data governance in the mobility field.

Power relations

As mentioned above, data governance is influenced by power relations between integrated actors. For example, national states have the power to steer demand, but for mobility practices, governments are losing power of their knowledge on travel patterns, because of emerging power of companies (Docherty et al., 2018). Powerful actors, such as governments and authorities, can reject specific projects (Veeneman et al., 2018). Political ambitions and the willingness to pay for financial costs can be part of the reason to reject projects. On the other hand, actors' power can provide political support which is needed to fund specific projects (Veeneman et al., 2018). In other words, the actors' power cannot be seen apart of the governance between actors in mobility policy making. That is why this research investigates which important types of power exist in policy making. The types of power are discussed to explain their importance.

Knowledge in policy making can function as the "structure of the political discourse" (Radaelli, 1995, p. 167). Knowledge interrelates with institutions, which gives "stability to shared causal beliefs" that "set up structure of meaning" (Radaelli, 1995, p. 178). This results in knowledge being seen as an independent variable for policy making. Linked to this statement, the power of knowledge of actors changed. Initially, national states had all the power on available knowledge on travel patterns (Docherty et al., 2018). It was applied as resource to adapt to new circumstances which the state would face. However, the role of knowledge in policy making has changed in the last decennia. For example, data sharing among actors influences data governance (Micheli et al., 2020). That is done to limit knowledge gaps. But also, modern technologies as open data are increasing to change the scientific world (Liu & Dijk, 2022). Not only data collection (Micheli et al., 2020), but also data analysis asks for specific knowledge of actors (Liu & Dijk, 2022). In other words, changing knowledge circumstances and actors' capacities of knowledge influence the *knowledge power* of a single actor in mobility policy making.

The second power that is part of policy making is formal authority or *formal power*. Aghion and Tirole (1997, p. 2) discuss how "the right to decide" and "the effective control over decisions" as formal authority contribute to policy making. The authority of distributed among actors affects the right to select decisions that can affect organizations (Aghion & Tirole, 1997). The formal authority relies in the top of the organization, where the real authority is located down under. The formal power of decision making is influenced by the real authority, which provides the top of the organization with the information that is needed (Aghion & Tirole, 1997). Concluding, the difference between decision makers with a formal authority or power and real authority is made. The formal power is dependent on other actors in and outside the institutions, but it still has the final say.

Third, the resources of actors can affect actor's role in the governance of policy making. Ilhami and Achmad (2023) discuss how smaller actors with high interests in effective policy outcomes are limited through their resource barriers. Collaboration with other stakeholders can improve their position, where their expertise in specific resources is interesting for other actors (Ilhami & Achmad, 2023). An example of resources is knowledge, which is explained before. But the resources of qualified labor inside an organization, funding sources and human resources are part of the resources as well (Ilhami & Achmad, 2023). Specifically, resources as financial instruments and efficient datasets play an role in power relations between actors (Micheli et al., 2020). In other words, the *power of resources* can affect policy making.

Fourth, *relational power* among actors can play a role in the data governance of policy making. Kask et al. (2022) show how the stakeholder network of mobility hubs is graphed. Many actors are interconnected with each other without directly influencing the hub policy making (Kask et al., 2022). Despite these connections, it does not directly provide actors with more power. The link between data sharing among actors provide more power through data distribution (Veeneman et al., 2018). This is done by reaching a mutual gain, which is part of network relations. Concluding, the relations between actors can provide mutual gains, which can have positive effects in policy making.

In the end, the power relations between actors varies from formal to relational power. The focus on power distribution is partly there to understand the data governance on the topic of data politics. Besides power relations, communication methods are part of data governance, which is discussed down below to better understand the 'action arena' of the IAD-Framework.

2.2 Theoretical frameworks

In this chapter, the theoretical frameworks of this research are introduced. First, policy design is introduced to explain how different frameworks are essential to understand the world around. Thereafter, the IAD-Framework and the PSM are introduced to explain the definitions and to link them to policy making. Essential elements are highlighted to understand the link between the frameworks and this research. Thereafter, the frameworks are discussed in relation to current scientific research on mobility hubs.

2.2.1 Policy Design

Change is a universal concept that happens in every sector in many different ways, for instance in social policies (Cerna, 2013). Policy change is often researched, but in practice the focus is sometimes on "what works" (Cerna, 2013, p. 13). When the practical decision differs from the theoretical framework, it does not always align with each other. Main theories on policy design are introduced to understand policy change and implementation (Cerna, 2013). Policy analysis provides information on existing policies to understand "objective characteristics and severity of policy problems" (Howlett, 2019, p. 15). The problems vary in sizes and topics, which asks for different methods to understand policy problem (Howlett, 2019). Because of differences in problems, from small to big, policy design can become more complex (Howlett, 2019). Creating public policies is difficult because of a lack of actor's capacities in resources and shifting power relations. Policy change can be researched by focusing on multi-level governance, which focuses on these resources and power (Cerna, 2013). However, multi-level governance research can be conducted in a variety of ways and this study presents some of the many strategies for understanding policy change.

Policy design using collaborative governance is suggested by Ansell and Gash (2008). The model exists of starting conditions, collaborative processes, facilitative leaderships, institutional designs and outcomes (Ansell & Gash, 2008). Each element of the model includes different governance phases. The starting conditions focus on power relations, prehistorical cooperation and conflicts. The collaborative process consists of a cycle of communication of which trust-building and shared understanding are part of. The institutional design explains the ground rules and participatory inclusiveness. The facilitative leadership explains the initiating actors of the policy design (Ansell & Gash, 2008). The policy outcome is the result of the earlier phases of design. By comparing collaborative governance to mobility policy making, the essence of having a public actor as leader of the policy design does fit. The Dutch governmental institutions create hub policies as public agency (Rongen et al., 2022). But the limitation of network governance is that participants of policy making "engage directly in decision making and are not merely consulted by public agencies" (Ansell & Gash, 2008, p.3). This is not the reality at mobility policy making. In fact, Arnold et al. (2023) have showed that community consultation around mobility hubs is part of decision making. This research on decision making of hubs in the Netherlands does not align with the assumptions of collaborative governance.

Where collaborative governance is useful to understand the collaboration between actors in policy making, governance networks are "enduring patterns of social relations between actors involved in dealing with a problem, policy or public service" (Klijn & Koppenjan, 2015, p. 4). For example, actors in policy making act inside networks in which power is distributed. According to Klijn and Koppenjan, governance networks differ from multi-level governance (2015). Governance networks focus on the governance inside networks of policy making. The focus is on the interaction between actors as organizations and public actors. On the other hand, multi-level governance focuses on the difficulty of the multiple stakeholders to reach positive results (Klijn and Koppenjan, 2015). Networks are seen as solution because networks let out hierarchical layers inside governmental organizations. Multiple networks are researched with the focus on governmental organizations. In this research, the focus is on discovering the data governance inside mobility policy making. It is not about the interaction, but about the actors inside the network.

The Institutional Analysis and Development Framework (IAD-framework) suggested by Elinor Ostrom focuses more on multi-level governance in policy making (2005). Institutions in the IAD-Framework are researched by focusing on the available information per actor, positions of actors and actions of actors in policy making (Ostrom, 2005). In other words, the diversity of actors in mobility

policy making can be researched using this framework. To add more value in this research, the Problem Solving Model of Wilson (PSM) is included (1999). The PSM formulates distinct stages where uncertainties of information influence the problem solving.

Concluding, theoretical frameworks have various focus points. This research uses the IAD-framework and the PSM to understand the mobility hub policy making. The models are explained down below, whereafter the link to scientific field is explained.

2.2.2 IAD-framework

To understand the data governance of the policy making process of mobility practices in Geldermalsen, the IAD-framework is introduced. The framework is an institutional theory which can identify:

- "Major types of structural variables that are present to some extent in all institutional arrangements, but whose values differ from one type of institutional arrangement to another." (Ostrom, 2019, p. 41)

In other words, to understand the data governance in mobility policy making in the case study of Geldermalsen, the crucial elements are aimed to be identified by using the IAD-framework. The IAD-Framework is a multilayer institutional framework that consists of exogenous variables, an action arena, the resulting patterns of interaction and their outcomes (Ostrom, 2005). The action arena is affected by rules-in-use, attributes of the community and physical and material conditions, which is shown in figure 1. The action arena itself consists of the action situation (e.g., set of participants, level of control, costs, and benefits) and the actors (e.g. resources and motivation) (Ostrom, 2005). Then, the action arena affects the patterns of interactions. The interactions affect the outcomes. Affecting both, the evaluative criteria is integrated (Ostrom, 2005). In the end, the outcomes of the framework indirectly influence the exogenous variables and action arena. Before explaining the framework on a deeper level, this research uses the Politicized IAD-framework (Whaley and Weatherhead, 2014). Because of the bigger political-economic context and discourses in policy making, their research add two extra variables. This is graphed in figure 2. Whaley and Weatherhead (2014) introduce power dynamics, contextual factors and the economic situation to understand policy making within context and power influences in a system. The action arena of the IAD-framework is then influenced by these added elements.

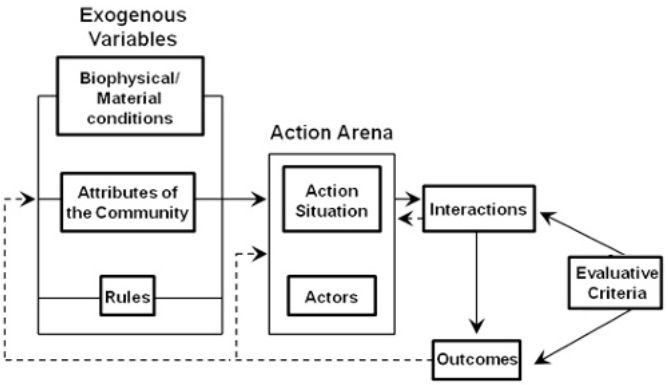

Figure 1: A framework for Institutional Analysis (Whaley & Weatherhead, 2014, p. 3).

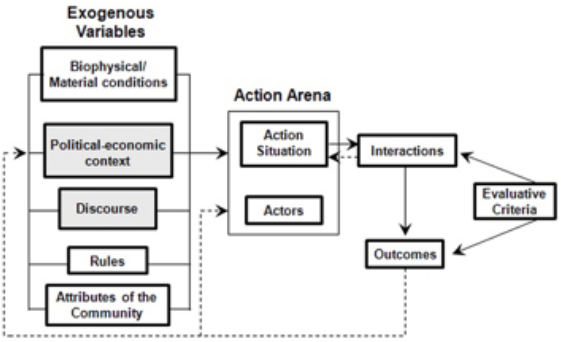

Figure 2: The politized IAD-framework (Whaley & Weatherhead, 2014, p. 4).

Exogenous variables

In this sub paragraph, the exogenous variables of the politicized IAD-framework are explained. Referring to the topic of this research, the variables are connected to specific types of data that are present in each domain of the factors. By doing so, the data flow becomes clear, which is part of the action arena.

The action arena is first affected by the "physical world and its transformations" (Ostrom et al., 1994, p. 44). The analyst can examine the biophysical conditions in asking the question how these conditions affect certain elements of the framework. Spatial factors can affect the rulemaking, information sets of situations and policy outcomes (Ostrom et al., 1994). It depends on the context of the analysis in which the spatial world affects the situation. The way how material conditions affect the policy making differs, originated from the cognitive component (Ostrom, 2005). Intrinsic values of

individuals, groups and systems overlap each other. Each layer has different values, leading to multiple understandings of spatial affects. In other words, the variable of biophysical and material conditions affects the action arena in multiple different ways. When relating types of data to the biophysical conditions, the geospatial data fits the variable. Geographic-Information-System (GIS) data explains the spatial context of the policy process (Liu & Dijk, 2022). The characteristics of the spatial environment show the access to certain resources in the action arena (Whaley & Weatherhead, 2014). In other words, the spatial environment of this research might affect the resource power of actors around the mobility hub Geldermalsen.

Second, the action arena is affected by the political-economic context. The focus of this variable is as follows:

- "The wider political and economic factors that directly or indirectly influence the behavior of participants in the action situation, but also to expand backward in time so as to understand the events and processes that have given rise to present-day conditions." (Whaley & Weatherhead, 2014, p. 5).

The role of the state and the market is integrated. Here the link to political sciences is made. The power distribution among actors cannot be made when this variable is not integrated (Whaley & Weatherhead, 2014). The power dynamics can have certain effects on the policy making, that are part of the political context. Specifically, the level of rulemaking and governance is remarked with this variable. By acknowledging the existence of differing governmental layers, the influence of higher rules can affect the more local policy making (Whaley & Weatherhead, 2014). In other words, the political and economic data is essential in researching the power dynamics between actors. The data governance in this research does focus on this, where this type of data is included.

The third exogenous variable of this research is the discourses affecting the process. Whaley and Weatherhead (2014) explain how differences in definitions of discourses are present.

- "An ensemble of ideas, concepts and categories trough which meaning is given to social and physical phenomena, and which is produced and reproduced through an identifiable set of practices." (Whaley & Weatherhead, 2014, p. 4)

Discourses provide a meaning to attributes, that act as social interpretation of events around us. The interpretation and discourses are interwoven with each other, as discussed in the politicized IAD-framework (Whaley & Weatherhead, 2014). By acknowledging differences in social interpretation, the position of actors is introduced. The position of actors helps to understand the available and limiting actors. In other words, the information on discourses enables researchers to investigate the role of actors in the process. This can help to understand the types of power distribution of data governance.

The fourth variable of the IAD-framework are the rules-in-the-game. The rules are part of the framework to show "all relevant aspects of the institutional context within which an action situation is located" (McGinnis, 2011, p. 175). For example, without an institutional context, a 13-year-old could drive a car at a high speed. But the institutional context forbids this in the action situation (Ostrom et al., 1994). "The rules are part of the underlying structure that shapes the representations we use" (Ostrom et al., 1994, p. 41). In other words, the world we conceive is affected by the unconscious existence of rules. Several types of rules exist, classified from position to authority rules. Each affects distinct parts of the action arena, which is shortly explained down below. Whaley and Weatherhead (2014) show that informal understandings are part of social interactions, where formal rules are "rules-on-paper" (McGinnis, 2011). In this research, the formal rules concerning mobility hubs are integrated. Connected to differing governmental layers, the mobility hub policies are investigated, where they are part of the action situation.

The final factor 'attributes of the community' covers "all relevant aspects of the social and cultural context within which an action situation is located" (McGinnis, 2011, p. 175). By focusing on the spatial characteristics of the structure, the possibility to self-organize is researched (Whaley & Weatherhead, 2014). The groups size, age, gender and functions are examples of these aspects or characteristics of the community. This affects the trust among actors, the power distribution, or the reciprocity of a group (McGinnis, 2011, p. 175). In relation to this research, the socio-demographic data explains some characteristics of the community. Also, the political structure is part of this, where city counsels, provincial and national parliaments all exist of differing individuals. In other words, multiple types of data come back in the variable of attributes of the community in which the action arena operates in.

Action arena

In this sub paragraph, the action arena of the IAD-framework is explained. The action situation and the actors are introduced to explain how the action arena operates. In this part, a few elements are introduced that are important for the relevance of the framework.

The action area consists of an action situation and the actors or participants (Ostrom, 2005). The interplay between both is affected by the described exogenous variables as rules-in-use and discourses. As shown in figure 1, the interplay results in an outcome. Because of the fact action arena can happen everywhere, from people's home to international counsels (Ostrom, 2005). In between the arenas, an interaction takes place. When referring to figure 1, the interaction between action arenas produces outcomes. In other words, the action arena is located in the middle of the process. To understand the action arena, the participants and the action situation are separately explained.

The actors or participants in the arena are the ones making decisions (Ostrom, 2005). To research actors in the action arena, the researcher has to make some assumptions concerning the following topics (Ostrom et al., 1994):

1. The preference of actors
2. Actors' information processing
3. Individual selection criteria
4. Actors' resources

To start with the actors' preferences, it is assumed that actors always aim for individual preferences related to the outcome (Ostrom et al., 1994). Every actor should have a preference, despite knowing how the situation is going to evolve. If a single actor has full information on actions, outcomes and preferences, this is not always the case. Therefore, the amount of information processing of actors needs to be studied. Additionally, bounded rationality explains the limitations in processing big amount of data (Ostrom et al., 1994). Third, the selection criteria explain what actors decide whether having all information or not. Deciding without having full information on one hand differs from deciding after a long study (Ostrom et al., 1994). Fourth, the individual resources focus on actors having the power to possess and process all data available. Also, budget and time problems are constraints that are faced (Ostrom et al, 1994). In other words, diverse types of data are part of the preferences and limitations of actors. To understand the action arena in this research, actors are researched in the document analysis to understand their role in existing documents and to what extent data information is used in the past.

The second part of the action arena, the action situation, is graphed in figure 3. In the top, exogenous variables are part of the input which affect the seven components of the action situation (Ostrom, 2005).

1. Participants
2. Positions
3. Actions
4. Information
5. Control
6. Potential outcomes
7. Net costs and benefits

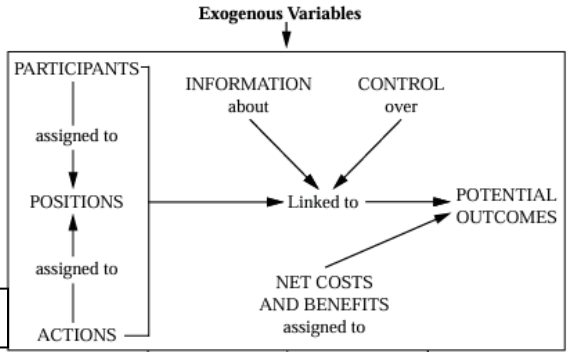

Figure 3: The structure of an action situation (Ostrom, 2005, p 33).

The working components of actions and participants connect to positions. The participants take action, use information and experience interaction to create an outcome. Lastly, net costs and benefits influence the potential outcomes as well. In other words, all seven components are essential in the action situation. Each of the working components have values which are affected by specific rules (McGiggis, 2011). These rules are the outcome of earlier interaction in action situations. An example is the position rule, that "specify a set of positions, each of which has a unique combination of resources, opportunities, preferences and responsibilities" (McGiggis, 2011, p. 174). The position rule affects the position working component of the action situation. In policy making, decision makers, advisory organs, researchers and civil organizations are positioned next to each other. A second example are the information rules, which explains the information available to each position (McGiggis, 2011). In combination with the authority rules, which affect the set of actions that are assigned to certain positions,

the information rules affect the decision making process. Figure 4 shows all rules that affect the behaviour of a single participant. In other words, the action situation can be split up in seven working elements each having own specifying rules.

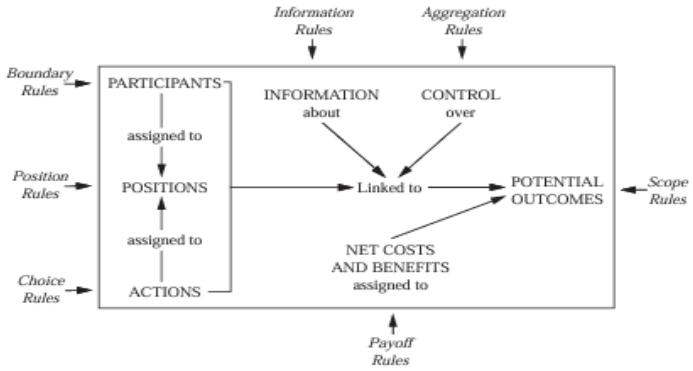

Figure 4: Rules affecting working components action situation (Ostrom, 2005, p. 206).

Relevance of framework

As mentioned above, this research focuses on the data governance in policy making of mobility hubs affecting Geldermalsen. The literature review discusses the identification of data (sets), that align with the *information rules* that are part of the action situation. Thereafter, the element of power is introduced to understand the power balances in the action arena of the IAD-framework. This comes back as *position rules* and *authority rules* that are part of the action situation. The last focus point of this research is on the interaction between actors, which is part of the actors in the action arena.

The IAD-framework of Ostrom aims to explain how institutions are interconnected to each other (Ostrom, 2005). The action arena shows the positioning in which actors are put in a certain social context. The concept of an arena suggests that each institution is conditioned with ideas and discourses which vary per specific incident or context. The position of actors in the IAD-framework is where my research refers to. The "authorized actions" of actors explain the position that are "conceived as anonymous slots in which participants can move" (Whaley & Weatherhead, 2014, p. 5). The idea of actor's position results in a dynamic interplay with an "argumentative exchange". To understand this exchange in action arenas, it has to be clear that not every arena is the same. The structure of the arena can vary from formal settings to informal situations (Ostrom, 2005).

Concluding, when researching the mobility policy making arena using the IAD-framework, it is essential to understand the structure of the arena. In this research, the interaction between actors in the mobility policy arena is studied by identifying the communication methods between actors.

Communication methods

The communication channels and the type of communication can be assumed to be present in action situations (Ostrom, 2005). The amount of information for actors in the arena is related to the communication levels. Sharing information, such as problems, can help to "achieve a common understanding of the problems jointly faced" (Ostrom, 2005, p. 65). Sharing norms and trust of participants or actors can influence the action behaviour. In other words, the role of information is linked to communication methods, which makes it important to focus on in this research.

The first communication method researched are open meetings. When operating as a public institution, open governing focuses on meetings that are open for the public (Barrett, 1985). When looking at decision making for example, politicians can operate in the open to try to solve societal problems (Ostrom et al., 1994). But meetings can also be open to other institutions than the public. Open access to resources is part of an open society in which individuals can make their own rules, but multi-level governance research can be conducted in a variety of ways. This research introduces some of the many strategies for understanding policy change (Ostrom et al., 1994). Additionally, every actor in an open market is linked to full information, where they have all the information needed to decide what to do. In other words, open meetings can vary in separate ways. This research studies the open meetings that are present in policy making to understand the structure of policy making in the case study in Geldermalsen.

In decision making, existing research shows that informal meetings between actors can occur (Barrett, 1985). Barrett states that informal discussions between a few politicians do not directly influence policy making. However, the fact that informal gatherings are purposed to discuss policy topics means that there is a link between informal meetings and policy making. Where formal policy

making is aimed for, the Congress in the USA, studied by Barrett, states that decision making should be open for the public. That is why informal meetings are often let out in official documents (Barrett, 1985).

Third, to reach an open decision making process, governmental institutions should try to include public participation (Barrett, 1987).

- "Openness increases government responsiveness to the needs of the general public by allowing the public to compete." (Barrett, 1987, p. 1196)

The public groups that take part in policy making can try to show the needs of the public. It can increase the quality of work of governmental policy makers (Barrett, 1987). Because governmental organizations own all kinds of confidential information and integrated information on public needs, information and public participation are linked to one another. Concluding, this research investigates the role of public participation in policy and decision making.

The increase of online platform usages forms the bases for digital platforms to provide a variety of content for its users (Nooren et al., 2018). Digital platforms are a suitable location to show public interests, which align with public participation. Digital platforms can put pressure on "existing government policies for stimulating innovation and economic development" (Nooren et al., 2018, p. 265). In other words, policy making can be affected by digital platforms, but digital platforms can also act as place for communication method between individuals.

As final remarks, the type of communication methods between actors is outlined to try to understand the linkage between multiple action situations.

2.2.3 Problem Solving Model

Adding to the IAD-framework, the PSM of Wilson is given (1999). As mentioned before, the IAD-framework does not separate divergent phases of policy making inside the action arena. Multiple researchers highlight how the IAD-framework separates policy formulation and decision making, but it does not explain how data or information is integrated in the model with multiple arenas. The PSM is used as framework to create a link with information and distinct phases of policy forming. The PSM of Wilson (1999) starts with the researcher asking how uncertainty is part of Information Retrieval systems (IR-systems). IR-systems are explained in the following way:

- "It is suggested that these models address issues at various levels of information behaviour and that they can be related by envisaging a 'nesting' of models." (Wilson, 1999, p.249)

In other words, the IR-systems structure information behaviour of organizations to understand the problems by splitting up elements of IR into different models. The PSM of Wilson is one of these models, where it focuses on the element of uncertainty inside information behaviour. Uncertainty in information seeking and retrieval is always there for the "users" in information behaviour (Wilson, 1999, p. 265). Wilson refers to communication activities to understand uncertainty better. Communication is seen as an evolving structure in which "learned responses to strain" are experienced (Wilson, 1999, p.265). And when communication is practiced in information seeking, the uncertainty is part of the conditions of the practice. According to Wilson, the cause for the existence of uncertainty relies in problems. Referring to Schutz and Luckmann (1974), when facing problems, the person experiences a problematic situation. Wilson states that by finding solutions for a problematic situation, the uncertainty becomes more a certainty (Wilson, 1999). The goal of the problem is to solve the "advance of uncertainty" (Wilson, 1999, p.265). Figure 5 shows how identifying the problem of uncertainty evolves into the solution statement, with uncertainty resolutions on the way.

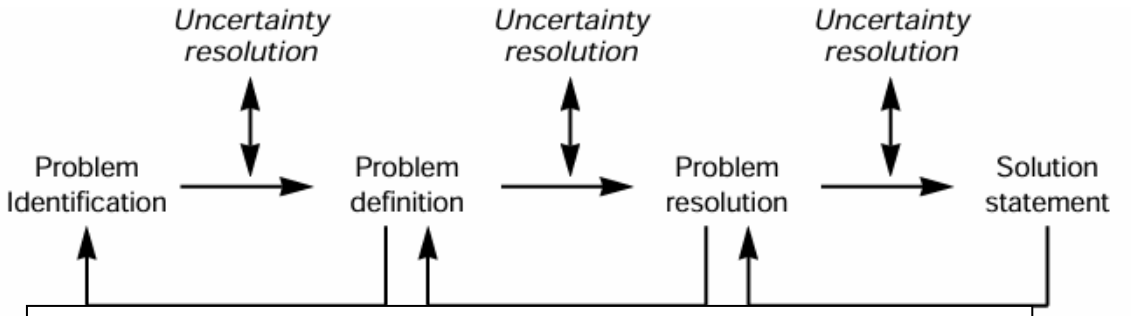

Figure 5: A Problem Solving model of the information seeking and searching process

In the route to the goal of problem solving, multiple stages are recognizable for individuals (Wilson, 1999, p. 266).

- Problem Identification
- Problem Definition
- Problem Resolution
- Solution Statement

The problem identification focuses on the sort of the problem. Questions on the kind of the problem can be asked (Wilson, 1999). Thereafter, the problem definition tries to question the "nature of the problem" (Wilson, 1999, p. 266). Understanding the elements of the problem helps to produce methods that consequently create a solution. The problem resolution then focuses on the methodology to find an answer to the problem. If a resolution exists, the solution statement explains "how we are going to deal with the problem" (Wilson, 1999, p. 266). This can be seen in figure 5, where it shows how uncertainty is solved. Also, if the resolution of the uncertainty is not found, the feedback mechanisms can set someone back a stage.

Concluding, the problem solving happens in four stages where the uncertainty should decrease and resolute per stage. The uncertainty relies in information seeking, where the problem of uncertainty occurs. In an effort to link the stages of PSM to mobility hub policies, this research includes the stages in the coding process to understand what phases of policy making are experienced in the recent history regarding mobility hubs.

Policy formulation and decision making

As mentioned above, in policy making a diversity of actors is integrated. However, not every actor is situated in the same stage of policy making. Each of the actors experience individual information seeking stages in decision making (Berryman, 2006). The research of Berryman explains how information seeking is done while forming a decision. But, according to Almeida and Báscolo (2006), differences are recognizable between stages of policy making. Almeida and Báscolo (2006) highlight that due to the complexity of policy making, actors vary in strategies in addressing the problems in knowledge seeking. Decisive actors in policy making can have different fundamental methods to address information seeking than for instance policy makers (Almeida and Báscolo, 2006). In their research, information seeking is referred to as knowledge transfer, as it means using information in decision forming. This research separates the two stages of policy making - policy making and decision making. Due to the political context of an actor and relationship towards the problem, the strategy of information seeking can vary (Almeida and Báscolo, 2006). This research states that the interaction between researchers in policy making and decisive actors can be part of the reason to have different strategies to address problems. Also, the consensus between actors inside the stages is part of information seeking (Ford et al., 1999). The focus on the interaction between actors of both stages, but also the focus on consensuses inside the policy stage are present. In other words, the PSM of Wilson (1999) can change regarding the actors in policy making. The policy making of policy formulation and decision making include other actors, which means that different information transfer can be present. This research separates policy formulation and decision making.

The stages of the PSM are used in this research to understand the information seeking inside the data use of policy formulation and decision making. The information seeking differs per actor and per stage. When a particular stakeholder is involved in forming a problem definition, the way in which information is sought is different from that of an actor involved in forming solution statements. Ultimately, uncertainty is reduced in further phases of the model. The PSM compares the phases in the document analysis to gain insight into which actors are involved in which phase. General characteristics per stage are also highlighted. Based on the information collected by the problem solving model, an overview can be made of which actors are involved in which phase that are part of the Geldermalsen hub. Then, the stages of decision making and policy formulation from the IAD can be compared with the stages of the PSM to better understand the actor's positioning around Geldermalsen.

2.2.4 Research Gap

In the critical review, the topics of data governance and mobility hubs are introduced. Thereafter, the theoretical frameworks of IAD and PSM are outlined to discuss the link to policy making. The elaborative discussion shows the foundations for the research gap this research tries to fill in.

Previous research has shown that differences in policy making and decision-making are present in information seeking (Almeida & Báscolo, 2006). Within these processes, information is used to make choices. New developments in the field of data are less researched (Liu & Dijk, 2022). Possibilities of new data sources for information-based policy making are proposed. Therefore, Liu & Dijk (2022) propose certain directions of traditional data and new big data as effective tools. These researchers ask for further research into policy practitioners to gain experiences around data use. This is where this research steps in trying to add knowledge on data flows within policy formulation and decision making. Previous research has similarly exposed data governance with data sharing and data types, but no study is previously conducted that summarizes data flows in multiple policy phases (Kask et al., 2022). On the one hand, this research tries to describe what data is used and what the data governance looks like around hubs. On the other hand, it adds knowledge on collecting more practical data of policy making and decision making. This is done by doing a case study in the city of Geldermalsen.

2.3 Conceptual framework

The conceptual framework of this research is shown in figure 6. The image shows the discussed relationships between the most important themes from the literature review and the theoretical background. On the left this conceptual framework the exogenous variables, such as biophysical/materials and rules-in-use. Each variable affects the action arenas in a different way. The focus point of this research relies on the role of data information interwoven in the factors. For example, the data information can be connected to the spatial design that affects decision making of stakeholders. The flow of data begins on the left and results in differences in the action arena of decision making. Second, the policy formulation and the decision making arenas are presented. Both arenas exist of actors and actor situations in which the context of the policy making changes. The first sub question of this research focuses on the actors present in both arenas. Besides that, each actor has changing actor situations. Also, the actor situation changes between policy formulation and decision making, what is researched in sub questions 2 and 3. In this model, interaction is added, which investigates the data flow between arenas. This is researched in sub question 4. For example, policy proposals from the policy formulation affect decision making arena. The other way around decision making data can influence the policy formulation. Each arrow inside the action arenas and in between is researched. In the end, the policy outcome after decision making affect the empirical world. Because focusing on a data flow towards policy outcomes and effects of this policy is different research, the arrow towards policy outcomes is interrupted.

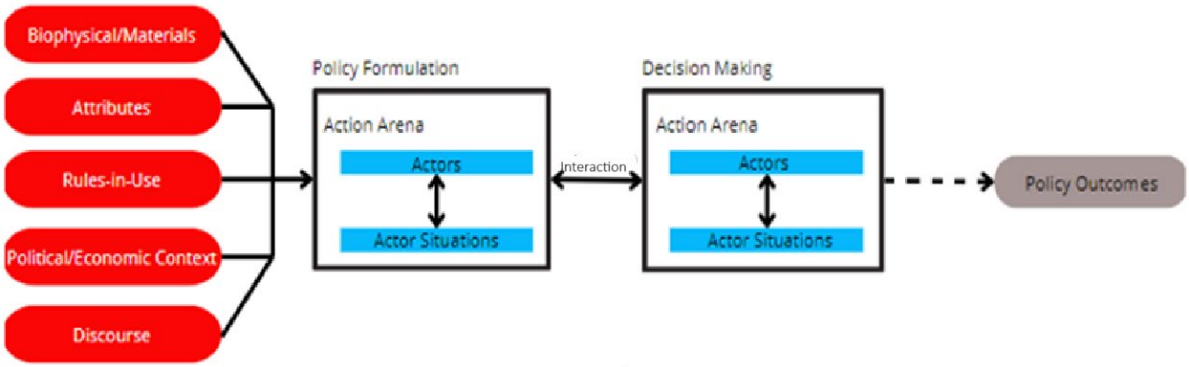

Figure 6: Conceptual Model (Own creating)

2.4 Operationalization

In this research, two theoretical frameworks are introduced and discussed in their relevance. Because the literature review and the theoretical frameworks are explained very deeply, the operationalization of the research summarizes the essential themes of the study that are integrated in the resulting part. The sub questions of the research each cover other parts of the research. The codes and code groups, as shown in table 1, form the foundation of the codebook, which is included in the appendix in chapter 8. The full code book does show all code groups, codes and subcodes.

The code group of rules-in-use is part of the document analysis. The codes that are part of the document analysis are discussed above in the literature review. The actor's role and barriers are identified using the actor's typology. Adding to this, the integrated data explains the usage of certain domains of data in existing policies. Lastly, the policy process is researched, in which statements of mobility hub policies fit to specific stages of the PSM.

The code groups 'policy formulation' and 'decision making' cover the same types of codes. First, inside both policy phases or arena's, the involved actors are identified. Thereafter, the interviewed actors are questioned to understand the power they have in policy or decision making. Third, the integrated data and datasets are identified in both arenas. Fourth, the topic of communication methods is researched to show what platforms and meetings are used in between actors. Last, the spatial level of policy formulation and decision making is researched to understand in what governmental layer the process is taking place.

The code group covering the interaction between the policy arenas includes the same codes as the code groups that are mentioned above. However, the code of 'actors identification' is let out of the research. This is because all actors are placed in one of the two action arenas. Therefore, no actor can be identified inside the interaction between arenas.

Code groups	**Codes**
Rules-in-use	Actors' typology
	Integrated data
	Policy process
Policy Formulation	Actors' identification of policy formulation
	Actors power in policy formulation
	Integrated data in policy formulation
	Dataset identification in policy formulation
	Communication methods in policy formulation
	Spatial level of policy formulation
Decision Making	Actors' identification in decision making
	Actors power in decision making
	Integrated data in decision making
	Dataset identification in decision making
	Communication methods in decision making
	Spatial level of decision making
Inter-arena dynamics	Actors power between arena's
	Integrated data between arena's
	Dataset identification between arena's
	Communication methods between arena's
	Spatial level between arena's

Table 1: Operationalization of the literature review

3. Methodology

In this part, this part includes the explanation of the methodology that this research uses. First, in 3.1 the research strategy is outlined. Thereafter the methods are introduced in 3.2, which are semi-structured interviews and a document analysis. Finally, chapter 3.3 integrates the validity and reliability of the research.

3.1 Research strategy

To collect data that can answer research questions, scientific research requires appropriate strategies. In research, qualitative and quantitative approaches are strategies to use in scientific research. In qualitative research, the goal is to build a theory from what is observed. In quantitative research, the goal is to evaluate an existing theory (Van Thiel, 2014, p. 151). In this research, qualitative research is chosen. In qualitative research, theoretical relationships are explored in advance. However, the research perspective begins with a clean slate, after which the observations form the theoretical connections that can answer the research question (Van Thiel, 2014, p. 151). Qualitative data is not hierarchically ordered, unstructured and it is hard to circumscribe. However, qualitative analysis faces the same phases of research as quantitative studies. These are data collection, data ordering and data analysis (Van Thiel, 2014, p. 151).

To achieve data saturation in data collection, qualitative methods research can be conducted using multiple sources, which is called data triangulation (Thurmond, 2001). Data triangulation ensures construct validity, which is only achieved when multiple sources reach the same conclusions (Yin, 1984). If multiple data sources answer different questions, it is not called data triangulation. In this research, interviews are combined with a document analysis. Both answer overlapping questions, which fits the data triangulation focus point. The interviews and the document analysis are specified on a single case, the city of Geldermalsen.

The case study approach discussed by Yin is used in research to ‘contribute to our knowledge of individual, group, organizational, social, political, and related phenomena (Yin, 1984). Case studies highlight the real-world context of specific relationships between issues under study (Stake, 2005). By focusing on the case background, local politics, and social groups, the structure behind a case is learned. Case study research is possible using a sole case, but also by doing a multiple case study (Yin, 1984). Multiple cases are more "compelling" and "robust" in the way the data are related to each other (Yin, 1984, p. 91). However, the sole case study can be used evaluating a single experiment or theory. The importance of clear distinction between the case and the theory is needed (Van Thiel, 2014, p. 89). The field of research need to fit the selected case. Because this case is not often unique, the research domain or field is put in the bigger context of mobility hubs. The single case of Geldermalsen acts as “representative” choice, which means the objective is to “capture the circumstances and conditions of an everyday or commonplace situation” (Yin, 1984, p. 42). Following this up, the theory needs specific propositions that are based on older thoughts or theories (Yin, 1984). By evaluating a single case, the theory is tested in a local context to confirm it, or to suggest adaptations to the theory. In this research, splitting the ‘action arena’ of the IAD-Framework is a theory in the context of mobility hubs which is tested.

Research Paradigm

Each researcher has his or her own view of the relationship between research objects and opinions. This research is based on the constructivist view of knowledge. According to Amineh and Asl (2015), constructivists view knowledge as something that a person actively perceives by constructing the meaning of it. What people already know is important because it can improve their understanding of topics. With practice, people have the contextual and concrete strategies to learn better (Fosnot, 2023). The facilitator provides information where people themselves take the autonomy in "ownership of the ideas" (Fosnot, 2013, p. 1920). The knowledge and ideas exist only in the mind of a person. It is about what is already known and the proportion of new knowledge (Amineh and Asl, 2015). Social constructivists stated that cultural background and social position are central to the perception of information. This changes the insights per person (Amineh and Asl, 2015). By doing a stakeholder

analysis in combination with interviews, the personal background is highlighted. The focus on personal insights correlates with the constructivists perspective.

3.2 The case: Geldermalsen

Because this research involves a single case study, a representative case is chosen (Yin, 1984). By choosing the representative case, the case study is used as an example as one of the many cases in the research field. For example, the sole case of a train station among all other train stations in the Netherlands. Using this methodology, lessons learned are informative for similar cases (Yin, 1984). The selected mobility hub must be one of the many, whereas it also needs to fit the scope of the research.

The size of the mobility hub is an important criterion because this research focuses on smaller mobility hubs. In this study, only one of the 342 municipalities in the Netherlands is examined (Ministry of BZK, 2024). Related to the topic, the respective municipality in the case study needs to fit the research scope. These are the presence of a train station, a position in a rural area and having mobility hub aspirations. In national to local policies the train station of Geldermalsen, located in the municipality West Betuwe, is introduced as new mobility hub. This train station acts as an important hub within the city and regional network, which is explained below.

Typology of mobility hubs

The Netherlands has thousands of bus stops and hundreds of train stations, but each is unique in size and use. As described in the literature review, not every station meets the criteria to be classified as a mobility hub. This research focuses on the Province of Gelderland, whose report (Provincie Gelderland, 2020) introduces diverse types of mobility hubs. Six hubs are identified in this document: urban hubs, suburban hubs, regional hubs, rural hubs, neighborhood hubs, and logistics hubs. These are shown in figure 7. In accordance with representativity of the case (Yin, 1984), the station in Geldermalsen is positioned among many other railway stations in the same typology: regional hubs. Regional hubs are hubs in smaller cities, where the focus is on commuters who drive to the station and then use public transport for the rest of the trip (Provincie Gelderland, 2020). Figure 7 shows that regional hubs are located in a rural context, with links to cities and inter-regional areas. Rural and neighborhood hubs are more focused on the local perspective. The regional hub focuses on the connection between the smaller city and the larger region in which it is located. Related to the regions around, West Betuwe has a low population density (CBS, 2024). The municipality of West Betuwe in which Geldermalsen is located, is located in between the more densified region of the Randstad and the cities of Den Bosch and Eindhoven in the province of Brabant, as you can see in figure 8 and 9.

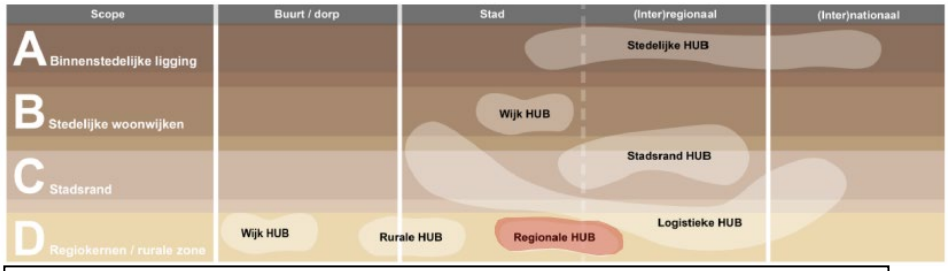

Figure 7: Typology of hubs in Gelderland. (Province of Gelderland, 2020).

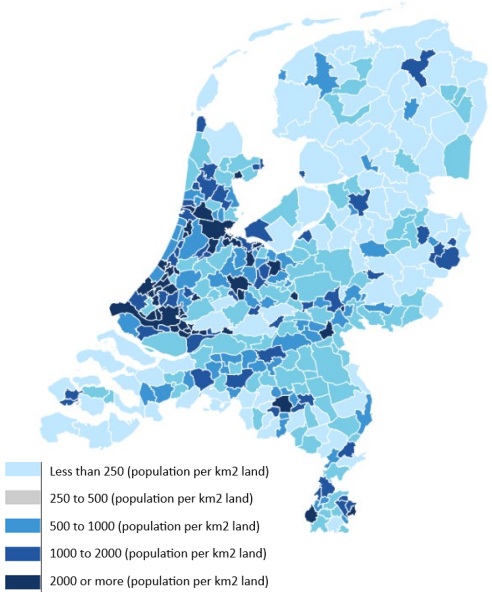

Figure 8: Population density in the Netherlands. (CBS, 2024).

Introduction of Geldermalsen, West Betuwe

The municipality of West Betuwe is located in the western part of province of Gelderland in the Betuwe region (see figure 9). This municipality consists of 26 villages, ranging from small groups of houses to the largest village, Geldermalsen (see figure 10). The total area is about 229 square kilometers (AlleCijfers, 2024). The total population of the municipality in 2023 is 52720 inhabitants with a density

of 470 households per square kilometer. The city of Geldermalsen has about 11000 inhabitants (Gemeente West Betuwe, 2024).

Figure 9: Historical map of Gelderland (Kadaster, 2023)

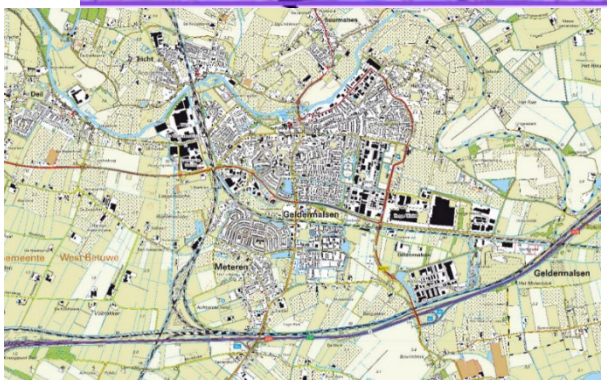

Figure 10: City map of Geldermalsen (Kadaster, 2023)

Mobility in Geldermalsen

As shown in figure 11, travel distances in the western part of the Netherlands are far less than other regions in the Netherlands. Despite this fact, citizens living in the rural area between urban cities of Utrecht in the north and ‘s Hertogenbosch in the south have longer the travel distances than the surrounding regions. The rail and highway network of the Netherlands connects the rural to the urban areas, which is shown in figure 12. For example, Geldermalsen is located on the trainline between Utrecht en ‘s Hertogenbosch (figure 12). Also, Geldermalsen is surrounded by auto hightways as the A2 and the A15 (figure 13). The highway and railway are nearby, so many residents can drive longer distances to their daily jobs.

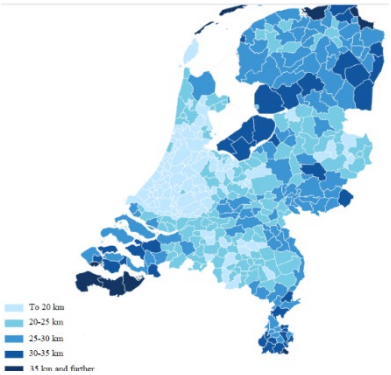

Figure 11: Travel distance employees and their jobs (CBS, 2018).

Figure 12: Train network around Geldermalsen (NS, 2021).

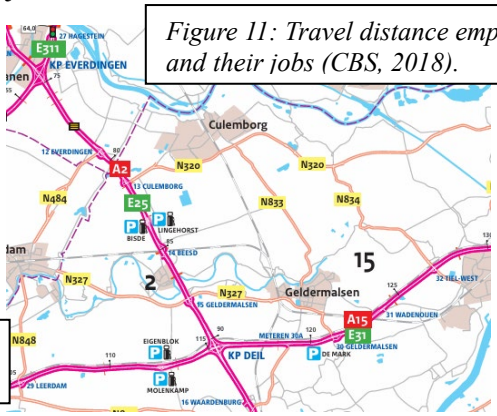

Figure 13: Road network around Geldermalsen (Rijkswaterstaat, 2013).

Since the capacity of the road and rail network determines how commuters travel, it is also important to show that Geldermalsen station does not only serve residents, but also serve as a transfer point for people to change modes of transportation. As mentioned in the literature review, mobility hubs act as a central point in a trip. It is at these locations that people change modes of transportation. The first and last mile transport of both stations show which vehicle is used to get to and from the station. According to Regio Rivierenland (2023), which is a collaboration between municipalities in the Betuwe, passengers from Geldermalsen use a car 30 percent of the time to get to the train station. This shows that the car is an especially important means of transport in the city. Where West Betuwe is part of the Rivierenland region, this organization aims to change the mode of transportation from car-oriented to more sustainable modes such as the train (Regio Rivierenland, 2023).

Transport Policy in Geldermalsen

To understand the future transport policy in Geldermalsen, it is necessary to describe the current situation. In recent years, the railway station area was transformed from a normal railway station to a regional mobility hub. The municipality of West Betuwe introduced the redevelopment plans in 2019 with the Lingense Alliance (Mobilis, 2022). The plan was part of the national high-frequency rail transport in the Netherlands, which aimed to increase the number of trains per hour from four to six per direction. This improved connections to larger urban areas such as the Randstad (Mobilis, 2022). The station of Geldermalsen was not ready to handle this number of trains, as in addition to the Amsterdam-Utrecht-Eindhoven line, the MerwedeLingelijn from Dordrecht to Geldermalsen also used the same train platforms. The Alliance's project is called Railway Environment Geldermalsen (Mobilis, 2022). In addition to an extra platform, a new pedestrian tunnel was built. Third, a new waiting room was created inside the old station building. The station serves as a transfer station between different train lines, but also for other modes of transportation such as cars. The redevelopment project is completed in 2022, but new mobility plans were already introduced by the municipality to transform the station into a mobility hub. The city's mobility vision introduced the goal of becoming a regional mobility hub (Mobycon, 2020).

One of the city's goals is to become a healthier place, which can be achieved through bicycle infrastructure. According to Mobycon (2020), a shift to cycling as a means of transportation also contributes to this goal. The Mobility Vision is the first to mention how the station can become a mobility hub. Despite the ongoing redevelopment at the time, the municipality aimed for new park and ride facilities and shared mobility (Mobycon, 2020; Gemeente West Betuwe, 2022). The increase of modes at the station makes it possible to define it as a mobility hub, as mentioned in the literature review. The change of modes is also part of the goal to become even more of a transfer station, making it easier for commuters to change modes. The environmental vision for 2040, introduced in 2022, proposes additional (shared) bicycles and cars, e-bikes and (hub) taxis (Gemeente West Betuwe, 2022). The additional means of transport make it more attractive for commuters to travel in a healthier and more sustainable way. The new bicycle hub in 2022 introduced the new free, shared bicycles to make the last trip to work in a healthy and sustainable way (Slimschoonrivierenland, 2022). This project worked out the goal to become a mobility hub, where the first official 'hub' was introduced in Geldermalsen in 2022.

In the future, the municipality of West Betuwe wants to become part of the intercity route between Utrecht and Den-Bosch. At this time, this is done with sprinters, which goes from station to station. Skipping Geldermalsen, an intercity stops only at larger stations (Gemeente West Betuwe, 2022). The environmental vision states that if Geldermalsen becomes an intercity station, it can boost the local economy even more.

Mobility hub policies affecting Geldermalsen

As mentioned above, the mobility vision and mobility agenda of the municipality West Betuwe introduced the mobility hub as a policy goal (Mobycon, 2020; Gemeente West Betuwe, 2022). But provincial and national mobility policies can affect the policy making and decision making on the local level.

The provincial government of Gelderland have introduced mobility hubs in the mobility policies of “Visie voor een Bereikbaar Gelderland” (Vision for an accessible Gelderland) and the “Gelderse Klimaatplan” (Gelders Climateplan) (Provincie Gelderland, 2020; Provincie Gelderland, 2022). In these documents, special nodes or hubs are suggested where travelers can change their mode of transport

(Province Gelderland, 2020). The hubs should become changing points. “You can park your bike easily, the electric car can be charged and there is a place to work.” (Provincie Gelderland, 2020). The vision itself aims to serve as tool for sustainable, safe and good accessibility. The provincial climate plan introduces for the period of 2021-2030 the plans for reducing emissions in the province (Provincie Gelderland, 2022). The policy document shows how the domain of mobility needs to reduce 2.6 MtCO2 of emission between 2017 and 2030. Part of the solution are flexible hubs, which aligns with the mobility vision of Gelderland (Provincie Gelderland, 2022). Mobility hubs are required to be part of the emission reduction. The provincial mobility vision refers to the station of Geldermalsen as place to attract people to travel smarter and cleaner, as you can see in figure 14 (Provincie Gelderland, 2020). Arriving by train, chatting with coffee, getting a shared bike, choosing a mode of transport, all can be done at train station Geldermalsen since it has become a hub.

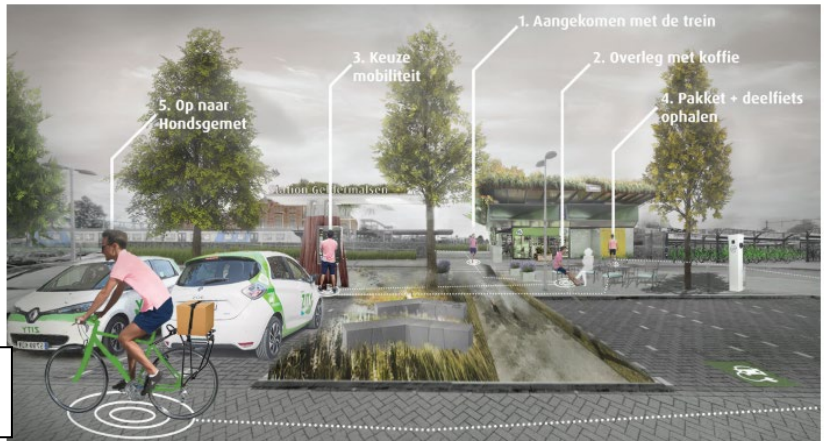

Figure 14: Attract travelers in Geldermalsen to travel sustainable and smart (Province of Gelderland, 2020).

The national mobility policies that introduced mobility hubs as policy instrument differ between environmental plans to accessibility documents from the Ministry of IWM. Inside the mobility vision of 2050, hubs are integrated as solution to connect all strengths of modalities. The efficiency of available space in the network forces to fit the supply and demand of mobility better (Ministry of IWM, 2023). Opportunities for hubs in rural areas are explained, which fits the Geldermalsen case. Second, the Climate Agreement of 2019 have already focused how mobility hubs serve as central node points in logistic chains of mobility (Rijksoverheid, 2019). Changing from cars to public transport need to be attractive and made easy, which is part of the case of Geldermalsen. Third, the “Ontwikkelagenda Toekomstbeeld OV” (Development Agenda Future Vision Public Transport) focuses on the role of hubs as part of a societal solution, which can connect diverse societal issues into one policy goal (Ministry of IWM, 2021). The document define hubs “as switch in mobility chains and meeting place” (Ministry of IWM, 2021). The vision describes how rural areas can use mobility hubs in potential, which fits the case of Geldermalsen. Lastly, the ‘Beleidsoverzicht en Factsheets Beleidsinstrumenten’ (Policy overview and Factsheets Policy instruments) shows how regulating instruments affect the train stations in the Netherlands (PBL, 2023). For example, cycling infrastructure is discussed which is part of mobility hubs. In other words, this policy document is important in researching mobility hubs in the Netherlands.

Data governance in West Betuwe

As final remarks, in this chapter there is no reference made to the current data usage of local policy makers in Geldermalsen. The document analysis in chapter 4.1 studies the data identification of domains that are present in mobility policies affecting Geldermalsen. Also, actors participating in local policy making are researched. Thereafter, the usage of data, types of datasets, actors power and other elements of data governance are researched inside Geldermalsen. In other words, governmental characteristics of power relations and known data flows in policies are highlighted in other part of this research.

3.3 Research Methods, Data Collection and Data Analysis

In this chapter introduces the research methods, which split up the phases of data collection and data analysis. First, the research introduces a document analysis, whereafter semi-structured interviews are explained.

3.3.1 Document Analysis

The research includes a document analysis to investigate the use of data information in mobility hub policies. Existing policies are studied to understand the process of policy making around the concept of mobility hubs. A document analysis is a “systematic procedure for review or evaluating documents”

(Bowen, 2009, p. 27). As other qualitative methods, it aims to "elicit meanings, gain understanding and develop empirical knowledge". Bowen states that documents act as social facts, which means documents experienced through phases of design in which sharing and reproducing is part of. The existing mobility policies experienced the policy cycle in which different actors put in their data information. The researcher is able to combine multiple insights to study convergence and corroboration between the different data sources (Bowen, 2009). Due to the different political levels of policy and distinct roles of actors in policy making, multi-actor analysis is chosen remarking the differentiation of national, provincial and municipal levels.

Data preparation

Multi-actor analysis uses analytical tools to examine specific policy documents related to the research topics. Normally, multi-actor analysis is done with stakeholders that are not hierarchically ordered (Enserink et al., 2022). In this research, the government actors are structured, but they are effective on various levels and therefore still operationalize on a multi-actor level. Each governmental institution is free to create its own policies (Enserink et al., 2022). The governmental layers each have introduced mobility hub related policies for the coming years. Therefore, at least two specific documents per level are studied.

This research investigates local policies of the municipality of West Betuwe, in which Geldermalsen is located in. The mobility agenda of 2021-2025 in Geldermalsen is the major focus (Gemeente West Betuwe, 2021). This policy includes the upcoming agenda points related to mobility issues in the municipality. These policies and goals describe the future and current state of the station area in the city. Besides local documents as the mobility agenda, the province of Gelderland introduced mobility hubs in Gelderland (Provincie Gelderland, 2020), which discusses different types of hubs. It provides examples of how cities fit to certain typologies. Finally, the national government introduced the mobility vision for 2050, which discusses national goals for the next decades (Ministry of IWM, 2021). Each layer, from local to international, is researched by including multiple mobility policies including mobility hubs.

Data collection

According to Bowen (2009), multiple strategies exist to analyze documents. First, content analysis focuses on processing information into "categories related to the central questions of the research" (p. 7). Bowen discusses how content analysis can serve as a first step in policy or document analysis. Inside the text, quotes are highlighted that fit the research focus. But in this research, thematic analysis is done. Fereday and Muir-Cochrane (2006) explain how this strategy involves rereading and multiple iterative rounds of analyzing. The strategy forces the researcher to look much deeper into the text. It involves codes, which are identified as themes for the research. Using the thematic analysis, the documents are part of the total of integrated data, where the general themes are used in other methods as well.

The included main themes of codes focus on the phases of the policy process. The problem identification to the solving statement identify differences inside policy design. Second, the actor's typology is researched focusing on actors identification. That is to show which actors contributed to mobility hub policies. Thereafter, the identification of actors form the foundation for contacting interviewees for the research. Third, the integrated data inside mobility policies focusing hubs separated themes of data, such as environmental data, geospatial data and economic data. The identified data domains form the basis for the major themes used in the analysis of the interviews.

3.3.2 Semi-structured Interviews

The second method of data triangulation in this study is in-depth interviews. DiCicco-Bloom and Crabtree (2006) explain that less structured interviews provide the deeper motivations and experiences of the interviewees. Learning from experiences helps to learn new connections between subgroups and issues. In this research, semi-structured interviews are chosen to allow space for the interviewee to provide insights other than what is known. Understanding the actors use of data fits the inductive perspective (Clifton and Handy, 2005). Surveys provide the numbers, while interviews provide more insight into the background stories. It helps "penetrating below the superficial question-and-answer format" (Richardson et al., 1995, p. 64). Descriptive surveys are not usable to find the opinion of commuters, in-depth interviews can.

Data preparation

The first step in preparing for interviews is the sampling stage. Given that there are fewer interviews than surveys, heterogeneity among respondents is important to be able to contribute to future research (Robinson, 2013). Heterogeneity is the representation of all sub-groups of the target population. Due to the big target population in policy design and decision making, the case requires at least 10 interviews for validity. This means that the 12 actors who are interviewed, participate in policy making. To match the requirement of representation of the target group, stratified sampling is chosen (Richardson et al., 1995). Stratification focuses on spreading interviews evenly among one or two chosen variables. In this research, policy phases and spatial scales are used for stratification. The document analysis separates included actors in policy design of mobility polices into phases of policy design. Interviewed actors represent both policy phases, which are policy formulation and decision making. Adding to stratification, snowball sampling is used to find respectable interviewees. The most important institution, the national government, is first interviewed by interviewing the Knowledge Institution of Mobility (KIM), which is part of the respective ministry. The snowball sampling results in new contacts from the national to more local levels (Van Thiel, 2014, p 199). The different scales of governmental institutions help to learn about the perception towards tools inside policy making. Finally, the advising actors in policy formulation are contacted directly by emailing the organizations, such as ROCOV and academia.

To have a prominent level of information saturation, open questions are formed related to 5 central themes, which is the basis in the interview guide. Earlier policy making, future policy making, structuring data, improvements for data collection and collaborations are the major themes. They connect phases of the IAD-Framework into one questionnaire. Each concept is worked out into different sub-questions. The complete interview guide is shown in the appendix, chapter 8. Finally, interviews are recorded using audio-records. This is done in consent with the interviewees. The interviews are between the 30 and 60 minutes, which are analyzed afterwards.

Data collection

The data collection follows the method of Wolcott (1994). After transcribing the audio recordings of the interviews into text, his methodology refers to coding processes, mostly in the case study approach. His first step is to highlight valuable information in descriptions (codes). The next step is the identification of paternalistic structures in the transcripts. The third step is the conceptualization of the research framework, after which the results are presented in tables and graphs.

The in-depth interviews with policy makers and decision makers are used to answer the research questions which focus on data flows. The flow of data in policy formulation, decision making and inter-arena activities are the foundation of the coding process. Each of the data flows is split up into major themes, which fit the theoretical framework. The following codes are the main themes per data flow:

- Actors' identification
- Actors power
- Communication methods
- Dataset identification
- Integrated data
- Spatial level

The main codes are studied in all three data flows to identify the characteristics of the data information used by interviewees. The actor's identification is only investigated inside the action arenas, because no actor is positioned inside the interaction between the action arenas. The actors are part of one of both arenas or inside both arenas. Also, the six themes help to understand the interviewed actor's position in the action arena. This part correlates with the action situation, as part of the action arena of the IAD-Framework. The seven themes are separated in the resulting chapter, because they cover various parts of the analysis. The actor's identification and power focus on the position inside the data governance. Adding the spatial level of the data governance, the network of actors is aimed to be understood. Second, the dataset identification and integrated include the classification of the data inside the arenas. Finally, the communication methods research the interplay between the actors.

Related to the experiences of the in-depth interviews with actors lead to differences and similarities in insights towards these the role of data information in policy formulation, the resulting chapter is written.

3.4 Validity and Reliability

Internal and external validity and reliability are critical to any research. This research aims to maintain exacting standards of validity and ensure reliability. In research, validity can be divided into two parts: internal and external validity (Van Thiel, 2014).

The internal validity of research focuses on how the researcher has ensured that the measurements and instruments used fit. The theoretical framework must fit the operationalization so that no other research would fit the instruments and conceptual relationship (Van Thiel, 2014). In this research, the combination of IAD-Framework of Ostrom and the PSM of Wilson are reviewed in specific literature of the field in the direction of urban planning. In this way, possible external factors are highlighted and linked to the operationalization. The research tries to collect in-depth information from interviews and background information from document policy analysis to learn from externalities that are not discovered.

The external validity of research refers to the extent to which the research can be applied to another research. Other institutions, individuals, and government organizations must be able to generalize the results of this research. To do this, the group studied must be representative of a broader context (Van Thiel, 2014). Doing a stakeholder analysis helps to understand the insights from connected actors in mobility hub policy processes.

The reliability of research refers to the 'accuracy' and 'consistency' of the measurements (Van Thiel, 2014). If the research aims for accuracy and consistency, the researcher should focus on structuring and representative research. When using these elements correctly, it helps to ensure the researcher the findings are 'the right one' (Van Thiel, 2014, p. 48). Accuracy focuses on getting the right data of the variable. The collected data should include a precise and correct use. By spreading a topic across different experts and stakeholders, each insight is collected. In this research the elements of data information, actors' power and mobility policies are investigated, but only in the way that it suits the qualitative part. Interviewing experts and connected actors fits the correctness and preciseness of the research. This study does not focus on significancy, but on what directions and how certain elements influence the dependent variable. The consistency refers to whether the calculations are repeatable so that the results are similar each time (Van Thiel, 2014). This is secured using a sole case of Geldermalsen.

4. Results

In the resulting section of this research, the research questions of this study are answered. The first part of the findings focuses on the document analysis, after which the three sub chapters are discussed using information from the semi-structured interviews.

4.1 Stakeholders in Policy Governance

In this sub chapter, the mobility policies of the Dutch National Government, the province of Gelderland and the municipality of West Betuwe are researched. The mobility policies are studied by analyzing the topic of mobility hubs occurring in the respective policies. The themes that are researched concerning mobility hubs are the actor's typology, the integrated data for hubs, opportunities of mobility hubs and the policy process phase. The researched themes answer the first sub question of the research:

- Who are the key stakeholders involved in policy governance of mobility hubs, and what roles do they play?

As discussed in chapter 3, the three governmental layers in the Netherlands are identified and then studied. In this research, the differentiation of national, provincial and local layers is made. Each scale has various mobility policies, which include mobility hub related aims, problem identifications and solution statements. The mobility policies, shown in table 2, focus on mobility hubs and related topics as climate change.

Policy Document	**Governmental Layer**
Klimaatakkoord 2019	National
Toekomstbeeld OV	National
Mobiliteitsvisie 2050	National
Beleidsoverzicht en Factsheets Beleidsinstrumenten	National
Gelders Klimaatplan 2021-2030	Provincial
Visie voor een bereikbaar Gelderland	Provincial
Mobiliteitsvisie West Betuwe	Local
Mobiliteit agenda West Betuwe 2021-2025	Local

Table 2: The mobility policies in different governmental layers researched in document analysis.

Two of the analyzed mobility policies are presented by the Ministry of IWM (2021; 2023). The 'Toekomstbeeld OV' is a general public transport document that describes a general overview of objectives in the Netherlands. Second, the mobility vision (Mobiliteitsvisie) includes general objectives for the mobility in the country. The third national document is the Climate Agreement (Rijksoverheid, 2019). It is made in a collaboration with hundreds of stakeholders discussing sustainability goals and instruments in the Netherlands. Finally, Planbureau voor de Leefomgeving (PBL) published the 'policy overview and factsheets policy instruments' (PBL, 2023).

The provincial documents of 'Bereikbaar Gelderland' and 'Gelders Klimaatplan' are analyzed (Provincie Gelderland, 2020; Provincie Gelderland, 2022). The document of 'Bereikbaar Gelderland' covers the vision of the province on the concept of accessibility. The 'Gelders Klimaatplan' specifies the provincial objectives in the future for climate related issues.

The municipal document of the mobility vision discusses general goals for mobility issues across the villages in the municipality (Mobycon, 2020). The mobility agenda of West Betuwe relies on future mobility projects and connected costs, objectives and man hours (Gemeente West Betuwe, 2021).

As mentioned in the theoretical framework, stakeholders discovered in the document analysis are part of the data governance regarding mobility hubs. Chapter 4.1 focuses on the understanding what actors take part, when they are involved and what data or information is used. Part 4.2 to 4.4 include the actor's role, power, communication. In other words, chapter 4.1 explores general information by investigating the documents. Thereafter, the other chapters focus on a more deeper understanding of the data governance concerning hubs.

Actors' typology
The actor's typology in the document analysis focuses on exploring what actors are part of the mobility policies. The included actors are introduced to explain what the stakeholders background is. The eight policies come from three governmental layers, which means changing stakeholders are highlighted. The information on what actors take part, is used as foundation in chapters 4.2 to 4.4.

Governmental actors
First, the governmental sector is connected to the policy formulation. For example, the coalition of political parties in the national government is part of the Climate Agreement (Rijksoverheid, 2019), multiple departments of Ministries take part in hub policies (PBL, 2023; Ministry of IWM, 2023) and provincial and local governments are integrated in the 'Ontwikkelagenda Toekomstbeeld OV' (Ministry of IWM, 2021). In general, local governments are part of local policies, and so on. However, the provincial 'Gelders Klimaatplan' (Province of Gelderland, 2022) shows how municipalities are included in the policy formulation on the provincial level. The province positions itself as connector of different layers of governments, such as national and local governments. It uses national funds to implement ambitions on a provincial and local context (Province of Gelderland, 2022).

Mobility partners and private actors
Second, hub policies are influenced by mobility organizations. For example, inside the policy formulation of the Ontwikkelagenda Toekomstbeeld OV, NS Stations took part (Ministry of IWM, 2021). The experiences of this actor were shared to create an extensive list of future mobility hubs (Ministry of IWM, 2021). In local policies, NS and Prorail were included to design the station area in Geldermalsen. Their perspectives on accessibility problems were included, because of the formal power of mobility partners (Ministry of IWM, 2023). In fact, the NS is the owner of station Geldermalsen. This document also connects other private parties. Housing corporations and project developers are part of new area developments (Ministry of IWM, 2023). Developments around hubs are also influenced by these partners. Other forms of private partners included in policy making are employers. Accessibility of their employees is an interesting opportunity for mobility hubs (Province of Gelderland, 2022; Rijksoverheid, 2019). The Climate Agreement discusses how the coalition of 'Anders Reizen' (travelling differently) connects employers to lower CO2 emissions by 50 percent. The private partners are part of this development, where they already committed themselves to the program. Increasing the number of employers that aim for less emissions in their employees trips can employ opportunities for hubs (Province of Gelderland, 2022). The regional mobility brokers contacted more employers in West Betuwe to take part of these projects, which make them aware of possibilities in commuters travelling (Gemeente West Betuwe, 2022). These mobility brokers and other private organizations are part of policy formulation to create mobility domains and agendas (Province of Gelderland, 2020).

Academia and researchers
First, the knowledge infrastructure is focused on fundamental knowledge in laboratories and pilot studies to collect practical information (Province of Gelderland, 2022). Experts use this information to take part in policy formulation. Independent experts are contacted to provide knowledge on climate change mitigation. On the other hand, academia can present new theories, which are used in multiple documents. Case studies are used to evaluate new concepts, such as programs like Bus Rapid Transit (Ministry of IWM, 2021). Government related knowledge bureaus as KIM and CROW (Center for Regulations and Research in Soil, Water and Road Building) are independent research organizations, which are often collaborating with national to local governments to research specific topics. Knowledge sharing is integrated in policy formulation of the analyzed documents (Province of Gelderland, 2020; Ministry of IWM, 2021).

Civil institutions and citizens
Finally, civil organizations are researched inside policy formulation. Nationally, civil organizations are less integrated in policy formulation. Associations of cycling and walking (Fietserbond and Wandelnet) put their insights into policy formulation. The Climate Agreement shows which national and local actors formally commit to the document (Ministry of EZK, 2019). Interest groups of the mobility sector and civil organizations as the Fietserbond signed to commit to the agreement. Furthermore, the Climate

Movement for youngsters and 'Studenten voor Morgen' participated in the formulation of the 'Gelders Klimaatplan' (Province of Gelderland, 2022). On the local level, West Betuwe have contacted local civic organizations in the policy formulation (Gemeente West Betuwe, 2022; Mobycon, 2020). The Fietserbond and Wandelnet are contacted for future policy implementations related to hubs.

Citizens played a remarking role in policy formulation. Qualitative information of citizens is integrated by Gelderland using the Kieskompas in which citizens were asked how they want to be connected to climate mitigation projects (Province of Gelderland, 2022). Adding to this, the citizen counsel, which was contacted, advised on the climate issues. More local, West Betuwe used a bid book where citizens are asked to put in wishes for traffic and transport plans (Mobycon, 2020). These strategies try to implement citizens participation in policy formulation in multiple governmental layers.

4.1.1 Policy process

As discussed in the theoretical framework, the PSM of Wilson includes four stages of problem solving. The first stage of problem solving includes problem definition, which shows inside the document how diverse problems are defined. Thereafter, the documents are researched to find problem identification statements. This stage helps to understand the why and how of the context. Third, the problem resolution tries to focus on how to find an answer for these problems. Finally, the solution statement shows the final goals and methods to contribute to a better future. In this research, the link is made between problem solving and policy making.

Actors participating in problem solving experience different amounts of uncertainties. In the beginning phases of the model, the uncertainty is bigger than in the solution statement stage (Wilson, 1999). If actors are positioned in the policy definition stage, the stakeholder's information seeking is different than actors in the solution statement stage. This chapter focuses on which actors are part of which stage. Adding to this, general characteristics per stage show topics of the information seeking that is done. Finally, to better understand the positioning of the actors around Geldermalsen, the stages of decision making and policy formulation from the IAD can be compared with the stages of the PSM.

Policy Definition

The vision of 'Bereikbaar Gelderland' (2020) defined multiple problems in Gelderland. In the beginning, the number of residents is going to grow in the future, which must increase the total of trips of residents. The accessibility of urban areas is also staggering, while mobility is a primary necessity for people. (Gemeente West Betuwe, 2022). Accessibility and mobility are interwoven in the daily life of citizens (Mobycon, 2020; Rijksoverheid, 2019). Youth go to school, elderly want to participate in society and employees go to work (Ministry of IWM, 2023). Adding to this, the number of jobs inside Gelderland is growing and more houses are built every year (Province of Gelderland, 2022). The societal problems are not only experienced on a provincial level, but also nationally and local. For example, the national mobility vison states that some groups of people are not able to use mobility systems, which makes vital functions inaccessible (Ministry of IWM, 2023).

The document of 'Gelders Klimaatplan' implies that the province of Gelderland has a big task to work with, where the emissions of greenhouse gasses inside the provincial borders need to decrease 55% in 2030 compared to 1990 (Province of Gelderland, 2022). This goal is rooted in other national and provincial documents, where it is introduced. The decrease of emissions is implemented in the national document of the Climate Agreement and the provincial Omgevingsvisie Gaaf Gelderland. Related to the topic of mobility hubs, the province of Gelderland is forced to reduce minimally 2.6 Mton CO2 compared to 2017 (Province of Gelderland, 2022).

Inside the problem definition, themes as accessibility and environmental objectives are part of the issues governmental organizations face the upcoming decennia. The effects of societal problems to citizens living in Geldermalsen and the province of Gelderland are defined.

Policy Identification

The identification of problems includes the search for the real nature of the problem (Wilson, 1999). The document Bereikbaar Gelderland shows initial problems as population and transport growth and a staggering economy (Province of Gelderland, 2020). Due to the Covid pandemic, affects resulted in unexpected changes in the provincial transport numbers (Province of Gelderland, 2020). Despite the pandemic, West Betuwe expected a growth of mobility demand until 2040 (Mobycon, 2020). The growth

of public transport is part of this, which takes place inside and in between urban networks (Ministry of IWM, 2023). Because of the formal responsibilities governments have on a working public transport, the province is forced tackle bottlenecks in the infrastructure (Province of Gelderland, 2020). Not only public transport is facing bottlenecks, but car highways in the Netherlands also experience congestion (Mobycon, 2020).

Adding to this, the travel behavior of commuters will change due to an ageing society (Ministry of IWM, 2023). This relates to mobility hubs, because of the mobility system hubs are located in. The environmental problems of global warming and the needed decrease of emissions are faced. Where mobility is responsible for 36% of CO2 emissions in Gelderland (Province of Gelderland, 2022), it is only 20 percent of the national CO2 emissions (Ministry of IWM, 2023). The greenhouse gasses emission decrease can be reached using less fossil energy or by collecting CO2 inside savings (Province of Gelderland, 2020). However, the province itself does not have the capacity to combat the problems (Province of Gelderland, 2020; Province of Gelderland, 2022). The zero-emission objectives of international entities lead to national policies adapting to climate problems (Ministry of IWM, 2023).

In the problem identification, a big role of governmental institutions exists. The environmental objectives in national policies are copied into more local policies. In other words, an interplay between governments exists. Citizens are less integrated into the identification, because governmental institutions try to understand how to combat the problems defined. As it seems, this is not done in corporation with citizens.

Problem Resolution

The problem resolution specifies which strategies are chosen by governments to combat the identified problems. Governmental actors as the Ministry of IWM (2023) take initiative in creating a mobility vision. This forms the bases for a national accessibility plan. The identified problems as population growth and a changing travel behavior are partly the reason. A national vision can influence other governmental layers to create other mobility visons or agendas (Mobycon, 2020). For example, 'Bereikbaar Gelderland' have created five building blocks where hubs are the central focus point. Using this strategy, the province can connect important urban networks and nearby villages to other economical and societal important locations inside and outside Gelderland (Province of Gelderland, 2020). The concept of accessibility is connected to mobility hubs as resolution inside the building blocks. The mobility hub acts as a project, which is introduced to improve the accessibility of existing hubs. The hub is a central node in the bigger network, which needs to function to transport people safely (Ministry of IWM, 2021; Province of Gelderland, 2022). Also, accessibility is a problem resolution that combats problems as energy transition, biodiversity, proximity of housing. New investments need a coherence between the broad scale of issues. Not only the type of problems is important, also the mix of governmental layers is essential (Ministry of IWM, 2021; Rijksoverheid, 2019). Up or down scaling of policy objectives is part of the possible interventions of governments.

Facilities in station areas influence efficiency and sustainability of hubs in a positive way (Ministry of IWM, 2023). Adding to this, flexibility of supply and demand at hubs is important to consider. New transport concepts can be suited better, when the structure of hubs is more flexible (Ministry of IWM, 2023). Connecting the identified problems, the mobility hub is an integral project which aims to include partners as the industry, civil organizations, transport companies, municipalities and private corporations to collaborate (Mobycon, 2020; Province of Gelderland, 2022). Also, in line with the governmental regulations participation of residents is included. In this example, knowledge is shared and a citizen consultation is organized.

In this research, the focus is not on the process of information seeking of the stages of the PSM. However, it is about the focus on included actors to major themes that are discussed. The problem resolution integrates various stakeholders, such as citizens, transport agencies and governmental organizations. Adding to this, the resolution covers topics as strategy forming and integral policy objectives. In other words, the topics are introduced to tackle the problem identified. In this stage, more actors seem to be connected.

Solution Statement

The final stage of PSM is the solving statement (Wilson, 1999). The analyzed documents introduce varied objectives, frameworks and regulations for mobility hub related problems. In other words,

mobility policies, such as the provincial ones, have put 'goals' as the first corner stone of solution statements. For example, the objective to put mobility as integral instrument to combine a broad variety of assignments (Ministry of IWM, 2023). National climate objectives as the reduction of emission is just an example (Rijksoverheid, 2019). Adding to this, local policies focus on local problems. First, the goal to lobby for local purposes in provincial projects is an example (Mobycon, 2020). Second, the analyzed documents introduce frameworks that can research to what extent mobility problems can be integrated into other fields of policy making (Province of Gelderland, 2022).

Environmental measures are also evaluated using cost efficiency, feasibility and affordability (Province of Gelderland, 2020). Using the frameworks, new measures can be part of existing projects or new developments. The national framework Regional Energy Strategies (RES) tries put national agreements into practice (Rijksoverheid, 2019). Currently, mobility hubs are not part of RES, but public transport should be connected as part of a broad integration of societal issues (Ministry of IWM, 2021). These frameworks are introduced by policy makers, but can help decision makers to decide which measures they want to use.

The third theme of the solution statement discusses the focus of evaluating the existing measurements. The 'Gelders Klimaatplan' is evaluated and changed every two years (Province of Gelderland, 2022). Also, 'Bereikbaar Gelderland' explains how measurements are monitored to test the effectiveness (Province of Gelderland, 2023). In both ways, existing mobility hub policies and hub related measurements are tested.

In the end, solution statements show how strategies of the problem resolution are used to produce new objectives in new policies. Evaluating existing policies and integral policy making are aimed for in the future. Governmental organizations produce many different strategies and objectives. In the end, the decision makers have the power to decide what strategies are going to be worked out. Other stakeholders are not directly highlighted due to the unclear link.

4.1.2 Integrated data

The scope of the research is on the data governance in mobility policies concerning Geldermalsen. The document analysis identified different datasets inside existing mobility policies across the three governmental layers. The datasets are thematized aligning with identified datasets from the theoretical framework. Thereafter, the document analysis shows which of these theoretically identified datasets reoccur in existing hub policies. This shows the relevance of datasets that are discussed in the following chapters.

Political data

First, the dataset of politic domains is discussed. Political data across mobility policies is often referred to. First, existing political structures, such as older governmental agreements, regulations and agenda's is included. The Climate Law of 2021 discusses environmental standards. The WHO introduced advisory norms for air pollution, which is backed by European norms from the European Union. The Healthy and Active Living Agreement of 2023 strives for a healthy physical environment. Delta program Spatial Adaptation aims for climate proof infrastructure. The National Environment Program looks at reductions in mobility practices for cleaner air. National accessibility goals are leading for policy design (Ministry of IWM, 2023). (Inter-)national, provincial and local policies affect new mobility policy formulation, because of the lawfully bases of these documents. The dataset of existing policies is huge, where all 8 documents refer to earlier made regulations and goals.

The difference between regulations, goals and standards can be made. Existing national documents refer to the Climate Law, which forces emission reduction (Ministry of IWM, 2023). Also, the provincial 'Gelders Klimaatplan' refers to international agreements as the European Green Deal with formal standards. Also, the Environmental Act of 2024 forces institutions to work with regulations and laws (Province of Gelderland, 2022). On the other hand, less mandatory goals and frameworks are referred to from national to local documents. The local 'Mobiliteitsvisie West Betuwe' uses the national guidelines, cycling guidelines and the municipal mobility agenda for future policy implementation. The differences between non-mandatory goals and mandatory regulations is made. Goals can be used in an integral program to combine, where urgent measurements are placed on a menu to form the 'robust bases' (Ministry of IWM, 2021).

. The domains of data are part of the political-economic context of the IAD-framework. Also, the rules-in-use are integrated when references are made to existing policies.

Economic and environmental data

Datasets focusing on economic and environmental data go hand in hand. All three governmental layers explain how economic data is used to calculate if mobility measurements are affordable and reaching (Rijksoverheid, 2019; Ministry of IWM, 2021; Gemeente West Betuwe, 2021). For accessibility and mobility goals, project costs are calculated based on different economic and environmental datasets. First, investments from the Mobility Fund are part of policy formulation (Ministry of IWM, 2023; Province of Gelderland, 2022). Second, the economic situation of the market price fluctuations are important in combination with CO2-levy of the emissions of projects, according to the documents of 'Gelders Klimaatplan' and 'Bereikbaar Gelderland. Third, the financial capacity of policy and decision makers is integrated in policy formulation. National, provincial and local documents describe an integral development as solution to combat economic limitations. Scarcity forces governmental actors to efficiently use money, people, and time (Province of Gelderland, 2022). Solutions might be differentiation of parking prices related to emissions (PBL, 2023) or CO2-levy inside different regions (Province of Gelderland, 2022). Other environmental data in mobility documents mostly refer to existing environmental acts and standards, as discussed below political-economic datasets. In the end, economic and environmental data are part of policy making.

Transportation and demographic data

The studied documents use transport datasets to defend policy decisions. The 'Mobiliteitsvisie 2050' uses information on transport kilometers, travel purposes as commuter trips and studies on trip modalities. These numbers are based on big datasets from the Centraal Bureau for Statistiek (CBS), which researches transport numbers and background information of travel trips. Besides external platforms, the national government also did their own integral mobility analysis in 2021 (Ministry of IWM, 2023). They use private sources as cycling facts in the policy formulation (Rijksoverheid, 2023). Integrating transport data changes per governmental layer. The national institution uses mostly national datasets, but the Province of Gelderland (2022) monitors transport data themselves. The local municipality of West Betuwe collaborated with local consultative groups for data collection for general ideas for hubs (Gemeente West Betuwe, 2022).

Demographic data is originated from different directions as well. The local document of the mobility vision of West Betuwe have focused on general knowledge of demographic data, such as societal ageing and population growth. The document is created based on local collaboration and referred provincial documents (Mobycon, 2020). The provincial layer again included demographic data from own research (Province of Gelderland, 2020). The national layer again referenced to the CBS as database.

Based on the discussion on demographic and transport data, transportation and demographic data are integrated in various ways. The national documents seem to use national data platforms as CBS as main source. On the other hand, the local policies refer more often to local data sources.

Geospatial data

Aligning with the biophysical element of the IAD-framework, the analyzed documents integrate geospatial data in policy formulation. Spatial data can be separated into local data and more regional or national data. On the one hand, local data focuses on spatial elements on a station level. The 'Ontwikkelagenda Toekomstbeeld OV (Ministry of IWM, 2021) shows that the lay out of the hub is the center of policy implementation processes. The geospatial data integrated into the documents is local, because it refers to the local context of the mobility hub. Adding to the local environment, the 'Mobiliteitsagenda West Betuwe' (Gemeente West Betuwe, 2022) focuses on the small villages in the municipality and its participation of local corporations and citizens. Also, the distance between villages in the area is a focus point because it influences the travel behavior. Provincial and national documents focus more on general assumptions of hubs and the location choice of these hubs. 'Bereikbaar Gelderland' (Province of Gelderland, 2022) remarks strategic location choice and travel distances towards hubs as spatial data. The national agenda of the public transport (Ministry of IWM, 2021)

outlines the importance of population density, public facilities, capacity and size of cities. Concluding, the geospatial data changes per governmental layer.

Empirical data
The scientific world influenced the analyzed documents in all governmental layers in diverse ways. First, case studies are highlighted in multiple policies, where they are used as dataset. The mobility vision (Ministry of IWM, 2023) highlights how regional case studies show opportunities and barriers in mobility practices. Case studies show empirical data of implementation of new concepts, such as ParkShuttle, Bus Rapid Transit and working at home. The national document of 'Ontwikkelagenda Toekomstbeeld OV' introduces pilot studies of regional hubs to learn about hub implementation. Pilot studies help to learn more on lessons of governance. According to this document, an integral analysis needs to be done to get all important opinions of stakeholders. Adding to this, a citizen board is included to collaborate with experts about the climate change approach of the province (Province of Gelderland, 2022).. The case studies are often done by academia or governmental organizations, but in practice, can be done by any research organization. In practice, the municipality West Betuwe used a small participation project of citizens in their mobility vision (Mobycon, 2020).

4.1.3 Relevance for case study Geldermalsen

In each part of the resulting chapters, a paragraph is added to summarize the link of the findings to the case study of Geldermalsen. Each of the documents directly or indirectly affects the mobility hub of Geldermalsen. However, the relevance varies per policy document. According to local policies, the local government in Geldermalsen influences the policy making. The important role in problem solving is an example of this. Having an influence too, other layers of governments put in financial instruments, such as funds. Also, mobility partners and civil organizations are integrated in the policy making. Fietsersbond as civil party and NS Stations are just examples of stakeholders impacting the local policy process. Finally, on a smaller scale, academia seem to have less influence on the local hub practices. Affecting national policies does not directly affect the local practices. However, CROW is part of local policy making. In other words, mobility hub policy making is influenced by many stakeholders, who have varying power and input.

The stages of the PSM show different places in which stakeholders take part in the problem solving of the policy process. In the local policy document of Geldermalsen, local governments and citizens take part of the first two phases. Thereafter, a broad scale of actors is included in formulating a resolution to tackle the problems. The following chapter discusses this interlinkage more deep.

Finally, the integrated domains of data or datasets in existing policies show diverse, interesting conclusions for the case study. Geldermalsen uses local databases in collaboration with local initiatives in policy making. Transport data, demographic data and geospatial data originate from more local sources. On the other hand, empirical data, environmental data and economic data seem to be more national originated. For example, national and provincial financial instruments contribute to local policy making in Geldermalsen. Adding to this, empirical data from pilots in other regions of the country are part of national policies, whereafter these can influence the local policy making.

Lastly, to better understand the positioning of the actors and understanding the data usage around policy making in Geldermalsen, the stages of decision making and policy formulation from the IAD can be compared with the stages of the PSM. The types of actors and data are related to each other to increase the understanding of Geldermalsen.

4.2 Data Information in Policy Formulation

In this sub chapter the position of data information in the policy formulation arena is studied. This sub chapter is split up in the different topics that are researched: dataset identification and categorization, actors' identification and power influence and finally, communication methods are investigated. This chapter try to answer the fourth sub question of this research:

- In what way is data governed in the policy formulation phase, focusing on power relations, communication and types of data?

In this research, eleven semi-structured interviews are done. In table 3, the interviews are presented with the anonymous in-text reference. The table is only presented in this chapter because it shows the same interviewees who are integrated in chapter 4.3 and 4.4.

Interviewee	In-text reference
Researcher KIM	R1
Researcher University of Amsterdam	R2
Researcher University of Groningen	R3
Consumer organization ROCOV speaker 1	C1
Consumer organization ROCOV speaker 2	C2
Department Water, Traffic and Living Environment Rijkswaterstaat	W1
Department Innovation of Arriva	A1
Mobility Broker	B1
Department of Traffic of municipality West Betuwe	T1
Member of Municipal Parliament	M1
Policy department of province of Gelderland	G1
Member of Provincial Parliament	P1

Table 3: Interviewees with in-text reference

4.2.1 Actors Identification and Power Influence

In this sub chapter, the findings of part 4.1 are integrated as foundation. This is to understand what actors are integrated in the policy formulation phase or arena. As mentioned before, the document analysis shows that in problem resolutions, a diversity of stakeholders is integrated. Despite the lack of many actors in other stages of the model, the chapter of 4.2 deepens out what actors take part of the policy formulation phase and its data governance. First, a short overview of integrated actors is given, whereafter an overall understanding of types of power in the policy formulation arena is formulated.

Overview of identified actors

The actor's identification is done to understand the interviewee's position in data governance. Because in table 3, the interviewees are introduced, chapter 4's actor identification focuses on dividing actors into governmental layers. The role of actors in data governance is interwoven into the spatial categorization. The codes on spatial levels focuses which governmental layers are present in which level. The national level is coded the most times, but the local and provincial are also present. When looking forward, the national level consists of the most diverse individual actors. However, the focus point of this research tries to highlight the local level deeper than the other two governmental layers.

The analysis on the interviews results in an overview of actors across varying governmental levels. Some of the actors fit in multiple governmental layers, which results in overlapping stakeholders. Table 4 serves as foundation for the rest of this sub chapter of 4.2 to refer to.

National level	Provincial level	Local level
Ministry counsel (including Ministry Infrastructure and Water Management)	Consumer organization ROCOV	Local policy makers (including mobility department)
ProRail	Provincial policy makers	Municipal advisor traffic and transport
NS	NS (-stations)	Municipal political factions
Knowledge Institute Mobility (KIM)	Regional mobility actors (Arriva)	Citizens and commuters in West Betuwe
Rijkswaterstaat	Rijkswaterstaat department of Gelderland	Mobility brokers
Mobility actors (Arriva)		Local department CROW
Researchers		Regio Rivierenland (Collaboration of multiple multiple municipalities)
CROW (Knowledge Institute)		Villages in West Betuwe (in Kernagenda's)
Media (newspapers)		
Advisory Bureaus		
National Research Organization (NWO)		
CBS (Statistics)		
Planbureau voor de Leefomgeving (PBL)		
World Health Organization (WHO)		

Table 4: Integrated actors in policy formulation arena.

Overview of types of power

Analyzing the power relations inside the data flow in policy formulation is done by focusing on the following types: knowledge power, relational power, resource power and formal power. Where power relations can explain the data governance, it is essential to discuss which types of power happen. Also, the link to actors related to certain types of power are discussed. In the end, the link to Geldermalsen is made.

The knowledge power in governmental layers explains how specific actors are connected to policy formulation. There is not seen a difference between the layers, but there is a difference in types of knowledge power. The difference is between the requested and unrequested advice. The requested advice is initiated by governmental actors which ask non-governmental organizations about their knowledge or data about specific issues as hubs. The KIM is an independent research organ inside the Ministry, which is part of research projects of the Ministry (R1). With 'interactive' communication, KIM contributes with their knowledge to the policy makers of the Ministry (R1). The question origins from the Ministry, whereafter KIM provides feedback to policy plans (R1). In collaboration with smaller governments, knowledge of mobility hubs is shared in between governmental layers (R1). Research of the KIM is reviewed by external, independent academia (R2), which put their position on the table as well. Rijkswaterstaat also serves national tasks in knowledge development, which influences policy making (W1). The formal position of Rijkwaterstaat is confirmed by the quote: "What I am also working on is an assignment from the Ministry to Rijkswaterstaat" (W1). The organization is asked for advice for policy making. Other institutions as consumer organization ROCOV are also asked for advice:

- "There is always someone from the province at the ROCOV meeting. An advisor with public transport in his portfolio. These are skilled, adequate people sitting at the table." (C1)

The consumer organization explains that governmental people join their meetings to include the consumer perception into policies (C1). Unrequested advice consists of voluntary roles of actors to provide feedback on mobility plans (C2).

- "And at some point, we can also suggest things ourselves. If they pick that up, that is another matter" (C2).

Rijkswaterstaat's interviewee explains that not all given advice is requested. "That really comes from within ourselves" (W1). External organs as mobility companies as Arriva also have researched specific mobility issues, which shared knowledge without having a direct question of governmental organizations (A1). This shows how the knowledge is unrequested, but the power is positioned at the advising organization. To relate to the local level of Geldermalsen, requested and unrequested information is shared to policy makers. External organs, such as ROCOV, have the power to take part in policy making.

The formal power in the policy formulation scopes deeper into this differentiation of required and non-required advice. The interviewed policy maker of Gelderland explains that municipalities as Geldermalsen are "in the lead" when it comes to certain projects (G1). The highest 'priority' is an element of 'filtering' projects and data for governments important to use in policies (T1). Concluding, the formal power explains what is done with the advice of other actors.

The relational power emphasizes the network of policy makers. This helps to share experiences and knowledge (G1). Also, smaller municipalities lobby in national politics to gain more awareness of the importance of the role of region Rivierenland, in which Geldermalsen is located in (T1). This collaboration of municipalities is an example of relational power and what can be done with it.

Resource power inside policy formulation is focused on the capacities of interviewed actors in data governance. The municipality of West Betuwe explains how a single advisor on "data-driven work" investigates the available mobility data (T1). Gelderland also has an employee focusing on analyzing data of mobility hubs in the province (G1). The Ministry financially supports KIM to research and collect data for them (R1). Each governmental institutions have the capacity to analyze and collect mobility data, which means having the resource power. Other non-governmental organizations experience different amounts of resources, where each actor has their strengths and limitations. Rijkwaterstaat has a whole department for modelling and applications, where data is part of (W1). Researchers are limited in power due to financial barriers for new research projects (R2), which is confirmed by the other interviewed researcher:

- "That organization (NWO) then sets certain requirements, yes, what you have to do to get that money." (R3)

The mobility broker explains how their "mobility scan" can influence policy forming (B1).

- "Include the mobility scan in your mobility policy and use the numbers from that scan as a reason to focus on this." (B1)

The mobility scan gives a new tool for policy formulation, which contributes to the advising opportunities for external mobility brokers (B1). The non-governmental actors all show their experiences on resource power, where one is more limited than others.

In the end, inside the policy formulation of West-Betuwe, the power distribution is a combination of three governmental layers affecting different parts of the practices. The link to Geldermalsen is made in 4.2.4.

4.2.2 Dataset Identification and Categorization

The dataset identification and categorization play an important role in the resulting part of this research. Inside the arena of policy formulation, a broad scala of integrated data is used. However, this research focuses on the typology of data and which datasets can be identified. This chapter is therefore split up to highlight the most used types of data on one hand. Second, the dataset is identified by explaining the most used types of datasets in this arena. By highlighting data characteristics, the data flow in the policy arena can be linked to the existing policy documents to understand the case of Geldermalsen.

Data Categorization

The data categorization includes the integrated data split up into different domains of data, which is explained in chapter 2. In the policy formulation arena, the following domains are researched: demographic data, economic data, empirical data, environmental data, transportation data, political data and geospatial data. However, not every type of data reoccurred often in the analysis. Therefore, this research focuses on the types of data that are referenced the most per dataflow. Because this changes per flow, not every data type is discussed in every layer. This flow discusses: empirical data, transportation data, political data and geospatial data.

Empirical data

In policy formulation scientific data is used. Scientific data focuses on including new concepts as hubs in the policy design. The Ministry asked Rijkswaterstaat to improve knowledge development of mobility hubs (W1), which focuses on the question how new concepts can be integrated into organizations. The Ministry wanted to know how hubs can be part in policy formulation of other fields. By including the research of Rijkswaterstaat in policy formulation, the Ministry integrates scientific data. In other words, Rijkswaterstaat provides information and expertise to policy formulation (W1), which is scientifically originated. Other researchers are asked to review the policies and research of governmental institutions (R2). But sometimes, researchers do not have all knowledge that is needed. In fact, "it does not work that way, because the practice has unique knowledge that we cannot have" (R2). It shows that practical knowledge and scientific knowledge need to work together. Practical knowledge can be collected in experiments or pilot studies (G1, R2). Arriva as transport organization has initiated an experiment to collect practical knowledge at Geldermalsen (A1). The collected results were shared afterwards with different policy makers, such as the municipality and the province. Practical knowledge can also be conducted using experiences from consumer organizations (C2). Less presented groups in society, such as deaf or blind people, can experience station areas quite different than normal people do. These experiences are also part of policy formulation. Concluding, different scientific and practical data are used in policy formulation around mobility hubs.

Transportation data

Transportation data consists of information where people travel, how they travel and in what numbers they do that. Transport data is mentioned by mobility brokers, mobility actors and researchers. The interviewed policy maker of West Betuwe shows how transportation data is a particularly important data source in policy formulation (T1). Often, mobility actors collect these forms of data, whereafter they sometimes publish the data. Other actors rely on these mobility partners, such as consumer organizations (C2). Numbers of travelers in specific public transit lines can help actors in formulating their point of

view in policy making. For example, provincial policy makers use the numbers of travelers in formulation (G1). Transport standards of CROW are also part of the provincial policy making. Checking in and out in public transport is valuable data for mobility actors, because it shows the percentage of people using trains and busses for example (A1). Arriva's interviewee remarks that using the boarding data helps to create policies. Also, policy formulation can rely on selected links. The interviewee of Rijkswaterstaat explains that by selecting a specific road, railway or path in an online system, the ingoing and outgoing movements are shown in a network to their final destination (W1). This can show the potential of mobility hubs. Research bureaus as CBS and CROW present many open travel data, which can be used in policy formulation. Smaller organizations as mobility brokers research study mobility data on an organizational level, which consists of commuting data (B1).

Political data

Existing policies are examples of earlier ways of thinking. National, provincial and local policies did not look at the contextual aspect of stations (G1). These discourses and rules are integrated into the political context. The political and economic landscape influences how policy is made.

- "The idea of stations as place and node arises. And of course, it also means multiple, different sorts of policy. Those can strengthen each other, but also get in each other their way." (R2)

This researcher states that by introducing mobility hubs, policies are going to change the situation. It is a way of thinking how policies are created. Societal issues on limited spaces are connected to hubs (A1). The Dutch public transit landscape is focused on the train as backbone (A1). In fact, politics would not be choosing for the public transport (G1).

Geospatial data

Spatially, data can include the station environment, the road infrastructure or railway conditions. In policy formulation of mobility hubs, actors sum up spatial limitations or possibilities where hubs are situated in. Related to hubs, societal plans of building houses have provided opportunities. Hubs can open new neighborhoods to connect them at the public transit network (W1). New policies can align with existing spatial planning policies. The scarcity of space increases the need for hubs (A1).

- It is so scarce. You must arrange the space so efficiently that we need places where it comes together, where people can transfer, allowing you to create new connections." (A1)

New connections come together in one place, whereafter people can change modes of transport. Spatial information on parking and ownership can be included in new agreements (A1). Adding to this, the local context has influenced local policy makers. How to work a on case bases what policies fit, is very context dependent (R1).

- "The role of spatial context can be determining which effects have which sorts of input." (R1)

In other words, every hub experience different local circumstances. To many examples are given, but in general, the spatial information is not directly integrated in policies, but it is part of mobility hub policy design. This is because this geospatial data has come up by interviewing actors inside the formulation arena.

Dataset Identification

The dataset identification shows the most used datasets, which are used to determine what data governance takes place in the policy formulation. By focusing on the types of data sets, a descriptive overview of the data governance can be given. Not all datasets are discussed, because some are used more than others. In this arena, the most used datasets are: expert panels, data reports, formal documents, and pilot studies. Other types of datasets are used, but not that often. Therefore, they are not discussed.

Experts panels

As mentioned above, many different actors collaborate in the policy formulation arena. The governmental actors write the mobility policies, but advisory actors are interwoven in the design process. The expert panels are advisory organs that put their data into the formulation process. The background of a single expert changes what data information is put on the table. For example, the consumer organization is a combination of diverse backgrounds (C1). The consumer organizations operate as combination of many smaller parties, such as the cycling union (Fietsenbond) or the hiker union (Wandelnet) (C2). On the other hand, other advisory actors put their 'knowledge, expertise and

craftmanship' to policy formulation (W1), which can be collected in unusual ways, such as pilot studies or research results (R1, R3).

Data reports
In policy formulation, different sets of data reports are identified. For example, data reports including transport data from the NS or ProRail are part of discussion (C2). Other advisory actors are dependent of these reports, such as consumer organizations (C2). Arriva does not present open transport data, because only NS is formally forced to show their information (A1).

Second, CROW and CBS are actors that do research on transport and demographical issues. They present it in data reports (W1). For example, CBS researched 'movements in the Netherlands'. The researcher of the University of Amsterdam explains how quantitative studies of other institutions are used in his work (R2).

Finally, the consumers organization ROCOV has studied NS railway stations across the country. After visiting, different experts from the organization put together an inspection report. This is shared with NS and ProRail (C2). This data report shows limitations of certain station environments. This data report does not directly influence policy makers, but it positions different advising actors in a network.

Formal documents
Integrated in the policy formulation, existing regulation policies or 'visions' are used as foundation. It includes a combination of other transport visions, from cycling mobility policies to goods transport policies (R3). Also, regulating frameworks for action are copied from existing policies (G1). Not only complete documents are used, the municipality of West Betuwe uses fixed patterns (T1). Categories of patterns, such as traffic safety and road structure, form the structure of new policies. West Betuwe also integrates agendas from each small village in the municipality (T1). By sum up the wishes of specific towns, the needs of all villages can be used. This happens very direct, but indirectly formal documents are integrated by researchers (R3). Researchers use existing policies in their own research to review, backup or explain theories. Thereafter their research can be used in policy formulation again. For example, mobility hubs were unexplored in the beginning. The KIM (Knowledge Institute of Mobility), which is connected to the national Ministry, researched hubs as one of the first. That is why policy formulation of the national government could use the added information of this research (R1). Formal documents sometimes are adopted by other governmental layers when the topic of research is new. Mobility hubs were introduced in national and provincial policies, whereafter municipal governments took over the information (G1). In the policy design each actor can bring in their ambitions for new policies. Thereafter policy makers try to connect the ambitions into one (G1). Each ambition is a short policy 'brief', which shows a shortlist of what each actor wants.

Pilot studies
The concept of pilot studies, case studies or experiments provide the practical data that is needed in new concepts in policy formulation. The mobility hub became a new concept in the last years and was therefore the topic of a new pilot study (G1). They researched on questions like:

- "What accents do we use? What is our focus? (G1)

Pilot studies as a dataset puts in practical data which is needed. 'Teething problems' in small projects avoid bigger problems when concepts are not experimented with (R1). For example, national pilots on the new concept of public mobility are introduced recently (G1). This shows the importance of collecting practical data using pilots. "You need to try" to learn the reality using experiments (R2). But practical knowledge is not always done by policy makers in the Netherlands. Other countries also experiment on topics like mobility hubs (R1). As you can see, international cases influence national programs and national policies test experiments in regional areas as the Achterhoek (G1). Evidence-based lessons from one region can be transferred to policy making in other regions (R3).

4.2.3 Communication Methods

Communication in policy formulation focuses on key methods that are most commonly used in this flow. Understanding the data flow through communication methods is discussed in the theoretical framework. Data governance consists of data and actors intervening in a particular way. This way is researched in this part.

Communication methods

The communication between actors in mobility data governance consists mostly of open meetings and public participation. The open meetings consist of congresses, meetings of conversation. Consumer organization ROCOV's official meetings are visited by a provincial official (C1). On a project bases Rijkswaterstaat works together with governmental layers. For example, doing field research as "we will now be in Breukelen next Tuesday" (W1). Researchers work together in consortia with external experts (R2). Transport agencies are included using representatives in talking groups (A1). Reporting the experiences of actors on projects as "action perspectives" show how the official meetings are set up and are part of policy making (G1). Provincial policy formulation uses open meetings with "municipalities, ProRail, NS and sometimes Rijkswaterstaat" (G1). The users of public transport are connected through regional consultation (P1). In other words, each interviewee explained how their role in policy making uses open meetings to discuss their experiences and input.

New mandatory regulations are introduced which force governments to implement public participation (G1). West Betuwe has done this by collecting practical data of citizens using 'Kernagenda's' (T1). These village level agendas are initiatives where every village wrote their own vision on plans in the municipality. The village agendas are combined and used into the new mobility vision of the municipality (T1). Also, public participation through including consumer organizations as ROCOV is seen as "constant feeding" (P1). In the end, new policies can help the barrier between policy makers/researchers and citizens:

- "So, everyone will still be looking for the best ways to involve citizens in research, as equal partners." (R2)

The communication method of digital platforms is used (R2). Open websites include toolkits to put in city data to look what happens in the model (R2), which can influence policy making. Other open sites as NS share some transport data (A1) or key figures for municipalities and provinces for mobility distances (G1). Also, digital platforms share research findings in scientific journals (R3). In other words, the communication of digital platforms is diverse.

4.2.4 Relevance for case study Geldermalsen

Knowledge power includes requested and non-requested advice, which reoccurs in each layer. Therefore, stakeholders can contribute to policy formulation, without direct invitations. On the other hand, formal institutions have the final say in the policy making, which positions local policy makers above the advisory organs. Also, resources and relations are interesting for Geldermalsen, where non-governmental actors as mobility brokers can provide new instruments of mobility scans. The relational collaboration between multiple municipalities is an extra power to share experiences and knowledge.

Adding to the power distribution, the identification of datasets and domains of data is essential to understand data governance in Geldermalsen. For example, empirical data of researchers are used in a different way compared to national processes. Practical information is gathered by pilots and walking's by ROCOV to measure the real data. National policies are often more based on more scientific evidence from academia.

The built environment as geospatial data and the political thinking in existing policies occur different times at the local policy making. Overarching policy documents of other governmental layers affect the formulation. Additionally, the built environment of Geldermalsen is a fact, which is not directly used in formulation, but more on the execution of hubs. Finally, the transportation data in Geldermalsen origins mostly from national bureaus. But some transport agencies collect data, which can be shared or kept secret. Adding to the domains of data, datasets in Geldermalsen are very diverse too. Experts panels as civil organizations are integrated in policy formulation. Also, data reports can show the practical information of the situation. However, formal documents are the most used in the policy formulation. The twenty-six villages in the municipality of West Betuwe have Kernagenda's, which translates to a single agenda per village. In other words, a summary is made of these agendas. It forms the foundation for new hub policies as wishes of all places become more clear.

Referring to the Kernagenda's, the municipality uses public participation as communication. Public wishes are interwoven in these agendas, which show a very participatory method. Also, open meetings are part of the formulation. All interviewees state that in open meetings, diverse stakeholders are connected.

4.3 Data Information in Decision Making

In this sub chapter the position of data information in the decision making arena is outlined. This sub chapter is split up in the different themes that are researched: dataset identification and categorization, actors' identification and power influence and finally the communication methods are investigated. This chapter answer the fourth sub question of this research:

> - In what way is data governed in the decision making phase, focusing on power relations, communication and types of data ?

4.3.1 Actors Identification and Power Influence

In the decision making arena, actors which are part of the data flow are identified. First, a brief overview of integrated actors is given, whereafter an overall understanding of types of power in the decision making is formulated.

Overview of identified actors

The actor's identification is done to understand the interviewee's position in data governance. Because in table 3, the interviewees are introduced, chapter 4's actor identification focuses on dividing actors into governmental layers. The role of actors in data governance is interwoven into the spatial categorization. The codes on spatial levels focuses which governmental layers are present in which level. The local level is coded the most times, but the national and provincial are also present. When looking forward, the national level consists of the most diverse individual actors. However, the focus point of this research tries to highlight the local level deeper than the other two governmental layers.

The analysis on the interviews results in an overview of actors across varying governmental levels. Some of the actors fit in multiple governmental layers, which results in overlapping stakeholders. Table 5 serves as foundation for the rest of this sub chapter of 4.3 to refer to.

National level	**Provincial level**	**Local level**
Ministry counsel (including Ministry Infrastructure and Water Management)	Gedeputeerde Staten (Provincial executives)	Municipal council of mayor and alderman
National government	Provincial political factions	Municipal political factions
ProRail	Media (newspapers)	Municipal coalition of factions
NS	NS	
Media (newspapers)	Regional mobility actors (Arriva)	
Rijkswaterstaat		
Mobility actors (Arriva)		

Table 5: Integrated actors in decision making arena.

Overview of types of power

Analyzing the power relations inside the data flow in decision making is done by focusing on the following types: knowledge power, relational power, resource power and formal power. Where power relations can explain the data governance, it is essential to discuss which types of power are experienced. Also, the link to actors related to certain types of power are discussed. In the end in chapter 4.3.4, the link to Geldermalsen is made.

Analyzing the power relations inside the data flow in decision making show how formal power is an important mechanism for actors to have a saying in decision making. The formal power can be split up into the three political arenas. The governmental layer exists of decision makers which formulate coalition programs each four years (M1).

> "There are four of us now together. These are all swept together. And from us a little and more than the rest." (M1)

This shows the dynamics in between the municipal decision makers. Voting for mobility policies done by political factions, the municipal council of the mayor and council members work out the implementation plan (M1). The direction is pointed out by the factions, which means the formal power relies on this politics parties. In the provincial level the coalition of political parties can also influence the implementation (P1). The municipal government is dependent on the provincial layer in certain projects (T1). For example, Gelderland invests in local projects as the hub in Geldermalsen (G1). However, the provincial layer is dependent of the national support, such as financial funds (P1). The formal power is distributed among politicians inside a layer, but also from higher governments towards the local municipality.

Second, the financial capacities of governmental layers are important. Adding to that, the strategy of investing financial resources is important too (W1). The focus on 'labeling' money is remarkable, because 'labeled' money cannot be changed quite easy (W1). Labeling of money in national politics exists (W1), but the local politics also highlighted how a pot of money can help in new projects (T1). Also, resource power is present in the resource of man hours inside a political party. Bigger parties can attend more open meetings (M1). The interviewed local politician explains how smaller parties the resource power do not have to be everywhere (M1). Finally, the relational power is not discussed in the interviews.

In the end, inside the policy formulation of West Betuwe, the power distribution is a combination of three governmental layers affecting hub practices. The link to Geldermalsen is made in 4.3.4.

4.3.2 Dataset Identification and Categorization

The dataset identification and categorization play an important role in the resulting part of this research. Inside the arena of decision making, a broad scala of integrated data is used. However, this research focuses on the typology of data and which datasets can be identified. This chapter is therefore split up to highlight the most used types of data on one hand. Second, the dataset is identified by explaining the most used types of datasets in this arena. By highlighting data characteristics, the data flow in the policy arena can be linked to the existing policy documents to understand the case of Geldermalsen.

Data Categorization

The data categorization includes the integrated data split up into different domains of data, which is explained in chapter 2. In the decision making phase, the following domains are researched: demographic data, economic data, empirical data, environmental data, transportation data, political data and geospatial data. However, not every type of data reoccurred often in the analysis. Therefore, this research focuses on the types of data that are referenced the most per dataflow. Because this changes per flow, not every data type is discussed in every layer. This part discusses: economic data, political data and geospatial data.

Economic data

Inside the political arena economic data is of a major influence. Each year political parties can invest their financial budget (G1). Structural and incidental money are used on key points of their policy (P1). When money is put in projects, it is already invested. The lack of investments can result in wrong outcomes (P1). Decisions in the past have resulted in less train investments. However, the mobility hub is introduced in new policies. Existing railway lines do not have the capacity for the estimated growth (P1). Economic data of earlier political decision affect current decision making. For example, the national government reserved an estimated 1.5 billion for a highway in the province of Utrecht. But this project is put on hold, which makes it interesting to move tons of money to other projects (W1).

- "The money is labeled somewhere. And if you try to change that label, that is a difficult issue." (W1)

In other words, the reservation of money in projects is an economic issue which can affect the decision making of other projects. In the end, "the only real resource you have in politics, is money" (P1).

Secondly, political parties must decide whether financial cuts are needed. Provincial parties negotiate about public transport where some lines are only transporting a few people per hour (C1). This costs a lot of money, which can move parties to other directions. Concluding, financial cuts or moving tons of money between projects are economic based decisions.

Political data

Decision makers operate in a political arena where societal objects are discussed and weighted. Decision are made depending on the essence of the problem (C1). Other fields of society, such as health care and education are also important for the politicians. Existing official documents, such as the 'Hoofdlijnenakkoord' acts as political information where decision makers need to work with. The Hoofdlijnenakkoord is an agreement of national politicians which is formed in the coalition talking of the national government. The national agreement aims to restart paused projects, such as highway projects (W1). This objective influences organizations as Rijkswaterstaat, because it is not in their power to decide what to do with the money reserved for the highway projects.

Adding to this, the interviewed local politician explains how political decisions are affected by the size of the political party in the municipal counsel (G1). This data affects the formal power of individual decision makers, which is explained above. Also, it is the way of thinking of decision makers how mobility hubs are integrated in decisions. "Of course it is political thinking. It is populistic" (C1). The provincial politician explains the political thinking on railway networks. The shortcoming of investments or short-term thinking have influenced the current public transit situation (P1), which forces new investments to take place. It explains how decision makers must manage political issues regarding their point of view and the political situation. This kind of data explains how politicians operate, which links the action situationship and the actor.

Geospatial data

The local politician in West Betuwe describes how the spatial characteristics of the city Geldermalsen play a role in his motivation. Turning the railway station to a mobility hub in Geldermalsen only affects the surrounding citizens. Because the municipal politics is responsible for twenty-six villages in a large area, other train stations are located closer to many citizens. This motivates the politician to be skeptical (G1). The distance to the mobility hub Geldermalsen is too far for many people, which makes it less interesting to invest in the train station. Also, the location on the railway between Utrecht and Den Bosch is important, which is busy. That makes it difficult to connect the provincial network (P1). In other ways, geospatial data of the case study affects the point of views of decision makers.

Dataset Identification

The dataset identification shows the most used datasets, which are used to determine what data governance takes place in the policy formulation. By focusing on the types of data sets, a descriptive overview of the data governance can be given. Not all datasets are discussed, because some are used more than others. In this arena, the most used datasets are: formal documents and data reports. Other types of datasets are used, but not that often. Therefore, they are not discussed.

Formal Documents

Inside decision making formal documents as a dataset have a different use than in policy formulation. Integrated formal documents mostly function as formal proposals. Incoming documents from policy formulation are first being voted for by the municipal college (T1). Thereafter the local council votes on policy measurements. For example, the municipal college, which decides on daily governance issues, suggests formal proposals in which the municipal counsel has to vote for (M1). Because the municipal college exists mostly of people from the same party as the interview decision maker, the formal proposals fit to their political perceptions (M1). In other words, the college is an independent structure, but the point of view does not differ a lot compared to the ruling political party (M1).

Inside the decision making arena, political parties are chosen in elections. Before elections, each party has their own election program. When a single party wins, they negotiate with other parties to form a coalition program (M1). The coalition in West Betuwe exist of 4 different parties, which had four individual election programs. This part of decision making is influencing by the formal election programs, which are presented to voters before the elections. Every ruling period, innovative programs are introduced which include new financial budgets to work out the coalition plans (P1). Non-ruling parties can make an initiative proposal to get their perspective in decision making (M1).

Data Reports
Data reports include huge amount of data on specific topics, such as transport or economic numbers. But in decision making, the data reports are limited to specific themes. First, the local politician explains how integrated data is put into policy proposals. The data is already worked out, which makes it part of the policy proposal which parties discuss about (M1). On the other hand, the provincial politician is aware of transport data, which he refers to. When the organization is completely data-driven, data can be used as "proof that you are on the right track" (P1). However, the provincial politician states that "you can quickly dismiss a kind of out-of-the-box idea or a trial possibility", when using data-driven planning (P1).

4.3.3 Communication Methods

Communication in decision making focuses on key methods that are most commonly used in this flow. Understanding the data flow through communication methods is discussed in the theoretical framework. Data governance consists of data and actors intervening in a particular way. This way is researched in this part.

Communication methods
To understand data governance in decision making, the communication methods explain how the network between actors operates. The communication methods divide the daily business into four types of talking that are researched: digital platforms, open meetings, informal meetings and public participation. However, only open meetings is coded a lot. Open meetings in decision making include not only counsel meetings, but also image forming and judgement of topics (M1). These meetings contribute to the communication on data, because every party can "have your say about it again" (M1). All political parties communicate in the council meeting, but the coalition of the municipality have talked about beforehand in coalition talking (M1). On the other hand, opposition has the tools of "initiative proposals" and "amendment motions" to redirect to their point of view (M1).

The provincial level acts in the same way, where the provincial interviewee highlights the role of the coalition in decision making (P1). Inside the coalition the politician remarks that open meetings between single politicians is also possible to talk about certain issues (P1). In collaboration with regional projects as Rivierenland, local objectives and planning is discussed (P1). The decision makers in the province discuss with the municipal representatives inside these regional projects.

- "It is a kind of conversation where you make an agreement of okay, as a region you are responsible for x number of homes." (P1)

Local and provincial political layers are interwoven, but the national layer is explained as well:

- "Ultimately it is the political decision what is actually chosen." (R1)
- "And then they do something with it, and it comes back to us in the assignment." (W1)

Other interviewees explain how the national government uses open meetings to decide on political decisions. The policy documents, including mobility policies, have produced many decisions which are made in the national parlement. In other words, decisions often are made in different phases of voting and formulating proposals, but open meetings were the way to go for governmental layers.

4.3.4 Relevance for case study Geldermalsen

In each part of the resulting chapters, a paragraph is added to summarize the link of the findings to the case study of Geldermalsen. Each of the documents directly or indirectly affects the mobility hub of Geldermalsen. However, the relevance varies per policy document.

The decision making phase in mobility hub policy making in Geldermalsen is researched. The data governance exists of different operationalized components, such as power relations and differing actors. The local layer of Geldermalsen does not have a big variety of actors in the decision making. In fact, only three stakeholders are highlighted in the interviews. However, the power is not positioned directly in the local politics. This is because of the formal power that is distributed among the governmental layers. The province of Gelderland have respective influences on the local policy making in Geldermalsen. Also, the financial power is interesting in local decision making. Financial decisions are made in the past, but can still have effects on the decision making today. So called labelling money put certain amounts in specific projects, whereafter it becomes very difficult to change the aim for the money. In fact, in this example money is only reserved, but not yet used. The financial impact is part of

the power distribution. In combination with the changing political structure, former coalitions have affects years later.

The decision making is affected by different domains of data. Economic data comes back in labeling money. Also, financial data that causes economic cuts is part of local policy making. Adding to this, decision making is influenced by political data. Information on the size of political parties and their way of thinking is part of it. Finally, the domain of geospatial data is integrated in decision making. Political parties are chosen by the whole municipality, which makes it essential to decide in favor of all 26 villages.

Also, the size of political parties indirectly affects the types of datasets that are used. Bigger parties are part of the municipal coalition in Geldermalsen. Formal documents as coalition programs form the foundation of daily decision making, which is done by the alderman and mayor of West Betuwe.

In the municipality of Geldermalsen, open meetings form the foundation of communication between actors. Council meetings, image forming of political parties and coalition talking mostly happen in formal settings. Open meetings often include multiple political parties to discuss and negotiate, whereafter the voting process starts. In fact, the structure of decision making relies on open meetings, because voting rounds are open.

4.4. Data Information in Interaction between Policy Design Arena's

In this sub chapter the position of data information in the interaction between the policy formulation arena and the decision making arena is outlined. This sub chapter is split up in the different themes that are researched: dataset identification and categorization, actors' identification and power influence and finally, communication methods are investigated. This chapter answers the fourth sub question of this research:

- In what way is data governed in the interaction between the policy formulation phase and the decision making phase, focusing on power relations, communication and types of data?

4.4.1 Actors Identification and Power Influence

In the interaction between the formulation arena and the decision making arena actors are identified. First, a brief overview of integrated actors is given, whereafter an overall understanding of types of power in the interaction is given.

Overview of identified actors

Initially, this chapter would not cover the actors that are part of the data flow. However, table 6 shows what actors take part in the data governance. The codes on spatial levels show which governmental layers are present in the interaction between the arenas. The local level is coded the most times, but the national level consists of the most diverse individual actors. The analyzed interviews named many different actors that are part of the interaction flow and fit a specific governmental layer. The following table shows which actors are part of the interaction flow, as shown in table 6.

The analysis on the interviews results in an overview of actors across varying governmental levels. Some of the actors fit in multiple governmental layers, which results in overlapping stakeholders. Table 6 serves as foundation for the rest of this sub chapter of 4.4 to refer to.

National level	**Provincial level**	**Local level**
Ministry counsel (including Ministry Infrastructure and Water Management)	Consumer organization ROCOV	Local mobility policy makers
National government	Provincial political factions	Municipal political factions
ProRail	Provincial policy makers	Municipal advisor traffic and transport
NS	NS	Municipal council of mayor and alderman
Knowledge Institute Mobility (KIM)	Regional mobility actors (Arriva)	

Rijkswaterstaat		
Mobility actors (Arriva)		
Researchers		
Media (newspapers)		

Table 6: Integrated actors in interaction between arenas.

Overview of types of power

Analyzing the power relations inside the data governance in the interaction between arenas is done by focusing on the following types: knowledge power, relational power, resource power and formal power. Where power relations can explain the data governance, it is essential to discuss which types of power happen. Also, the link to actors related to certain types of power are discussed. In chapter 4.4, the link to Geldermalsen is made.

Analyzing the power inside the data governance between the studied arenas shows how formal and knowledge power are important mechanisms for actors to have a saying in policy and decision making. However, the relational and resource power are not discussed due to a lack of references.

An interviewee from ROCOV shows how difficult it is to contribute as an advisory organ to the formal power of government decision makers.

- "Of course they may deviate from it. That is clear, because we provide advice." (C2)

Advise is a voluntary data source, which can be ignored or partly be taken into policies. The same happens with the policy writers of the municipality of West Betuwe. The local politics have the final say. In the end "you can say, it is something or it is not" (M1). A lengthy process of policy formulation can be overruled by one meeting in the municipal voting rounds. Sometimes specific responsibilities between stakeholders are mandatory, such as the NS with publishing open transport data (A1). In the end, formal power mostly refers to the decision makers which can overrule advise or policy document from the formulation arena.

Another important power in data governance is the knowledge one. Advisory organs as ROCOV can provide information without asking (C2). Their knowledge relies on the multiple smaller consumer organizations, which provides a broad range of expertise. Advising decision makers to put ROCOV into the knowledge power in which they can contribute. The researcher of the KIM shares this position, where their knowledge plays a role in "concrete cases" (R1). Usage of scientific papers of KIM in the national political government is just an example (R3). On the other hand, mobility organizations as Arriva have the possibility to keep restricted access on transport data (A1). This enables a positive placement in concession talking on new train or bus regions. The data is only shared a brief time before the concession area comes on the market.

The other powers analyzed such as relational power only occurred on small occasions. However, resource power is interesting in the interaction in the dataflow. The financial resources of the decision makers are relevant because policy makers are independent of the politics (G1). This also relates the formal power, as discussed before.

In the end, inside the interaction between the arena in West Betuwe, the power distribution is a combination of knowledge and formal power affecting different parts of the practices. The link to Geldermalsen is made in 4.4.4.

4.4.2 Dataset Identification and Categorization

The dataset identification and categorization play an important role in the resulting part of this research. Inside the interaction of the policy arenas, a broad scala of integrated data is used. The direction of the data flow goes two directions, where policy makers influence decision makers and therefore decision makers can influence policy makers. However, this research focuses on the typology of data and which datasets can be identified. This chapter is therefore split up to highlight the most used types of data on one hand. Second, the dataset is identified by explaining the most used types of datasets in this arena. By highlighting data characteristics, the data flow in the policy arena can be linked to the existing policy documents to understand the case of Geldermalsen.

Data Categorization

The data categorization includes the integrated data split up into different domains of data, which is explained in chapter 2. In the policy formulation arena, the following domains are researched:

demographic data, economic data, empirical data, environmental data, transportation data, political data and geospatial data. However, not every type of data reoccurred often in the analysis. Therefore, this research focuses on the types of data that are referenced the most per dataflow. Because this changes per flow, not every data type is discussed in every layer. This part discusses: empirical data, transportation data, political data and economic data. In the end, a short overview of the missing data types is given if they are referenced in the coding process.

Empirical data
Researchers have provided decision makers with a lot of data in which they can formulate their point of view. Sometimes researchers are interviewed for their input on scientific studies (R3). But governmental organizations as Rijkswaterstaat also translate theoretical concepts to the Ministry of IWM (W1). Decision makers from the Ministry can use this 'translation' into their practices. Experiments with empirical data, which is scientific, can break political impasses (R1, R2). As mentioned before, national decision makers can use information from researchers or experiments (G1). Provincial politics also use experiments of policy makers to make their decisions. This interaction between policy makers and decision makers shows that fitting experiments, scientific-validated, can influence the politics.

Economic data
As mentioned before, economic data in policy formulation included financial motivations to implement specific elements in policies. On the other hand, economic data in decision making covered financial cutbacks for example. But the interaction between the arenas relies on economic data, which is not directly part of policy formulation, but which still affects the decision making. For example, the economic costs of small busses going through neighborhoods in West Betuwe are too high without volunteers (C1). Bus lines are not always profit making (C2). Decision makers have to decide what to do without volunteers driving around.

- "This is not a qualitative, structural solution for public transport." (C1)

Economic data influences decision making in a forcing way, where policy makers do not have the power to decide what to do. Financial related decisions are made in the decision making arena, who provide the financial tools (G1). Policy makers are influenced by these financial decisions, because the politics decide which domains money goes to.

Transportation data
Transportation data which was used in policy formulation to inform decision makers were changing in the recent years. In the past, 'predict and provide' tried to forecast bottlenecks and traffic flows (W1). This strategy of predicting is, according to professionals, ending. Transportation data should focus more on optimizing what we already have (W1). But it stays a political thing what decision are made in mobility problem solving. On the other hand, experiences from operating mobility agencies can be part of decision making (A1). Arriva experiences what is needed in specific regions by looking at transport numbers. Because Arriva is categorized in the policy formulation arena, the interaction between both arenas is connected.

Dataset Identification
The dataset identification shows the most used datasets, which are used to determine what data governance takes place in the interaction between the arenas. By focusing on the types of data sets, a descriptive overview of the data governance can be given. Not all datasets are discussed, because some are used more than others. In this arena, the most used datasets are: expert panels, formal documents and pilot studies. Other types of datasets are used, but not that often. Therefore, they are not discussed.

Expert panels
Advisory actors as consumer organizations and academia influence the policy formulation arena. Despite that they are categorized inside this arena, the experts' panels can still advise decision makers using the interaction flow. For example, consumer organizations as ROCOV have visited all municipal boards across the province of Gelderland (C1) to convince decision makers the necessity of maintaining public transport in specific rural areas. This strategy influences the local layer of government, but on a

national level the Ministry of IWM initiated a collaboration program in which Rijkswaterstaat is part of in an advising role (W1). This connects decision makers, policy makers and advisors into one structure.

Another strategy of expert panels relies on knowledge sharing through academic papers.

- "At one point I saw that the parliament was using this in a parliamentary motion" (R3).

Academia as experts are not only taken part in official meeting, but datasets are also used in independent methods. It can be one of the most effective ways to share knowledge (R3).

Formal Documents

The data governance between policy formulation and decision making exists of diverse types of formal documents. As mentioned above, decision arenas are fluctuating systems where different coalitions operate every period. Every coalition of political parties has new budgets, also for mobility problems (G1). The coalition creates frameworks in which policy makers can produce new measurements. Last coalition focused on mobility hubs (G1), therefore current provincial policy makers are making policies that fit the goal of hubs. Financial support is needed, which is regulated by decision makers. The formal document provides frameworks for policy makers to work with.

However, policy makers formulate new policies on the mobility hubs, which is presented to the decision makers, as it goes (G1). The formal policy document is voted on by decision makers (M1). In the end, policy formulation can integrate preferences and direct orders, but in the end:

- "In reports we are very strict to try to avoid saying: You shall do this, if the best solution is the following, because that is more of a political question" (R1).

This shows the importance of a fitting policy in relation to the objectives of political parties. Policy makers in the municipality of West Betuwe have categorized the level of importance of measurements.

- "So we are focusing on three aspects and money has now initially been made available for those three. Once we have checked off the three, we will look again at which ones we consider important and one of them is the hubs" (T1).

Pilot Studies

The dataset of pilot studies focusses on testing new concepts in practice. This is mostly done in the policy formulation arena in which researchers are located. Next to researchers, the Province of Gelderland also starts different test locations. Conclusions of pilot studies are shared with decision makers. The interviewed policy maker in Gelderland shares that positive case studies or pilots can affect politics (G1). On the other hand, the provincial decision makers (Provincial Staten) also asked him to start a pilot study (G1). When politics are in an impasse, experiments can help (R2).

4.4.3 Communication Methods

Communication in the interaction focuses on key methods that are most commonly used in this flow. Understanding the data flow through communication methods is discussed in the theoretical framework. Data governance consists of data and actors intervening in a particular way. This way is researched in this part.

In the interaction between the decision making and the policy formulation multiple communication strategies have occurred. Digital platforms serve as open data in different fields. Public transit companies sometimes publish transport data accessible to all stakeholders in both arenas (A1). Research studies are used by media and politics as data source, which means both arenas have used this knowledge from science (R3). This can influence or support decisions being made (R1). This communication is only done from policy formulation towards decision makers.

The open meeting is used the most as interaction methods between both arenas. Meetings between consumer organizations and provincial politicians (C1, P1) and between policy and decision makers from the same governmental layer (M1) are examples of formally conversations. Informal meetings did not come up in the interviews, which means they do not happen a lot between arenas.

Finally, public participation is present in bigger data sets, such as transport datasets (P1). But there is not described how direct opinions from citizens is used in decision making. Consumer organizations as ROCOV have an influence in the communication, but not directly use the public participation. The other way around, a new method of a communication project to share experiences of

new concepts as hubs is suggested (P1). Unidentified tools can be used to share the information, but it shows the perspective of provincial decision makers on information sharing to other actors.

4.4.4 Relevance for case study Geldermalsen

In each part of the resulting chapters, a paragraph is added to summarize the relevance of the findings to the Geldermalsen case study. Each of the documents has a direct or indirect impact on the Geldermalsen mobility hub. However, the relevance varies from one policy document to another.

In the data governance in the interaction between the arenas, the actors involved in local policy making are limited. Only the decision makers, ROCOV and the policy advisor are involved. Despite the variety of actors present in the table (6), not many have a direct influence on the local process. Advisory bodies are not often included because their advice is limited to policy formulation. Organizations, such as ROCOV provide unrequired advice that has no direct power.

Local policy-making is mostly confronted with formal power, which is based on the decision-making side. After a long process of policy formulation, a proposal is sent to the decision makers. Because of their formal position to decide whether they agree or not, power is experienced. In other words, the formal power in the interaction is one-sided. In addition, there is knowledge power in the interaction, but it seems that this only happens at higher levels of government.

The areas of data in the interaction, local policy making is partly influenced by national and provincial interaction. Empirical evidence can break policy deadlocks, which can happen at the local level. However, this is not found directly in the analysis. In contrast, economic data is used as information. In fact, decision makers vote for certain financial budgets for mobility hub practices. After that, the politicians in West Betuwe can start writing plans that use this money. The interaction between the arenas mostly consists of formal documents as datasets.

In the local policy making, interaction between the policy writers and decision makers is done by policy proposals. These are complete agendas or visions, as discussed above. In the local policy making, communication is done by digital platforms, open meetings and public participation. Mostly, the digital platforms show transport data that are shared by transport agencies, that are part of the policy formulation. Decision makers can use this information in their information seeking process.

5. Conclusion

This research explores data governance in policy and decision making of mobility hub policy around the case study of Geldermalsen in the province of Gelderland, the Netherlands. This research uses semi-structured interviews and a document analysis to better understand the Geldermalsen mobility hub. From local politicians to nationally renowned researchers, all kinds of stakeholders contribute to this research. They explained insights to answer the following main question:

- What is the data governance in policy formulation and decision making of the regional mobility hub Geldermalsen, the Netherlands?

A comparison between the three data streams and policy documents is made to clearly show where differences can be observed and where emphasis is found. The research divides the policy making process of Geldermalsen into policy formulation, decision making and the interaction in between. Based on the structure of the sub-questions, this research attempts to highlight three differences and similarities between the studied data flows.

This research compares the actors typology per governmental layer of the document analysis and the actors identification in the interviews. Therefore, it aims to emphasize the observed differences in the diversity of actors in the local governmental layer of West Betuwe. In the policy formulation, advisory bodies as ROCOV are integrated more often, researchers from KIM and independent ones are consulted, multiple local policy writers, mobility brokers and transport agencies are integrated. These actors participate in the local context of Geldermalsen. Adding to this, provincial and national government agencies are involved to include overarching issues, such as environmental objectives and regulations. However, diversity in decision-making disappears where less diverse actors are involved. Local factions, daily counsels and the coalition in the counsel are part of the decision making. In other words, the policy formulation of West Betuwe includes many non-governmental organizations, where decision making uses just governmental institutions. This image is confirmed by the document analysis, which showed a broad range of actors in the problem resolution. This stage of the PSM align with policy formulation actors. Adding to this, the document analysis also discusses how the solution statement is less diverse and exist only of governmental organizations.

Second, when focusing more on the data aspect of the research within the data flows, the types of data and the relevant data domains vary considerably regarding the case study. Formal documents such as existing policy documents on sustainability and mobility are included in each type of data flow concerning the mobility hub of Geldermalsen. There is more diversity in the identification of data. In policy formulation, expert panels, pilot studies and data reports from all layers are often included. However, the data flow within decision making shapes decisions on existing documents or proposals. Again, there is diversity in the interaction between the arenas, with experts and pilots still coming to the table. Also, the domains of data are interesting. While decision making seems to focus on economic, political and spatial data, policy formulation also consists of empirical data and traveler data.

Third, all forms of power are reflected in policy making in Geldermalsen. The policy formulation consists of the research powers of relation, knowledge, resource and formal. However, the decision making is mainly controlled by a formal power of politicians. However, the financial capabilities of a government greatly determine choices, which these governments can guide with formal power. For example, the municipal coalition can create financial budgets that affect the policy objectives the policy writers have to work with. In the interaction, the formal power is directed from policy deciders to the formulation arena.

. When concluding, the policy formulation and decision making seem to be in line with the literature review. However, PSM and IAD-framework are not often interrelated. So, this research suggests that when linking the frameworks, the problem solving stages from definition to resolution align with the policy formulation of this research. On the other hand, information seeking in solution statements is suggested to fit the solution statement.

6. Discussion and Recommendations

The research' aim was to study the local context of Geldermalsen. By choosing a small hub, the aim was to be able to address constraints and benefits in governance to other contexts of smaller stations in other areas. The main goal was to add extra knowledge on practical experiences with data and its handling. However, the research lacks in various ways.

The research highlights three data streams that are identified in mobility policy and decision making. These data streams are each focused on distinct stages of problem solving of Wilson (1999), where this qualitative study was used to discover this. These streams were then compared. Because comparisons are made in a study of qualitatively collected data, differences in interpretation and intentions of those involved are not addressed. But the researcher's bias does always affect the qualitative research in a certain way (Austin & Sutton, 2014). Qualitative case study research is conducted to extract and use lessons for similar cases. However, because it is a new way of doing research in which the three streams of data are compared in a subjective style of research, it is possible that false standards set false conclusions are drawn by comparing collaborations between levels (Van Thiel, 2014). Data is drawn more broadly than hard data such as figures. Combining quantitative and qualitative data would lower the change of missing essential elements of the results, because mixed methods tackle weaknesses in research on the built environment (Amaratunga et al., 2002). Future research could look at how data is involved in mobility processes in a quantitative way. By conducting qualitative studies, the background of meanings is provided, but misses the numeric data aspect which can make data flows better understood. In this research, the how and the why of information seeking are included. However, the IAD-framework refers to biophysical conditions and rules-in-use (Ostrom, 2005). Both integrate certain quantitative aspects, that were not included. Future research should focus on this elements, because of the arising role of big data (Liu & Dijk, 2022).

Second, the research aimed to include the empirical practice of data governance. Liu & Dijk (2022) describe how a space is left here in current debate. Empirical evidence helps to make better and more efficient choices in the future. However, the research ultimately leaves room to focus more on data management of governance. Information seeking describes a rather qualitative tone, where this research remains on the surface (Wilson, 1999). In this research, information is gathered on power, communication and types of data that emerged. However, the why and the how are missing. This could be brought to attention in a qualitative way to fill the existing gap.

Because several separate government agencies, advisory bodies and researchers have shared subjective material, there is a possibility that certain subjective opinions would be overlooked in a qualitative study (Amaratunga et al., 2002). This could highlight wrong actor dynamics or power relations, while a different situation applies. It is not clear in advance which actors have which point of view, which makes you dependent on interviewees due to subjectivity. By conducting additional research before contacting actors, a selection of suitable persons can be made. After all, people were left outside who should be included. For example, future research could focus on a particular stakeholder within data governance of mobility hubs. This research shows how governmental stakeholders as policy writers take part in many phases of the formulation. For example, following a policy writer in Geldermalsen would show a much deeper understanding on what difficulties or benefits there are for a single actor.

The concept of hubs is new in policy and is therefore rarely applied in practice (Arnold et al., 2023). Because actors have little practical experience and often refer to policy documents or advice, reference to practice could also be made more often in the future. Future research can investigate whether existing mobility hubs have undergone the same processes.

Future research can address the issues of subjectivity and power as new directions. However, there are also recommendations for policy and decision makers at all three levels of government in the Netherlands. The data flows examined show that there are major differences in the input from actors outside government. Few consultative bodies or other external parties are consulted at the decision-making level across the studied governmental layers. The involvement of new actors in decision making creates new sources of data and knowledge, but also new uncertainties within existing networks. New pilot studies on other mobility hubs could provide an opportunity to better understand new processes of data governance. Adding to this, Liu & Dijk (2022) show how new types of data have emerged in the past years. Following this thought, data governance on specific types of these data could be interesting.

7. References

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8. Appendix

8.1 Interview Guide

(Vraagt toestemming voor audio opname)

Goedendag meneer/mevrouw,

Voordat ik begin met het interview heb ik de vraag of u akkoord gaat dat ik quotes uit dit interview zou gebruiken voor mijn onderzoek. Dit kan anoniem worden gebruikt, indien u hier toestemming voor geeft.

(krijgt wel/geen toestemming)

Ik wil u eerstens bedanken dat u mee wil werken aan dit interview. Ik zal mijzelf eerst voorstellen. Mijn naam is Job Mogezomp, student Urban and Regional Mobility aan de Radboud Universiteit in Nijmegen. Mijn masterscriptie gaat over de rol van data in beleidsprocessen rondom de mobiliteit hub in de stad Geldermalsen. Aan de hand van verzamelde data interviews en een beleidsanalyse probeer ik een overzicht te creëren waarmee ik de rol van data in dit beleidsproces kan verklaren. Hierbij ligt mijn focus op hoe mobiliteit hubs worden meegenomen in beleid en welke soorten data hierbij voorkomen. De rol van actoren en de bijbehorende invloed die zij hebben in dit proces hebben ook mijn interesse. Het begrijpen van ervaringen en belemmeringen rondom de rol van data bij mobiliteit hubs op een regionaal niveau leert mij om toekomstig beleid beter aan te laten sluiten aan de wensen van alle soorten betrokkenen. Aan de hand van verschillende schaalniveaus interview ik beleidsmakers, onderzoekers en anderen met de vraag hoe zij met verzamelde data te werk gaan en op welke methodes zijn dit verwerken. Daarom ben ik ook bij u uitgekomen.

Voor dat het interview begint, heb ik nog wat informatie. De opnames zullen alleen voor de thesis gebruikt worden, zodat naderhand specifieke citaten terug kunnen worden gevonden. Hierdoor kunnen makkelijker en beter conclusies getrokken worden. Indien het nodig is, kan mijn scriptiebegeleider hier ook naar luisteren. Alles zal anoniem blijven, indien u dit belangrijk en nodig acht. Indien nodig, is het ook mogelijk om de opnames onder codenamen op te slaan.

Dit is de informatie vooraf, heeft u al vragen voordat het interview begint?

Introductie

Om een algemeen beeld van u (en uw bedrijf) te krijgen, heb ik de vraag of u mij kort wat kan vertellen hierover.

- De algemene bezigheden binnen de organisatie?
- Wat zijn de belangrijkste pijlers van de organisatie?
- Op welke afdeling werkt u?
- Wat is uw functie binnen deze afdeling?
- Met welke vraagstukken houdt u zich bezig?
- Eerdere werkgevers?

Eerder mobiliteitsbeleid

Kunt u mij vertellen op wat voor manier u (of uw organisatie) de afgelopen 5 jaar deelnam aan de vorming van transport of mobiliteit beleid?

- Uw positie binnen beleidsvorming?
- Doelstellingen en eisen van het beleid?
- Maatregelen en initiatieven in het beleid?
- Welke datatypen zijn voor dit beleid gebruikt?
- Belangrijkste uitdagingen en oplossingen?
- De resultaten en lessen uit evaluaties?

Huidig en toekomstig beleid

In hoeverre bevat huidig en toekomstig mobiliteitsbeleid nieuwe doelstellingen en eisen?

- Nieuwe kansen en uitdagingen?
- Innovatieve oplossingen/strategieën?
- Methoden voor dataverzameling voor beleid?
- Combinatie met andere vakgebieden (duurzaamheid, politiek)?
- Participatie van verschillende betrokkenen?

Het structuren van data voor beleid

Op welke manier kan data gebruikt worden om mobiliteitsbeleid te ontwikkelen en te testen?

- Belangrijke databronnen voor beleidsvorming?
- De strategie van het interpreteren van data?
- De data-analyse en de methodiek hierbij?
- Voordelen en nadelen van verschillende type data in de vorming van beleid?

Verbeterpunten dataverzameling

Wat zijn de huidige uitdagingen in beleidsvorming processen en hoe kunnen deze worden verbeterd?

- Belangrijke obstakels bij verzamelen van data
    - Effecten hiervan
- Te verkrijgen data
    - Kwantitatief vs. kwalitatief
- Strategie om obstakels te ontwijken of veranderen?
- Data uitwisseling met andere instanties?
- Beperkingen of mogelijkheden in kennis van beleidsmakers?
- Verwachtingen voor de toekomst?

Samenwerking andere overheden

Op welke manier werkt u (of uw organisatie) samen met andere overheden in de creatie van nieuw mobiliteitsbeleid?

- Toestemming voor het delen van data?
- Type samenwerkingen tussen overheden
    - Hoe kan dit worden gedeeld?
    - Uitdagingen bij deze typen?
- Feedback vanuit andere instanties?
- Voorbeelden van samenwerkingen?
- Verbeterpunten in samenwerkingen?
    - Trainingen?
    - Minder regelgevingen?
    - Anders…

Afsluiting:

Dat waren alle vragen die ik had voorbereid. Ik wil u bedanken voor uw tijd en inzet voor mijn onderzoek. Ik heb nog twee afsluitende vragen.

Heeft u nog verdere vragen of onderwerpen die u onderbelicht vindt, waar u nog op wil terugkomen?

Heeft u interesse om het uiteindelijke resultaat van mijn onderzoek opgestuurd gekregen.

→ opsturen → e-mailadres vragen

8.2 Codebook

Code group	Codes	Subcodes
Rules-in-use	• Rules-in-use: Actors typology	
		• Citizens and users
		• Civil society
		• Governmental sector
		• Mobility partners
		• Privat sector
		• Public services
		• Researchers
Rules-in-use	• Rules-in-use: Integrated data	
		• Demographic data
		• Economic data
		• Environmental data
		• Geospatial data
		• Political data
		• Empirical data
		• Transportation data
Rules-in-use	• Rules-in-use: Policy process	
		• Problem definition
		• Problem identification
		• Problem resolution
		• Solution statement
Policy formulation	• Actors identification in policy formulation	
		• Actors barriers
		• Actors details
		• Actors motivations
		• Actors role
Policy formulation	• Actors power in policy formulation	
		• Formal power
		• Knowledge power
		• Relational power
		• Resource power
Policy formulation	• Communication methods in policy formulation	
		• Digital platform
		• Informal meeting
		• Open meeting
		• Public participation
Policy formulation	• Dataset identification in policy formulation	
		• Dashboard
		• Data report
		• Expert panel

		• Feedback form
		• Formal document
		• Pilot study
		• Survey
Policy formulation	• Integrated data in policy formulation	
		• Demographic data
		• Economic data
		• Empirical data
		• Environmental data
		• Geospatial data
		• Political data
		• Transportation data
Policy formulation	• Spatial level of policy formulation	
		• International level
		• Local level
		• National level
		• Provincial level
Decision making	• Actors power in decision making	
		• Formal power
		• Knowledge power
		• Relational power
		• Resource power
Decision making	• Communication methods in decision making	
		• Digital platform
		• Informal meeting
		• Open meeting
		• Public participation
Decision making	• Dataset identification in decision making	
		• Dashboard
		• Data report
		• Expert panel
		• Feedback form
		• Formal document
		• Pilot study
		• Survey
Decision making	• Integrated data in decision making	
		• Demographic data
		• Economic data
		• Empirical data
		• Environmental data
		• Geospatial data
		• Political data
		• Transportation data
Decision making	• Spatial level of decision making	

		• Local level
		• National level
		• Provincial level
Decision making	• Actors identification in decision making	
		• Actors barriers
		• Actors details
		• Actors motivations
		• Actors role
Inter-arena dynamics	• Communication methods between arena's	
		• Digital platform
		• Informal meeting
		• Open meeting
		• Public participation
Inter-arena dynamics	• Spatial level between arena's	
		• International level
		• Local level
		• National level
		• Provincial level
Inter-arena dynamics	• Actors power between arena's	
		• Formal power
		• Knowledge power
		• Relational power
		• Resource power
Inter-arena dynamics	• Integrated data between arena's	
		• Demographic data
		• Economic data
		• Empirical data
		• Environmental data
		• Geospatial data
		• Political data
		• Transportation data
Inter-arena dynamics	• Dataset identification between arena's	
		• Dashboard
		• Data report
		• Expert panel
		• Feedback form
		• Formal document
		• Pilot study
		• Survey