Issue 25(4), 2025
ISSN: 1567-7141
DOI: 10.59490/ejtir.2025.25.4.7908

TU Delft OPEN Publishing
Research Article

Is anyone going to light the fire? Drivers and barriers in the initiation of flexible use of charging infrastructure on major passenger transport hubs in the Netherlands

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Keywords
Initiation
Collaboration
Drivers and barriers
Flexibility
Charging infrastructure
Major passenger transport hubs

Publishing history
Submitted: 20 November 2024
Revised date: 28 April 2025
Accepted: 25 June 2025
Published: 08 December 2025

Cite as
Pennings, R., Wiegmans, B., & Spit, T. J. M. (2025). Is anyone going to light the fire? Drivers and barriers in the initiation of flexible use of charging infrastructure on major passenger transport hubs in the Netherlands. *European Journal of Transport and Infrastructure Research, 25*(4). https://doi.org/10.59490/ejtir.2025.25.4.7908

Abstract

Third party use of charging infrastructure for electric buses on major passenger transport hubs offers potential to make better use of existing electricity grid capacity, especially given the current lack of grid capacity. This requires flexibility in the charging operation, which is hampered due to lacking ownership of this opportunity to share charging infrastructure. This research aims to develop understanding of the perception of drivers and barriers for stakeholder organizations (SOs) to initiate collaboration on flexible use of this infrastructure. A survey under 141 respondents was applied to collect these perceptions on the drivers and barriers, the most logical initiator and motives behind these choices. Results indicate that presence of sufficient benefits, fitting organizational culture and entrepreneurial freedom are main drivers for initiation of collaboration. No specific barriers stood out. Furthermore, public parties – specifically the transport authority – are indicated as most logical initiator. The paper shows that challenge for initiating collaboration lies in the unclarity around the mandate to take initiative. Although the presence of mandate is not seen as main driver for one's own organization, it is seen as reason why other organizations should be the initiator. The lacking overall mandate for collaboration causes inertia, and thereby is the reason why the fire is not lit yet. Fortunately, this challenge of ownerless opportunities in complex SO-environments can be overcome, but it does require a new way of looking at how infrastructure is applied and managed.

1 Introduction to flexible use of charging infrastructure

The growing demand for urban space (OECD, 2017), combined with the lack of electricity grid capacity, puts pressure on the electrification of sectors (European Network of Transmission System Operators for Electricity et al., 2024), such as mobility. Potential for better use of infrastructure is seen in granting access to third party usage when available, but its application is hampered by lacking established responsibilities and fragmentation of responsibilities between sectors for the initiation of this better use (Toering et al., 2025; Pennings et al., 2023a; Pennings et al., 2023b). In this research, the drivers and barriers to initiating this sharing of infrastructure are analyzed to determine how initiation can be achieved for flexible application of infrastructure. Because the application of flexibility is not fully understood by stakeholders (Pennings et al., 2023a; Torres-Rincón et al., 2020; Sánchez-Silva, 2018), its application has been hampered. The focus of this research is on major passenger transport hubs in the Netherlands, given the existing urgency in two sectors: (1) the transition to zero-emission vehicles in the mobility sector, and (2) the challenges in the available grid capacity in the energy sector.

From a societal relevance point of view, there is a strong demand for physical space around major passenger transport hubs (abbr. MPTH) (Bijlsma et al., 2023; Hamers et al., 2021) and limited available electricity grid capacity (Netbeheer Nederland et al., 2022) puts pressure on the development of charging infrastructure for mobility (Ashkezari et al., 2024; College van Rijksadviseurs & Bureau Spoorbouwmeester, 2023). Because these MPTHs have strategic locations (Rongen et al., 2022), sharing the already existing bus charging infrastructure at these locations can help offer more charging infrastructure capacity without or with limited extra demand for infrastructure and space. This sharing is possible in different ways, for example, by sharing the charging facilities (installation and/or charging point) between different users for the charging of buses or other vehicles (e.g., logistic vehicles) (Pennings et al., 2023a; Melander & Wallström, 2022) or by sharing the capacity of the grid connection with other users (such as nearby vehicle charging locations) (Enexis Netbeheer, 2022; European Commission, n.d.). Because sharing options require the involved stakeholder organizations (SOs) to collaborate, all options are considered in this study. The potential of these options for sharing infrastructure is referred to as *infrastructure capacity* (abbreviated as IC). This sharing of IC requires flexibility from the SOs involved, as they have to adapt their demand and supply, and requires collaboration between the SOs involved. Given the fragmentation in mandated responsibilities per SO and limited understanding of the overall opportunities involved, this leads to a lack of overall ownership of this opportunity and subsequently to a missing initiator (Pennings et al., 2023a; Pennings et al., 2023b). This leads to an untapped potential for better use of the existing electricity infrastructure.

From a scientific perspective, the need for the initiation of collaboration on sharing IC is indicated for MPTHs (Pennings et al., 2023a) and logistics hubs (Pennings et al., 2023b) , and can be seen in other sectors, such as shared car parking spaces (Cai et al., 2018) and shared airport infrastructure (Zografos et al., 2016). The existing literature differs depending on the type of SOs involved. Significant research exists on the theoretical advantages of collaboration in general (Carbonara et al., 2014; Emerson et al., 2011), on the potential sharing of vehicles between public transport and logistics (Cleophas et al., 2018; Li et al., 2021; Li et al., 2022; Machado et al., 2023). However, limited research is available on sharing IC between these parties. Existing research on sharing IC between firms shows potential benefits for each of the Triple Bottom Line elements (economic, environmental, and social) (Melander & Wallström, 2022; Pennings et al., 2023b). Research on the application of public transport energy systems (metro, tram, and trolley) exists (Fernández-Rodríguez et al., 2019; van der Horst et al., 2023; Diab et al., 2023), but limited available research on the sharing of bus charging infrastructure is found, let alone on the initiation of sharing IC. Most available research is qualitative in nature (Pennings et al., 2023a; Pennings et al., 2023b) and the necessity for quantitative research is indicated (Pennings et al., 2020). For SOs to move towards the initiation of collaboration, sufficient drivers and surmountable barriers are required. The sharing

of IC requires SOs to embed this way of working in their organizations, networks, and politics (Mair & Reischauer, 2017). The motives of individual actors within stakeholder organizations (IAWSOs) play an important role in collaboration (Mair & Reischauer, 2017; Milanova & Maas, 2017) and Gustafson & Hertting (2016), since these influence an SO's stance towards collaboration. Overall, there is a current gap in the knowledge on the drivers and barriers for SOs to initiate collaboration on the flexible use of IC.

The goal of this research is to develop an understanding of SO's drivers and barriers to initiate collaboration on the flexible use of IC in order to kick-start collaboration in this application. This builds on the problem statement that SOs are currently not incentivized to take the role of an initiator for collaboration in the flexible use of IC. This is coined into the following research questions: *How do different individual actors within stakeholder organizations perceive main drivers and barriers for initiating collaboration on flexibility in electric bus charging infrastructure on major passenger transport hubs? And, who would be the most logical stakeholder organization to take the role of initiator and kick-start collaboration?*. The scope of this research was set at bus stations on MPTHs in the Netherlands (classified as 'Mega' and 'Kathedraal' stations (ProRail, 2022). The relevant SOs are the transport authority, municipality, distribution system operator, public transport provider (with IC on the MPTH), other potential IC users (such as other public transport providers without IC, logistics parties, and parties near the grid connection) (Pennings et al., 2023a) and experts. Appendix A elaborates on the relations between these SOs. The added value of this study to the existing body of literature is in (1) the identification of drivers and barriers for collaboration with the introduction of new variables (availability of shared electricity infrastructure), and (2) that it provides quantitative insights on which SOs can be the potential initiator and combine unique SO combinations on MPTHs with increasing interfaces between these parties. The contribution of the focus on MPTHs is in the specific setup of the relations between the stakeholders, in which adjustments can be established to incorporate measures to facilitate drivers and mitigate barriers.

Figure 1 illustrates the conceptual framework developed. It shows the trajectory from the identification of the possible flexible use of IC in collaboration. The decision-making process per SO in relation to its possible role in collaboration is indicated. This process focuses on the internal drivers and barriers of an SO in order to build on SOs capabilities in relation to their position towards the role of initiator. It splits the SO drivers and barriers and the personal motives for the IAWSO working at the SO, indicating the role of IAWSO's perception of the decision-making process.

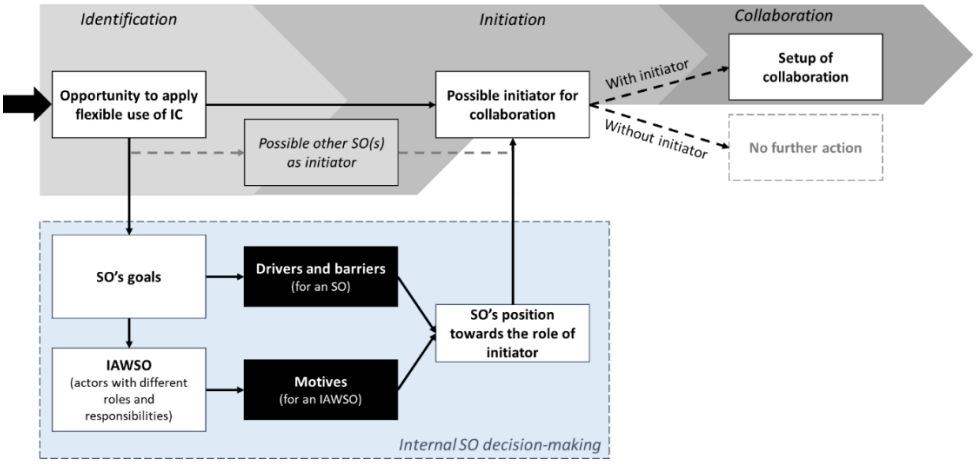

Figure 1. The conceptual framework for the application of drivers and barriers, and motives in the initiation of collaboration.

2 The drivers, barriers and motives for initiation of collaboration on flexible use of IC

The goal of the literature review is to gain insight into the existing body of knowledge on the drivers and barriers, motives, and most logical initiators for collaboration on the flexible use of IC. The literature was collected by (1) a search on Scopus and Google Scholar for (combinations of) the words 'Initiator / Initiation / Start', 'Collaboration', 'Flexibility', 'Sharing' and 'Driver/barrier', 'Infrastructure / Electric charging infrastructure / Passenger transport hubs', (2) references in the papers found and (3) authors and papers as indicated by experts. Papers were selected based on their relevance to the topic. This resulted in an initial pool of 119 papers. These articles have been screened for their relevance for the literature review based on their relevance to the topic. The literature review is structured as (1) the drivers and barriers for SOs, (2) the motives for IAWSOs, and (3) the most logical initiator for collaboration on the flexible use of infrastructure.

2.1 Drivers and barriers for SOs for the initiation of collaboration

Drivers and barriers have an impact on the decision making of SOs, as indicated in the conceptual framework (Figure 1). Given the large number of potential drivers and barriers in the literature (Karam et al., 2021; Wiegmans & Geerlings, 2010; Rogers, 2003), an approach is required to cover the full spectrum of these drivers and barriers and provide a structure for application in the literature review. Numerous possible approaches for understanding influences (such as PESTLE, Porter's Five Forces, Scenario Planning, 7S, and Resource-Based View) on organizations exist. Given the relevance of building on an SO's internal capabilities, since it helps highlight the level to which SOs are capable of taking up extra responsibilities, the focus is primarily on an internal-focused approach. This internal approach subsequently helps to show the level at which an SO can contribute to collaboration. The 7S-model (Peters & Waterman, 1982; Channon & Caldart, 2015) was selected because it focuses on the effectiveness of the full internal organization with a focus on both hard and soft elements, which is relevant for the way SOs can adjust internally to cooperate with external SOs, and it gives a structure in a complex organization to cover the full internal organization (Channon & Caldart, 2015). In this structure, drivers and barriers were sought and identified. For the 7S-element, one relevant topic, driver and/or barrier, was selected. This selection was based on a systematic review of the existing literature, in which an overview of possible topics per 7S-element was made, and the most relevant topic was identified based on its fit to the scope of the research. An overview of the drivers and barriers is presented in Table 1.

Table 1. Overview of 7S-elements and their relevance as driver and/or barrier.

7S-element:	Relevance as a driver and barrier
Shared values	An organization's culture indicates the focus on the added value the organization can bring (Channon & Caldart, 2015) and will give insights on their SO's goals. Understanding of collaborative added value, both for the total system as for each SO individually (Deken et al., 2018), will give SOs clarity on the potential of collaboration. This needs to be balanced towards collaborative advantage versus collaborative inertia (Huxham, 2003) and needs identification of all relevant SOs early in the process (Elmahroug et al., 2014). An SO's culture aimed at collaboration is seen as a driver for initiation of collaboration. Lacking cultural embeddedness of collaboration is seen as a potential barrier.
Strategy	When organizations are unable to accomplish something on their own, is a broadly recognized precondition for collaborative action (Emerson et al., 2011), which makes it a strategic option to collaborate with others. This does require common ground between parties. Challenge lies in attaining a collaborative advantage, which is not always a certainty in collaboration (Verweij & van Meerkerk, 2020). Therefore, when collaboration brings more benefits than working solo, it is seen as a driver. Vice versa, when working solo brings more benefits, it is seen as a barrier for collaboration.
Structure	SOs need to follow the right incentives fitting their own goals and responsibilities (Melander & Wallström, 2022), which can be both handling a challenge or grasping an opportunity,

	internal or external (Emerson et al., 2011). These goals and responsibilities indicate the presence of formal mandate for an SO to take a certain role. The presence of this formal mandate is seen as a driver, the lack of this mandate is seen as a barrier.
Systems	Initiation of collaboration requires both formal (Poitras & Bowen, 2002) and informal cross-field interactions (Villani & Phillips, 2020). This shows a grey area where connection between parties is needed, but the responsibility is not assigned. Although legitimization (mandate) will lead to things being done, it lacks full results if it is only addressed from formality (Buhr, 2002). Furthermore, the effectiveness of project initiation is seen in the combination of the degree of freedom for autonomy and creativity that is given to the individual decision-makers in different levels of the organization, together with the rules and processes of the different organizations (Mullaly, 2014). It further requires the availability of leadership to initiate and help secure resources and support (Emerson et al., 2011; Huxham, 2003). This highlights the importance of an adaptive approach in the initiation of a collaboration. It indicates the presence of this adaptive approach as a driver, and the lacking as a barrier.
Style	The effectiveness of collaborations requires organizational and individual commitment on the long term (Safford et al., 2017; Keszey, 2018; Yström et al., 2021), which is influenced by management style. Lacking overarching problem (or opportunity) ownership is indicated as a reason why current collaborations on flexible use of IC are hampered (Pennings et al., 2023a; Pennings et al., 2023b). This ownership of a problem or opportunity does not per se indicates that an organization owns the assets or project (Cantarelli & Flyvbjerg, 2015), but can apply to other SOs as well. When IAWSOs feel ownership and entrepreneurial freedom within an SO, this can drive initiation of collaboration. Vice versa, lacking ownership can work as a barrier.
Staff	Staff with the capability for building trust and relationships can help initiation of collaboration (Langfield-Smith, 2008; Melander & Wallström, 2022). This requires individual skills, fitting behavior, individual expertise and position (Yström et al., 2021; van den Brink, et al., 2019), as well as roles to perform the subsequent operational responsibilities (Hsu et al., 2007). The capability and availability of staff can help drive initiation, and be a barrier when lacking.
Skills	SO's have their own goals and work to achieve these as effective and efficient as possible (Bartuševičienė & Šakalytė, 2013), which leads to these SOs having skills and experience in their respective topics (Serrat, 2017). It introduces the level to which an organizations has the ability to achieve certain goals in their field(s) of expertise, and thereby its potential willingness to take initiative. The presence of skills can drive organizations to initiation, the lacking of skills can work vice versa.

Overall, this indicates seven potential drivers and barriers for SOs in initiating the flexible use of IC. The relation to the different forms of flexibility is indicated in Table 2, which shows that each 7S-element relates to different combinations of forms of flexibility and, therefore, are presumed to have different impacts on collaboration.

Table 2. Overview of the effect of the 7S-elements on the forms of flexibility. Derived from (Pennings et al., 2023a; Pennings et al., 2023b).

#	7S-element	Form of flexibility			
		Physical infrastructure	SOs	Management (organization)	Goals
1	Shared values	X (vision on effective use of infrastructure)	X (vision on required collaborations)	X (vision on required organization to meet future needs)	X (vision on required goals to achieve organization's objectives)
2	Strategy	X (application of infrastructure to execute actions)	X (potential collaboration to execute actions)		X (required actions towards achieving goals)
3	Structure	X (prerequisites for collaboration opportunities)		X (organization's agility to adapt to challenges)	X (organizations agility towards changing goals)
4	Systems		X (formal relations with SOs)	X (level of formal mandate)	

5	Style		X (informal relation with SOs)	X (management style and feeling of ownership)	X (translation of organization's style towards goals)
6	Staff			X (organization's employees)	
7	Skills	X (vision on effective use of infrastructure)	X (vision on required collaborations)	X (vision on required organization to meet future needs)	X (vision on required goals to achieve organization's objectives)

Since goals can differ per SO type, the level to which the 7S-elements are perceived as drivers or barriers can differ, as indicated in the conceptual model (Figure 1). To test the perception of each driver and barrier in relation to other drivers and barriers, presumptions are made on these relations and thereby on the more and less likely drivers. These presumptions are derived from Tables 1 and 2.

- For shared values, it is presumed that organizations with a broader (public) scope will have a better overview of SOs and a better picture of possible benefits. Therefore, these types of organizations are more likely to be seen as potential initiators than organizations with a slimmer scope [Presumption P1].
- For strategy, the presumption is that the higher these incentives (benefits) are, the more motivated an SO is to take the initiative. Therefore, it is expected to be an important driver [Presumption P2].
- For structure, it is presumed that having a mandate will move SOs to take the role of initiator, and lacking a mandate can withhold SOs from doing so [Presumption P3].
- For systems and styles, the adaptiveness of SO's approaches and implicitly felt ownership are seen as drivers. This leads to the presumption that organizations with sufficient entrepreneurial freedom are more likely to be driven to take initiative [Presumption P4].
- For staff and skills, it is presumed that these are perceived as requirements for successful initiation, and are therefore a barrier when lacking. However, they are not directly perceived as essential drivers [Presumption P5].

2.2 IAWSO's motives behind their perception of the SO's drivers and barriers

IAWSOs must make decisions on opportunities from their SO's perspective, given their roles and responsibilities within this SO, as indicated in the conceptual framework (Figure 1). Many studies on IAWSO motives in the sharing economy have focused on the overall sharing economy (Mair & Reischauer, 2017; Milanova & Maas, 2017; Gustafson & Hertting, 2016) to specific practical examples such as cargo bikes (Bissel & Becker, 2024), MaaS (Hauslbauer et al., 2023) and energy cooperation (van Klingeren & de Moor, 2024). These studies show a variety of motives ranging from intrinsic self-interest motivations to societal interests. To provide an overview of possible motives for IAWSOs in the flexible use of IC, an approach based on the scope of the motive (from self-interest to organizational interest to societal interest) is applied to cover the full scope of possibilities. These are derived from the division of self-interest, organizational interest, and societal interest. This was divided into six types of motives based on the literature, as shown in Table 3.

Table 3. The motives and their applicability.

#	Motives	Type of interest	Sources
1	Intrinsic self-interest	Self-interest	(Gustafson & Hertting, 2016), (Bissel & Becker, 2024), (Hauslbauer et al., 2023), (Milanova & Maas, 2017)

2	Extrinsic self-interest	Self-interest	(Gustafson & Hertting, 2016), (Anderson et al., 2015), (Bissel & Becker, 2024), (Hauslbauer et al., 2023), (Milanova & Maas, 2017)
3	Professional competence	Organizational interest	(Gustafson & Hertting, 2016), (Bissel & Becker, 2024), (Babiak & Trendafilova, 2010)
4	Project-specific	Organizational interest	(Bissel & Becker, 2024), (Babiak & Trendafilova, 2010)
5	Organization-specific	Organizational interest	(Babiak & Trendafilova, 2010) (Neville & Menguc, 2006) (Dentchev & Heene, 2004)
6	Societal driven (economic, environmental and/or social)	Societal interest	(Gustafson & Hertting, 2016), (Böcker & Meelen, 2016), (Milanova & Maas, 2017), (van Klingeren & de Moor, 2024), (Bissel & Becker, 2024)

The relevant motives can differ for an IAWSO, depending on the role of the IAWSO (at an SO), the sector, the socio-demographic group, and users and providers (Böcker & Meelen, 2016; Milanova & Maas, 2017; Gustafson & Hertting, 2016). This indicates that the motives are influenced by the goals of the SO and thereby shows the importance of having an understanding of the motives behind each SO's perceived drivers and barriers. Therefore, it is presumed that the SO type will influence the perception of the IAWSOs of the drivers and barriers. More specifically, IAWSOs at more economically driven SOs will be more focused on organizational interests and extrinsic self-interest, whereas IAWSOs at more societally focused organizations will be more focused on (intrinsic) self-interest and societal interest [Presumption P6].

2.3 The most logical SO to initiate collaboration is …?

The question is, which party is the logical one to take ownership of the initiation of a collaboration? In the case of flexibility in charging infrastructure at Amsterdam Central Station, the missing responsibility for a party to take ownership of the overall collective is highlighted. This causes a stalemate in bridging the fragmentation in sharing IC between SOs and achieving subsequent societal benefits (Pennings et al., 2023a). These findings are similar in the case of sharing space and infrastructure between different parties in an urban distribution center (Pennings et al., 2023b). This highlights the need and current lack for a party to take ownership of the overall opportunity to apply flexibility. Although public organizations are seen as more influential (Wang et al., 2020), this does not mean that this is a public responsibility. One factor of influence is political entrepreneurship, in which (persons in) public parties can drive the development of urban projects (Block & Paredis, 2013). The question is to what level this is located within and outside of the responsibility of a public figure in relation to job responsibilities, and to what level does each public party bring a similar level of entrepreneurship? A possible driver could be the broader societal scope of public versus private parties (Pennings et al., 2023a). Overall, this shows that although potential benefits (societal and economic) are present, there is no clear owner of this problem or opportunity. This research emphasizes the need to understand the perceived owner, what is in it for them, and what are the perceived drivers behind this ownership. It is presumed that in these potential public-private collaborations – with broad societal added value – the public parties, such as the municipality or transport authority, are the most logical ones to take the role of initiator. When approaching this from an economic perspective, the presumption is that organizations with a more economical focus will take the initiative. Parties limited by regulations, such as DSOs who are legally limited in sharing data (TNO, 2021) and proactive investments in infrastructure,(Lavrijssen & Braggaar, 2020) are seen as less likely to take initiative [Presumption P7].

Overall, this systematic review shows that the core of the problem is that limited insights exist on the drivers, barriers, and motives from each SO's perspective in the case of sharing IC. This in turn leads to a lack of responsibility for initiation. This shows the need to gain insights into these

perceptions to determine the differences and similarities between SO's in their perceptions towards taking a possible role as an initiator.

3 The method for getting insight on the perception of drivers, barriers and motives

The goal of this research is to develop an understanding of SO's drivers and barriers to initiate collaboration on the flexible use of IC in order to kick-start collaboration on MPTHs. By identifying the perceptions of individuals for each SO type, the most logical indicator(s) for initiation can be derived. Three steps were taken to achieve this goal:

1. Identification of drivers and barriers for initiation (2.1) and motives for individuals (2.2) per SO-type, as indicated in the conceptual model (Figure 1). The goal is to understand whether differences exist between SOs, and if so, which differences exist.
2. Identification of the most logical initiator (2.3) and the main driver(s) for this choice (2.1). The goal is to check whether differences exist between SOs and, if so, which differences exist.
3. Comparison of the identified drivers and barriers with the perceived most logical initiator(s) to identify if this matches, and if (and which) gaps exist. This will be addressed in the *Results and Discussion* section.

For the data collection, a survey was conducted using a digital questionnaire. A survey was applied because it provides the option to collect both quantitative and qualitative input in a structured way and the ease of conducting a survey due to the digital accessibility of the SOs (Bryman, 2012). The survey was distributed by email using Survio as the questionnaire software (www.survio.com). Data collection was combined with data collection for another manuscript on the costs and benefits of collaboration on the flexible use of infrastructure on MPTHs (under development). This research used another set of questions within the data collection, but had a similar population and sample size (3.2) and approach to data collection (3.3). In this case, a generalized example of an MPTH is used.

3.1 The applied methods

Several methods can be applied to develop an understanding of SO's drivers and barriers to initiating collaboration. The applied methods, motivation behind these choices, and applied tests for the results are presented in Table 4.

Table 4. Overview of the applied methods and motivation for choosing this method (based on (Bryman, 2012)).

Step:	Topic	Applied method	Motivation
1	Drivers and barriers	Likert	Likert has been chosen since it fits well with determining perceptions of drivers and barriers, it is easy to interpret and it helps the comparison of across different groups.
	Motives behind drivers and barriers	Ranking	Ranking in the motives offers clarity in the prioritization of options and reduces biases.
2	Initiator	Single choice option	Single choice option is effective for gaining conclusive insights and is easy to understand for respondents.
	Motives behind initiator choice		

3.2 The population and sample sizes

The required sample size was derived from the population size. Because the application of sharing IC on MPTHs is limited, the population size is expected to be small and estimated to be 213

persons[1]. Given this small population, the sample size can be determined using published tables, calculations, the entire population, or sample sizes of similar studies (Singh & Masuku, 2014). The latter two are not possible due to the lack of access to the full population and lack of similar studies. Published tables indicate a sample size of approximately 139 persons for a population of 213(Israel, 1992), and calculations indicate a sample size of 137 persons[2] based on Cochran (Bartlett II et al., 2001; Adhikari, 2021). Overall, 141 responses were collected out of 199 surveys sent, giving a response rate of 71%. The response rate is high for this type of research (Kaplowitz et al., 2004; Wu et al., 2022). This is because of the author's personal network in this sector. Table 5 indicates the number of responses per SO type, and Table 6 lists the demographic features of the respondents.

Table 5. Overview of the response rate per SO-type.

SO-type	Number of responses	Response rate
Transport authority	21	72%
Municipality	24	80%
Public transport provider	20	74%
Distribution System Operator	17	55%
Potential other users	21	78%
Experts	38	72%

Table 6. Demographic features of the respondents.

Demographic features	Number of respondents	Percentage of feature
Gender		
Male	125	89%
Female	16	11%
Roles		
Director (organization)	10	7%
Management (organization)	21	15%
Program management	15	18%
Project management	43	30%
Specialist	42	30%

3.3 The approach of the data collection

The approach consisted of six steps, starting with input from the literature review. These steps were (1) the setup of the questions and casus for the survey, (2) a test round of the survey with six experts, (3) conducting the survey, (4) cleaning survey data, (5) data analysis, and (6) presentation of results.

IAWSOs were selected based on (A) working for one of the SOs, (B) experience with the topic at one or more SOs, or (C) involvement as an expert on the topic. For each SO-type, a list of relevant SOs was created, and these relevant SOs were approached. Throughout the survey period, attention was paid to the number of people per SO-type to arrive at a balanced input[3]. The survey language used was Dutch. The survey was conducted between May 8th and June 14th, 2024. An overview of the questions can be found in Appendix B. Apart from these questions, questions to determine each person's type were included. The survey included an explanation of MPTHs and their context, but apart from the indicated questions, no further explanation of other concepts was

[1] Based on: 29 locations, approx. 7 relevant individuals per location, 50 duplications (individuals responsible for multiple locations, 60 experts. (29*7) – 50 + 60 = 213 individuals.
[2] Input used: Z=1,96 (95%); p=0,5; E=0,05, N=213.
[3] An overview of the roles and organizations of each respondent can be retrieved from the author.

given. The risk of socially desirable answers was countered by making it explicit in the survey that the answers should not be socially desirable.

3.4 Data analysis and significance of the results

The collected data were cleaned by deleting the input where the respondents indicated that they did not understand or could not answer a certain question. The data analysis was performed using SPSS (version 29). Depending on the type of survey question, different statistical tests were applied to analyze the output. These tests were selected to fit the type of question and the sample size and are listed in Table 7.

Table 7. Types of statistical tests used. For the comparison, 'Overall' indicates all input from all IAWSOs together and 'Per SO-type' indicates that each SO's IAWSOs were clustered.

Step:	Topic	Comparison	Tests used
1	Drivers and barriers (Likert)	Overall	Repeated Measures ANOVA
		Per SO-type	MANOVA
	Motives behind scaling of drivers and barriers	Overall	Repeated Measures ANOVA
		Per SO-type	MANOVA and Kruskal-Wallis
2	Most logical initiator	Overall	Chi-square for independence
		Per SO-type	Chi-square for goodness of fit
	Motives behind choice for most logical initiator	Overall	Chi-square for independence
		Per SO-type	Chi-square for goodness of fit

The significance of the data was tested by interpreting the collected data. Table 8 provides an overview of the significance tests.

Table 8. Overview of the tests for significance of the data. Two perspectives are applied, the 'Overall' and the 'SO-type'. 'Overall' indicates all input from all IAWSOs together (this means all respondents together) and 'Per SO-type', which indicates that each SO's IAWSOs were clustered (e.g. all IAWSOs working at DSOs together as one SO-type).

Perspective	P-Value	Significant	Remarks (if applicable)
Drivers: Do the seven drivers differ significantly? E.g. if one or more drivers stand out compared to another, it shows preference.			
Overall	<.001	Yes	For Pillai's Trace, Wilks' Lambda, Hotelling's Trace and Roy's Largest Root.
Per SO-type	.734	No	Based on significance Box's M and non-significant Pillai's Trace.
Barriers: Do the seven barriers differ significantly? E.g. if one or more barriers stand out compared to another, it shows preference.			
Overall	.123	No	Based on significant Sphericity, non-significant Greenhouse-Geisser and multivariate tests.
Per SO-type	.638	No	For Pillai's Trace.
Differences in motives for drivers and barriers: Do the six motives differ significantly? E.g. if intrinsic self-interest differs significantly from project-specific motives, it shows preference.			
Overall	<.001	Yes	Based on significant Sphericity, significant Greenhouse-Geisser and multivariate tests.
Per SO-type	.179 (MANOVA); .157 to .918 (Kruskal-Wallis)	No	For Pillai's Trace. Singularity present.
Most logical initiator: Do chosen stakeholders for most logical initiator stand out significantly? E.g. if one SO is selected significantly more than others would indicate a strong preference, it shows preference.			
Overall	<.001	Yes	
Per SO-type	.119	No	
Differences in motives for the most logical initiator: Do the motives for the most logical stakeholder differ significantly? E.g. if structure scores significantly higher than staff, it shows preference.			

Overall	<.001	Yes	
Per SO-type	.681	No	

4 The results & discussion of drivers, barriers and motives towards finding an initiator

The results and discussion are presented below.

4.1 Benefits are seen as main driver, barriers are based on case-specific requirements

Table 9 shows the average perceptions of drivers and barriers. The lack of significance – both for drivers and barriers – between the perceptions of the different SO types involved indicates a similar perception and common ground between the respondents, independent of the SO-type. The moderate spread of the standard deviation for drivers indicates that responses are more clustered around the mean score compared to the barriers, where a high spread indicates more dispersed responses.

Table 9. The mean score of the perception of drivers and barriers, on a scale of 1-5 (Likert; 1 = Very unimportant; 5 = Very important) and the standard deviation (SD).

	Driver		Barrier	
7S-element	Mean score	SD	Mean score	SD
Shared values (organizational culture)	4,09	0,89	3,39	1,24
Strategy (benefits)	4,44	0,69	3,31	1,27
Structure (mandate)	3,57	1,04	3,11	1,14
Systems (way of working)	3,86	0,91	3,19	1,16
Style (entrepreneurial freedom)	4,02	0,83	3,25	1,27
Staff (availability)	3,56	0,96	3,28	1,09
Skills (capabilities)	3,63	0,96	3,15	1,10

The perception of the drivers for all SOs indicates the benefits as the main driver, followed by organizational culture, entrepreneurial freedom, and the way an organization works. The staff, skill, and mandate scores were significantly lower. This highlights the importance of the presence of benefits (economic, environmental, and/or social) as a driver for the initiator as well as for other SOs. This is in line with the existing literature (Emerson et al., 2011) and presumption [**P2**], but the challenge still lies in having a sufficient collaborative advantage for all SOs (Verweij & van Meerkerk, 2020). As respondents indicated, benefits are seen as a necessity from their own SO to support them in taking the initiative to collaborate. The point of attention is the distribution of collectively gained benefits among the SOs involved.

A high score for entrepreneurial freedom indicates the perceived value of an adaptive approach and informal entrepreneurial freedom, as was presumed [**P4**]. A possible reason for this score is that it offers space for setting up initiation and required workarounds for existing structures, as indicated by the respondents and the literature (Mullaly, 2014; Emerson et al., 2011; Huxham, 2003). As respondents indicated, the newness of the topic requires capacity and opportunity from an SO to initiate collaboration, which highlights the importance of freedom and way of working. At the same time, IAWSOs are required to cope with entrepreneurial freedom in order to fulfill its potential benefits.

No significant differences were found between the barriers. Respondents indicated the challenge in the limited availability of existing structures to develop these new types of collaborations between SOs, limitations in regulations for distribution system operators, and the challenge that parties need to work together, who are sometimes competitors in tenders. Overall, some limitations exist and are evident. Furthermore, given the non-significance between the barriers, this indicates

that although all barriers are perceived to have a level of importance, a clear indicator of perceived main barriers is not available in general. This is further emphasized given the high spread of the standard deviation, which indicates more dispersed responses. This can be due to barriers following the urge for initiation (cause), but not per se limiting the existence of this urge and can therefore be seen as the next step or strongly context-dependent. Therefore, these barriers can be interpreted as requirements (consequences) for successful collaboration, but not as clear barriers for the initiation itself, since they are (partly) case-specific.

The significantly lower scores for skills and staff as drivers compared to other drivers, but their importance as a barrier, confirms the presumption [**P5**] that these are important requirements for successful initiation, but not the main drivers for initiation.

4.2 Public parties are seen as most logical initiator(s) due to their broad scope of benefits and perceived mandate

The results for the question 'which party is seen as most logical SO?' can be seen in Table 10. No significant differences in these results were seen between the SO types. This indicates that IAWSOs at different SOs did not have significantly different perceptions and that the highest-scoring SOs did not select themselves or others strongly different from other SO types.

Table 10. The results of the perceived most logical party to take the role of initiator.

Ranking of perceived most logical initiators	Score
Transport authority	33,3%
Municipality	17,7%
Differs based on the local context	17,0%
Public transport provider	11,3%
Distribution system operator	7,8%
Potential users of IC	4,3%
Other	8,5%

These results show a strong preference for a public party (transport authority or municipality), which is in line with the existing literature (Wang et al., 2020; Block & Paredis, 2013) and the presumption that the municipality or transport authority is the most logical one to take the role of initiator due to their broad societal perspective [**P7**]. It is interesting that the transport authority (with a smaller societal scope) scores higher than the municipality (with a broader scope and expected high societal benefit). Possible reasons indicated by the respondents are the required upfront knowledge and understanding of the potential of making flexible use of IC, which, given the responsibilities of the transport authority, could be expected to be present at this SO. This is consistent with the presumption [**P1**] and the existing literature (Deken et al., 2018; Elmahroug et al., 2014). The point of attention is the level at which a transport authority owns this responsibility. This level of ownership can differ according to transport authority and context. Seventeen percent of respondents indicated that the most logical initiator depended on the context. This could be seen as a bottom-up reactive approach, where steps are taken based on local urgency or opportunity. The challenge lies in the high dependence on the individual person to start as an initiator, compared to a top-down approach where a mandate can be given to a specific SO. Depending on the course, decision makers want to take on this topic, and this current reactive approach can be continued. However, as respondents indicated the complexity of this topic (with laws and regulations, finance, and required agreements) and the transcending of knowledge within SOs, this highlights the need for a different approach. Furthermore, given the growing societal pressure on the need for grid capacity, a top-down approach can make the trade-off explicit and therefore speed up sharing IC and thereby transition to zero-emission mobility.

The motives behind choosing the most logical initiator are listed in Table 11. No significant differences were found between the SO types, which indicates that the perception of respondents on the main motives for an initiator is similar for all involved SOs.

Table 11. The results for the main motives for the most logical initiator choice.

This SO:	Score
Has much benefit to gain in the collaboration	44,7%
Has the mandate to initiate collaboration	20,6%
Has an organizational culture aimed at collaboration	9,9%
Has a way of working fitting for researching and developing the opportunities	8,5%
Has sufficient and capable staff to do the initiation	7,8%
Can freely (without mandate) research and develop opportunities	7,1%
Has the skills to do the initiation	1,4%

The benefit of the initiator is seen as the main motive for choosing a logical initiator, followed by the mandate of this organization. This benefit can be seen in the economic, environmental, and social benefits (Pennings et al., 2023a). Therefore, it is logical for public SOs (compared to private SOs with a stronger economic focus) to fit with the main perceived drivers. However, the perceived motive of an SO with the mandate to do so (4.2) differs from the perceived main drivers for initiating collaboration (as seen in 4.1), where these mandate scores are relatively low compared to other drivers. This is interesting because although parties do see it to a lesser extent as a main driver to start initiation themselves, they see it as important for other parties who have a mandate to start it, the latter being in line with existing literature (Melander & Wallström, 2022; Pennings et al., 2023b). This is in line with the presumption that a lack of mandate can withhold SOs from taking the role of initiator **[P3]**, and at the same time highlights the unclear situation in which this mandate is not officially given to a party, but the perceived presence of it with a party. Given that the results for the most logical initiator show that – given the lack of significance between the results per SO-type – that respondents at the public parties themselves do not per se see their organization as the logical initiator. This indicates the lack of current and perceived roles for many of these organizations, which can be partly attributed to the lack of explicit mandates for these parties to do so.

This is where the puzzle does not fit. As long as this mandate is not explicitly given (e.g. by allocating concession responsibility through regional or national government) to a party, it keeps hovering above the situation but does not give the clarity needed to start. This clarity was indicated by the respondents as a necessity to address this topic. Furthermore, respondents indicated that it is a team that should work together and not a single SO. To achieve this, all SOs should do their logical part to contribute to collaboration, but the overview and initiation should be mandated to a single SO. Overall, it highlights the need for clarity on the goal and the SO to take responsibility for the initiation and roles of other SOs in supporting initiation. Since this clarity is not yet fully present, it hampers the initiation of collaboration on the flexible use of IC. This finding provides an avenue for further research.

4.3 IAWSOs want to contribute to society – independent of their SO-type – and that offers possibilities

The motives behind the ratings of the drivers and barriers are shown in Figure 2. These show significant differences per motive (respondents ranked each motive). There was no significant difference between the respondents based on their SO, which indicates that the perception of respondents on the motives is similar for all involved different types of SOs.

Figure 2. Results of the individual's personal motives behind the choice for drivers and barriers.

Overall, the contribution to society (both personal and through one's own organization) scores high, organizational interests score in between, and extrinsic self-interest scores low. This can possibly be attributed to either socially desirable answers and/or the conviction of SOs involved in this field of work. Since no significant differences are found between SO types, it indicates an overall perception of the people involved in this field, which debunks the presumption [P6]. Although the literature (Böcker & Meelen, 2016; Milanova & Maas, 2017; Gustafson & Hertting, 2016; Pennings et al., 2023a) also indicates the differences in SO perspectives, it shows that IAWSOs themselves have a very similar view, which might indicate the difference in execution of responsibilities at SOs versus individual perception. Since the results (4.1) also show that there is no significant difference in the perception of the respondents from different SO types for the drivers and barriers, and their personal motives between different SO types, it emphasizes the unanimity. This individual motivation for the societal perspective can help initiate collaboration by making these types of economic, environmental, and social benefits clear to all SOs via the IAWSOs involved early in the process. This requires an understanding of these possible benefits and specific SO interests prior to decision-making on the initiation of collaboration. Given this individual similarity in personal motives, it can provide a strong basis for the initiation of collaboration between IAWSOs (Mair & Reischauer, 2017; Milanova & Maas, 2017; Gustafson & Hertting, 2016). As indicated by the respondents, since collaborations on flexibility are new for the involved SOs and require working around existing structures, this likeliness in motivation can contribute to strengthening the collaboration. Overall, it shows the like-mindedness of IAWSOs, and thereby the possibility of forming a strong basis for collaboration.

4.4 Limitations of this research

The limitations of this research include the possible growth of the population size, the experience of the respondents, and social desirability. Although the sample size fits the population, the newness of the topic in its context and possible further applications can lead to growth in population size. Therefore, this research contributes to the current direction setting, but at the same time is also subject to possible growing populations and experiences of respondents over time. Furthermore, a number of questions in the survey were aimed at the motives of individual respondents. Although actions were taken to limit socially desirable answers to questions, socially desirable answers might have diluted the results.

5 Conclusions

This study aims to answer the following question: *'How do different individual actors within stakeholder organizations perceive main drivers and barriers for initiating collaboration on flexibility in*

electric bus charging infrastructure on major passenger transport hubs? And, who would be the most logical stakeholder organization to take the role of initiator and kick-start collaboration?'.

To answer this question, a conceptual framework was developed for the application of drivers, barriers, and motives in the initiation of collaboration. The 7S-model was applied to highlight possible drivers and barriers for stakeholder organizations, thereby indicating internal capabilities and gaps for SOs to take the role of initiators. This theoretical framework helped identify possible drivers and barriers and is thereby useful for the identification of relevant elements within an SO, which can be used to lay the overall puzzle for collaboration. It helped to give direction to the relevant drivers and barriers within its context, but it lacked further in-depth analysis of the need to strengthen drivers and mitigate barriers. These are welcome additions for further research on this topic.

The results of this research show that the main drivers for initiating the application of flexibility in MPTHs are the benefits, organizational culture, entrepreneurial freedom, and the way of working. For barriers, it was found that not one clearly stands out, which is attributed to the importance of the local context. This provided an answer to the first research question. For the second research question, public parties (transport authority or municipality) are seen as the most logical initiator, and specifically the transport authority in the case of MPTHs. This preference fits the existing literature (Wang et al., 2020; Block & Paredis, 2013) and leads to an indication of the most relevant initiator and the relevant drivers for motivating this initiator. The risk is that the lack of an explicit mandate of this most logical initiator – indicated as an important driver – causes inertia in the initiation of collaboration, since the most logical stakeholder does not have all main drivers present. This highlights the current gap in the way the stakeholder system is set and, at the same time, clarifies how this possible impasse can be solved: by embedding the mandate for initiation in the responsibilities of the public parties, in the case of the MPTHs, this would most likely be the transport authority.

Respondents' personal motivation showed that personal motivations were similar between respondents, independent of their work at an SO. It shows potential for common ground between individuals, which can be relevant as a bottom-up building block for collaboration.

The main contribution of this research is that it indicates the main drivers and barriers for initiating collaboration with the introduction of new variables (availability of shared electricity infrastructure) and helps show the perspectives of different SO's. Therefore, it fills a gap in current scientific literature (Pennings et al., 2023a; Pennings et al., 2023b). Furthermore, it highlights the perceived most logical initiator for the application of flexibility in MPTHs, which contributes to the need for insights on the relevant party to take the role of initiator.

For policymakers, the findings of this research show the importance of establishing drivers and mitigating possible barriers to responsibilities for public parties and in agreements between parties. In this case, the responsibility of initiating flexible application can be done by establishing this responsibility at the transport authority, which can subsequently cover this responsibility and potentially delegate this responsibility to transport providers. This can be considered a top-down building block. It is recommended for policymakers to structurally embed the role of initiators in the application of flexibility at the transport authority. This provides the opportunity to embed this in public transport concessions, thereby motivating the transport provider as well.

Generalizing these findings indicates the challenge of 'ownerless opportunities' in complex SO environments. This is not specific to MPTHs but is applicable to other sectors such as the management of public space, logistics, and management of the electricity grid. The point of attention is that the specific SO relations might differ and require sector-specific adjustment, but strong similarities in approach can be applied. Although flexibility is, in varying forms, applied in the scientific literature in relation to infrastructure (Torres-Rincón et al., 2020; Sánchez-Silva, 2018),

an overall approach to its application is missing and offers potential for further research and application.

Together, these top-down and bottom-up building blocks can be used to accelerate the steps towards actual applications. The main research directions are as follows.

1. Setting up a way to work for these types of new collaborations to upscale the application of flexibility. A new research avenue is seen in investigating how to secure flexibility in the way SOs work, both for their own SO's setup as well as in the relation between SOs. This implies the need to share experiences with drivers and barriers in this topic, between transport authorities themselves and other SOs, to speed up the application. This can also take other cases with charging infrastructure for electric vehicles into account – such as at bus depots – in order to upscale the potential impact.
2. Setting up a distribution for the costs and benefits so that the economic, environmental, and social benefits are fully taken into account in decision-making, and an optimized win-win relationship can be found. This can build on existing societal cost-benefit analysis and offer a logical extension to support complex multi-stakeholder collaborations between sectors that previously had limited interaction. Deepening these insights into societal costs and benefits and the perception per SO of the economic, environmental, and social benefits can help optimize added value per SO. This requires developing a distribution method which fits and balances SO's interests and pursues a win for each SO involved in order to get to a win-win. Given the importance of IAWSO's perception, this method should focus on the place of these perceptions with regard to costs and benefits.

Overall, the challenge of 'ownerless opportunities' in complex SO environments can be overcome, but it does require a new way of looking at how infrastructure is applied and managed. This new approach requires SOs to revisit and extend their responsibilities to bring broader societal value-added to their infrastructure. In this way, a (bon)fire can be lit.

Data Access Statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author and Contributor Statement

Conceptualization: Authors 1, 2, and 3; Methodology: Authors 1, 2, and 3; Data collection and curation: Author 1; Formal analysis: Author 1; Visualization: Author 1; Writing – original draft: Author 1; Writing – editing: Authors 2 and 3.

Use of AI

During the preparation of this work, the author(s) did not use AI.

Conflict Of Interest (COI)

There is no conflict of interest.

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Appendix A: The relationships of the SOs for MPTHs in the Netherlands

The relations between the SOs are indicated in Figure 3.

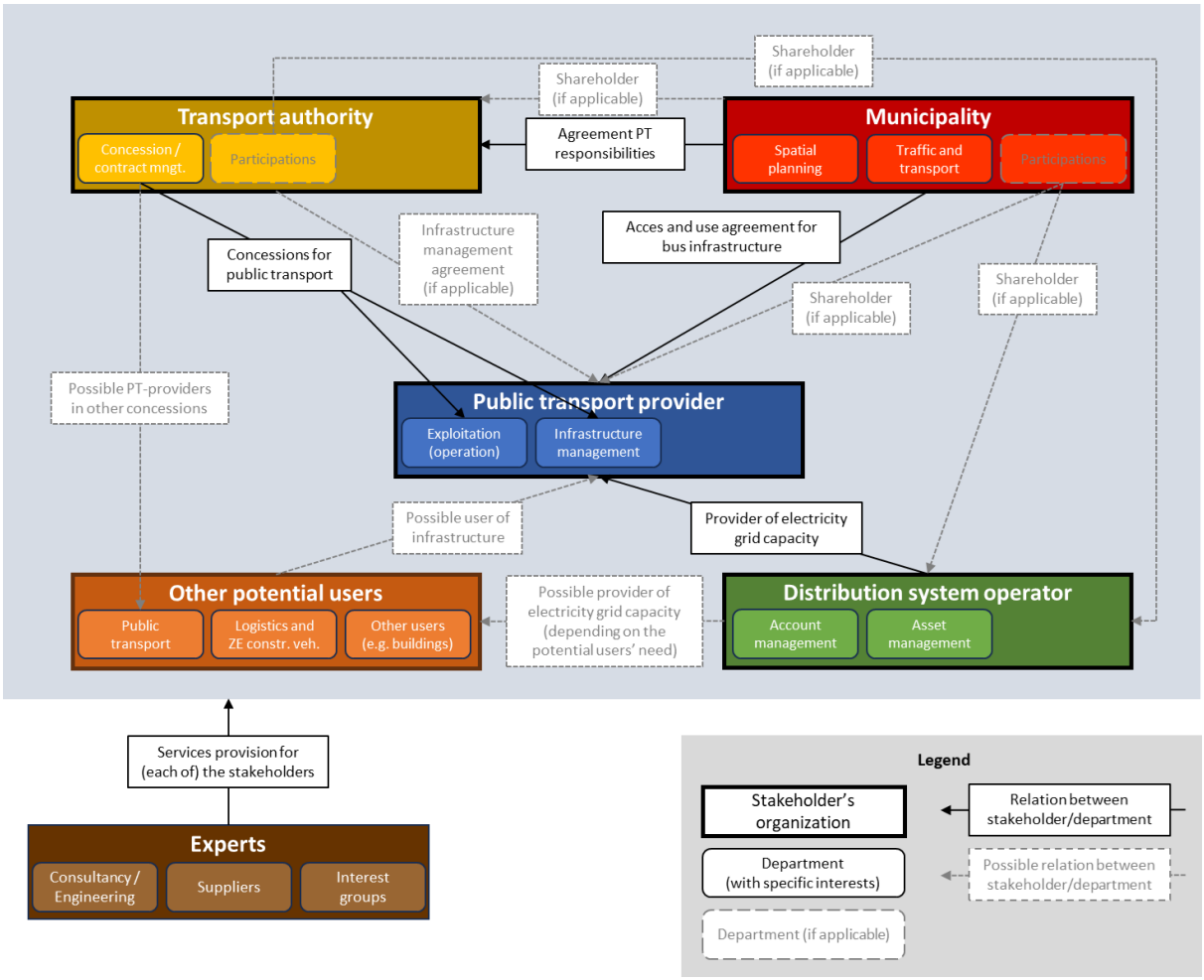

Figure 3. The relationships of the SOs for MPTHs in the Netherlands. Figure is derived from Pennings et. al. (2023a), additions from various sources (Metropoolregio Rotterdam Den Haag, n.d.; Rijksoverheid, n.d.; Gemeente Amsterdam, 2024; Transdev Netherlands, n.d.; RET, n.d.; Enexis Netbeheer, n.d). Per department of each SO, specific IAWSOs are involved in decision-making.

Appendix B: Overview of the survey questions

Table 12 gives an overview of the main survey questions. For the application in questions 1A and 1B, the statement per driver/barrier has been written in confirmation (driver) and denial (barrier), as shown in Table 13. The motives, as indicated in Question 1C, are listed in Table 14.

Table 12. Overview of the main survey questions.

#	Question	Type of answer	Presumptions
1A	From your own [IAWSO's] perspective, how do you score the following drivers on the level of their contribution to initiate collaboration?	On a 5-point Likert-scale per type of driver/barrier (interval): 'Very unimportant – Unimportant – Neutral – Important – Very important'.	P1-5
1B	From your own [IAWSO's] perspective, how do you score the following barriers on the level of their contribution to initiate collaboration?		

		See Table 13 for drivers/barriers.	
1C	Rank the motives for selecting these barriers as they count for you as an IAWSO	Ranking of six motives (see Table 14).	P6
2A	Which party do you see as the most logical one to take the initiative for collaboration?	Choice between one of the SOs, another party or a combination of parties.	P7
2B	What do you see as that party's most important driver to do so?	Choice between the 7 barriers	P1-5, P7
*	If you have any additions or elaborations, please add *(This question was added after each of the questions above)*	Open	P1-7

Table 13. The applicability of each 7S-element as a driver or barrier as applied in the survey.

#	7S-element	Application as a driver/barrier
1	Shared values	The organizational culture is aimed at collaboration with other parties
2	Strategy	Collaboration with other parties brings more benefit than working solo
3	Structure	My SO's organization has the [formal] mandate to take the initiative
4	Systems	My SO's organization has a way of working focused on supporting me to initiate collaboration
5	Style	My SO's organization offers me the entrepreneurial freedom to initiate collaboration without formal mandate
6	Staff	My SO's organization has sufficient and capable staff to initiate collaboration
7	Skills	My SO's organization has the skills to initiate collaboration

Table 14. IAWSO's motives and their application in the survey.

#	Motives	Application as a motive
1	Intrinsic self-interest	I find it personally important to make a direct contribution to society in my work
2	Extrinsic self-interest	It contributes to my personal status, finances or job opportunities
3	Professional competence	It coincides with and applies to my professional experience and skills
4	Project-specific	It benefits my project responsibility
5	Organization-specific	It benefits my organization's goals
6	Societal driven (economic, environmental and/or social)	It contributes to societal goals