

## ***Onzekerheden in de implementatie van mobiliteitshubs* – Guy van Nifterik, Vincent Marchau, Sander Lenferink, Peraphan Jittrapirom**

Planners hebben hoge verwachtingen van de komst van mobiliteitshubs in de transitie naar een duurzaam mobiliteitssysteem. Mobiliteitshubs zijn multimodale vervoersknooppunten waar de reiziger kan overstappen op andere vervoersmodi, maar kunnen ook een scala aan activiteiten bieden – zoals werkplekken, huisvesting, eetgelegenheden, winkels of groen – binnen stedelijke en landelijke gebieden. De toepassing van deze mobiliteitshubs wordt echter gekenmerkt door meerdere systeem- en actorgerelateerde onzekerheden. In dit paper onderzoeken en beschrijven wij deze onzekerheden met behulp van een hiervoor ontwikkeld theoretisch model. Het model is vervolgens toegepast op hub-implementatie door een analyse van hublitteratuur en interviews met beleidsmakers. Waar inhoudelijke onzekerheden gerelateerd zijn aan het mobiliteitssysteem, zijn normatieve, strategische en institutionele onzekerheden gerelateerd aan de interactie tussen wederzijds afhankelijke publieke en private actoren. Uit de toepassing van het model op hub-implementatie blijkt dat het gebrek aan kennis over de (toekomstige) perspectieven van actoren op mobiliteitshubs en over de invloeden van de mobiliteitshubs op het mobiliteitssysteem de afstemming van strategische afwegingen belemmert. Dit resulteert vervolgens in onduidelijkheid over de verdeling van verantwoordelijkheden, eigenaarschap van de mobiliteitshub, of de financiering van de hub. Hiermee is dus te stellen dat zowel institutionele als inhoudelijke onzekerheden de mate van strategische en institutionele onzekerheden vergroot.

## **Uncertainties in Mobility Hub Implementation**

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Mobility hub implementation is surrounded by many uncertainties. We conceptualise these uncertainties into governance and system uncertainties within a framework and argue that dominant uncertainties in MH implementation are related to normative assumptions of actors, the system within which these mobility hubs are expected to operate, and strategies to come to mobility hub policies. These uncertainties, in turn, result in uncertainties about the formal and informal rules guiding actor behaviour.

# Uncertainties in Mobility Hub Implementation

## *Introduction*

The transport system needs to transition to become more sustainable. Mobility hubs (MHs) are expected to support this transition. Initially, MHs are planned as nodes of connectivity between different transport modes – such as active modes, public transport, and shared mobilities – to enable multimodality, but MHs could contribute to broader environmental and socioeconomic objectives (Arnold et al., 2022) by constituting places of activities within urban, suburban, and rural areas to achieve a better node/place balance (Bertolini, 1999; Rongen et al., 2022) at local, urban and regional scales. In fact, literature has highlighted the potential of MHs to support, among others, liveability (Weustenenk & Mingardo, 2023), safety (Aono, 2019; Arnold et al., 2022; Witte et al., 2021), accessibility (Anderson et al., 2017; Arnold et al., 2022; Weustenenk & Mingardo, 2023; Witte et al., 2021), decreased greenhouse gas (GHG) emissions (Arnold et al., 2022; Hosseini et al., 2023; Ku et al., 2022; Witte et al., 2021), and economic competitiveness (Arnold et al., 2022; Bosworth & Salemink, 2021; Rongen et al., 2022).

Policymakers therefore have high expectations of MHs to help transition to a sustainable mobility system, but face important uncertainties related to e.g. the effects of MHs on modal behaviour, the type of MHs that should become available, the nature and scope of supportive policies accompanying MH development, the cooperation and collaboration between public and private actors or the division of responsibilities among actors involved in MH planning. These uncertainties are, therefore, not only related to the technical system at hand but are also related to multiplicity of actors involved. While theoretical fields such as decision making under deep uncertainty (DMDU) have been prolific in the development of theories and methods around uncertainties about the technical system (Marchau et al., 2019), there has been much less focus on other types of actor-related uncertainties that have substantial effects on policymaking within multi-actor governance networks.

It is therefore important to better understand to what extent and how these uncertainties affect multi-actor decision arenas. While previous theoretical work has highlighted the existence of various types of uncertainty (Akse, 2024; Dewulf & Biesbroek, 2018; Friend & Heckling, 2004; Klijn & Koppenjan, 2015; Veenma, 2021; Vis, 2024), an application to a specific case has been missing. MHs constitute a relevant case here due to the interdependent and multi-actor nature of its governance arena, involving public and private actors – such as governments, transport providers, and travellers – whom all possess different perceptions and perspectives on MHs along with relevant and specific resources and agency for MH implementation. To handle these uncertainties, it is important to understand the uncertainties in MH implementation better.

Ultimately, this research seeks to develop a framework depicting the causal relations between uncertainties in MH implementation and to develop a stepwise approach with participatory methods to handle these uncertainties. To this end, in this paper, we present a research agenda to come to a better understanding of these uncertainties in MH implementation. To achieve this, we draw the following research questions:

- **RQ1:** What framework conceptualizes the uncertainties in network governance?
- **RQ2:** Based on this framework, what uncertainties are dominant in MH implementation?
- **RQ3:** What are the causes, effects, and relationships between these uncertainties?
- **RQ4:** How can policymakers handle these uncertainties in MH implementation?

Part I of this paper provides a theoretical introduction framework on uncertainty in network governance (RQ1). Part II identifies the dominant uncertainties in MH implementation (RQ2). Part III describes the causal relations between these uncertainties based on a literature review and preliminary interview analysis (RQ3). In part IV, we present the challenges we are facing in this research and argue for the development of intervention methods to handle these MH uncertainties (RQ4).

## *Methods*

This paper is a work-in-progress that builds on a literature review that includes scientific and grey literature about MHs and a series of unstructured preliminary interviews with MH policymakers. The

literature was first collected systematically using search terms related to MHs on Google Scholar, Web of Science, and Business Sources Complete (e.g., “mobility OR transportation AND hubs,” “multimodal” AND “hubs”) and snowball sampling based on the reference lists. The preliminary interviews were conducted as part of a process to get acquainted with this PhD research about uncertainties in MH implementation. These interviews did not follow a structured interview guide. Although these discussions were not recorded, notes were taken and reviewed by the policymakers to ensure objectivity. These discussions typically lasted 30 minutes to 1 hour and took place in The Netherlands within the Dutch planning context. The retrieved literature and interviews were not subjected to a structured coding process but were openly analysed. In particular, we highlighted and retrieved information relating to uncertainty in MH implementation.

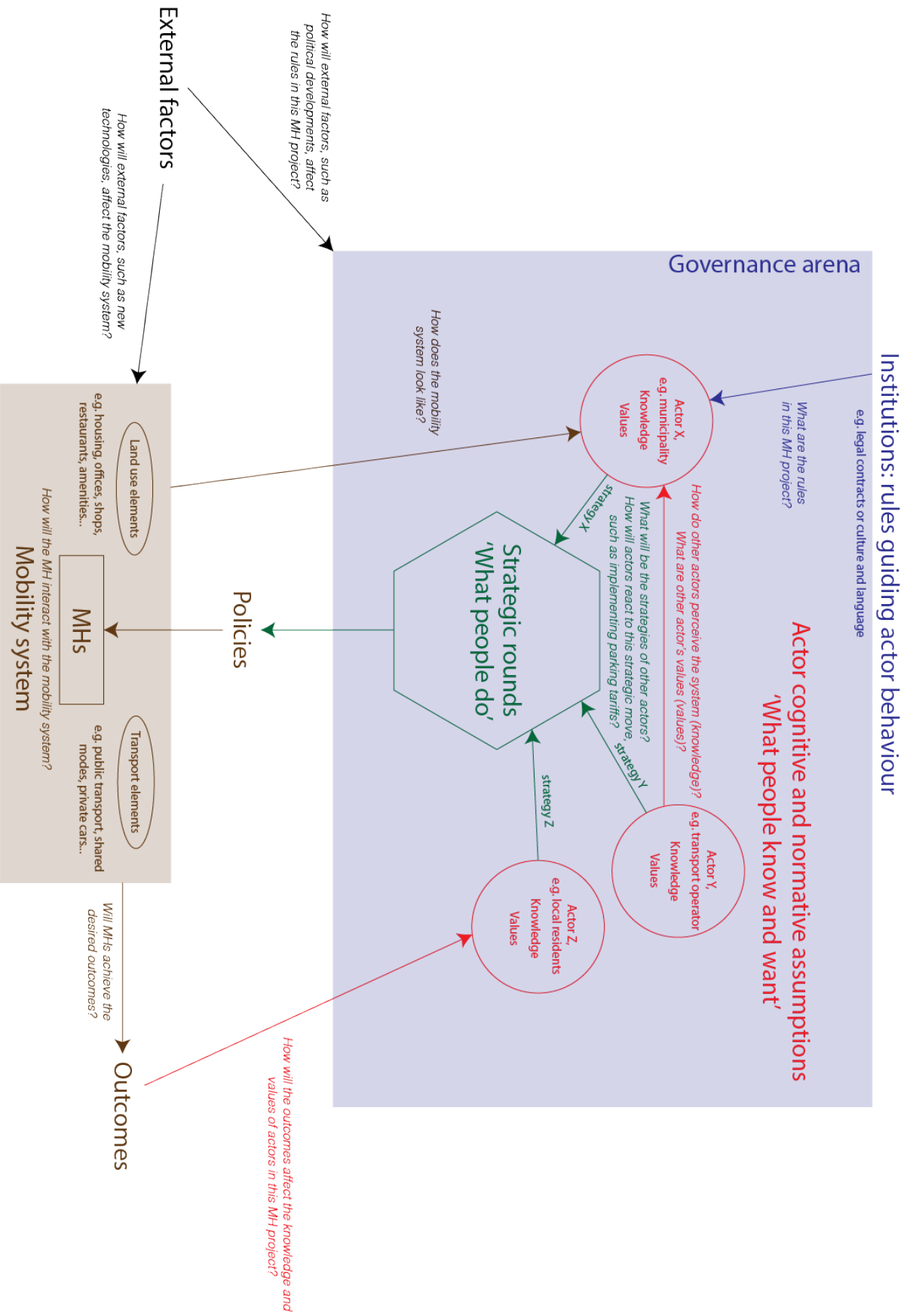
### ***Part I: uncertainties in MH implementation (theoretical framework)***

In this section, we provide a literature review of the scientific literature about uncertainty. We first define uncertainty and distinguish uncertainty about the system and uncertainty about actors. Then we integrate these uncertainties in a framework of uncertainties in network governance, which we illustrate using examples from MH implementation.

Uncertainty is traditionally defined as the limited knowledge about future, past, and current events (Marchau et al., 2019). This level of knowledge might be located somewhere between complete certainty and total ignorance, commonly referred to as ‘levels of uncertainty’ (Marchau et al., 2019). Therefore, decision-makers experience uncertainty when they are exposed to a gap between the currently available knowledge and the knowledge needed to come to optimal plans and policies (Marchau et al., 2019). In some cases, this missing knowledge might be gained by conducting additional research (Walker et al., 2003), but in other cases, the problems faced by decision-makers are ‘wicked’, meaning these problems involve a large number of actors holding conflicting values and afford an unlimited number of policy alternatives (Enserink et al., 2022; Rittel & Webber, 1973). Moreover, Veenman and Leroy (2016) argue that these ‘unstructured problems’ are characterised by a lack of consensus on relevant norms and values and a lack of certainty about relevant knowledge.

These wicked problems generally require cooperation and coordination across many actors and organisations since governments, market actors and civil society are unable to solve these problems by themselves (Klijn & Koppenjan, 2015). MH planning is therefore characterised by a high number of stakeholders (Witte et al., 2021) due to the involvement of a range of public and private parties such as local, regional, and national governments, public stakeholders, market actors such as shared mobility providers, or members of civil society (Arnold et al., 2022; Geurs et al., 2023). This multi-actor governance system usually takes the form of public-private partnerships which require cooperation of actors within networks for effective MH planning (Arnold et al., 2022; Rongen et al., 2022). MH planning is an example of network governance. In network governance, interdependent actors take part in relatively stable and (self) regulating governance networks within regulative, normative, cognitive and imaginary frameworks characterised by interaction processes to collectively address problems and develop public policies (Klijn & Koppenjan, 2015; Sørensen & Torfing, 2005). Acknowledging this wickedness broadens the focus from uncertainty about the system with uncertainty about the actors involved in planning the system.

Several papers, books and PhD-theses have addressed these actor-related uncertainties. These studies focused on actor responses to uncertainties (Akse, 2024; Veenma, 2021; Vis, 2024) and to the nature of these uncertainties (Dewulf & Biesbroek, 2018; Friend & Heckling, 2004; Klijn & Koppenjan, 2015; Veenma, 2021). Yet, there is no comprehensive theoretical framework integrating and distinguishing these uncertainties in network governance. In fact, studies use different typologies for uncertainty, making it difficult to conduct research about these different types of uncertainty. Therefore, we propose a new theoretical framework depicting the various locations of these uncertainties by using examples from MH implementation (Figure 1).



**Figure 1:** uncertainties in network governance

Figure 1 integrates the different conceptualisations of uncertainty from Friend and Heckling (2004), Klijn and Koppenjan (2015), Marchau et al. (2019) and Veenma (2021). Figure 1 acknowledges that decision-making relies on rules, knowledge, and values (Dietz, 2013; Gorddard et al., 2016; Horcea-Milcu et al., 2022; Tschakert et al., 2016) to make decisions (strategic) within a system (substantive) and presents two main elements: the governance arena (blue box) and the system (brown box). The governance arena depicts the area where decision-makers interact and take decisions, while the system refers to the technical system in which interventions (such as MHs) are implemented. To illustrate this framework, we choose the perspective of Actor X, in Figure 1 described as ‘the municipality’. The following list describes the different elements in Figure 1:

- Institutions (in blue) are the formal and informal rules of network governance, such as laws and regulations, cultures or languages. Institutions regulate actor behaviour and institutional change is generally slow (Klijn & Koppenjan, 2015). Institutional uncertainty is therefore related to the rules in a multi-actor project. For example, Actor X may not have sufficient knowledge about the legal contracts binding these actors together or the multiplicity of organisational cultures involved in a particular MH project.
- Actors (in red) all possess different knowledge (cognitive) and values (normative) (Friend & Heckling, 2004; Veenma, 2021). These cognitive and normative assumptions generally relate to the system at hand, but may also pertain to knowledge about e.g. the guiding rules or the strategies involved in a project. As a result, Actor X may be uncertain about what other actors know (cognitive) and want (normative) in a particular MH project. In fact, other actors may pursue different objectives and possess different knowledge, leading to ambiguity and conflicts between actors when developing MH policies.
- Strategic rounds (in green) are the different strategic moves initiated by actors in decision-making (Friend & Heckling, 2004; Klijn & Koppenjan, 2015; Veenma, 2021). There may be uncertainty about actor (inter)actions or coordination of strategies. Strategic uncertainty is a consequence of the inherent actor interdependency in network governance, where the choice and enactment of strategies of other actors is unpredictable. For example, Actor X may not know how Actor Y (transport operator) will react to the development of parking tariffs: if Actor Y chooses not to increase public transport provision as a compensating measure, the system at hand may become less accessible to large groups of the population.
- Substantive (or system) uncertainty (in brown) is related to the nature of the problem or the effectiveness of the solutions (Friend & Heckling, 2004; Klijn & Koppenjan, 2015). There are different uncertainties related to the system. First, Actor X may not know how the mobility system looks like or what problems are most stringent. Second, Actor X may not know how the MH will perform within the mobility system – what the structural system dynamics with system elements will be once the MH has been implemented (Marchau et al., 2019). Third, Actor X may be unsure about the capacity of MHs to achieve the intended outcomes. In turn, these outcomes may alter the cognitive and normative assumptions held by actors within the governance arena, leading to more uncertainty related to the other involved actors (in red).
- External factors (in black) may affect different locations of uncertainty (Marchau et al., 2019). For example, Actor X may not know how external political developments will influence formal and informal rules in the governance arena or how the rise of new technologies – such as e-scooters – alter the structural system dynamics of the MH within the mobility system.

As a result, uncertainties in network governance are multiple and complex. They are not only related to the system at hand, but are also related to the governance arena actors are operating in. Moreover, these uncertainties do not operate in silo’s; rather, they are intimately connected and shape interaction within institutions (Akse et al., 2023; Klijn & Koppenjan, 2015). The next part highlights the dominant uncertainties in MH implementation based on our literature review and the preliminary interviews.

## ***Part II: uncertainties in MH implementation (results)***

The previous section integrated the different uncertainties found in literature into a framework (Figure 1). In this section, we focus specifically on the dominant uncertainties in MH implementation. These results are based on the review of MH literature and the preliminary interviews. We distinguish the following four dominant uncertainties in MH implementation:

**Normative uncertainties:** we refer the uncertainties related to actor values as ‘normative uncertainties’. These uncertainties are predominantly related to the type and nature of MHs that should be implemented within the mobility system (Aono, 2019; Arnold et al., 2023; Arnold et al., 2022; Benz & Stauffacher, 2024; Weustenenk & Mingardo, 2023). We distinguish the following objects of normative uncertainty:

- Objectives of MH: The preliminary discussions with policymakers highlight the difficulties in reaching consensus about objectives of MHs within the mobility system. In fact, different actors may pursue very different objectives motivating their participation in MH policymaking. Public actors such as municipalities may want to achieve public values related to, for example, social safety and environmental sustainability. Private actors like companies or local residents, in turn, may want to pursue growth, economic benefits, or to be able to park their private car in the direct vicinity of their residence.
- Design and location of the MH: This potential divergence of objectives has implications for the design and the location of the MH. Questions are related to the number and nature of services, facilities, or transport and shared mobility options. Rongen et al. (2022) highlights that form follows function, meaning that design choices need to be made based on the (consensus on) objectives held by stakeholders. Similar normative trade-offs are related to the location of MHs: should it be placed to serve places with a sufficient access to transport to improve accessibility (low hanging fruit) or should it be placed in places where there is not sufficient transport to encourage behavioural change (Arnold et al., 2023)?

**Substantive uncertainties:** Uncertainties about the system are central to MH implementation. These uncertainties can be related to external factors such as the introduction of new modes on travel behaviour (Arnold et al., 2022), but are mainly related to the unknown structural dynamics of the system following the implementation of MHs. A major concern is the uptake and usage of the MH, such as modal shift as part of behavioural change as a result of MH policies and supportive policies (Weustenenk & Mingardo, 2023) or the contribution of MHs to the local economy. These substantive uncertainties are therefore essentially related to the achievement of the set objectives as a measure of success of the implementation of MHs within a mobility and land-use system.

**Strategic uncertainties:** Literature and preliminary discussions report the existence of many strategic uncertainties in MH implementation. These are mainly related to the coordination and cooperation of actors in the development of MH policies. In fact, actors mainly work in silo’s and focus on own projects and interests (Weustenenk & Mingardo, 2023), what makes public-private collaboration difficult. Policymakers reported uncertainties in the development of supportive policies and in the integration of land-use and mobility planners. This is particularly important as the success of MHs is highly dependent on the mutual commitment of actors to coordinate actions for shared social, environmental, and economic benefits. For example, policies aiming at a reduction of car ownership and usage must be combined with public transport and shared mobility policies to be successful.

**Institutional uncertainties:** Since most MHs involve many actors from public and private actors, there are many reports of institutional uncertainty in both the literature and the discussions with policymakers. These uncertainties are generally related to funding of the MH (Anderson et al., 2017), responsibilities of actors (Anderson et al., 2017; Arnold et al., 2022), governance models or business cases (Coenegrachts et al., 2021). Although MHs are conceptually not a new phenomenon (Rongen et al., 2022), a clear definition of what MHs are is lacking. Moreover, MHs should be tailored to their environment, there is no ‘one size fits all’ design example. Policymakers therefore report difficulties making sense of what MHs are, what governance and business models should be developed, who will and should be responsible of implementation and operations, and how the MH should or can be funded.

These four uncertainties, however, cannot be considered apart from each other. There are various synergies between these uncertainties. The next section provides a discussion about the relationships between these uncertainties.

### ***Part III: dynamics of uncertainty on MH implementation (discussion)***

The previous section show that normative, substantive, strategic, and institutional uncertainties are predominant in MH implementation. However, these uncertainties cannot be considered apart from each other. In fact, causal relations may exist between these uncertainties. For example, the multiplicity of objectives (normative uncertainty) and the unknown contribution of MHs to these objectives (substantive uncertainty) may increase the risk of actors not coordinating or cooperating towards develop MH policies (strategic uncertainty). This means that divergent objectives and asymmetries of data may lead to divergent strategies. Together, these uncertainties may in turn increase institutional uncertainty, since responsibilities for handling these uncertainties are unknown. These uncertainties may, therefore, be an important predictor of often mentioned barriers related to governance and business models or MH funding and ownership.

Another important observation is that knowledge (cognitive) and values (normative) can be related to different locations of uncertainty. Typically, these are related to the system of interest, but can also be related to rules or strategies. In fact, given the *lack of knowledge* about the contribution of MHs to the *desired outcomes* (cognitive substantive uncertainty), actors do not *know* what strategies to enact (cognitive strategic uncertainty) – e.g., what policies or package of policies to implement – or how the responsibilities *should* be allocated (normative institutional uncertainty) – e.g., who should be held accountable for the financial risks related to MH operation. Actors are therefore likely to navigate between cognitive and normative assumptions, hence acknowledging the existence of a relation between knowledge and values in planning (Horcea-Milcu et al., 2022). As such, there is not *one* type of cognitive or normative uncertainty; instead, they may be related to different locations within Figure 1.

### ***Part IV: Challenges and further research***

There are important limitations to this research. Although the preliminary interviews and literature review yielded interesting insights, we have not yet conducted structured data collection with MH policymakers. Important challenges remain about how to retrieve these uncertainties in interviews and make policymakers think about the relations between these uncertainties. Practical problems are the wording of the questions to be asked and the choice between data collection methods to come to a better understanding of uncertainties in MH implementation. For example, how to choose between semi-structured individual interviews, focus groups, structured workshops, a Delphi study, applying a Q-methodology, or a combination of these methods? During Plandag, we would like to discuss the following points:

- The framework (Figure 1): is the framework understandable for research and practice? To what extent can it be used for application in practice?
- The methods for this paper: what method to choose to retrieve uncertainties and the relationships between uncertainties from policymakers?
- The approach to cope with uncertainty: does it make sense to first handle normative and substantive uncertainty, before addressing strategic uncertainty? If so, what methods can serve this approach?

The goal of this paper was to understand the dynamics of uncertainty in MH development to develop a stepwise approach to handle these uncertainties. To this end, we have set a theoretical framework about uncertainties in network governance (Figure 1). We have then identified the main uncertainties in MH implementation based on literature analysis and preliminary interviews with policymakers. We come to the conclusion that causal relations exist between these uncertainties. Specifically, it seems that normative and substantive uncertainties result in strategic uncertainty. These different uncertainties, in turn, lead to more institutional uncertainty. Work remains, however, to validate our findings and to come to a comprehensive approach to handle these uncertainties in MH implementation.



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