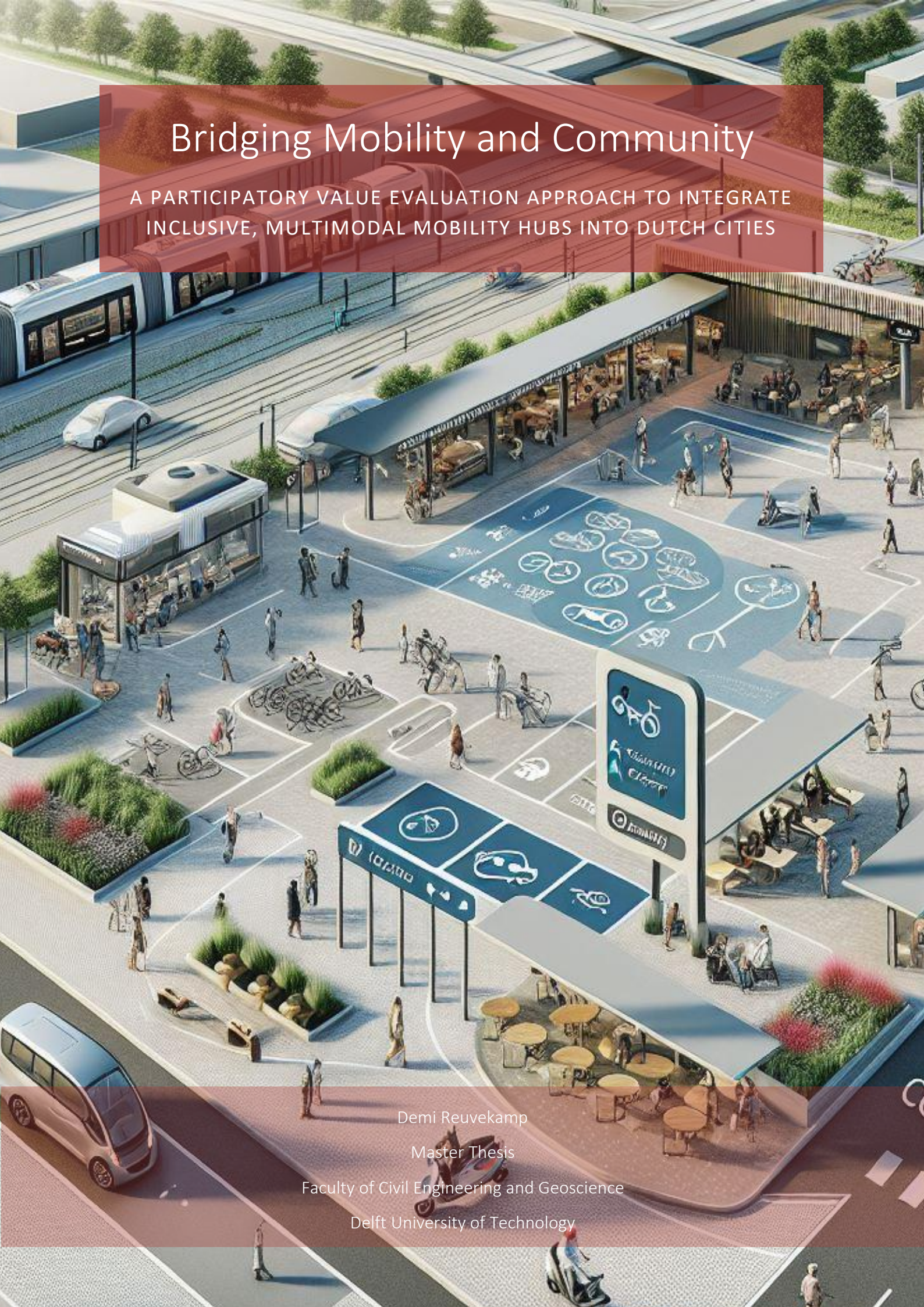

Bridging Mobility and Community

A PARTICIPATORY VALUE EVALUATION APPROACH TO INTEGRATE INCLUSIVE, MULTIMODAL MOBILITY HUBS INTO DUTCH CITIES

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Master Thesis

Faculty of Civil Engineering and Geoscience

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Bridging Mobility and Community

A Participatory Value Evaluation approach to integrate Inclusive, Multimodal Mobility Hubs into Dutch cites

Graduation thesis project for the degree of
Master of Science

in Transport, Infrastructure and Logistics
at the Faculty of Civil Engineering and Geoscience
in collaboration with the Faculty of Technology, Policy and Management
and the Faculty of Mechanical Engineering
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Acknowledgements

Dear Reader,

I gladly provide you with my MSc Thesis “Bridging Mobility and Community: A Participatory Value Evaluation approach to integrate Inclusive, Multimodal Mobility Hubs into Dutch cites”. For the past 5 months I got the opportunity to experience what it would be like to apply all I learned throughout my years at Delft University of Technology, into a real world project, making a real-world impact. This thesis is the final product to complete my master’s program in Transport, Infrastructure and Logistics. Which I took with a specialization in Transport Governance.

I could not have written this piece without the support of others. So, I would like to thank my TU Delft supervisors, Niek and Niels, for their support, practical guidance, flexibility, and ever good spirit towards my project. I also thank Jan Anne for joining the grading committee and contributing to the evaluation of my work. A special thanks goes to APPM for hosting me during the past weeks and offering the opportunity to learn so much throughout this project. In particular, I would like to thank Bernice for her day-to-day supervision, ever positive attitude, and valuable feedback. Additionally, I want to thanks Bas for his support and sharing all his technical insights into the project. I am also very thankful for all colleagues, friends, and family who helped by sharing my survey and supporting the research process.

This project has been a great experience, I have always had a great interest in discovering how transport initiatives can benefit everything and everyone around them. This project thought me so much about potential for the future and leaves me hopeful for the great urban development that is to come. I will continue to work hard, and make sure we design a urban environment not only for the community around it, but with them.

Demi Reuvekamp

Delft, June 28th, 2025

Executive Summary

Introduction and Problem Statement

To meet the sustainability goals of the future, the Netherlands must literally shift gears toward active and publicly shared transport. Mobility hubs are a promising policy initiative toward more sustainable transport, they are considered physical links between multiple modes of transport. Hubs offer barrier-free travel by enabling seamless transitions between public and private transport modes, while also offering a platform to scale shared mobility and reduce private car ownership.

However, simply realizing a mobility hub is not a guarantee for success. Understanding long-term performance factors is important to shape a policy strategy for successfully integrated hubs that are effectively used by community members. While there is extensive research on the technical and environmental benefits of mobility hubs, there remains to be a knowledge gap concerning their integration of the consumer perspective in the planning and design. Specifically, the absence of community-centered design approaches is likely to limit the hubs ability to meet local needs and desires effectively. This gap is magnified by a lack of methodologies to systematically capture and incorporate public preferences into urban mobility planning.

This research focuses on how Participatory Value Evaluation (PVE) can be utilized to bridge this gap. As a relatively new participatory method, PVE enables policymakers to involve citizens directly in the decision-making process by simulating real policy choices and constraints. Participants are asked to allocate limited resources among various policy options, reflecting the trade-offs faced by decision-makers. The method allows for collecting detailed data on public values, preferences, and priorities. Understanding what drives community engagement and how these insights can be integrated in mobility hub development is important for effectiveness and long-term sustainability. Up to this point, the integration of PVE into mobility hub development is not fully explored and the potential to enhance community alignment and policy effectiveness remains unknown for this mobility innovation.

Problem Statement

Despite the growing recognition of mobility hubs as instruments for creating more sustainable urban mobility, their success is currently compromised by a lack of community involvement in the planning and design processes. To realize mobility hubs that are socially accepted and more effectively used by communities, there is a need to explore how PVE can be integrated into planning and development stages. This helps to ensure mobility hubs are not only technically efficient but meet consumer requirements.

Main research question

In what ways can a Participatory Value Evaluation approach enhance the design and planning of multimodal mobility hubs by incorporating community preferences to better align with user needs?

Methodology

This research primarily involved the design, execution and analysis of a PVE. The design of the PVE was informed by a multi-faceted analysis. Four European mobility hubs, from the SmartHubs database, were selected for a case study. The SmartHubs Project's categorizes hubs based on their physical, digital, and democratic integration levels. The level of integration defines whether a hub is merely a single mobility service, or a (smart) mobility hub.

The four selected hubs represent different levels of integration and meet the research scope (Figure 1). The hub categorization is based on research by Weustenenk and Mingardo (2022) and is comparable to the one by the city council of Zwolle.

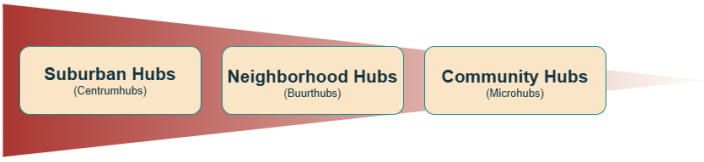

Figure 1. Selected hub scope

The selected mobility hubs are analyzed using Technological Innovation System (TIS) theory, independently of the SmartHubs integration scores. This analysis examines policy context, stakeholder roles, and transport services, and leads to a generalized innovation loop based on Hekkert et al.'s (2007) Functions framework. Success and failure factors (SFFs) identified through this process and observations from Zwolle's existing hubs formed the basis for selecting attributes in the Participatory Value Evaluation (PVE).

A PVE survey was then developed for Zwolle's mobility hub plans. Conducted online via Populytics' Wevaluate platform, it gathered both quantitative choices and qualitative feedback. The PVE included three parts: personal demographics, a "score" choice task, and a "space" allocation task. Within the choice tasks respondents got to distribute limited space among different mobility hub attributes. Each task captures several different aspects of hub design. To ensure broad and inclusive participation, the survey was distributed via neighborhood platforms, local news pages, personal and professional networks, and printed flyers across various neighborhoods.

To explore the policy relevance of the PVE findings towards mobility hub planning in Zwolle (and beyond), two expert interviews were conducted. Using a semi-structured format (Ilovan & Doroftei, 2017), the interviews allowed for open-ended, in-depth discussion. The interviews were conducted in Dutch, recorded, and transcribed for analysis.

Data processing and analysis

To capture heterogeneity in respondent preferences, a Latent Class Cluster Analysis (LCCA) has been used. LCCA allows for the classification of respondents into latent (unobserved) groups based on similarities in their response patterns, offering insights into user segments that can inform more tailored policy interventions. This research used LatentGOLD 6.0 software to fit models with 2 to 4 classes. Final class selection was guided by Bayesian Information Criterion (BIC and AIC), and the relevance of the cluster characteristics, favouring solutions with the highest level of interpretability.

The open-ended responses within the PVE are analyzed using a thematic analysis to identify recurring patterns and underlying themes in participants' reasoning. An inductive coding approach has been applied manually, meaning that themes emerged from similarities in argumentation, values, and trade-offs expressed in the data.

The expert interviews were conducted in Dutch, recorded, and transcribed for analysis. Key quotes were translated into English with care to preserve the experts' original meaning. The interviews are analyzed in such a way they identify important viewpoints, which help contextualize implementation challenges and opportunities of the PVE.

The PVE Results

This upcoming section presents a summary of the analysis and results of the PVE. Through statistical modeling general patterns, as well as heterogeneity in preferences across respondent groups are uncovered. In the chapter 7 of this report the cluster analysis results are supported by quotes of respondents.

Sociodemographic features

The gender distribution aligns relatively well with national figures, though one non-binary respondent had no comparison data. The sample overrepresents theoretically educated (78%) and younger respondents (ages 18-24), and middle aged respondents (ages 45-54). Older (ages > 64) and practically educated individuals are slightly underrepresented. Since most respondents were located in Zwolle, this overrepresentation may be partly explained by the city's demographic profile.

The sample contains a large share of bike users. However, Zwolle is considered a very urbanized area, which typically have larger shares in bike kilometers. Private car use is underrepresented and none of the respondents reported using shared modes as their primary transport. As the PVE focuses on Zwolle's mobility hub plans, it is relevant that 72% of respondents have personal experience with travelling though the city.

Score choice task

Respondents got the chance to distribute 20 points across 5 attributes, in each of the four categories. All scores are interpreted against a baseline of 4, as this represents a balanced distribution across attributes.

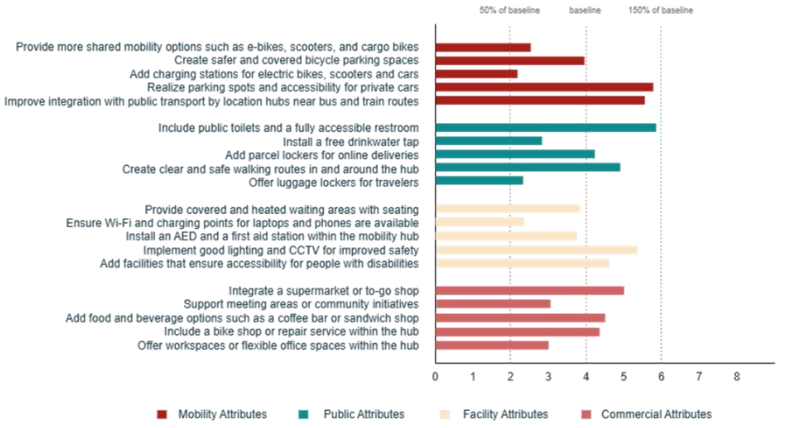

Figure 2. The average scores assigned to the mobility hub attributes in the score choice task. The maximum available amount of points was 20 per category (as listed in the legenda).

Three ***highest*** scoring attributes: Include public toilets and accessible restrooms (5.77); Realize parking spots and access-ibility for private cars (5.72); Improve integration with public transport (5.56). On average respondents prioritized basic amenities and accessibility, with a strong focus on inclusivity, comfort, and (social)safety. Results highlight the importance of seamless, multimodal connectivity and user-friendly services.

Three ***lowest*** scoring attributes: Add charging stations for electric vehicles (2.35); Ensure Wi-Fi and charging points for personal devices (2.43); Offer luggage lockers for travelers (2.38). Many low scoring attributes are seen as secondary to core functions like movement, access, and basic infrastructure. On average respondents appear to prioritize space and usability over digital or energy-related amenities.

Cluster analysis score choice task

Within the cluster analysis, three distinct respondent groups have been identified. Cluster 1, the largest group (56%), can be described as Bike and Public Transport Enthusiasts. They strongly prefer sustainable mobility, scoring highest on public transport integration (5.78) and secure bike parking (4.95), while showing low interest in car parking (2.96) and non-transport amenities like Wi-Fi (2.34). This group values accessibility for all users (4.91). It includes many bike users (61%) and few car users (15%), which aligns with the shown preferences for bike and public transport infrastructure. Demographically, it skews younger (41% aged 18–34) and is predominantly male (63%).

Cluster 2, representing 22% of respondents, can be described as Practical Providers. They prioritize comfort and convenience, scoring high on car parking (7.54), toilets (6.12), and supermarkets (5.94), but show low interest in shared mobility (1.71) and community features (2.51). there is a high education level (89%) and a balanced gender split. Interestingly this cluster shows no participants (0%) who use public transport as their most frequent mode, though their relatively high score for its integration (5.82) suggests potential for a mode shift.

Cluster 3 is the most outspoken cluster, representing 22% of respondents. Calling them the Car-Oriented Comfort Seekers, they mainly prioritize car parking (10.85) and accessibility (7.01). Additionally scoring high on supermarkets (6.90), and safe walking routes (5.87), while scoring very low on charging stations (0.65), workspaces (1.69), and Wi-Fi (0.54). This older, predominantly female group (72%) is highly car-dependent as 100% owns at least one car, and 67% use it as their main transport mode, with minimal bike use (6%).

Overreaching Features – score

Despite differences between clusters, several priorities are shared across the full sample. Essential amenities like public toilets (~5.99) and public transport integration (~5.45) are consistently valued, highlighting a shared demand for functionality and convenience. Safety also emerges as a key theme, with features like lighting and surveillance (~5.60) widely supported. But also other attributes reflect an emphasis on safety, reflecting a collective need for environments where people feel comfortable and supported. In contrast, charging stations (~2.02) and workspaces (~2.80) are universally considered less important in mobility hubs.

Space choice task

Within the space choice task respondents distributed a limited amount of space to several hub functions. Among the highly allocated functions are secure bicycle parking, which received the highest space allocation (0.61). This aligns with previously given high scores, reinforcing its importance as a core hub function. Additionally private car parking ranked high (0.58), indicating that, despite the general hub focus on shared mobility, personal vehicle access remains a priority for many respondents.

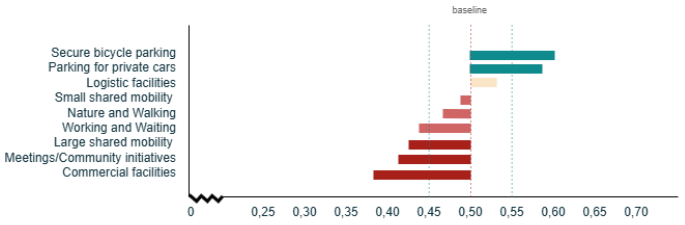

Figure 3. Average space allocation to each function. Slider started at a neutral midpoint (0,5) representing balanced allocation across all functions. 0 indicates no assigned space, while 1 indicates all available space for this particular function is assigned.

Among the below-average allocated functions are logistic facilities, small shared mobility, and nature and walking. Commercial functions scored lowest (0.37), a contrasting result compared to its importance in the score task, respondents may prioritize core mobility infrastructure over space-intensive amenities. This highlights the need for compact, multifunctional designs.

Cluster analysis space choice task

Unlike the score choice task cluster analysis, the space choice task uses two clusters to gain the highest level of interpretability. Cluster 1 represents the flexible mobility optimizers, comprising 62% of the sample. They value shared and sustainable mobility, mainly allocating space to shared modes (0.56 small and 0.52 large), while also embracing bike-friendly infrastructure (0.59). This group also supports community initiatives (0.52), but shows a lower interest in commercial facilities (0.37). Many respondents (41%) do not own a car and rely on bikes (61%) as their main mode of transport. Demographically, this cluster is younger (44% aged 18–34) and predominantly male (56%).

Cluster 2 represents 38% of the respondents who are well describes as the Car-Oriented Space Seekers. Main priorities are car access and structured urban space. They allocate a very high share of space to private car parking (0.82) and the least to shared mobility (0.37 small and 0.27 large), favoring independence over communal alternatives. This older (67% aged over 45), mostly female group (54%) shows limited interest in nature (0.41) and community functions (0.23), again pointing towards a preference for independent spatial use. Car use dominates, with 93% owning at least one vehicle and 67% using it as their main mode.

Overreaching features – space task

Despite the differences, one very clear shared priority stands out among both clusters: safety. Whether through secure bicycle parking (~0.61), or logistic facilities including surveillance, lightning and first aid (~0.53). Both clusters emphasize the importance of well-maintained spaces that enhance security. Regardless of mobility preferences, this common thread suggests that a sense of safety and stability is essential to urban space planning.

Qualitative Insights from Open-Ended Responses

A very large share of respondents took the time to provide additional information and express the reasoning behind the choices they made. It became clear that behind a lot of preferences, there is a deeper layer connected to physical, and maybe even more to social safety. Commercial facilities like a supermarket to-go gained high scores, from a convenience perspective, but maybe even more interestingly from a safety point of view. Respondents highlight they like the fact that these services attract people, and that more people in and around hub locations would improve their sense of safety. Several respondents fear that, in case of mediocre design, mobility hubs will become a hang-out spot for the “wrong” people. This decreases their desire to use the hub, and mainly decreases their feeling of safety. In line with this fear, and also strengthening insights behind the lower interest displayed in shared mobility services, respondents highlight that time has proven that shared

mobility services clutter public space and that users cannot seem to take care of these facilities like they would take care of their own vehicles.

People did highly value parking spaces for cars and bicycles. Interesting here is the two distinct kinds of reasoning behind this choice. On the one hand, there were respondents who reasoned from their own perspective. They would like to have enough space to park their vehicle safely, to then switch to a provided mobility service for the extend of their journey. On the other hand, there were the respondents reasoning towards others. They felt having parking opportunities was the only way to make it attractive enough for private vehicle users, to considers using a multimodal travel approach. The same arguments came up according to the high value for the integration with public transport, respondents feel this is necessary toward the success of a mobility hub. Which in retrospect is also one of the main requirements established by the SmartHubs project.

Insights from expert interviews

The first interview was held with the project manager of Zwolle's Adaptive Development Strategy for Mobility hubs, who also brings extensive experience as a policy advisor in the field of mobility. The second expert is one of Zwolle's official principal for mobility projects, who initiated and commissioned Zwolle's previous multimodal mobility hub projects.

Both experts agreed that currently there is not much time and space embedded in a policy process to consider lessons learned from other, either national or European, hubs. Therefore, there is lots of room to start integrating these insights and prevent making the same mistakes twice. Doing a case study and analyzing hubs these hubs according to the TIS framework or any other systematic learning tool can benefit the planning and design assignment of hubs. Both experts see great potential, of course with the needed limitations and marginal notes in regards to the (planning) phase a specific hub is in. PVE can be of great use to policy makers if implemented right. It must be realized at a point in time were the results can still be used / changes can still be made. But at the same time, it must be realized at a time when there is already significant information about space and the budget requirements to include these in the questions. That way you can ask those questions that provide the most valuable insights.

Conclusion

Altogether, this study demonstrates how PVE can meaningfully enhance the planning and development of mobility hubs by grounding decisions in citizen preferences and realistic trade-offs. Especially when applied early in the process, PVE helps shift planning discussions from political or technical starting points to those rooted in public values. Its ability to simulate constrained choices offers richer, more actionable input than traditional consultation methods.

Beyond its practical benefits, the research also contributes theoretically by using insights from the TIS functions framework to set-up an even more meaningful participatory approach. This interdisciplinarity brings a learning perspective to innovation in urban mobility, highlighting how insights from structural and functional components can guide more socially accepted and context-sensitive solutions. In practice, the findings offer a replicable approach for municipalities aiming to align hub development with local priorities. By integrating PVE at strategic points along the planning timeline, planners can improve public support, reduce risks, and create hubs that better reflect the evolving needs of specific communities.

PVE enhances mobility hub planning by translating community values into concrete, context-sensitive design choices. The research shows that respondents take significant time to elaborate on their considerations, adding a layer of depth to their numerical choices. PVE allows policymakers to simulate real policy trade-offs under realistic constraints to capture a deeper sense of what it is the community wants. This could not only improve the technical design of hubs (mode choice and mode infrastructure), but can also increase their social legitimacy (public support, design towards social safety), and usage rates.

PVE can function as a bridge between current political mobility hub planning and the community. The current planning and design process can be limited by narrow politic vision. PVE includes useful community engagement through an efficient platform that reaches a diverse audience, ensuring that mobility hubs are designed not only for communities but with them.

Limitations

While this study provides valuable insights into the integration of community preferences in mobility hub planning, several limitations should be acknowledged:

- Limited representativeness of the PVE sample: The PVE results are not statistically representative of Zwolle's population, as the sample size is too small and skewed toward younger, highly educated individuals. This may underrepresent perspectives from older adults, those with lower education levels, or limited digital access.
- Narrow scope of expert interviews: Although valuable, the expert interviews involved only two professionals and did not include perspectives from national policymakers or private-sector stakeholders. As a result, the policy insights may be shaped more by local and project-based experience than broader strategic viewpoints.
- Cross-sectional nature of the research: This study captures a snapshot in time, while mobility hubs are evolving rapidly due to technological, policy, and design changes. Preferences identified now may shift as new mobility needs and services emerge.

Recommendations for future research

Based on the research and its limitations, the following recommendations were made to enhance the effectiveness of future mobility hub planning efforts and participatory evaluations:

- Learn from existing hubs – national and European: Cities often consider their context too unique to apply lessons from others. Policymakers should instead engage in comparative learning to adapt known success factors and avoid recurring issues observed elsewhere.
- Improve the choice architecture of PVE "space" choice tasks: Mismatch between value and space tasks: The "score" and "space" choice tasks sometimes yielded inconsistent results. A more detailed, single space-based task, ideally incorporating actual square meter constraints, could improve realism and alignment with real-world planning.
- Incorporate budget constraints into the PVE: Including budget limitations would make trade-offs more realistic and reflect the financial implications of design choices. This would bridge the gap between citizen preferences and feasible policy outcomes.
- Implement a two-tiered participatory approach: Expert interviews recommend combining broad PVE studies with local, small-scale participation sessions. This approach grounds initial citizen preferences in real-world design choices and fosters local ownership of mobility hubs.
- Collaborate with professional institutes for participant recruitment: To ensure diverse and inclusive participation, future PVEs could benefit from partnerships with professional survey panel providers. This would reduce self-selection bias, improve sample size, and enhance credibility.
- Design longitudinal studies to track evolving preferences: Given the evolving nature of mobility needs, future research should explore longitudinal PVEs. Revisiting participants post-implementation can reveal shifts in values and offer insights into long-term behavioral change.

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1. Introduction

To meet the sustainability goals of the future, the Netherlands must literally shift gears toward active and public transport. In 2023, an average Dutch inhabitant travelled 12,1 thousand kilometers. Over 50% of these travelled kilometers were done by car (CBS, 2024). The Dutch Knowledge Institute for Mobility Policies expects to see an even further grow in the amount of car owners in the upcoming 25 years (Zijlstra et al., 2022). Considering that the Netherlands has a very strong connection between car ownership and car usage, it is to be expected that the amount of kilometers travelled by car will increase accordingly. This level of private car travelers is associated with a wide range of negative impacts for society, consider things like traffic congestion, greenhouse gas emissions and noise pollution (Rahman, 2023). Besides these broader societal impacts, the increasing use of cars also negatively impacts the growth opportunities of other modes of transport (Zijlstra et al., 2022).

"1 out of 3 people in the Netherlands says that owning and using their car to commute is not free willing but feels necessary." (Zijlstra et al., 2022)

A change in the main commuting mode of travelers is usually linked to a significant life event (Rahman, 2023). This relation offers a chance to analyze the factors that influence commuters to begin or stop using their private cars (Rahman, 2023). Innovations and changes in the way people move typically follow the social and distributive needs of their time, they are driven by social developments among communities (Cascetta & Henke, 2023). Knowing what drives change is important from a policy perspective. It can help to direct policies towards appropriate target groups (Rahman, 2023). Cascetta & Hanke (2023) identify the currently needed mode shift as part of the seventh transport revolution. The biggest challenge is environmental sustainability. Their research provides insight into three main principles of change: avoid, shift, and improve. The question is how government policies can be adapted to support this shift toward less polluting transport modes and improve the pollution levels of current vehicles within each mode (Cascetta & Henke, 2023).

Mobility hubs could contribute to various policy goals within the framework proposed by Cascetta & Hanke (2023). Mobility hubs are considered physical links between multiple modes of transport (Witte et al., 2021). These hubs offer a broad range of mobility functions and can also serve as focal points for spatial development goals. Mobility hubs also contribute to barrier-free travel, ensuring smooth transitions not only between different public transport modes but also between public and private transport options (Witte et al., 2021). Beyond contributing to the public transport sector, mobility hubs present an opportunity to scale up shared mobility services. One of the objectives of shared vehicle initiatives is to reduce the number of privately owned cars (Witte et al., 2021). Research indicates that establishing mobility hubs for shared mobility will save more public space than it initially requires.

Reducing car dependency is needed, especially considering the expected growth in ownership and usage of private cars (Zijlstra et al., 2022). Can mobility hubs play a role in this main mode shift? Witte et al. (2021) confirm the growing interest in implementing mobility hubs along the main road network. The goal is to establish hubs that solve bottlenecks and optimize network usage with limited investments. Various types of hubs are considered within this transportation improvement effort (see chapter 2 for details of different scale and size hubs). All hubs however share a common goal: encouraging motorists to complete their trips without relying on a private car. Another aspect of improving current transport modes is the role of mobility hubs in achieving zero-emission city logistics. To reach the goal of a zero-emission city by 2030, there must be changes within urban logistics fleets (Witte et al., 2021). Mobility hubs can help to facilitate this transition, serving as logistics transfer points contributing to zero-emission last-mile delivery.

Mobility hubs could offer promising solutions, but how to shape a mobility hub strategy in such a way that it will be successfully integrated and then effectively used by community members? Research by Arnold et al. (2023) established the importance of understanding the long-term performance factors of a mobility hub. In addition to this, there was a great highlight on the type of amenities a mobility hub should have. When designing a mobility hub, it is important to focus not only on the available transport modes but also on fostering a sense of place and community at the chosen location (Arnold et al., 2023). Integrating both aspects ensures that the hub meets not just the community's transportation needs but also its social needs. Arnold et al. (2023) highlight an often-overlooked aspect: performance.

Simply building or realizing a mobility hub is not a guarantee for success (Choudhury, 2024). To be successful, hubs need to be effectively used. But how do you achieve this? The SmartHubs project researched over 160 European mobility hubs and established a disconnect between genuine accessibility and the current way hubs are implemented (Choudhury, 2024). To make a hub successful, you must look at more than infrastructure. Social desirability and citizen participation are important from a design aspect as they help to establish needs and requirements of users (Bahamonde-Birke, 2023). Despite the growing recognition of mobility hubs as instruments for promoting sustainable transport, there is limited research on what community members themselves prioritize and expect from a mobility hub. There remains to be a research gap in the effective incorporation of the community members' perspectives into the policymaking processes. Current strategies largely focus on infrastructural optimization, environmental goals, and operational efficiency, often overlooking the more social dimension of the mobility transition. This oversight could lead to a disconnect between policy intentions and actual user adoption, potentially compromising the success of mobility hubs.

To address the previously established research gap, Participatory Value Evaluation (PVE) emerges as a promising method for gaining deep insights into community preferences and values. As a relatively new participatory method PVE enables policymakers to involve citizens directly in the decision-making process by simulating real policy choices and constraints (Mouter et al., 2020). Participants are asked to allocate limited resources among various policy options, reflecting the trade-offs faced by decision-makers. This approach not only captures what people prefer but also why they prefer it, offering nuanced data on the values and priorities that underpin mobility behaviors (Mouter et al., 2020; Mouter et al., 2021). A more comprehensive view on the influence PVE could have on mobility hubs can be found in chapter 2.

Problem formulation

Urban mobility systems in the Netherlands face increasing pressures due to rising car dependency, environmental concerns, and evolving societal needs (Cascetta & Henke, 2023; Zijlstra et al., 2022). While mobility hubs have been introduced as promising solutions to enhance multimodal connectivity and reduce environmental impacts, their effectiveness often falls short when community needs are not sufficiently considered (Choudhury, 2024). Multimodal connectivity, or public transit, in a mobility hub context refers to the seamless integration of different transport modes within a single location, making it easier for users to switch between modes efficiently (Schmidt, 2024). By facilitating these mode shifts, mobility hubs could reduce reliance on private car use, thereby contributing to lower emissions and more sustainable urban environments (Schmidt, 2024). The core challenge lies not just in implementing mobility hubs, but in designing them in such a way they meet the requirements and are therefore actively used by the communities they are meant to serve (Arnold et al., 2023).

Many mobility hubs are designed from traditional planning models that prioritize technical and infrastructural efficiency over genuine community integration (Choudhury, 2024; Rongen et al., 2022). This has resulted in mobility hubs that may be well-designed from an operational standpoint but fail to resonate with the daily realities, preferences, and mobility behaviors of local populations. A shortcoming in the hubs

community alignment can result in underutilization. To address this disconnect, there is the need to shift towards participatory planning approaches that place community voices at the forefront of decision-making processes.

Knowledge Gap

While there is extensive research on the technical and environmental benefits of mobility hubs (Arnold et al., 2023; Gerike et al., 2022; Hached et al., 2023; Pereira & Silva, 2023; Zhai & Ye, 2024), there remains to be a knowledge gap concerning their integration of the consumer perspective in the planning and design. Specifically, the absence of community-centered design approaches is likely to limit the hubs ability to meet local needs and desires effectively (Faherty et al., 2024; Geurs et al., 2023; Junyent et al., 2024; Rongen et al., 2022). This gap is magnified by a lack of methodologies to systematically capture and incorporate public preferences into urban mobility planning.

This research focuses on how PVE can be utilized to bridge this gap. PVE allows for the direct involvement of citizens in policymaking, enabling the collection of detailed data on public values, preferences, and priorities (Mouter, 2021; Mouter et al., 2020). Understanding what drives community engagement and how these insights can be systematically integrated into mobility hub development is critical to improve their effectiveness and long-term sustainability. Up to this point, the integration of PVE into mobility hub development is not fully explored and the potential to enhance community alignment and policy effectiveness remains unknown for this mobility innovation.

Problem Statement

Despite the growing recognition of mobility hubs as instruments for creating more sustainable urban mobility (Junyent et al., 2024), their success is currently compromised by a lack of community involvement in the planning and design processes (Geurs et al., 2023). To realize mobility hubs that are socially accepted and more effectively used by communities, there is a need to explore how PVE can be integrated into planning and development stages (Geurs & Münzel; 2022; Geurs et al., 2023; Mohiuddin et al., 2023). This helps to ensure mobility hubs are not only technically efficient but meet consumer requirements (Gunton et al., 2022).

Main research question

In what ways can a Participatory Value Evaluation approach enhance the design and planning of multimodal mobility hubs by incorporating community preferences to better align with user needs?

Sub questions

To systematically address the main research question, this study is structured around a set of sub-questions aligned with the methodology outlined in Chapter 4. A European mobility hub case study, analyzed using the Technological Innovation System (TIS) Functions framework, will identify key success and failure factors. The case study insights will serve as a foundation for the Participatory Value Evaluation (PVE). The PVE's combined quantitative and qualitative results will offer a comprehensive understanding of the factors shaping the implementation and public acceptance of multimodal mobility hubs. Finally, expert interviews will complement the findings by clarifying their policy relevance and exploring implications for future urban mobility planning.

1. How do structural and functional components observed in European mobility hub projects inform the potential for hub integration in the Dutch urban context?

2. Which TIS based success and failure factors, influencing the implementation of multimodal mobility hubs, are transferable to guide the implementation of mobility hubs in the Netherlands?

3. Which attributes of mobility hubs are prioritized by the community, as revealed through PVE?

4. How do different user groups vary in their preferences and trade-offs regarding mobility hub features, based on PVE data?

5. What additional insights do the qualitative PVE responses provide, and how do these enrich the interpretation of quantitative results?

6. How can the combined insights from the TIS and PVE results inform policy recommendations for mobility hubs that align with local community needs and promote their usage?

Scientific relevance

By exploring the crosspoint of technical transport planning and participatory urban governance, this research will offer insights into sustainable urban mobility. It will help grow the understanding of how PVE can be operationalized within the context of mobility hub development, providing empirical evidence on its effectiveness in capturing community preferences and informing policy decisions.

By applying the Technological Innovation Systems (TIS) framework alongside PVE, this study offers a novel interdisciplinary approach that integrates insights from structural and functional components of urban planning, and participatory governance. The findings are expected to contribute to the theoretical development of participatory methods in transport planning and expand the application of PVE.

Societal relevance

From a societal perspective, this research addresses the pressing need for more inclusive and equitable urban mobility systems. By emphasizing community participation through PVE, the study aims to ensure that mobility hubs are designed in ways that reflect the diverse needs of local populations, including underrepresented and vulnerable groups.

The outcomes of this research have the potential to influence policy frameworks, promoting more democratic and transparent decision-making processes in urban mobility planning. Ultimately, this contributes to the development of mobility hubs that not only support environmental sustainability but also enhance social cohesion, accessibility, and public trust in transport policies.

Structure of the Thesis

Table 1 provides a structured overview of the upcoming report, outlining the content of each chapter in relation to the specific research (sub)questions addressed. It also briefly describes the research methods applied in each part, these will be further elaborated upon on chapter 3 and 4. This structure serves as a guide to navigate through this report and to understand how each component contributes to answering the linked sub-research question.

Table 1. Overview of thesis lay-out and accompanying research questions and method(s)

Chapter	Related Research Question(s)	Research Method(s)
1. Introduction	Background information towards the main Research Question	Problem domain analysis
2. Literature Review	Background information towards all research questions	Desk research, review of academic and policy literature
3. Theoretical Framework	—	Framework identification based on desk research
4. Research Methodology	--	Explanation of methods: Case study, PVE (and data analysis techniques), Expert interviews
5. Case Study Analysis	Sub-question 1 (foundation towards PVE set-up)	Case study analysis of selected European mobility hubs; document review; Report significant structural and functional components; Identify Technological Innovation Systems (TIS) Loop
	Sub-question 2 (foundation towards PVE set-up)	TIS functions framework to identify Success and Failure Factors (SFFs) in the European hub cases
6. Participatory Value Evaluation – Set up	--	Explanation of the set-up of the PVE survey; Explanation of the origin of the questions and the role of the previous insights
7. Participatory Value Evaluation - Results	Sub-question 3 (PVE general results analysis)	PVE conducted among stakeholders and citizens; analyzed using Descriptive Statistics and a one sample T test
	Sub-question 4 (PVE cluster analysis results)	LCCA to uncover preference heterogeneity across different respondent groups; qualitative reflection based on PVE data
	Sub-question 5 (PVE qualitative analysis results)	Thematic inductive coding to analyze the qualitative data gained from the PVE
8. Expert Interviews	Sub-question 6 (expert Policy insights)	Interviews with experts in the mobility hub field and a specific knowledge of the project in Zwolle
9. Discussion	Reflection on analysis results and sub-questions	Comparative analysis, synthesis of results
10. Conclusion	Main Research Question	Concluding the research and answering the main research question
11. Recommendations	--	Provide recommendations toward further scientific research and further policy interventions

2. Literature Review

Urban Mobility Challenges and Opportunities

As cities grow, so does the demand for efficient urban mobility systems (Herrera-Acevedo & Sierra-Porta, 2024). However, creating such efficient systems presents significant challenges. Ortúzar (2019) established three main elements in regards to mobility and urban sustainability challenges: Excessive dependence on private cars, overconsumption of land area and an unacceptably large ecological footprint.

The Dutch population grows rapidly, expecting one million extra inhabitants by 2037 (Stoeldraijer et al., 2024). At the same time the way people move through the current mobility system continues to be unsustainable (Papadakis et al., 2024). The extensive use of private cars remains intact due to the advantages users experience in contrast to modes like walking, cycling and public transport (Metz, 2013). These perceived car advantages like accessibility, travel time and marginal utility have interfered with the adoption of sustainable mobility practices (Metz, 2013; Papadakis et al., 2024). But what exactly is sustainable urban mobility? It represents the idea that cities provide environmentally-friendly transportation options to their inhabitants, this in such a way that it does not harm the environment or cause poor social impacts (Ortúzar, 2019). In 2015 the United Nations set up an agenda for sustainable, future development. They state that making cities sustainable, demands "investment in public transport, creating green public spaces, and improving urban planning and management in participatory and inclusive ways" (United Nations, 2015). While ambitions are needed, this goal of the United Nations faces several challenges.

Shared mobility fails to attract car users

Efficient sustainable mobility systems need to change user behavior (Gabrielli et al., 2014). By raising individuals' awareness of mode choices, their behavioral patterns and the consequences of their trips, researchers strive to create a broad modal shift (Gabrielli et al., 2014; Papadakis et al., 2024). An important element in realizing this goal is the role of shared mobility providers offering sustainable alternative travel modes. However, Fitschen et al. (2024) explain that shared mobility solutions often fail to attract car users. This is an important consideration as car users form an important group when it comes to the effectiveness of sustainable policies towards changing mode choice (Fitschen et al. 2024). This prompts the question of why car drivers are difficult to shift toward alternative transport modes. One of the principal factors influencing mode choice is the cost associated with the journey. Regardless of the proposed cost advantage of shared mobility, it is challenging to create a cost-based encouragement for car users to switch from personal cars to more sustainable shared mobility (Liljamo et al., 2020; Fitschen et al. 2024).

Another reason shared mobility are not representing a big mode share yet, is the growing ownership and government promotion of electric cars. Worldwide each government applies their own reasons for promoting electric car use, from risk management to pure industrial policies (Lane et al., 2013). Several researchers have worked on frameworks for optimal policy-making towards electric vehicle adoption (Mohammadzadeh et al., 2022). It is proven that by implementing policies that reduce operating costs, governments can encourage customers to purchase electric vehicles (Mohammadzadeh et al., 2022). And while electric cars seem like a sustainable alternative at first glance, they do not solve our excessive dependence on private cars (Ortúzar, 2019), neither do they solve the issues around traffic congestion (Delucchi, 2000). Research by Delucchi (2000) established the external costs for several passenger transport modes. Comparing electric cars to gasoline cars, the results are surprisingly similar when it comes to air pollution, noise pollution, accident rates and congestion. While electric cars have a slightly better score on air pollution (1,5 cents per vehicle mile, compared to 2,0 for gasoline cars), the congestion cost are equal (4,0 cents per vehicle mile) and the electric cars score even slightly higher on the accidents costs (Delucchi,

2000). Also, a more recent, research by Grigorev et al. (2021) explored the impact of electric vehicles on traffic congestion and energy consumption. They modelled current and hypothetical traffic and charging demand scenarios, based on the degree of acceptance and diffusion of electric vehicles in the marketplace. Results of the research show that even in the lowest degree situation, the total travel time of each driver would increase by almost 4.9%, which equals an extra 6.18hours spent in traffic (Grigorev et al., 2021). So while electric vehicles are promoted by governments, they fail to prevent the negative mobility impacts for society as mentioned by Rahman (2023).

Equity and accessibility challenges

Equity and accessibility are foundational principles for sustainable urban mobility, yet achieving these goals remains a persistent challenge. Herrera-Acevedo & Sierra-Porta (2024) mention several integration features for a sustainable city. One of those features is the maximization of accessibility and efficiency for users. Besides the significant impact on users modal shift, the development of a compact city that optimizes urban space and reduces commuting distance is of great importance (Herrera-Acevedo & Sierra-Porta, 2024). These specific city features will improve overall transport efficiency, as well as enhance social cohesion. However, this feature of sustainable urban development brings along a new challenge regarding equity.

Vulnerable populations often face challenges in accessing efficient transport systems. Inequitable access to transportation disproportionately impacts these disadvantaged groups, exacerbating social and economic inequality in urban areas (Martinez et al., 2024). Policies intended to improve urban mobility may unintentionally deepen these disparities unless equity is explicitly considered from the outset. Despite these challenges, cities have opportunities to create more inclusive systems through shared and multimodal transport solutions that reduce reliance on private vehicles while enhancing accessibility for diverse users (Iannacci et al., 2025).

The planning and implementation of mobility hubs present a unique opportunity to improve accessibility for all. Frank et al. (2021) emphasize that locating multimodal mobility hubs in strategic areas can significantly enhance rural accessibility, providing underserved populations with better connections to urban centers. They also demonstrate the potential of mobility hubs to create sustainable and inclusive mobility systems when locations are optimized to serve diverse user needs (Stadnichuk et al., 2024). Butzin et al. (2024) discuss how regional challenge-based innovation policies, which include citizen participation, can anchor social equity within urban mobility projects. The inclusion of marginalized voices in the planning process ensures that mobility hubs serve as equitable access points for all, particularly for vulnerable populations.

Addressing accessibility also requires a focus on urban functionality. The importance of quantifying urban function accessibility lies in understanding how transportation networks influence population mobility (Liu et al., 2024). Such insights are critical for designing mobility systems that cater to the needs of different demographic groups, ensuring equitable service distribution. In addition to geographic considerations, social equity must be embedded in the decision-making processes for urban mobility projects. Klaever et al. (2024) argue that expertise from structurally disadvantaged groups should inform participatory transport planning processes. This approach not only enhances inclusivity but also ensures that policies and infrastructure reflect the realities of those most affected by mobility inequities.

Policy integration emerges as a crucial factor in tackling urban mobility challenges. Hull (2007) emphasizes that effective integration between transport policies and broader urban planning initiatives can significantly enhance the sustainability of urban transport systems. Best practices from successful urban mobility projects demonstrate that stakeholder engagement and innovative policy design are important to achieve long-term success (Papadakis et al., 2024).

To harness these opportunities, policymakers must adopt a holistic approach, integrating environmental, social, and technological considerations into urban mobility planning (Gössling & Cohen, 2014; Jeyaseelan et al., 2022). Furthermore, equity-centered models and frameworks are needed to address spatial inequality and segregation. Tammaru et al. (2023) advocate for tailored solutions that respond to the unique barriers faced by different communities. Strategic planning of mobility hubs, as Aydin et al. (2022) propose, can mitigate these spatial inequities. PVE adds value by capturing diverse stakeholder perspectives, ensuring that mobility policies reflect the priorities of underrepresented groups. By addressing existing challenges and embracing innovations, cities can work toward systems that are more sustainable, efficient, and also fundamentally equitable.

Mobility Hubs: Concept and Implementation

As established there is an urgent need for improved sustainable mobility planning. Integrating a variety of sustainable transport modes into a smaller region would enhance an optimal use of urban space. Many European cities, including the Netherlands, currently face the opportunity to implement shared, sustainable, multimodality systems, better known as mobility hubs (Junyent et al., 2024). Mobility hubs use technological advancement to offer an improved connectivity and contribute to the promotion of active mobility, shared transportation and all other sustainable modes of transport (Arnold et al., 2023; Hached et al., 2023). The concept of mobility hubs reflects a broader trend toward creating efficient, environmental friendly urban transport systems that enhance socio-economic improvements (Arnold et al., 2023).

Geurs et al. (2023) provided a list with all potential definitions of a mobility hub, the most striking was the one by CoMoUK: “A Mobility Hub is a recognizable place with an offer of different and connected transport modes supplemented with enhanced facilities and information features to both attract and benefit the traveler”.

Which types of hubs are there

Weustenenk and Mingardo (2022) did extensive research toward the characteristics of mobility hubs and finalized their research with a clear overview of six different types of hubs. Each of these hubs has their own characteristics and are classified from a smaller scale hub to a larger scale hub.

The first hub established is the *community hub.* Community hubs are small-scale mobility hubs located in private areas, such as garages or parking lots, primarily serving specific communities like residents or employees. They offer shared mobility options (e.g., electric cars, bikes, mopeds), lack public transport connections and neighborhood services, and are often linked to project developments to reduce parking needs and increase housing density.

Neighborhood hubs combine shared mobility options with public transport connections, such as buses or trams, and are typically accessed on foot or by bike. Located near amenities like grocery stores, they offer local services like package pick-up points, with fewer and less complex transport modes compared to suburban hubs due to the absence of high-frequency or regional transit options.

The third hub is the *suburban hub*, which focuses on providing accessibility to less urbanized areas, typically featuring public transport stops like bus stations or small train stations, with ample parking for private vehicles. These hubs offer simpler transport options and fewer services compared to more urbanized hubs, with limited high-frequency transit and logistics facilities.

The city *district hubs* focus on enhancing livability and urban redevelopment by clustering functions and reducing car parking to ensure accessibility for residents and visitors. Located in urban areas, these hubs offer a wide range of transport modes , along with small retail facilities and package pick-up points. They provide a high level of services, serving an (inter)regional scale rather than a local one.

City edge hubs are typically located near ring roads or metropolitan outskirts. They function as Park and Ride facilities, enabling transfers between private vehicles and collective transport. These hubs serve an (inter)regional scale, offering essential facilities such as parking, carpooling, and electric charging, with fewer services and simpler transport options compared to city center and district hubs.

The final category is the *city center hub*, they are typically centered around major railway stations, offer high-quality public transport and are easily accessible by walking and cycling. They provide the most diverse and complex transport modes, operating on a national scale with extensive services and facilities, though limited space for parking.

Goals for mobility hubs within cities

Hached et al. (2023) provides insight in the objectives of the mobility hub. Apart from the obvious, creating a location for multimodal transportation, mobility hubs aim to provide solution towards environmental, social, economic and security objectives. The Mobi-Mix project of Hached et al. (2023) showcases the implementation of mobility hubs in Norfolk (UK) and Valenciennes (France) to promote shared and active mobility solutions. Norfolk, with a population density of 170 inhabitants per km², focused on reducing traffic congestion and encouraging shared and active mobility by integrating e-scooters, bikes, e-bikes, and cars into its mobility ecosystem. Similarly, Valenciennes, with a higher population density of 554.2 inhabitants per km², aimed to rebalance its modal split in favor of sustainable transport and establish itself as a living laboratory for carbon-free mobility. Mobility hubs in these cities, comprising bikes, e-scooters, and cars, were evaluated using the MODE framework, which employs sequential methodologies including exploratory, ex-ante, and ex-post analyses to assess impacts.

Preliminary estimates indicate significant reductions in car use and CO_2 emissions, with Norfolk's hub reducing 81,400 vehicle-kilometers and 23 tons of CO_2 annually in the short term, potentially reaching 359,500 vehicle-kilometers and 57 tons of CO_2 annually in the long term. Valenciennes' hub showed even greater potential, with reductions of 215,900 vehicle-kilometers and 67 tons of CO_2 annually. The project applied sensitivity analyses to ensure robustness and monitored behavioral changes through follow-up surveys comparing pilot users to control groups. However, pandemic-related delays postponed the completion of surveys and trials (Hached et al., 2023).

The environmental benefits of mobility hubs are closely tied to their ability to decrease greenhouse gas emissions, improve air quality, and foster climate resilience. Gerike et al. (2022) argue that integrating sustainable urban transport strategies into mobility hub planning can significantly mitigate the environmental footprint of urban transportation. By promoting public transport, cycling, and walking, mobility hubs reduce car dependency, thereby lowering carbon emissions and alleviating traffic congestion. Mobility hubs are designed to foster climate-resilient urban transport systems through adaptive infrastructure that emphasize shared mobility solutions. These low-emission modes of transport efficiently use resources, advancing the transition toward inclusive and sustainable urban environments (Pereira & Silva, 2023; Zhai & Ye, 2024).

Historical lessons from the Netherlands underscore the importance of adapting the mobility hub concept to specific urban and regional dynamics to enhance its effectiveness (Rongen et al., 2022). In the Netherlands, the mobility hub concept has gained traction in both research and policy circles. However, historical implementations of similar concepts, such as Park and Ride (P+R) facilities and transit-oriented development (TOD), have not significantly shifted travel behavior from private car use to multimodal transport (Rongen et al., 2022).

The implementation and integration of hubs

Planning and implementing mobility hubs require a comprehensive understanding of local contexts. Mobility hubs, and other types of transport nodes, have a lot of added value when their elements are effectively linked to their urban environment. It is important that they have the capacity to connect one center of activity to another (Junyent et al., 2024). To meet today's growing transport demand, the way urban planners use and design infrastructure must be reconsidered, especially when it comes to shared mobility services (Junyent et al., 2024).

Junyent et al. (2024) establish that the implementation of mobility hubs can contribute to the creating of seamless multimodal mobility, which they state as the only alternative to the large share of private cars in urban areas. Mobility hubs are an essential component to the sustainable urban mobility plans, which are used by European cities towards their mobility transition. For seamless implementation, location choice is of great importance. A new methodological framework combining Multi-Criteria Decision Analysis (MCDA) and Geographic Information Systems (GIS) aims to identify the optimal hub locations (Junyent et al., 2024). This approach ensures that hubs are strategically placed to maximize accessibility and usage.

The success of mobility hubs also depends on stakeholder engagement and integrated planning. Arnold et al. (2023) emphasize the need for exploratory studies to understand community needs and incorporate them into hub design and operations. A PVE approach not only improves user satisfaction but also fosters community support for mobility initiatives.

Participatory Value Evaluation in Urban Planning

Participatory Value Evaluation (PVE) has emerged as a transformative approach in urban planning, offering an inclusive framework that integrates diverse stakeholder perspectives into decision-making processes. This section synthesizes insights from contemporary research to explore the value of PVE, its methodological strengths and limitations, and its specific applicability to mobility hubs within urban environments.

The conceptual foundations of PVE

Back in 2008, Cargo and Mercer already researched the values and challenges of participatory research in a public health matter. They emphasized how engagement enhances the legitimacy and relevance of research. In 2021, Odera found another case were participatory evaluation played a significant role in user experiences. Students that took part in a participatory evaluation of their program experienced a significant change in how they experience the program compared to students who did not took part in the evaluation (Odera, 2021). User participation matter, also in a mobility setting. PVE is a participatory mechanism that allows stakeholders to express preferences regarding public policies under resource constraints like public budget (Mouter, 2021; Mouter et al., 2021). PVE enables participants to experience the trade-offs inherent in policymaking, thereby producing valuable, more contextually grounded data.

Mouter (2021) explains that PVE is not the first experiment to allow participants to allocate public budgets. A well-known public decision-making tool in Western countries is Cost-Benefit Analysis (CBA). CBA is rooted in welfare economics and determines a project's positive and negative social impacts based on estimates of willingness to pay (WTP). Since the WTP has faced significant criticism, an alternative approach has been introduced: willingness to allocate public budget (WTAPB). WTAPB reflects a situation where individuals make choices based on government budget allocation while considering the resulting effects of their decisions. However, one final important consideration has not yet been fulfilled by this WTAPB, namely the option to do nothing. PVE addresses this gap by allowing participants to advise against allocating funds to any of the projects considered. It is based on the microeconomic principle that individuals are utility maximizers, constrained by both public and private budgets.

Research shows that available policy tools often over-simplify today's complex problems (Gunton et al., 2022). Different people value different things, this insight helps to establish a broad range of priorities to any given project. However, it is important for any government or business to integrate a pluralistic evaluation framework to account for all these different perspectives. As Gunton et al. (2022) point out in their research, there is the need for a valuation approach that extends beyond economics metrices to capture all other ecological and social dimensions of a problem. PVE allows to capture these multidimensional societal values, making it particularly suitable for complex urban mobility decisions (Mouter et al., 2020).

PVE's application in urban mobility decision making

Faherty et al. (2024) researched the influence of stakeholder perspectives on urban mobility development in Dublin. This case study provides valuable insights to transfer onto the Dutch market, as Dublin equals the Netherlands in having a 50% trip rate with private vehicles. Another touchpoint is the goal to reduce over 50% of greenhouse gas emissions (Faherty et al., 2024). To achieve this goal, there is a need for sustainable urban mobility. Local expertise and feedback play a significant role creating more innovative projects, making citizen and stakeholder engagement a requirement for successful sustainable mobility (Lindenau & Böhler-Baedeker, 2014). Stakeholder engagement is not only helpful but also required, involving the community in mobility planning is a EU directive and stipulated by multiple international conventions (Lindenau & Böhler-Baedeker, 2014).

The study of Faherty et al. (2024) highlights that Dublin has a need to expand public transport and enhance active travel infrastructure. Comparable desires to the ones of the Dutch mobility system. They also emphasis the need for a behavioural change initiative. However, to accumulate a significant level of community acceptance toward such a change, the community perspective must be aligned with the policy direction (Faherty et al., 2024). This requires citizen participation strategies like PVE to not only surface individual preferences but also reveal systemic interdependencies, a critical insight for this studies mobility hub planning.

Mohiuddin et al. (2023) explore how individual perceptions of transportation systems influence mode choice, particularly for mobility-challenged populations in Dhaka. Although their methodological approach integrates choice and latent variable models rather than PVE explicitly, the underlying principle of capturing subjective experiences of citizens resonates with PVE's objectives. It is established that individual perceptions significantly influence mode choice, especially when it comes to viewing mode-related problems and obstacles (Mohiuddin et al., 2023). Learning how subjective data can influence policy making is also crucial for designing mobility hubs that are both accessible and responsive to diverse user needs. The inclusion of traditionally underrepresented groups, like mobility-challenged populations, is a notable strength of PVE. Mouter et al. (2021) document its efficacy in engaging young people within the Dutch energy transition context, highlighting how PVE can cut down participation time while producing actionable outcomes.

The influence PVE can have on decision making and socially accepted policy making is deemed to be credible, legitimate and relevant (Juschten & Omann, 2023). PVE represents a valuable starting point for significant citizen involvement. Digital PVE platforms can broaden participation while maintaining the methodological rigor of a research method. Besides this it helps to gain insights into the realization of policy options and the environmental, economic, and social (interaction) effects that impact decision-making (Juschten & Omann, 2023).

Integrating PVE and mobility hubs

The integration of PVE into mobility hub development represents a transformative approach to urban mobility planning. By merging the multimodal accessibility of mobility hubs with the participatory framework of PVE, cities can create transport solutions that are not only efficient but also deeply aligned with community needs and preferences.

Mobility hubs are inherently people-centric, and the incorporation of PVE enhances their design and implementation by prioritizing stakeholder input. Several case studies illustrate how people-centered design methods, such as PVE, can be instrumental in planning sustainable transport like multimodal mobility hubs (Taborda et al., 2023; Sagaris, 2024). PVE's strength lies in its ability to bring out public preferences, making it invaluable for addressing both systemic and localized challenges. Mouter (2021) demonstrates how PVE can guide the allocation of public budgets towards mobility infrastructure projects that resonate with societal priorities. A research in Lisbon also highlights that involving local stakeholders from the early stages of design results in hubs that reflect community priorities (Taborda et al., 2023). The participatory approach ensures that investments are not only economically sound and functional from a infrastructure perspective, but also socially equitable and supportive of community well-being.

Bahamonde-Birke et al. (2023) further emphasize PVE's utility in capturing public perspectives on Mobility as a Service (MaaS), biking infrastructure, and public transport, thereby fostering multimodal connectivity that aligns with public expectations. The research shows that the individual behaviour based value of a public investment does not always equal the social valuation. Bahamonde-Birke et al. (2023) utilized PVE to gain a social desirability perspective on multimodal transport, resulting in a shown preference for diversifying investments among mobility options. Mobility hubs provide in this preference toward investing in different travel modes, Ciriaco and Wong (2024) discuss the role of community needs in shaping resilient hubs, which conceptually align with mobility hubs. Their research confirms the multimodal desires of citizens as they found that accessibility of a hub is respondents main priority.

However, challenges remain in fully realizing the environmental and social potential of mobility hubs. Rani and Jayapragash (2024) identify barriers such as inadequate funding, regulatory constraints, and insufficient public awareness as obstacles to the effective implementation of mobility hubs. Overcoming these challenges requires coordinated efforts among policymakers, planners, and stakeholders to ensure that mobility hubs fulfill their transformative potential.

In conclusion, mobility hubs are pivotal to achieving both environmental and social sustainability in urban mobility systems. By reducing emissions, enhancing accessibility, and fostering community engagement, mobility hubs contribute to the creation of livable, equitable, and resilient urban environments.

3. Theoretical Framework

This chapter establishes the academic foundation of this study by reviewing theories and conceptual frameworks relevant to the research. It provides an overview of the Technological Innovation Systems (TIS) framework, which is used to analyze the development and diffusion of (mobility) innovations. In addition, it explains the Participatory Value Evaluation (PVE), a new participatory method to incorporate public opinion and desires into decision-making processes. These frameworks offer valuable insights into the systemic factors influencing innovation and the role of stakeholder engagement in shaping mobility transitions.

Technological Innovation Systems

Over time, system concepts have gained presence within academic studies on innovation processes and the associated policy-making (Bergek et al., 2015). There have been several attempts to study innovation systems in an empirical way to better understand and explain their performance, structure and dynamics (Bergek et al., 2008). Understanding these factors is important to inform a wide variety of crucial public policy problems. There is the need to extend the framework beyond just the assessment of system performance and also include the identification of factors influencing this performance (Berget et al., 2008).

The concept of a Technological Innovation Systems (TIS) emerged as an analytical framework to understand the development and diffusion of new technologies (Berget et al., 2008; Wieczorek & Hekkert, 2012). TIS builds upon earlier innovation system approaches, and focuses specifically on the development of a particular technology or technological field (Bergek et al., 2008). It has been widely used in studies analyzing the evolution of sustainable and emerging technologies, as it allows for the identification of the processes that facilitate or hinder innovation (Markard et al., 2015). This makes TIS particularly suitable for analyzing mobility hubs, which represent a complex, emerging innovation among transport, technology, and spatial planning (Arnold et al., 2023). Mobility hub implementation involves both technical and social change, making it necessary to understand the dynamics and barriers within the system (Gunton et al., 2022; Mohiuddin et al., 2023). The TIS framework is capable to capture structural components and functional components (Bergek et al., 2008; Hekker et al., 2007). The functional components influence the design, dissemination and use of a technological innovation (Berget et al., 2008). TIS is used to assess shortcomings in performance and formulate recommendations towards government policies in order to support a specific innovation (Markard et al., 2015)

"TIS functions as a central tool for performance assessment"
(Bergek et al., 2008, Hekkert et al., 2007)

TIS is valuable for policymakers and researchers because it provides a structured way to analyze the strengths and weaknesses of innovation systems and identify interventions that can accelerate technological transitions (Wieczorek & Hekkert, 2012). The TIS framework is constantly evolving and as it becomes broader adopted, also points of critique came in (Markard et al., 2015). TIS sometimes has ambiguous boundary definitions and the difficulty of capturing interactions between different systems (Markard et al., 2015; Andersson et al., 2023). Recent efforts have aimed at refining TIS to better account for contextual influences and multi-system interactions (Bergek et al., 2015).

The TIS 'functions' framework by Hekkert et al. (2007)

A significant development within the TIS literature is the functional approach introduced by Hekkert et al. (2007), which focuses on the functions that drive the performance of an innovation system. Among others, these functions include: knowledge development; market formation and resource mobilization. By

assessing these functions, researchers can identify systematic bottlenecks and propose measures to strengthen innovation processes.

The functional approach is particularly useful because it moves beyond structural descriptions of innovation systems to focus on their dynamics. It provides a diagnostic tool for evaluating whether an innovation system is progressing effectively and what types of interventions might be necessary (Hekkert et al., 2007; Wieczorek & Hekkert, 2012). Given the increasing complexity of technological transitions, this approach offers a systematic way to analyze how various actors and policies contribute to the development of emerging technologies.

The Seven Functions of TIS

The TIS functions framework is structured around seven functions that determine the success of an innovation system (Hekkert et al., 2007). Below is a brief description of each function, while Figure 4 provides a visual representation of the functions and illustrates possible innovation pathways through them:

1. Knowledge Development: the generation and accumulation of knowledge within the innovation system. This function includes scientific research, technological advancements, and experiential learning among actors.
2. Knowledge Diffusion through Networks: the dissemination of knowledge among actors is crucial for innovation. This function examines the role of networks, collaborations, conferences, and industry alliances in spreading technological insights.
3. Entrepreneurial Experimentation: entrepreneurs play a role in testing new technologies, applications, and business models. This function assesses the presence of risk-taking actors who drive technological development through trials and innovation.
4. Guidance of the Search: this function concerns the direction of technological development based on societal needs, policy goals, or market trends. It includes signals such as government targets, research priorities, and industry roadmaps that help shape innovation efforts.
5. Market Formation: new technologies often require niche markets before achieving large-scale adoption. This function examines the creation of early markets, subsidies, and incentives that support the initial diffusion of innovation.
6. Resource Mobilization: the development of new technologies depends on access to financial, human, and infrastructural resources. This function looks at the availability of investments, skilled labor, and supporting infrastructure.
7. Creation of Legitimacy: innovations must gain societal and regulatory acceptance to be successfully implemented. This function evaluates efforts to build legitimacy through lobbying, public support, and alignment with existing institutions.

For the present study, the TIS function framework is relevant as it allows for a nuanced analysis of how technological developments unfold within the context of multimodal mobility hubs within Europe. Applying this framework in a case-study setting can assess how different functions of the innovation system interact and where barriers to technological diffusion exist in diverse geographic and regulatory settings. As the development of mobility hubs varies significantly across regions due to differences in institutional frameworks, policy support, and market dynamics, the TIS function framework enables a systematic comparison of these factors. It helps to identify best practices, critical success factors, and potential policy interventions that can enhance the adoption and effectiveness of such hubs informing new policy decisions (Bergek et al., 2015; Andersson et al., 2023).

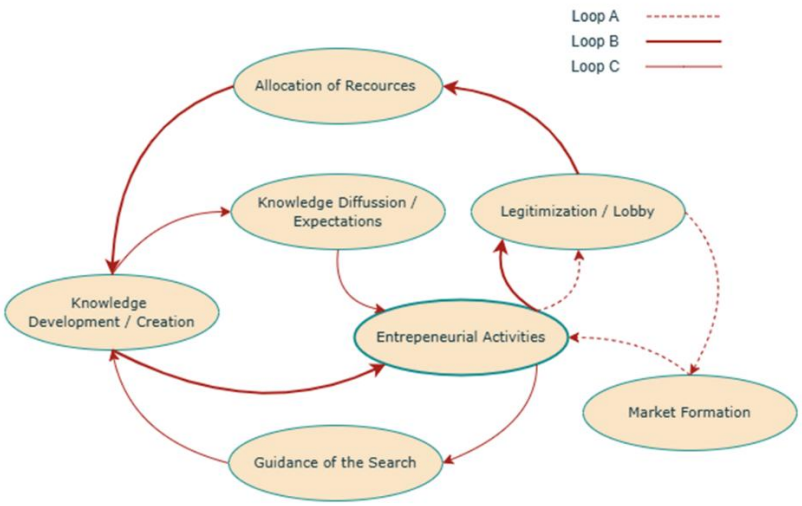

Figure 4. Examples of pathways through functions of innovation systems (Hekkert et al., 2007)

Participatory Value Evaluation

Travel Behaviour Research as the Foundation

Over the past eighty years researchers have been knee-deep into travel behaviour research (Axhausen, 2006). Travel behaviour research focuses on the physical movement of people within a wide range of disciplines (Axhausen, 2006). Nowadays there is the need to promote alternative travel modes, and with that, travel behaviour research gains even more importance. Regardless of the growing occurrence of multimodal transport options, there is not enough academic research on the factors shaping multimodality and its socio-environmental impacts (Huang et al., 2024). Travel behaviour research always considers a reference location, a place to which the traveler returns at the end of their day. Important research aspects, and therefore insights gained from travel behaviour research are the main mode of transport of each journey or tour a traveler takes (Axhausen, 2006).

To understand multimodal travel behaviour beyond the numbers, it is important to take into account travelers' attitudes toward travel behaviour. Attitudes are considered relatively stable over time, and at the same time, they are a strong predictor of behaviour (de Vos, 2022). Within travel behaviour surveys attitudes are mainly included through attitudinal statements (de Vos, 2022). However, agreeing to an attitudinal statement is not the same as gaining personalized inputs. Another important consideration is that attitudinal statements mainly collect intention data, rather than data on travelers' desires (Parkany et al., 2004). Many studies have shown poor correlations between intention data and actual revealed preferences (Parkany et al., 2004). There is a need for a suitable method to collect personalized, travelers' desire data.

Why should Human Participation be included

Human participation comes to mind as an answer to the question that arose from the previous section. Since the 1950's citizen participation has been broadly implemented to enhance community relations and promote effective democracy (Irvin and Stansbury, 2004). However human participation is a cost and time inefficient process, so what are the advantages and are they worth the extra investments?

Irvin and Stansbury (2004) highlight several important advantages of human participation from both a citizen and a government perspective. The main advantage is the educational aspect of participation. Citizens can learn from government representatives while informing and enlightening them. The feeling of impact and control over the policy process is another advantage citizens gain from participation processes.

From a government perspective the educational aspect is an advantage just as important. Government bodies can learn from the citizens, just like they learn from the government. Another important advantage is the building of trust, and legitimacy for the decisions that are made (Irvin and Stansbury, 2004). However, as citizen participation is time costly and (mostly) unpaid, the citizens taking part in participation initiatives are very often considered biased, either positively or negatively. Final policy decisions may be changed for the worse if strong citizens opinions weigh too much and are not representative of the entire population (Irvin and Stansbury, 2004).

Participation Methods from the past

Callahan (2007) confirms that within participation methods, there is significant understanding of either the uninvolved and passive citizens or the very active and engaged citizens. However, there are limited insights and not enough empirical evidence or theory on what takes place outside of these extremes. This is an important shortcoming as this "in between" is where most citizen participation takes place. When citizens have a greater feeling of dissatisfaction with the government's ability to effectively design and implement public programs there is greater interest in active participation (Callahan, 2007). On the contrary, when citizens are satisfied with the overall implementation of policy initiatives they seek less active involvement in decision-making processes. Governments seek methods that establish relationships between citizens and public administrators.

The challenge for government bodies is to balance the traditional values of fair and equitable participation with the much-needed efficiency and broad responsiveness (Callahan, 2007). Balancing these needs toward a transparent, democratic decision-making process is an almost fictitious situation, but at the same time a fundamental goal (Callahan, 2007).

Rosener (1978) set up a matrix that showcases four types of participation programs. Programs qualified at level four are least influenced by citizen participation. Within these programs there is little to no information on the relation between the participation and the achievement of goals, nor is there information on the details of the objectives and goals. The use of evaluation research methodology can help to establish how a participation is valued (Rosener, 1978). It can expose value biases and citizens' hidden agendas. All of this will help move participation into a level 1 program, where relationships, and the agreement on goals are clearly identified to reduce the doubtfulness surrounding the effectiveness of the participation concept (Rosener, 1978).

New Insights gained through PVE

Participatory Value Evaluation meets Rosener's level 1 criteria for participation, and it goes beyond them as well. Participatory Value Evaluation meets citizens' desires to participate in a nuanced way, but without consuming too much of their valuable time (Perree, 2025). This rare combination of participation features allows PVE to collect a well-rounded group of citizens.

Over the past four years, Populytics (a spin-off of Delft's University of Technology) has carried out around thirty PVEs for several big projects within the Netherlands. These PVEs have provided valuable insights in several fields of expertise, but with a main focus on infrastructure, spatial planning, mobility and energy/sustainability (Populytics, 2023). Professionals across various fields use the PVE to enhance decision-making and public engagement. Politicians use PVE to gain deeper insights into citizens' preferences and desires, while increasing acceptance of final policy choices. Another example are policymakers, who apply PVE to help citizens understand complex or sensitive issues. PVE helps to explore dilemmas collaboratively and foster greater acceptance of decisions, while enriching policies with public input.

In October 2024, Populytics published the results of their collaboration with the Ministry of Infrastructure and Water Management regarding national mobility and accessibility (Mouter & Mulder, 2024). A notable finding in this research, and in the other PVEs as well, is the large share of young participants (age 18 – 44). With an average of 36 percent, this is a much higher share than in traditional participation workshops, where the larger part of respondents is retired (Perree, 2025).

Another notable insight gained through a PVE is the reasoning behind citizens' choices. This is where PVE distinguishes itself from traditional quantitative research: it offers respondents room to justify and explain their choices while also giving advice and explaining what they would do as policymakers. The added value of these insight compared to, for example, a participatory workshop is the sheer volume of responses. The PVE on the Lelylijn railway collected motivational statements and choice explanations from 3,000 respondents (Mouter et al., 2023), a number that could never be reached in a participatory workshop. PVE offers a new combination of qualitative and quantitative research within participatory research. These respondents' insights combined with PVE's current fields of expertise, make this innovative method a suitable tool to utilize for gaining insights into the mobility hub strategies.

What could PVE mean for Policy

Started from January 1st 2024, all national laws and regulations about the physical living environment have been combined into one new law: de Omgevingswet *(National Environmental Planning Act)* (Ministerie van I&W, 2025). As soon as a public or private party wants to make a change to the living environment, they need to meet the requirements in the Omgevingswet (Ministerie van I&W, 2025). Participation is an important section within the Omgevingswet. For governments, the Omgevingswet establishes four phases in an environmental process (IPLO, 2024). These phases are also known as the phases of a policy cycle: policy development, policy implementation, execution and feedback. These phases can be linked to the function of the TIS and all of these phases require a particular participatory approach (IPLO, 2024).

The Information point for the Living Environment (IPLO) offers a participation guide, establishing five qualities that government participation should have: Transparency, Quality, Equality, Inclusivity and Suitability. According to these measures, many municipalities have created their own participation requirements. The municipality of Zwolle, for example, created Hanza! a guiding method to organize a careful participation process (Gemeente Zwolle, 2023).

The Hanza! process of Zwolle, contains three phases, which can all be linked to a certain step on the participation ladder (figure 5), a model that describes the different levels of citizen participation. During the second phase of Hanza!, Developing Solutions, various solution directions are researched and discussed with stakeholders. This corresponds well with the Consulting level of the participation ladder, where citizens give their opinions on plans or projects. In this phase, PVE can be a suitable method as it engages citizens in evaluating proposed solutions based on their values and preferences. This ensures that the solutions developed reflect the community's priorities and needs. The third phase of Hanza! includes the decision making, where a final solution is chosen, and the focus shifts toward implementation. This step could be supported by the Advising step in the participation ladder, here citizens are actively involved in advising on finalized plans and policies. By using PVE in this phase the qualitative feedback can be incorporated into the decision-making process, ensuring that the final decision reflects both expert judgment and the values of the community, thus contributing to a more legitimate and broadly supported outcome.

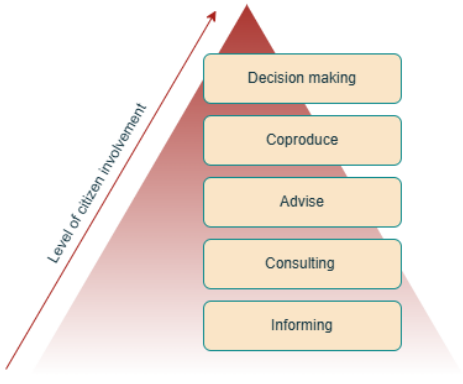

Figure 5. Participation ladder

4. Research Methodology

Case Study Analysis of Mobility Hubs

The first stage of this research involves an in-depth examination of currently existing mobility hubs to identify the success and failure factors of this mobility innovation. The analysis will be grounded in the Technological Innovation Systems theory of Hekkert et al. (2007), which is designed to understand and explain innovation processes in socio-technical systems as previously mentioned in the theoretical framework (Chapter 3). The results from the case study analysis will contribute to the 1st and 2nd sub-question of this research (Chapter 1).

The case study analysis (Chapter 5) will involve the following:

- **Selecting four hub locations for an in-depth case-study**. The selected hubs were sourced from the data platform of the SmartHubs Project and align with the research scope defined later in this chapter. The SmartHubs project came up with a multidimensional mobility hub typology, that categorizes hubs based on their physical, digital, and democratic integration levels (Geurs and Münzel, 2022). For this review the hubs are selected to represent different levels of integration, with a specific focus on the democratic integration. The level of integration among all three aspects defines whether a hub is merely a single mobility service, or whether it can truly be considered a (smart) mobility hub (Geurs et al., 2023). The democratic integration represents the level of citizen involvement, it is grounded in the principles of participatory governance and emphasizes how the involvement of community in mobility hub planning can help ensure hubs are more inclusive and responsive to the diverse user needs (Geurs et al., 2023).
- The next step in the case study is an **analysis of the selected mobility hubs in relation to the TIS** theory (Berget et al., 2008; Wieczorek & Hekkert, 2012). This will establish insights into the structural and functional dimensions of the innovation.
    - After each of the hubs is shortly explained, a more comprehensive analysis is conducted to establish key structural aspects of each hub. This includes an analysis of actors, institutions, and infrastructure. Understanding these dimensions is important, as it provides insight into how the hubs are embedded within broader national and regional policy frameworks. It also sheds light on the roles of various stakeholders, the regulatory and planning context in which the hubs operate, and the types of transport modes and services they offer. This structural understanding helps to evaluating how effectively the hubs contribute to policy goals such and how they can potentially be translated to a Dutch context.
    - After the structural aspects are analyzed, a functional analysis is done according to the core “functions” established in the framework by Hekkert et al. (2007). Based on the four analyzed hubs a more generalized innovation loop for mobility hubs will be created. The loop will contain the following functions: entrepreneurial experimentation, knowledge development, knowledge diffusion, guidance for research, market formation, legitimization and resource mobilization (Hekkert et al., 2007).
- Throughout Chapter 5, the gained insights will help to determine the specific success and failure factors (SFF) of the selected mobility hubs. Generalizing these SFFs to all mobility hubs will providing insights into important aspects to include in the Participatory Value Evaluation questionnaire. In addition it will offer an extra layer in the interpretation of the PVE results, comparing Zwolle to European hubs.
- The hubs were sourced using the SmartHubs Project's data platform. However, the hub analysis needed for the Technological Innovation System (TIS) framework, including the evaluation of structural and functional components of each hub, the identification of success and failure factors (SFFs), and the

establishment of a generalized TIS innovation loop for mobility hubs, was performed independently in this research.

Participatory Value Evaluation (PVE) Survey

Building upon the insights gained from the case study analysis, a PVE survey will be designed for the Mobility hub plans in *Zwolle*. PVE is an online participatory method that allows a large and diverse group of participants to engage in policy dilemmas. More information on the origin of PVE and its value towards mobility innovations can be found in the literature review (Chapter 2), while the value of PVE towards this specific research can be found in the theoretical framework (Chapter 3).

The PVE design considers the following:

- **Definition of attributes:** Based on insights from the Technological Innovation Systems theory and the success and failure factors, several critical aspects of mobility hubs (e.g. mobility options, public and commercial services) will be established to form the basis of the choice attributes presented to participants.
- **Development of choice attributes:** Several realistic mobility hub attributes will be set up. This involves presenting participants with various hub equipment options and the associated trade-offs in available space. This allows participants to experience the complexities and constraints involved in the actual decision-making process, and create informed choices and reasoned advice to policymakers. More insights in the choice tasks presented, and the finalized list of attributes can be found in Chapter 6.
- **Final design:** The PVE will be conducted online using the Wevaluate platform, developed specifically for this method by Populytics. Populytics is a spin-off of the TU Delft, fully focused on turning the scientific methods behind PVE into practice for all kinds of governments and companies (Populytics, 2025). The Wevaluate platform, designed by Populytics, will collect quantitative data based on participant choices and qualitative insights through respondents feedback. The survey will invite respondents to explain their decisions, share concerns, and offer suggestions. This dual approach will enhance the data set and offer a deeper understanding of public values and preferences.

Data Collection

To encourage broad participation in the PVE, a multi-channel distribution strategy will be used. The PVE will be shared through several neighborhood platforms, reaching local residents who are actively engaged in community discussions. Additionally, the researcher's personal and professional networks will contribute to the distribution process. Colleagues and acquaintances will help circulate the PVE link within their communities. Finally, printed flyers (Appendix D) will be distributed in several neighborhoods across the municipality to include residents who are less active online. This mixed strategy ensures both online and offline engagement, aiming for a more inclusive and representative set of responses from residents in the study area.

Data Analysis

The collected quantitative PVE responses will be analyzed using a combination of descriptive statistics and advanced choice modelling approaches. This data analysis will contribute to answering the 3rd, 4th and 5th sub-question within this research.

- **Descriptive Statistics:** used on the PVE data to estimate characteristics of the population and get a clear insight into the data (Ambrosius, 2007). To gain the respondents characteristics, the first section of the PVE will be set up with questions regarding gender, age, education level, relation to Zwolle, and finalized with a question on the most used mode of transport. The descriptive statistics will be analyzed through IBM27 SPSS software.

- **Latent Class Cluster Analysis (LCCA):** to capture the heterogeneity among respondent segments and their distinct preference structures, an LCCA will be used. LCCA allows for the classification of respondents into latent (unobserved) groups based on similarities in their response patterns. Using the LCCA method helps to understand the different user segments, which can translate for more tailored policy interventions (Molin et al., 2015). To perform the LCCA, this research uses the LatentGOLD 6.0 software package. Models with 2 up to 4 classes were fitted. Class selection was based on the Bayesian information criterion (BIC and AIC), and the relevance of the cluster characteristics, favouring solutions with the highest level of interpretability. For each of the clusters from the chosen class model, Chapter 7 will show the average score/preference towards the attributes of the PVE as well as the demographics of the respondents represented in the cluster. The cluster explanation will be accompanied by a suitable cluster title. Additionally, personal justifications provided by respondents will be used to contextualize the quantitative results.
- **Thematic inductive coding**: the open-ended responses within the PVE will be analyzed using thematic analysis to identify recurring patterns and underlying themes in participants' reasoning (Braun & Clarke, 2006). An inductive coding approach will be applied manually, meaning that themes will emerge directly from the data rather than being based on predefined categories. The answers from the respondents of the PVE will be collected per theme and per attribute they are concerning. Every one of the provided answer will be read, after which the answer will be clustered based on similarities in argumentation, values, and trade-offs expressed. Following the cluster analysis and interpretation, the most striking attributes will be included in the qualitative analysis. Consider attributes with consequently high/low scores, or notable outliers with very different interpretations among the clusters. For each of the chosen attributes, the clustered argumentation will be used to provide a deeper understanding in the thoughts behind the choices made by the respondents.

Expert Interviews

To complement the qualitative and quantitative results of the PVE and to gain a more in-depth understanding of their interpretation and policy relevance, a set of expert interviews will be conducted. These interviews aim to explore how professionals in urban mobility planning perceive the added value of the TIS and PVE outcomes and to assess their potential integration into ongoing planning processes for mobility hubs in Zwolle (and beyond). The insights from the experts will help answer the 6th sub-question of this research and additionally will provide a clear policy perspective towards addressing the main research question.

Two experts were selected based on their experience in urban development and participatory processes. The choice to consult only two experts was primarily driven by the scope of the research and the additional time constraints. Nonetheless, both experts offer deep and practice-based knowledge across a broad range of relevant topics. Their perspectives help critically reflect on the feasibility and utility of PVE results from a policymaking standpoint. In particular on how participatory insights can be translated into actionable decisions, aligned with institutional planning routines, and embedded in mobility hub design strategies. As such, these expert interviews not only contextualize the empirical findings but also strengthen the research by linking citizen-driven preferences to real-world policy and implementation dynamics.

Among the experts there is one external project manager and consultant, as well as one expert working within the municipality. Both experts got full access to the PVE results in advance to ensure a well-informed discussion. One of the main qualitative analysis methods was used for this section: A semi-structured interview format (Ilovan & Doroftei, 2017). A semi-structured interview is a qualitative data collection method in which the interviewer uses a series of predetermined, yet open-ended questions to gather information. It follows a partially structured methodological course, allowing for both consistency and

flexibility (Ilovan & Doroftei, 2017). This format gives room for the experts to elaborate on items they deem important.

The interviews were conducted in Dutch, recorded, and transcribed for analysis. Key quotes were translated into English for reporting, with a great deal of attention paid to preserve the original meaning of the experts. The interviews are analyzed in such a way they identify important viewpoints, which help contextualize the PVE findings and inform the discussion on implementation challenges and opportunities.

Research Scope

According to Weustenenk and Mingardo (2022) there are 6 distinct types of mobility hubs, chapter 2 provides a detailed explanation about each of these hubs and their characteristics. The city council of Zwolle defines a comparable categorization in their Adaptive Development Strategy for Mobility hubs (Gemeente Zwolle, 2022). This research will focus on the three smallest hub types: Suburban Hubs (Centrumhubs), Neighborhood Hubs (Buurthubs), and Community Hubs (Microhubs).

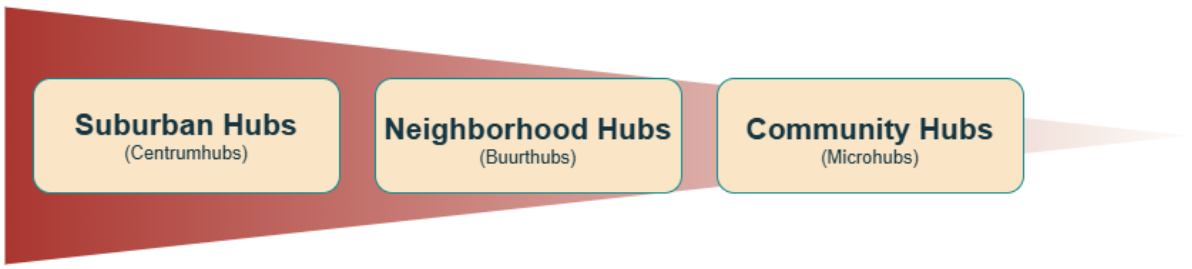

Figure 6. The three smallest mobility hub types, decreasing in scope from left to right

These chosen hub types are particularly relevant to this study for several reasons. First, they emphasize community involvement, prioritizing accessibility for local users and fostering engagement from both residents and commuters. Community and neighborhood hubs, in particular, are designed to integrate seamlessly into daily life, which aligns with the study's goal of understanding how mobility hubs impact social participation and travel behavior. Second, these hubs are notable for their scalability and adaptability. Although smaller in scale, they are highly flexible, making them feasible for implementation across various settings. By studying these hubs, the research aims to draw lessons on creating scalable and context-specific mobility solutions. Lastly, the hubs' integration with PVE is crucial. PVE is designed to capture public preferences and trade-offs, and focusing on smaller, community-centered hubs allows for a more tangible and relatable evaluation process. This ensures that participants are more likely to provide meaningful input on hubs that directly influence their daily mobility choices.

5. Case Study Analysis

The following chapter presents an analysis of four European mobility hubs selected from the SmartHubs project, which classifies hubs based on their physical, digital, and democratic integration. A selection was made to reflect a broad range of SmartHubs Scores. While the cases are drawn from SmartHubs, the structural and functional analysis in this chapter is conducted independently for this research, using the Technological Innovation Systems (TIS) framework. The analysis concludes with a generalized innovation loop based on the functions outlined by Hekkert et al. (2007). Throughout the chapter, significant success and failure factors (SFFs) are identified. All in all, the results from this analysis will inform the design of the question set for the Participatory Value Evaluation (PVE).

The SmartHubs Project

The four European mobility hubs selected for this case-study analysis were sourced from the data platform of the *SmartHubs Project.* Originally initiated by the University of Twente, the project assesses hubs based on an in-house developed integration level system (Geurs & Münzel, 2022). This system categorizes mobility hubs according to their physical, digital and democratic integration. According to the SmartHubs project, only mobility hubs receiving a score of ≥ 1 on all integration levels can truly be considered a mobility hub, instead of a single mobility service (Geurs & Münzel, 2022). A comprehensive overview of integration levels can be found in Appendix B.

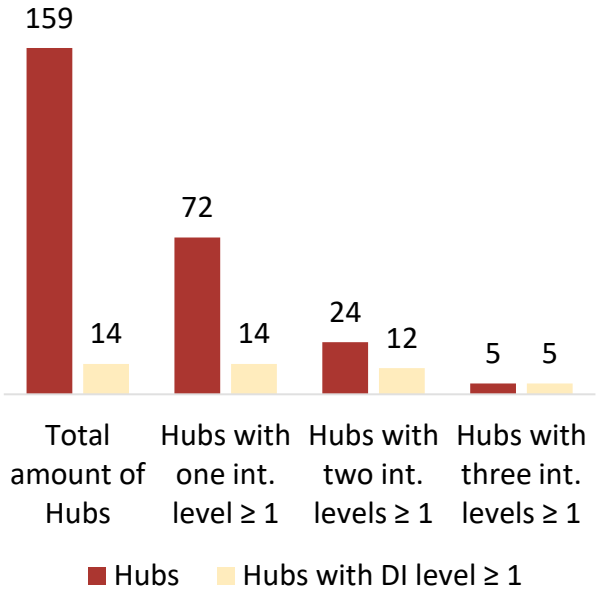

Figure 7. Hub overview based on the SmartHubs project

In line with the thesis research focus on participation processes, figure 7 is added to showcase the average level democratic integration (DI) across the mobility hubs in the SmartHubs project. The democratic integration represents the level of citizen involvement, it is grounded in the principles of participatory governance and emphasizes how the involvement of community in mobility hub planning can help ensure hubs are more inclusive and responsive to the diverse user needs (Geurs et al., 2023). A high level of DI indicates that the hub actively incorporates citizen participation, local governance structures, and mechanisms for public engagement.

The data in figure 3 shows that out of 159 total mobility hubs, only 14 hubs have a democratic integration score greater than zero. Otherwise put, 145 hubs score DI level 0, meaning there has been no involvement or consideration of stakeholder interests and user needs. So, the vast majority of hubs currently lack meaningful public involvement in their development and operation. Among all hubs there is only 1 that scores a level 4 on democratic integration, meaning this hub applies social learning where participation becomes permanent and independent. After that the highest DI level is a level 2 (also only achieved by one hub), meaning a form of participation is hosted, were the input of vulnerable users is directly integrated into the participation process. Looking at the final bar on the right-hand side of figure 3, it becomes clear that only five out of 159 hubs score at least level one across all components. Which means only these hubs are considered an actual mobility hub rather than a single mobility service (Geurs et al., 2023).

This overview of the DI scores highlights a potential barrier to the long-term success and public acceptance of mobility hubs. Without adequate democratic integration, hubs risk failing to meet local mobility needs,

reduce equity concerns, and foster a sense of ownership among users (Geurs et al., 2023). The following sections in this chapter will highlight the chosen mobility hubs that will be analyzed by the TIS framework, to eventually analyze the role of DI in the success and failure factures of mobility hubs. The following sections of this chapter will present the selected mobility hubs, which will be analyzed through the TIS framework. A specific focus on evaluating the role of democratic integration, will help determine the success and failure factors of mobility hubs.

Selected mobility hubs

To ensure a well-rounded analysis using the Technological Innovation System framework, a diverse selection of hubs was chosen to represent several regions/countries and several different levels and combinations of integration. This variety allows for a thorough examination of success and failure factors (SFF), providing insights into how different levels of integration influence the effectiveness and adoption of mobility hubs. In the remaining of this subchapter, the four chosen mobility hubs will be explained in further detail. Each of the hub descriptions will start by highlighting the SmartHubs score achieved by each of the case study hubs. The next subchapter will analyze the hubs according to the TIS concept.

eHub Handelskade (Nijmegen, Netherlands)

Score: 0/0/0 The eHUB Handelskade, established in 2020, is a *community hub* located in Nijmegen, Netherlands. As part of the eHub Nijmegen network, it offers electric bikes and electric cargo bikes to residents and visitors, promoting sustainable transportation options. The hub itself does not provide any other modes or parking/charging facilities for cars. However, the hub is in very close proximity to a public parking location with a charging station. The eHUB Handelskade currently lacks physical, digital, and democratic integration. As it is operating without coordination with public transport services, car services and a unified digital platform. The initiative is part of the Interreg North West Europe initiative and features distinct eHub branding and an information display to guide users in accessing the available services. (SmartHubs Project, n.d.-a; Dekkers, 2023; Luthart, 2023).

Hoppinpunt Wijgmaal Station (Leuven, Belgium)

Score: 1/0/1 The Hoppinpunt Wijgmaal Station NMBS is a *suburban hub* located in the village of Wijgmaal, part of the city of Leuven, Belgium. Branded under the 'Hoppin' initiative, which is being introduced throughout Flanders, this hub is strategically situated at the Wijgmaal railway station, facilitating options to transition between various modes of transportation.

The hub offers multiple services, including train and bus connections, as well as shared mobility options such as carsharing and bike sharing. Additional amenities include parking facilities for private bicycles and cars, e-charging stations, and a Bpost parcel locker for convenient package retrieval. The design and implementation of the Hoppinpunt Wijgmaal Station were carried out in collaboration with the local community, reflecting the neighbourhood's input and addressing their mobility needs. This participatory approach ensures that the hub not only enhances connectivity but also considered aligning with the preferences and requirements of its users. (SmartHubs Project, n.d. -b; Gemeente Leuven, 2025)

WienMobil station Maria-Tusch Straße (Vienna, Austria)

Score: 2/2/1 The WienMobil Station Maria-Tusch-Straße is an *neighborhood hub* located in Vienna's Seestadt Aspern district. Established in December 2021, the hub provides a range of shared mobility options, including car, bike, cargo-bike, and scooter sharing. Additionally, it offers parking facilities for private bicycles and cars, e-charging stations, and a self-service bike repair station. Public transport access is available within a 200-meter radius, ensuring strong multimodal connectivity.

The hub is integrated within the WienMobil ecosystem, with digital services accessible via the WienMobil app, which provides route planning and booking options. While the app centralizes mobility information, some services require redirection to external platforms for booking and payment. The development of the WienMobil Station involved community engagement through public consultations and workshops, ensuring that local needs and preferences were reflected in the final design. With its combination of physical, digital, and democratic integration, the hub supports sustainable urban mobility while fostering accessibility and convenience for residents and visitors in Vienna. (SmartHubs Project, n.d. -d; Wiener Linien, n.d.)

The Carrick centre (Maybole, United Kingdom)

Score: 2/1/4 The Carrick Centre in Maybole, United Kingdom, combines features of *neighborhood* and *suburban hubs*, with special attention to community interaction. The hub integrates various transport services to enhance connectivity and sustainability. Located next to Maybole railway station, a bus stop and near a National Cycle Network route, the hub provides seamless access to public transport, promoting multimodal travel options for residents and visitors. As the first accredited community mobility hub in the UK under Collaborative Mobility UK, the Carrick Centre offers shared mobility services such as e-bike rentals, carsharing and a community minibus service, improving accessibility while encouraging environmentally friendly travel. The hub also features electric vehicle charging stations, parking facilities for private bicycles and cars, and a parcel station.

Beyond its mobility functions, the Carrick Centre serves as a community space, housing a café, children's soft play area, food bank, and supermarket. Various community activities and events are organized on-site, fostering social engagement and inclusivity. The hub was developed in collaboration with South Ayrshire Community Transport, ensuring that local needs and preferences were reflected in its design. With its combination of physical, digital, and democratic integration, the Carrick Centre stands as a great example of community-led sustainable mobility, enhancing transport options while strengthening local connections. (SmartHubs Project, n.d. -c; Carrick Centre, n.d.; South Ayrshire Community Transport, 2024)

SFF - Success Factor: *The participatory planning process at the mobility hubs (Nijmegen and Leuven – DI 1, and Maybole – DI 4) demonstrate how community input increases hub legitimacy and alignment with local needs. These are factors missing in less successful examples (Nijmegen – DI 0).*

Application of the TIS Framework

To assess the success and failure factors of the selected mobility hubs, the TIS framework will be applied. Starting with an analysis of the structural components, being the actors, networks, and institutions that shape the development of each hub. This mapping provides insight into the stakeholders involved and the regulatory, financial, and organizational context in which the hub operates. Next, the functional components are analyzed by tracing the appropriate feedback loops and interactions within the framework. This step highlights how entrepreneurial activities, resource allocation, market formation, and knowledge diffusion contribute to the hub's performance. By systematically following this approach for each hub, both enablers and barriers to successful implementation and long-term sustainability can be identified.

eHub Handelskade (Nijmegen, Netherlands)

The eHub at Handelskade Nijmegen is part of the Interreg North West Europe initiative to promote smart shared green mobility hubs (Dekkers, 2023). The project states that eHubs, as these kind off hubs are called, are on-street locations providing access to all kinds of shared electric modes. The goal is to shift travelers away from their own private cars. The Interreg project partnered with six cities from five countries to develop knowledge and learn best practices (Dekkers, 2023). Nijmegen is a municipality in the Netherlands, and the largest city within the region of Gelderland. The realization of the eHubs contributes to broader

national and municipal goals to reducing car dependency, enhancing multimodal transport, and creating livable urban spaces (Gemeente Nijmegen, 2021). To be able to analyze the eHub Handelskade according to the TIS framework, first actors, their networks, and the institutional frameworks that shape its operations will be analyzed.

Actors and Networks: Collaborations for Integrated Mobility

Several stakeholders are actively involved in the design, implementation, and operation of the eHub at Handelskade Nijmegen:

- **Gemeente Nijmegen**: Nijmegen is one of the six partner cities of the Interreg NEW initiative, they are responsible for integrating eHubs into the city's mobility strategy (Dekkers, 2023). As a municipality Nijmegen published a report with their mobility ambition up till 2030. It states that for mobility hubs to be successful, several preconditions should be met. One of them being a high quality, and widely available eHub offering, which is affordable and trustworthy (Gemeente Nijmegen, 2021)
- **Provincie Gelderland**: Nijmegen is the largest city in Gelderland, this means their mobility hub efforts play a big role in fulfilling Gelderland's broader goals towards accessibility in the region. Gelderland strives to update their (public)transport and its transfer facilities (Provincie Gelderland, 2024b). A policy note from the region states that hubs are one of five cornerstones in Gelderland's accessibility vision (Provincie Gelderland, 2024a). The region want to increase the availability of shared modes and will support municipalities towards incorporating shared modes in their special planning.
- **Groene metropool regio Arnhem Nijmegen (GMR):** The GMR showcases the connectivity between Nijmegen and Arnhem (the third largest city in Gelderland) and their shared goals when it comes to mobility (GMR, n.d.). The GMR established an assessment framework for promising hubs. The GMR makes a distinction between short term, existing hub improvements and long term, hub design plans (GMR, 2021). One of their main goals is to make sure the hubs fit in with the regional mobility goals.
- **Deelfiets Nederland**: This private bike sharing initiative offers electric bikes at the eHub Handelskade. Deelfiets Nederland strives to be available at any time, keep bike sharing affordable and flexible (Deelfiets Nederland, 2025). They offer a easy interface app, where you can pay after your use. Deelfiets Nederland is partnered with the Interreg North Sea region move.

SFF - Failure Factor: *Absence of a centralized digital platform at the eHub Handelskade undermines convenience and could make mode switching less attractive to travelers, potentially decreasing use*

Institutions: Regulations, Policies, and Financial Support

The regulatory and policy framework surrounding the eHub Handelskade ensures its long-term success and integration into Nijmegen's transport system:

- Nijmegen's **Ambitiedocument Mobiliteit** outlines the city's vision for future mobility, their main goal is to have integrated improvement of Nijmegen's accessibility and sustainability (Gemeente Nijmegen, 2021). The document shows that large parts of Nijmegen experienced an average of 29% growth in the amount of motorized traffic. To prevent further grow and eventually decrease the use of emission vehicles, the city states they will invest in new mobility services and better public transport. The eHub at the Handelskade is part of a larger integration plan of ten eHubs within the city (Gemeente Nijmegen, 2021).
- As the eHubs in Nijmegen (and Arnhem) are part of the Interreg North-West Europe program, there are several policy documents explaining the operation and deliverables details of the hub project. The

Operational Plan for eHubs Nijmegen details the rollout strategy of all hubs, highlighting that the hub location determination was under strong time pressure. Leading to a limitation in location where there already was sufficient public space without a specific use (Meekes, 2020). The **eHubs Implementation Report** provides insights into the different hub locations and their associated services (Meekes, 2022).

- As Nijmegen and Arnhem are part of Gelderland, the regions **programma bereikbaarheid, uitvoering ambities** (Provincie Gelderland, 2024a) and the **strategische agenda mobiliteitshubs** (GMR, 2021) play a significant role in establishing and implementing the mobility hubs in Nijmegen. Both document highlight several constraints and objectives for the successful implementation of hubs in the region. There is a specific focus om meeting broader regional goals and sharing knowledge from existing hubs to improve future hubs. The GMR introduces fieldlaps to improve digitalization and social inclusion in the planning process (GMR, 2021).

Hoppinpunt Wijgmaal Station (Leuven, Belgium)

The development of the Hoppinpunt Wijgmaal Station is part of Flanders' broader strategy to promote sustainable and multimodal transport in the Leuven region (Regiopact, 2024). Leuven is Flanders 4th largest transport region, with over 30 municipalities included (Regiopact, 2024). Leuven is one of the largest cities within the region and its Hoppin mobility hubs serve as a mobility interchange point for the city. Hoppin is a government initiative set up to promote a modal shift among all partakers in transport, professional and leisure (*Hoppin*, n.d.-a). Hoppin strives to integrate various transport services to facilitate seamless and fast travel connections while reducing dependency on private cars. They put a focus towards the STOP principle: Stappen (walking), Trappen (cycling), Openbaar vervoer (public transport) and Personenwagens (shared cars) (Hoppin, n.d.-a). To be able to analyze the Hoppinpunt at Wijgmaal station according to the TIS framework, first the actors, their networks, and the institutional frameworks that shape its operations will be analyzed.

Actors and Networks: Collaborations for Integrated Mobility

The Hoppinpunt at Wijgmaal Station relies on strong cooperation between government bodies, transport providers, technology companies, and users. The primary actors include:

- **Stad Leuven**: The city of Leuven is a municipal stakeholder, as one of the 4 largest cities withing the broader transport region it collaborates closely with the Flemish government and transport operators. The integration of the Hoppin mobility hubs is part of a broader city renewal project. Especially for Wijgmaal, the city works on a new mobility approach, promoting safety and efficient multi modal (shared) transport (Stad Leuven, 2024)

- **Hoppin**: The Hoppin program is a Flemish government initiative, set up to extend their mobility offer, while investing in safe and efficient infrastructure (Digitaal Vlaanderen (Red.), n.d.). Hoppin strives to make travelers more conscious of the available, sustainable travel modes. The final goal being a mental shift among users, followed by a future modal shift. Through the Hoppin app, users can plan, book, and pay for multimodal journeys, simplifying the transition between different transport modes (Hoppin, n.d.-b).

- **NMBS** (Nationale Maatschappij der Belgische Spoorwegen): The national railway company operates the Wijgmaal Station, ensuring regional and national rail connections (Belgian Train, n.d.). Combining the locations of the Hoppinpunt and the Wijgmaal train station and busstop aligns with Flanders goals to create multimodal travel nodes to combine public transport with shared, sustainable, last-mile transport options (Belgielex, 2019)

- **De Lijn**: This public transport company operates bus, tram and metro services that connect the station to Leuven and neighboring areas. The presence of real-time bus schedules and ticketing integration via the Hoppin platform improves the efficiency of multimodal transport (De Lijn, n.d.)
- **Cambio**: Cambio is a private car-sharing company which offers a subscription based shared car service. You can register online, after which you can book your car trip either in advance or spontaneously in the Cambio app. All cars have pre-established parking locations, the Hoppin point Wijgmaal offers space two Cambio cars (Cambio, 2023)
- **Blue-bike**: Blue-bike is shared bicycles initiative from the NMBS, and since 2018 the bus operator de Lijn is their main shareholder. Working so closely with Flanders main public transport operators allows to make bikes available at a very broad scale (Blue-bike, 2024). Currently there are 200 Blue-bike locations in Belgium. The main goal is offering an even larger network of high-quality shared bicycles, linked to mobility hubs. This way Blue-bike enhances first- and last-mile connectivity, particularly for short urban trips (Blue-bike, 2024)
- **Bpost**: As part of a broader trend in mobility hubs, the Hoppinpunt Wijgmaal Station features a Bpost package locker. Bpost states that sending you package to parcel locker safes 30% CO2 on the delivery (Bpost, 2025). The Bpost locker at the Wijgmaal station is 24/7 available and operated using the Mybpost app. Combining parcel pickup and mobility allows commuters to send and collect parcels on the go, improving the seamless and fast mobility goals of the region (Bpost, 2025).

SFF - Success Factor: *By co-locating shared mobility services with existing rail and bus nodes, the Hoppinpunt Wijgmaal hub maximizes first- and last-mile efficiency, potentially essential for widespread use.*

INSTITUTIONS: (MOBILITY) POLICIES, PLANS AND FINANCIAL SUPPORT FOR MOBILITY HUBS

The Hoppinpunt Wijgmaal operates within a well-defined policy framework that supports multimodal transport development:

- The **Regional Mobility Plan of Vervoerregio Leuven** shows that Leuven aims for an active mobility transition, promoting sustainable modes of transport. The goal is to create an integrated and sustainable mobility system that meets the needs of all users. This system should be efficient, safe, and environmentally friendly, with a strong focus on active modes of transport such as cycling and walking, as well as a reliable public transport service.

  The plan promotes cycling as a complete alternative to the car, with investments in three types of cycling networks. Public transport is regarded as the cornerstone of the intermodal transport system. The Hoppin points are addressed in combination with an improvement of parking policies and optimizing space in city centres.

  This sustainable policy scenario strives for an integrated approach in which mobility, spatial planning, and environmental objectives go hand in hand to enhance the livability and accessibility of the Leuven Transport Region. (Regiopact, 2024)
- The decree **Basisbereikbaarheid** promotes “combimobiliteit”, facilitated by offering a high quality of various transport modes and the coordination of these modes at different hubs, such as Hoppin points. The mobility policy decree is strongly focused on sustainability and aligns with the European climate goals. Important aspects include reducing the ecological footprint of transport through greening and sustainability measures, improving infrastructure quality and traffic safety, and spatial planning that encourages sustainable travel (Belgielex, 2019).

The decree provides for a layered mobility planning system at the Flemish, regional, and local levels, allowing municipalities to set their own priorities within Flemish and regional objectives. It also mandates that all mobility plans must include strategic objectives, an action plan, and a monitoring system to evaluate progress (Belgielex, 2019).

- Local governments get the opportunity to apply for **Hoppinpuntensubsidie** with the Flemish government. The Flemish government offers a webinar explaining the subsidy arrangements, as well as a preprogrammed calculation tool. To be eligible for Hoppinpunt funding, the hub must (among others) be integrated in the regional mobility plans, meet the quality demand for accessibility and layout, and be within municipality control. Depending on the hub category, different subsidies can be assigned, each hub level has a predefined maximum amount of funding. (Vlaanderen, n.d.; Belgielex, 2022).

- As a city, Leuven is partnered with the **ShareDiMobiHub** project, which is part of the European Interreg North Sea initiative. The project strives for an integral approach, where changing people's travel behaviour is the main action. The project wants to increase multi-modal accessibility and states that a hub should meet mobility needs of the users. The European union helps to fund this mobility hub project. Leuven receives a total of 530.000 euro to increase the amount of Hoppinpunten and increase their use. It focuses on growing the supply and usage of mobility hubs and provides a general subsidy for all partner projects (Stad Leuven, n.d.; ShareDiMobiHub, 2025).

WienMobil station Maria-Tusch Straβe (Vienna, Austria)

WienMobil is a mobility sharing hub principle operated by Wiener Linien. The Wiene Linien are Vienna's main public transport provider (Wiener Linien, 2025). Already responsible for the city's train, tram an bus infrastructure, the Winer Linien expended their services by introducing the first WienMobil station in 2021. The hubs integrate the usage of public transport, shared mobility services, and micromobility options into a seamless urban transport network using the WienMobil app. Vienna is with length the largest city in Austria and their WienMobil hubs system in interwoven in the Aspern Seestadt project, Europe's largest urban development project. The Aspern Seestadt project is designed to have Vienna function as a low-car, high-mobility district and is partnered with the Aspern mobil LAB led by Wien's university of technology (Aspern Die Seestadt Wiens, n.d.). To be able to analyze the WienMobil station according to the TIS framework, first actors, their networks, and the institutional frameworks that shape its operations will be analyzed.

SFF - Success Factor: *WienMobil's unified digital platform lowers the barrier to multimodal transport, directly supporting user adoption and convenience for travelers.*

Actors and Networks: Collaborations for Integrated Mobility

The WienMobil Hub Maria-Tusch-Straße operates through a coordinated effort between public authorities, private mobility providers, and research institutions:

- **Wiener Linien**: As the public transport provider in Vienna, the Wiener Linien provide transport access to over 2 million travelers a day (Wiener Linien, n.d.). The Wiener Linien contribute greatly to the worlds sustainability needs, as a hundred percent of their power is from renewable sources. The Wiener Linien expended their public transport serves when they introduces **WienMobil**. A self-operated shared, electric, mobility platform responsible for integrating these additionally offered modes into the wider transport network (Wiener Linien, n.d.).

- **WienMobil**: As a new branch of the Wiener Linien, WienMobil offers all shared mobility modes available. Most mentionable about WienMobil is the fact that almost all modes are publicly operated

by WienMobil itself. WienMobil rad is completely independent, while WienMobil Auto is a partnership between the Wiener Linien and Carsharing service **Sharetoo** (Mobilitätsberatung Seestadt et al., 2024).

- **City of Vienna**: The city of Vienna has established a mobility diversity plan for 2025, the main goal of this plan is to achieve a 20-80 mobility policy (Stadt Wien, 2024). Meaning that 80 percent of all movements in Vienna must be done by either, public transport, bicycle or foot. They highlight that multimodal transport is important and that this trend requires adjustments within the traffic system (Stadt Wien, 2024). Their mobility diversity plan highlight the investment in multimodal transport options, like the WienMobil hubs. The city is committed to expanding the WienMobil network to 100 hubs by 2025 (MeinBezirk, 2021).
- **Federal Ministry Republic of Austria**: Vienna is the largest city of Austria, which makes their role in realizing Austria's mobility master plan significant. Austria's federal government has a target of becoming climate neutral by 2040. The starting point for this goal, is a backcasting model focused on shifting traffic and improving efficiency in all modes of transport. Important plans in regards to the grow of the amount of mobility hubs (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, 2021).
- **Aspern Mobil LAB**: As previously mentioned, the WienMobil hubs are part of a broader mobility renewal program. The Aspern – die Seestadt Wiens project is considered to be the "urban lab" of Vienna's smart city concept (Aspern Die Seestadt Wiens, 2023). Together with the Aspern mobil LAB they set up an experimental environment to examine all kinds of innovative mobility (hub) services. They also delve into further development, including involvement of local people (Aspern Mobil LAB, 2023).

INSTITUTIONS: POLICY AND FUNDING MECHANISMS

A range of policies, regulations, and funding programs support the development and expansion of the WienMobil hub network:

- The **Urban Mobility Plan Vienna (STEP2025)** provides (among other things) a roadmap for the development of multimodal hubs to enhance sustainable urban transport. By promoting interconnected infrastructure, the plan aims to reduce reliance on private vehicles, thereby decreasing traffic congestion and environmental impact. Additionally, the establishment of these hubs is intended to improve accessibility and convenience for all residents, supporting Vienna's broader goals of creating a fair, healthy, and efficient urban mobility system (Wefering et al., 2015).
- The **Wiener Fachkonzept Mobilitätis** a strategic implementation of the city's vision outlined in STEP 2025, aiming for a fair, healthy, compact, ecological, robust, and efficient transport system. The goal is to promote sustainable mobility by strengthening integrated transport systems with seamless connections and complementary services like mobility cards, bike-sharing, and car-sharing (Stadt Wien, 2015). The concept also pays attention to collaboration between Vienna and other parts of lower Austria, for even better integration of mobility.
- The **Mobility Master Plan 2030** sets national goals for e-mobility adoption, public transport enhancement, and integrated transport systems. The federal policy is including a new climate partnership, potentially linking government funding for provincial or municipal projects to a climate partnership. The administrative units of the government will financially participate in activities that benefit, among others, active mobility and climate friendly, multimodal mobility management ideas. (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, 2021).

- The **FTI-Strategie Mobilität** is a research program set up by the Austrian Ministry, it support research, technology and innovation policies that focus on mobility. This promotes technological, social, and organizational innovations, contributing to a sustainable transformation of the mobility sector. The research program helps these initiatives with funding from the European Union (NextGenerationEU) (Bittner-Krautsack et al., 2020).

***SFF - Success Factor**: The strategic alignment between local (City of Vienna), regional (STEP2025), and national policies (Mobility Master Plan 2030) offers strong institutional backing, a key enabler for the WienMobil network's growth.*

The Carrick Centre (Maybole, United Kingdom)

The Carrick Centre Green Mobility Hub, is located in Maybole, a small town in the South Ayrshire council area of Scotland. The realization of the mobility hubs is part of Maybole's regeneration plans and also supports broader goals within the South Ayrshire councils active travel strategy (SWECO, 2022). The goal for the region is to create a sustainable transport system that improves the viability of active transport modes as actual travel choices for everyday commute. The Carrick Centre mobility hub is a great example of combining mobility with community. The Carrick Centre integrates various transport modes, while hosting a big share of community organizations. The community integration started with extensive public and stakeholder consultation, all to make sure the new mobility innovations meet the needs of residents and the community (SWECO, 2022; Burns et al., 2019). To be able to analyze the eHub Handelskade according to the TIS framework, first actors, their networks, and the institutional frameworks that shape its operations will be analyzed.

Actors and Networks: Collaborative Efforts in Sustainable Mobility

The success of the Carrick Centre Green Mobility Hub relies on the coordinated efforts of various stakeholders. The primary actors in this collaboration include:

- **The Carrick Centre**: This community organization in the Maybole town centre is the actual heart the town. Offering a wide variety of institutions a home base location, the Carrick Centre offers something for everyone. Lately they opened up their youth club, in addition to the café, foodbank, soft play area, meeting rooms, the Maybole parish Church and the Green Mobility hub (Carrick Centre, 2022). The green mobility hub at the Carrick Centre is a joined effort with the South Ayrshire Community Transport program and Cycling Scotland.

- **The Town of Maybole**: Maybole has a progressive regeneration strategy, which is focused on revitalizing the local economy and improving public infrastructure (Burns et al., 2019). The regeneration project is a combined effort of the Maybole community council and the south Ayrshire council. One of the main goals is to realize the regeneration by including input from the community and the local businesses (Maybole Town, 2024). The town strives to create better active travel opportunities, as seen in the Carrick Centre green mobility hub.

- **South Ayrshire Council**: The Carrick Centre in Maybole is part of the broader South Ayrshire Region. The South Ayrshire Council is committed to encouraging walking, cycling, and the use of public and shared transport (SWECO, 2022). To make sure their proposed plans meet the community needs, all projects went through a community selection/scoring process. With the highest possible score of five, transport hubs with direct links to railways, busses and cycling routes were deemed important (SWECO, 2022). To suit the action to the word, the South Ayrshire council is investing over 1.2 million pounds into the Maybole regeneration project (Maybole Town, 2024).

- **South Ayrshire Community Transport:** The council's involvement through this region wide nonprofit travel initiative ensures that mobility hub aligns with regional planning objectives (South Ayrshire Council et al., 2019). The community transport initiative has a main focus on serving vulnerable and underserved populations. It offers a range of transportation options to the green mobility hub at the Carrick Centre. The main modes are the volunteer-driven minibus service, and the regions first electric community e-car club (South Ayrshire Community Transport, 2024; SP Energy Networks, 2021).

- **Cycling Scotland**: As part of Scotland's national effort to promote walking, wheeling and cycling, the Cycling Scotland national charity supports the integration of cycling infrastructure. Comparing 2024 to 2023, Cycling Scotland already increased the amount of cycling journey's by 30% (Cycling Scotland, 2025). Within the Carrick Centre Green Mobility Hub they helped the provision of safe, accessible bike storage and bike rental facilities for cyclists.

SFF - Success Factor*: The Carrick Centre's integration of social functions, such as a café, foodbank, and children's play area, demonstrates how multifunctionality increases relevance, daily use, and the community value of a multimodal mobility hub.*

INSTITUTIONS: POLICIES, PLANS, AND FINANCIAL SUPPORT

The development of the Carrick Centre Green Mobility Hub is shaped by a number of regulatory frameworks, policies, and financial support mechanisms. Institutional influences include:

- The region wide **South Ayrshire Active Travel Strategy** emphasizes 89 travel project/actions within several categories. Highlighting a difference between long and short term implementation goals, the travel strategy shows several actions for Maybole active travel plans (SWECO, 2022). Broader goals enhance reduction of congestion and improving public health. The South Ayrshire Active Travel Strategy also puts focus on the importance of combining travel actions with more community centreed actions on education.

- The South Ayrshire council used a consultancy advice program to establish its **South Ayrshire Sustainable Travel Plan** report**.** The travel plan advice program is funded by the Scottish Executive and managed by the Energy Saving trust. The plan highlights infrastructure improvements based on developments withing two test sites. The policies enhance the availability and accessibility of sustainable transport options (South Ayrshire Council et al., 2019).

- **Scotland's National Transport Strategy** sets out Scotland's vision for a greener and more inclusive transport system. They strive for integration of transport policy with digital connectivity. All of this to support plans to reducing the need to travel unsustainably. This national policy framework provides guidance and support for local and regional mobility plans (Scottish Government, 2020).

- the **Green Economy fund** by SP energy Networks, is a transmission and distribution network operator, offering financial support for projects that align with sustainability goals. This includes the adoption of electric vehicles and the development of green mobility infrastructure. The Green economy fund offers 20 million pound, from which just under 60 thousand went to the South Ayrshire community transport E-car club hire, available at the Carrick Centre. (SP Energy Networks, 2021).

- The **Maybole Town Centre Regeneration project** support active travel and is actively committed to making the Maybole area available for everyone. The regeneration project is mainly funded by the South Ayrshire council, as they have invested over 1.2 million pounds. This project funding helps the creation of the Carrick Centre Green Mobility Hub as a central component of Maybole's active travel plans (Maybole Town, 2024).

The innovation loop for Mobility Hubs

To understand the evolution of mobility hubs as an innovative transport policy, the following section will show the structured loop of functions a hub moves through. The usage of the TIS functions framework, established by Hekkert et al. (2007), illustrates how hubs develop, adapt, and improve through a continuous cycle of innovation functions. By analyzing the four previously established hubs a generalized loop for these hubs is established and shown in figure 8.

Each function in the TIS framework contributes to the progression of mobility hubs. The loop follows a logical sequence, with each function influencing the next, ultimately leading back to the beginning for refinement and further development.

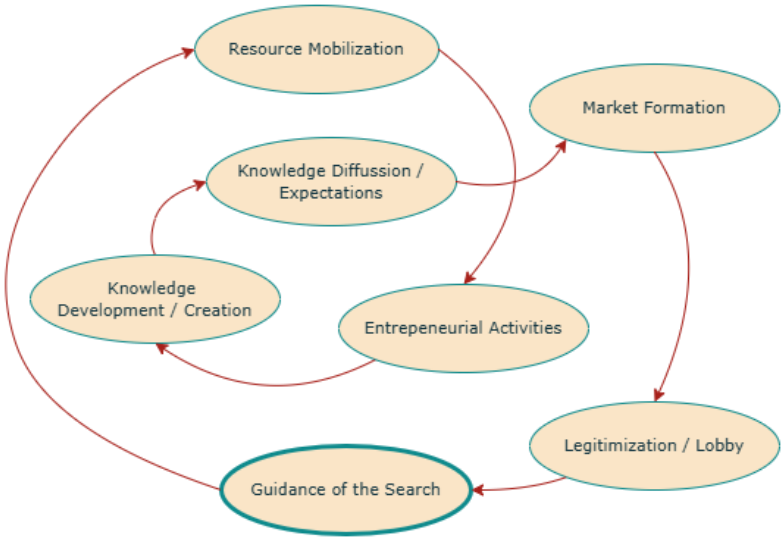

Figure 8. The TIS functions framework based innovation Loop for Mobility Hubs

SETTING THE VISION – GUIDANCE OF THE SEARCH

The process of planning and designing a mobility hub begins with a broader strategic vision and policy direction. This is where national, regional, or local governments define transport and sustainability goals that shape the development of mobility hubs. This step provides a clear direction for investment, policy incentives, and planning. Which essentially defines what should be prioritized and why.

In Vienna, the Urban Mobility Plan (STEP2025) sets clear goals to shift 80% of city travel to public transport, walking, and cycling. This ambition drives the expansion of WienMobil hubs, ensuring a coordinated and sustainable approach to multimodal transport. Similarly, Flanders' Hoppin initiative establishes a structured framework to promote shared mobility and multimodal travel, pushing cities like Leuven to develop hubs such as Hoppinpunt Wijgmaal Station.

ALLOCATING RESOURCES – RESOURCE MOBILIZATION

Once the vision is set, governments and private stakeholders allocate financial and institutional support to ensure the necessary infrastructure, technology, and operational frameworks are in place. Resource mobilization ensures that the vision set in Step 1 is backed by tangible support, allowing for practical implementation.

For example, the Carrick Centre mobility hub in Scotland received funding through the South Ayrshire council, allowing it to develop not just as a transport hub but a community centre green hub. In Nijmegen, the eHub Handelskade benefited from Interreg North-West Europe funding, which allowed the municipality

to experiment with shared electric mobility solutions and contribute to broader Dutch goals of reducing car dependency.

Taking Initiative – Entrepreneurial Activities

With funding and institutional support in place, entrepreneurs and mobility providers launch services, set up infrastructure, and pilot new solutions. This phase is crucial because it translates policies and investments into real-world applications, allowing for experimentation and early-stage learning.

In Vienna, Wiener Linien, the city's main public transport provider, expanded its role by launching WienMobil hubs, integrating their own shared mobility modes under a single digital system. This entrepreneurial expansion helps accelerate the transition toward seamless multimodal transport. In Leuven, the Hoppinpunt Wijgmaal Station saw participation from private operators such as Cambio (car-sharing) and Blue-bike (bike-sharing), creating a diverse and flexible mobility offering.

Advancing Knowledge – Knowledge Development

Once mobility hubs are operational, data is gathered on user behavior, technology performance, and integration challenges. This phase is vital for continuous improvement. This function ensures that mobility hubs evolve based on evidence and user preferences, rather than remaining static.

In Vienna, the Aspern Mobil LAB serves as a living lab to test new mobility solutions in real-world environments, enabling researchers and policymakers to make data-driven improvements.

Sharing and Collaboration – Knowledge Diffusion through Networks

Findings from research and early-stage implementation are then shared across networks, allowing for scaling, adaptation, and policy refinements. By encouraging collaboration across regions, this step accelerates the adoption of successful models, ensuring mobility hubs continue improving over time.

For instance, Leuven's Hoppin initiative is embedded in the European ShareDiMobiHub project, which means that the lessons learned from Wijgmaal Station contribute to a broader European mobility knowledge base. In Maybole (Scotland), the Carrick Centre's approach to community-led mobility is being awarded and acknowledged by CoMoUK, helping other regions replicate its success.

Expanding User Adoption – Market Formation

For mobility hubs to be successful, they must be embraced by the public and attract consistent usage. This requires policies that incentivize adoption and make shared mobility services competitive with car ownership. Market formation ensures that users see clear benefits in using mobility hubs, driving adoption rates beyond early adopters to the mainstream.

In Vienna, the WienMobil app centralizes public and shared mobility services, offering a seamless booking and payment system that enhances user convenience. Another strategy to gain market share is to incorporate community activities that increase engagement and foot traffic around mobility hubs. The Carrick Centre in Maybole is an example of this approach. By positioning itself as a community space rather than just a transport node, the Carrick Centre ensures steady user engagement and encourages regular interaction with mobility services.

Building Public Trust – Legitimization & Counteracting Resistance

New mobility solutions often face resistance, either from established industries (e.g., car manufacturers, taxi companies) or from the public (due to unfamiliarity or skepticism). This next function in the loop

ensures that mobility hubs receive public and political support, allowing them to become permanent fixtures in urban transport systems.

The Carrick Centre overcame such potential resistance by integrating a community-participation session, in which they gained insights in the user's needs, while creating while generating more awareness for the hub. This lead to better acceptance and creating more than just a transport facility.

CLOSING THE LOOP – REFINING GUIDANCE OF THE SEARCH

Finally, insights from real-world implementation, user adoption, and market research, feed back into policy adjustments and future mobility strategies. For example, findings from WienMobil's expansion will likely influence Vienna's future STEP2030 plan, refining policies for even more integrated transport hubs.

By returning to Guidance of the Search, the innovation system remains adaptive and evolving, ensuring mobility hubs continue to improve and expand in relevance. It is important to consider that this loop in its entire is not a linear process. Feedback from knowledge development can influence search guidance, while market formation may require additional resource allocation. Each hub moves through multiple loops as they scale, integrate new technologies, and adapt to user needs.

Sub-Question 1. How do structural and functional components observed in European mobility hub projects inform the potential for hub integration in the Dutch urban context?

European case studies show that successful hubs depend on a strong interaction between governance, policy support, and public engagement. Cities like Vienna and Leuven demonstrate how clear strategic visions and cross-sector collaboration can drive scalable, sustainable hub development. These lessons suggest that Dutch cities should adopt adaptive planning cycles, integrate hubs within broader policy frameworks, and ensure local community participation to improve relevance and acceptance.

Success and Failure Factors in Mobility Hub Implementation

Previously in this chapter, four European mobility hubs were evaluated using the TIS functions framework. Key success and failure factors (SFFs) were identified and integrated within the evaluation of each hub. By examining the real-world dynamics of hub development, such as governance structures, community participation, digital integration, and multimodal planning, it became clear which elements contribute to the effective implementation of mobility hubs, and which pose barriers. This concluding section brings together those findings to provide a global overview of the most transferable success and failure factors. In doing so, it offers a direct answer to the second sub question of this research.

Sub-Question 2. Which success and failure factors, influencing the implementation of multimodal mobility hubs, are transferable to guide the implementation of mobility hubs in the Netherlands?

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1. **Regional/national support through policy alignment**
   Ensuring that mobility hubs are supported by national and regional policies helps to align local initiatives with broader strategic goals, enhancing the overall impact and sustainability of the hub.
2. **Extend hubs to be more than a mobility/transport location**
   Mobility hubs should not only serve as transport nodes but also as multifunctional spaces that integrate social, commercial, and environmental aspects, providing value to a broader range of users.
3. **Community engagement in the planning process**
   Involving local communities in the design and decision-making processes ensures that mobility hubs meet the specific needs of residents, enhancing the hub's relevance and acceptance.
4. **Digital integration for seamless mode switching**
   Effective digital tools and platforms facilitate easy transitions between different modes of transport, improving the overall user experience and increasing the adoption of multimodal transportation.
5. **Strategic location for first-last mile connectivity**
   Mobility hubs should be strategically located to optimize connectivity for the first and last mile, ensuring that users can easily access the hub from residential or business areas, enhancing accessibility and reducing reliance on private vehicles.

Dutch planners can also benefit from designing hubs as multifunctional spaces to boost daily use. Integrating these elements into Dutch hub projects will help ensure long-term success and equity.

6. Participatory Value Evaluation – Set Up

This chapter outlines the design and rationale behind the PVE questionnaire used in this research. A PVE generally serves as an empirical method to assess how different user groups in Zwolle evaluate various attributes, in this case concerning the development of mobility hubs in Zwolle. Building on the functional and structural findings of the European case studies discussed in Chapter 5, the PVE translates the most common success and failure factors into a structured participatory method that invites residents to actively engage in hub design trade-offs.

The case study analysis revealed a wide range of attributes influencing the success of mobility hubs (Chapter 5), including modal diversity, amenity integration, digital accessibility, and a degree of community involvement. For example, the Carrick Centre's multifunctional public role and WienMobil's digital and physical connectivity informed the inclusion of amenities like parcel lockers, repair shops, and meeting spaces. The less desirable minimal-integration hubs, like the eHub Handelskade underscored the importance of inclusive and context-sensitive amenities, especially for active transport users.

The gained insights through the TIS analysis, provided the foundation for selecting the PVE decision attributes. By allowing respondents to make trade-offs between various hub attributes and configurations while also facing them with space constraints, the PVE simulates real policy dilemmas that local planners face. This matches well with the special attention given to the democratic integration dimension, as identified by the Smart Hubs project. The absence of democratic integration is frequently associated with underused or weakly integrated hubs (Geurs et al., 2023) and is something that can be prevented by using methods like PVE (Juschten & Omann, 2023).

In addition to the TIS-based findings, the selected attributes for the PVE are grounded in the practical observations from local cases like Zwolle's developing mobility hubs Weezenlanden-Noord and Diezerpoort. These hubs are already further along in their planning process and design plans have been established (Bosman et al., 2024). These planned sites demonstrate the potential variation in integration level, transport services, and inclusion of neighborhood functions. Given their similarities in public and area context makes them ideal prototypes for the PVE design for the broader application of mobility hubs in Zwolle. The similarities in social context, and the translation of certain features to the PVE, ensure that respondents can easily relate to the hypothetical but plausible scenarios presented.

In addition, the planned hubs provide realistic spatial context. This enhances practical relevance, the choice tasks in the PVE incorporate space allocation constraints that reflect actual planning limitations in Zwolle. This way the questionnaire enables participants to engage meaningfully with the same dilemmas faced by policymakers and urban designers. After each choice task, participants get the chance to explain and/or elaborate on their choices. In doing so, the PVE captures not only quantitative preferences but also qualitative motivations behind those preferences, enriching the understanding of what makes a mobility hub desirable, feasible, and socially accepted.

Structure of the PVE: Two Complementary Parts

The PVE consists of three parts: demographic/personal question, a "score" choice task and a "space" choice task, each targeting a different but complementary dimension of hub design. The parts will be explained in further detail in the following subsections. PVE questions and their corresponding attributes are listed in appendix E. Before the first section of the questionnaire the respondents get an explanation of the thesis research they will take part in. After reading through these details they must give their consent to enter, before they can take part in the following sections of the research.

PART 1: DEMOGRAPHIC FEATURES

After being introduced to the subject, respondents get a few questions regarding their demographic characteristics. The questionnaire includes age, gender and education level. In addition, question are asked about car ownership, and respondents most frequently used mode of transport. Finally respondents were asked about their relationship with Zwolle. These insights are important for the latent class cluster analysis later on in the research. After providing some demographic insights, respondents move on to the first choice task.

PART 2: SCORING ATTRIBUTES BY CATEGORY

In the first choice task, respondents are presented with four thematic categories: Mobility attributes, Public attributes, Facility attributes, and Commercial attributes. The categories are, as previously mentioned, selected mainly based on the structural insights from the European case study hubs. The mobility attributes focuses on enhancing the core transport functions of the mobility hub. It includes infrastructure and services that support seamless connections between different travel modes, such as public transport, private vehicles, bicycles, electric vehicles, and shared mobility. The goal is to create a hub that facilitates flexible, multimodal travel for diverse user needs. The public attributes aim to improve the general user experience and accessibility of the hub for all visitors. These components emphasize convenience, safety, and public service by offering practical amenities like toilets, water taps, lockers, and pedestrian-friendly infrastructure that support everyday travel and last-mile needs. The facility attributes highlight elements for functional needs, but also for added comfort. Features like lighting and CCTV for security and emergency equipment are included to hopefully enhance the overall user experience. Finally, the commercial attributes introduce social and economic functions to the hub, transforming it into more than just a transit point. These features support activities such as shopping, working, dining, and community interaction, helping to create lively, multifunctional spaces that attract a broader user base and encourage longer stays.

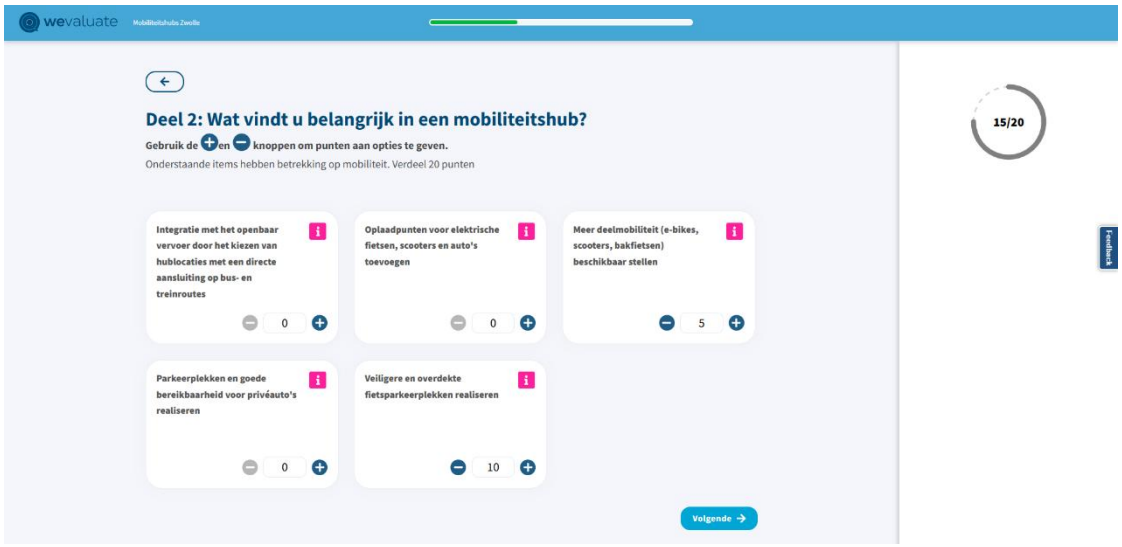

Figure 9. Example of a PVE "score" choice task

Each of the categories contains five specific attributes. Participants are asked to distribute 20 points across the five attributes per category, based on what they believe adds the most value to a mobility hub. The attributes corresponding to the categories can be found in appendix E. This scoring approach requires participants to make explicit trade-offs between desirable options. Besides this, it reflects the diversity in user priorities, allowing for quantitative comparison across themes and participant profiles. Moreover, the

open comment sections accompanying each scoring task enable rich qualitative input, uncovering motivations behind these choices.

PART 3: SPACE ALLOCATION CONSTRAINTS

In the second choice task of the PVE, respondents are asked to allocate limited physical space across nine spatial functions of the mobility hub. These functions are derived from the combined attributes of the four categories in the first part but reframed to focus on spatial needs. Participants distribute spatial emphasis via sliders, indicating which functions they believe should take up more or less space within the hub footprint. In the space choice task, participants allocate space across a set of mobility hub functions using sliders. Each slider represents a percentage (0–100%) of the maximum space that a given attribute can occupy. However, the actual space demand per attribute varies, ranging from 10 to 50 units. The amount of space allocated to each item is based on the in depth research on Zwolle's mobility hubs projects Weezenlanden-Noord and Diezerpoort. Respondents can see the amount of units a specific function takes up when they click the inform button at the top left corner of each attribute. All sliders are initially set at 50%, representing an equal and balanced distribution of space across all attributes. This neutral starting point is intended to give an optimal scenario and ensure participants begin the task without bias toward any specific function.

The total space available for allocation is 200 units. If all sliders are set to 100%, the combined space used is 280 units, which exceeds the available space. This setup intentionally requires participants to make trade-offs between competing functions. A system warning is triggered when the total allocated space falls below 100 units or exceeds the 200-unit limit, encouraging more deliberate and balanced choices. The goal is to capture spatial preferences and enable a visual, hands-on engagement with urban trade-offs. The choice task reflects real tensions faced by planners, balancing mobility functions, green space, and commercial vitality within limited urban plots.

Figure 10. Example of a PVE "space" choice task

The next chapters will give insights into the PVE responses and results, focusing on the distributed of respondent segments and ultimately offering insight into how participants envision the mobility hubs.

7. Participatory Value Evaluation - Results

This upcoming chapter presents the analysis and results of the Participatory Value Evaluation (PVE), which explores how different groups value and prioritize the use of public space in the context of mobility hubs. The PVE provides insight into the preferences and trade-offs made by participants when faced with spatial constraints, reflecting both individual and collective considerations. Through statistical modeling the chapter uncovers general patterns as well as heterogeneity in preferences across respondent groups.

Socio-Demographic features of respondents

Tabel 2 shows the distribution of socio-demographic features of the respondents who participated in the PVE. A total of 82 respondents finished the entire survey, among them was one respondent that did not provide their demographic features. The percentages gained from the PVE analysis are compared against national and municipal population statistics provided by the Dutch Central Bureau of Statistics (CBS) and the municipality database of Zwolle. The table breaks down the data by gender, age group, and level of education to assess the representativeness of the sample and to identify any notable deviations from national and municipal averages.

Table 2. Distribution of Socio-Demographic features

	Analysis Sample	National	Zwolle
All Respondents / Inhabitants			
Total	82		133.839
Gender			
Male	52.4% (43)	49.7%	49.3%
Female	45.1% (37)	50.3%	50.7%
Remaining	1.2% (1)	*No available data*	*No available data*
Age			
18 until 24	14.6% (12)	8.9%	9.5%
25 until 34	17.1% (14)	13.3%	14.0%
35 until 44	18.3% (15)	12.5%	14.7%
45 until 54	20.7% (17)	12.4%	12.4%
55 until 64	18.3% (15)	13.8%	12.1%
Older than 64	9.8% (8)	20.4%	17.3%
Education Level			
Elementary- or Highschool (all levels)	8.5% (7)	35.9%	29.0%
Practical education (MBO)	12.2% (10)	26.5%	32.0%
Theoretical education (HBO, WO)	78.0% (64)	37.0%	39.0%

Table 2 shows some notable observations. Were several of the analysis results match the national and municipal values quite well, some others are either under- or overrepresented. The gender balance is

reasonably close to national levels. One respondent identified outside of the binary categories, though no national/municipal comparison data is available for this group. There is a clear overrepresentation of theoretically educated respondents, who make up 78.0% of the sample compared to average 38% in both population groups. Conversely, respondents with only elementary or high school education and those with practical education are underrepresented. A final notable overrepresentation is among "young" respondents. All age groups between 18 and 64 are slightly overrepresented, while the "elder" respondents over the age of 64 are underrepresented. However, compared to the national population, Zwolle has a larger share of young residents (aged 18 to 44). Since most respondents were located in Zwolle, this overrepresentation may be partly explained by the city's demographic profile.

Table 3 Shows the relation of the respondents towards the city of Zwolle. As this PVE is a case study towards the mobility hub realization plans for the city, it is important to know how many respondents speak from personal experience with the city. From table 3 can thus be concluded that 72% of all respondents has a personal relationship and experience with travelling through Zwolle.

Table 3. Relation of the respondents with Zwolle

Relationship with Zwolle	**Analysis Sample**
Living in Zwolle	50.0% (41)
Working in Zwolle	14.6% (12)
Going to school in Zwolle	1.2% (1)
Visiting friends or Family	4.9% (4)
No direct relationship	28.0% (23)

Table 4 summarizes the mobility characteristics of the PVE respondents, including car ownership and the most commonly used mode of transport. These figures are compared with national statistics to evaluate how representative the sample is in terms of travel behavior.

Table 4. Travel behaviour distribution

	Analysis Sample	**National**
Car Ownership		
I own 1 car	57.3% (47)	47.0%
I own more than 1 car	13.4% (11)	27.0%
I do not own a car	28.0% (23)	26.0%
Most used transport mode		
Private Car	34.1% (28)	68.3%
Train	11.0% (9)	10.1%
Bike	41.5% (34)	8.9%
Bus, tram, metro	1.2% (1)	2.6%
Walking	11.0% (9)	3.5%
Shared mode	0.0% (0)	6.7%

One of the most notable insights gained from the travel behaviour questions is the high share of respondents who report they primarily use a bike to travel. With a percentage over four and a half times as big as the national average, this segment of the population is overrepresented. Another slight overrepresentation is the percentage of participants that walk as their main travel mode. This overrepresentation of so called “slow modes” can be (partly) explained by the city’s level of urbanization. Zwolle is considered a very urbanized area, which is the second to largest level of urbanization (CBS, 2025). Research by De Haas and Kolkowski (2023) showcases that the higher the level of urbanization, the higher the share of bike travel kilometers. For Zwolle, being very urbanized, the average share is just below 30% , a number that is already much more concise with the results from the PVE. Opposite to the slight overrepresentation of bike users, there is a under representation of the use of private cars, were the national average is twice as high. Also here it is important to consider that for the national percentages all levels of urbanization are included. Research shows that less urbanized areas are more car dependent (Zijlstra et al., 2022) A final interesting insight towards the theme of this research is the fact that none of the respondents reported using shared modes as their primary transport mode.

Results of choice task one – Score distribution

Which attributes are important to respondents?

Figure 11 shows the average number of points the participants of the PVE gave the different mobility hub attributes. As chapter 6 already explained, the attributes were provided to the respondents in four categories to be understandable and maintain ease of use. Figure 6 shows how the respondents assigned points to each of the 20 attributes. The score bars show scores on average. The baseline value is set to 4 as this is a equalizing score to all attributes per category. When interpretating these scores, it is important to consider a level of uncertainty. The one sample T test performed to analyze the mean scores of the PVE, considers a 95% confidence interval. Taking the integration of public transport as an example, figure 6 shows that a score of 5.6 is the mean (or, the sample mean) of this attribute. The confidence interval gives an indication of the precision of the estimate: the narrower the interval, the more precise. For the public

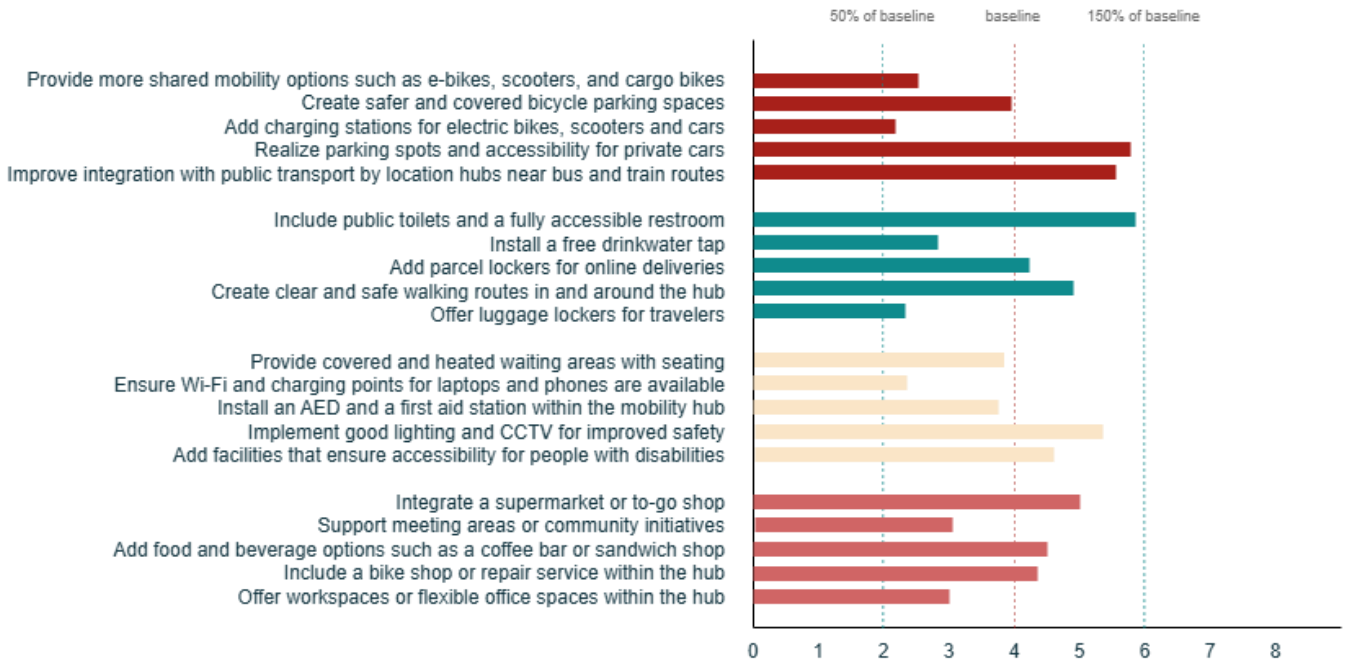

Figure 11. Average score of respondents on each of the attributes in the “score” choice task

transport integration attribute, the confidence interval runs from 4.9 to 6.2. So it can be said with 95% certainty, that in case of a representative sample, the mean score in the population is between 4.9 and 6.2. A complete overview of the confidence intervals of the attributes can be found in appendix F.

As previously mentioned, figure 6 displays the mean scores assigned to various hub-related attributes, grouped into the four categories from the PVE: Mobility, Public, Facility, and Commercial Attributes. The results reveal distinct patterns in user preferences, with certain attributes emerging as particularly valued while others appear to be of relatively low importance.

NOTABLY HIGH-SCORING ATTRIBUTES

Attributes related to basic public amenities and accessibility received the highest scores. Most notably, the provision of *"public toilets and a fully accessible restroom"* was rated as the most important feature. Combining this insight with other, relatively, high scores on *"add facilities that ensure accessibility for people with disabilities"* and "*integrate a supermarket or to-go shop*" suggests a strong user emphasis on inclusivity and essential services.

Similarly, *"improving integration with public transport by locating hubs near bus and train routes"* was highly valued, reflecting the importance of seamless multimodal connectivity in enhancing the utility of mobility hubs. This statement blends well with the notable high score on *"realize parking spots and accessibility for private cars"*, as several respondents mentioned that they would require parking for their car to then use public transport, or a form of shared transport as their main commuting mode.

A final notable high score, is the score on *"create clear and safe walking routes in and around the hub".* These results indicate that comfort and pedestrian safety are central concerns for respondents. Safety is a great overreaching theme within several of the attributes, as will be established later in in this chapter during the qualitative analysis. It can be concluded from these high scores that the important features reflect a user preference for hubs that support reliable, comfortable, and accessible transit experiences.

NOTABLY LOW-SCORING ATTRIBUTES

Conversely, a number of attributes were consistently rated as less important. Among the lowest-scoring were *"flexible office or coworking spaces"*, *"offer luggage lockers for travelers"* and *"ensure Wi-Fi and charging points are available"*. These elements, while potentially valuable in specific contexts, appear to be perceived as secondary to the core functions of a mobility hub. Their low mean scores suggest that respondents prioritize features directly linked to movement, accessibility, and basic infrastructure.

Another notably low score was on the attribute *"add charging points for electric vehicles".* While both bicycle and car parking options received relatively high importance scores, the low rating of electric vehicle charging infrastructure suggests that respondents may currently prioritize access and space over energy provision, or possibly perceive charging as the responsibility of other facilities or services outside the mobility hub.

Distribution of the individual scores

In addition to the analysis of mean scores as seen in figure 6, a cumulative distribution table was compiled to present the frequency with which respondents assigned specific point values to each attribute in the "score" choice task. Figure 12 provides an overview of this cumulative distribution, and shows detail on the variation and consensus in individual preferences, revealing not only which attributes were most valued on average, but also how consistently these preferences were expressed across the sample.

When interpreting this figure, it is important to consider that attributes with high mean scores but wide dispersion may indicate polarized opinions, whereas consistently high or low point allocations suggest a stronger collective agreement. This distributional perspective helps to identify attributes with broad support versus those with mixed or marginal relevance, offering further insight into how different features of mobility hubs are prioritized by the public.

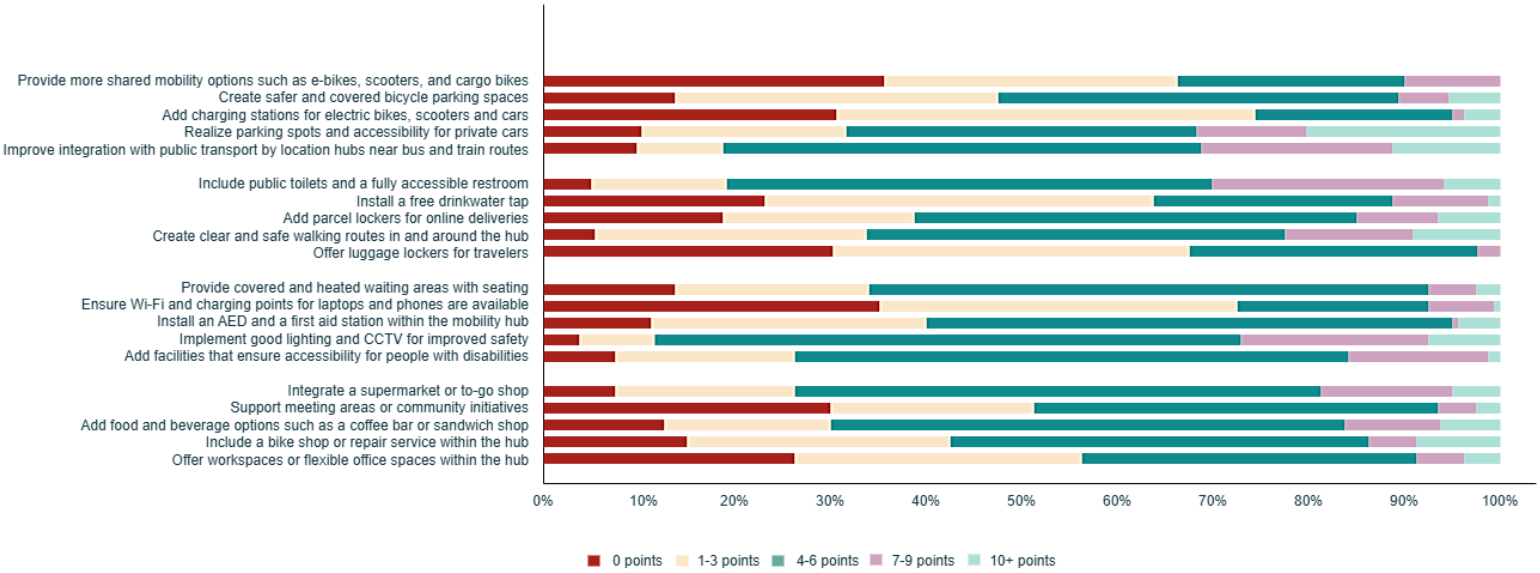

Figure 12. Cumulative overview of the distribution of points on the "score" choice task

The attributes in bar 3 and 4 will be explained to give an example of interpretation. Bar 3, "Add charging stations for electric bikes, scooters and cars" shows that almost all scores are below 10, with 95% of the of the scores below 6. This result suggests a more nuanced preference towards this attribute. In bar 4, "Realize parking spots and access routes for private cars", there is a contrasting analysis. This attribute displays a more outspoken result, with a relatively large share of high scores (10-20). This implies that the for this particular attribute participants showcase strong preference and large importance. The interpretation of the cumulative format helps to identify both areas of agreement and diversity in public preferences.

Sub-Question 3. Which attributes of mobility hubs are prioritized by the community, as revealed through PVE?

Three ***highest*** scoring attributes

- Include public toilets and accessible restrooms
- Realize parking spots and accessibility for private cars
- Improve integration with public transport

Three ***lowest*** scoring attributes

- Add charging stations for electric vehicles
- Ensure Wi-Fi and charging points for personal devices
- Offer luggage lockers for travelers

Which features characterize the respondent segments?

To analyze if there are distinct respondent groups among the participants of the PVE, a Latent Class Cluster analysis has been performed through the statistical software LatentGOLD. A in depth description of the LCCA method can be found in chapter 4, in short this method searches for respondent groups that provide a large share of similar responses. The clusters are created in such a way that one distinct group prioritizes the 20 tasks in a different, or even opposite, way to the other latent clusters. The performed LCCA appointed two viable models, one with two clusters and another with tree clusters. As the main goal of this analysis is to find distinct population segments, the decision was made to continue with the model containing three clusters. This allows to gain practical, segment insights that could be of value to policy and planning. The BIC value of the three cluster model is slightly higher, but with a difference of only ~123 on a BIC value of approximately ~7400 this is a relatively small increase which is deemed acceptable in this social science context, as adding the additional class improves interpretability. A full overview of cluster statistics can be found in appendix F. The results of the cluster analysis are substantiated by qualitative insights gathered from respondents in the PVE. These quotes not only reinforce the statistical distinctions between clusters but also provide context to the underlying values and trade-offs that respondents considered important when allocating space in the city.

Table 5. Cluster overview of "score" choice task

	Cluster1	Cluster2	Cluster3
Cluster Size	56%	22%	22%
Indicators			
Mobility Attributes			
Improve integration with public transport	5.78	5.82	4.74
Realize parking spots and accessibility for private cars	2.96	7.54	10.85
Add charging stations for electric vehicles	3.02	2.38	0.65
Create safer and covered bicycle parking spaces	4.95	2.54	2.36
Provide more shared mobility options	3.29	1.71	1.40
Public Attributes			
Offer luggage lockers for travelers	2.82	1.42	2.23
Create clear and safe walking routes in and around the hub	4.77	3.35	5.87
Add parcel lockers for online deliveries	4.19	4.45	4.33
Install a free drink water tap	2.90	4.66	1.03
Include public and accessible toilets	5.32	6.12	6.54
Facility Attributes			
Facilities to ensure accessibility for disabled population	4.91	1.68	7.01
Implement good lighting and CCTV for improved safety	4.97	5.20	6.58
Install an AED and a first aid station	3.90	3.87	3.18
Ensure Wi-Fi and charging points are available	2.34	4.53	0.54
Provide covered and heated waiting areas with seating	3.88	4.72	2.69
Commercial Attributes			

Include a bike shop or repair service within the hub	5.23	2.67	4.12
Support meeting areas or community initiatives	3.67	2.51	2.18
Offer workspaces or flexible office spaces	3.38	3.33	1.69
Add catering facilities like a café	3.87	5.54	5.10
Integrate a supermarket or to-go shop	3.85	5.94	6.90
Covariates			
Age			
18 until 24	17%	23%	0%
25 until 34	24%	11%	6%
35 until 44	17%	28%	11%
45 until 54	15%	22%	33%
55 until 64	13%	16%	33%
Older than 64	11%	0%	17%
Gender			
Male	63%	50%	28%
Female	33%	50%	72%
Remaining	2%	0%	0%
Education Level			
Higher professional education (HBO)	35%	33%	28%
Secondary vocational education (MBO, all levels)	11%	0%	28%
Higher secondary education (Havo, Vwo)	7%	11%	6%
Lower secondary education (KB, BB, Mavo)	2%	0%	0%
University education (WO)	43%	56%	39%
Relationship with Zwolle			
Visiting friends or Family	7%	0%	6%
Going to school in Zwolle	2%	0%	0%
No direct relationship	28%	40%	17%
Working in Zwolle	11%	17%	22%
Living in Zwolle	50%	44%	56%
Car ownership			
Yes, I own 1 car	50%	55%	78%
Yes, I own more than 1 car	2%	33%	22%
No, I do not own a car	45%	12%	0%
Most used transport mode			
Bus, tram or Metro	0%	0%	6%

Private car	15%	50%	67%
Bike	61%	28%	6%
Walking	7%	22%	11%
Train	15%	0%	11%

Cluster features

Taking a look at table 5, it shows that cluster 1 contains the largest group of participants with 56%. This cluster could be described as *"The Bike and Public Transport Enthusiasts"*. The cluster stands out with its strong preference for sustainable and integrated mobility solutions. Its highest scores highlight a focus on public transportation integration (5.78) and safe and secure bike parking (4.95). They value sustainable and active mobility options while showing less interest in car-related facilities. Their scores for private car parking are far below average (2.96). This first cluster also places less importance on non-transport related amenities, as shown by its low scores for Wi-Fi and charging stations (2.34) and the offering of luggage lockers (2.82). They do however value equality among users, as shown by the high score (4.91) on the addition of facilities that ensure accessibility for people with disabilities or limited mobility. Cluster one represents a great share of bike users (61%) and only a small share of car users (15%). These numbers aligns with the shown preferences for bike and public transport infrastructure. Demographically, this group mainly represents a younger audience, with 41% of its members between 18 and 34 years old. It also has a higher representation of men, accounting for 63% of the cluster.

"Without public transport a mobility hub isn't viable"

"Promoting cycling is always a plus, there should be no arguments against using the bicycle"

Cluster 2 represents 22% of the respondents, a comparable share to the third cluster. This cluster places practicality and convenience at the forefront of its priorities. Calling this cluster *"The Practical Providers"* aligns with their high scores on practical amenities like private car parking (7.54). Additionally, integral toilet facilities are highly valued (6.12) as well as the integration of a to-go supermarket (5.94). These findings suggest that Cluster 2 is driven by the need for essential, functional amenities that enhance comfort during travel or daily routines. On the contrary, this cluster demonstrates relatively low interest in shared mobility solutions (1.71) and community initiatives (2.51). Cluster 2 contains a large share of the highly educated participants, as 89% of them either completed a HBO or WO education. The gender distribution in this cluster is relatively balanced. Interestingly, this cluster shows no participants (0%) who use a public transport mode as their most frequently used. Considering their relatively high score on integration of the hubs with public transport (5.82), there is much potential improvement here to shift from private modes to public modes.

"Of course it makes sense if people can park their cars here, otherwise the added value of a hub is very limited."

"Good parking around a hub that has transport hub will entice people to get out of their cars and use less polluting transport"

Cluster 3 is the most outspoken cluster, containing 22% of the respondents it holds distinct preferences and characteristics that set it apart. Calling them *"The Car-Oriented Comfort Seekers"* aligns well with their very high score (10.85) on private car parking. They also value clear and safe walking routes around the hub (5.87) as well as to-go supermarkets (6.90) and good accessibility and facilities for all (7.01). As a very clear opposite to their most preferred points, cluster 3 also contains several attributes that received hardly any points. The respondents in this cluster show only a very slim value towards charging stations (0.65),

"A space that is designed based on the needs of disabled people, children and the elderly is a space that is well-designed for everyone."

"Wi-Fi and electricity are extras that I don't use and don't consider necessary"

workspaces (1.69) and digital infrastructure like Wi-Fi (0.54). Demographically, this cluster has a notable concentration of older individuals, with 50% aged 55 years or older. Women dominate this group, making up 72%. In terms of car ownership, all participants in Cluster 3 (100%) own at least one car, with 22% owning more than one. This reflects the group's strong dependence on private vehicles and related infrastructure. The sample used for this analysis shows a great share of bike users, but cluster 3 represents hardly any of these (6%) and focusses mainly on participants that mention their private car as their most frequently used mode (67%).

Overreaching Features

Despite the distinct difference in preferences shown between the clusters, they also reveal a few overarching priorities and patterns that resonate across the whole sample. One prominent theme is the appreciation for essential and practical amenities. Facilities such as integral toilets (~5.99) and integration with public transport (~5.45) are very consistently valued across the clusters, underscoring a shared desire for convenience and functionality in these mobility hubs. Safety emerges as another common thread, with the addition of lighting and camera surveillance to improve safety scoring very well (~5.60) across all clusters. Whether the focus is on personal security, safe walking routes and providing accessibility for all individuals, the emphasis on safety reflects a collective need for environments where people feel comfortable and supported. There are a few attributes that score relatively high, and very consistent across cluster. Showcasing less debatable items, that are simply appreciated as a sense of convenience. Examples of such attributes are the package lockers (~4.32) and the installation of an AED and first aid station (~3.65). Interestingly, there are also some attributes receiving low scores across all clusters. For example the charging stations (~2.02) and the offering of workspaces (~2.80) receive consistently low scores, indicating that these features are universally considered less important in mobility hubs.

"Essential for an accessible city. I think it is very important that there are more toilets. They should also be maintained to be clean and fresh."

"When I walk through the station at night, I often feel unsafe because it is dark. I think that cameras and good lighting will contribute to the feeling of safety."

"Charging is not that interesting as a primary facility. Secondary this could be possible, but given the travel distances this is actually not necessary

Results of choice task two – Space constraints

Which functions are important to respondents?

In addition to the "score" choice task showcasing the importance of the various attributes, respondents participated in a "space" allocation choice task. As chapter 6 already mentioned in more detail, respondents adjusted sliders to distribute available space based on their priorities. The sliders are initially placed in the centre (0,5) providing a neutral baseline for space allocation. At 0,5 all functions are included in the design and there is an optimal allocation of space. Respondents got to adjust the sliders based on their space allocation preferences. Adjusting to 0.0 means there is no space allocated to a certain function, while adjusting to 1.0 means the maximum available amount of space for this function is being assigned. The results reveal distinct trends that align with the preferences previously observed in the "score" choice tasks. Figure 13 showcases the average space allocated to each of the functions.

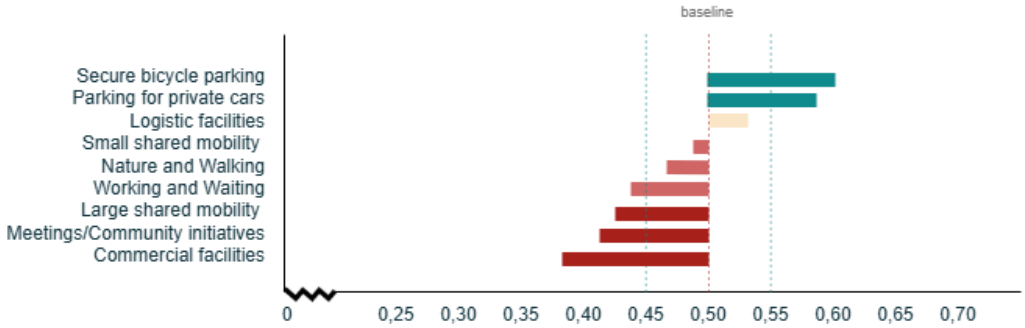

Figure 13. Average score of respondents on each of the functions in the "space" choice task

NOTABLY HIGH-ALLOCATED ATTRIBUTES

Secure bicycle parking emerged as one of the most favored functions, with respondents increasing its space allocation well beyond the baseline (0.61). This aligns with the high scores given to improving bicycle parking in the scoring task, reinforcing the strong demand for secure, covered bike storage solutions. The emphasis on bicycle parking suggests that respondents see cycling as a critical component of mobility hubs, warranting dedicated infrastructure to support it. Similarly, parking for private cars receives a quite large share of the space (0.58) indicating that, while shared mobility is a general hub focus, personal vehicle parking remains a priority for many.

NOTABLY LOW-ALLOCATED ATTRIBUTES

Logistic facilities, small shared mobility, and nature and walking were allocated slightly below the baseline, suggesting moderate support for these functions. Also notable is the lowest amount of space is, on average, allocated to commercial facilities (0.37). This is a bit of a contrast with the relatively high scores this segments received in the previous choice task. Respondents may value these amenities but prioritize mobility related infrastructure and vehicle accessibility, which require less space in proportion to one another. This significant difference between scores and space suggest there is a need form compact, multi usable design options that integrate commercial function without comprising mobility features.

Overall, the space allocation trends reinforce the insights derived from the score-based task, painting a comprehensive picture of the priorities shaping shared mobility hubs. The findings highlight a strong emphasis on cycling infrastructure, sustained interest in private vehicle access, and relatively lower prioritization of communal and commercial functions. These results provide crucial direction for planners and policymakers aiming to design mobility hubs that align with user preferences.

Which features characterize the respondent segments?

For the “space” choice task, a two-cluster solution was chosen instead of the three clusters identified in the “score” choice task. This adjustment was driven by the observation that the characteristics defining Clusters 2 and 3 in the “score” choice task had merged into a single, more unified cluster in the “space” choice task. By combining these two groups, the interpretability of the clusters improved significantly, allowing for clearer insights into spatial preferences and mobility behavior. A complete cluster overview of the “space” choice task is provided by table 6 and the cluster statistics for the “score” choice task are provided by appendix F.

The first cluster represents urban mobility optimizers, who prioritize shared and sustainable transport solutions, including bike-friendly spaces, safe parking, and community-driven environments. These individuals align strongly with the Cluster 1 profile from the “score” choice task, reinforcing their preference

for integrated slow modes, public transport, shared mobility, and social engagement within urban settings. The second cluster, in contrast, embodies the car-oriented space seekers, highlighting a dominant reliance on private car infrastructure and environments tailored for independent transport. This cluster merges Cluster 2 and Cluster 3 from the “score” choice task, consolidating both practical facility users and car-dependent individuals into a single private space-focused category. This refined approach ensures that the clusters capture clear behavioral distinctions, providing better insights into how different user groups interact with public space and transport infrastructure.

Table 6. Cluster overview of "space" choice task

	Cluster1	Cluster2
Cluster Size	62%	38%
Indicators		
Small shared mobility (e.g. e-bikes)	0.56	0.37
Large shared mobility (e.g. e-cars)	0.52	0.27
Secure bicycle parking	0.59	0.63
Parking for private cars	0.43	0.82
Nature and Walking	0.51	0.41
Logistic facilities	0.53	0.53
Meetings and Community initiatives	0.52	0.23
Working and Waiting	0.46	0.41
Commercial facilities	0.37	0.37
Covariates		
Age		
18 until 24	22%	3%
25 until 34	22%	10%
35 until 44	20%	16%
45 until 54	16%	29%
55 until 64	12%	29%
Older than 64	8%	13%
Gender		
Male	56%	46%
Female	40%	54%
Remaining	2%	0%
Education Level		
Higher professional education (HBO)	37%	26%
Secondary vocational education (MBO, all levels)	6%	22%
Higher secondary education (Havo, Vwo)	10%	3%
Lower secondary education (KB, BB, Mavo)	2%	0%

University education (WO)	43%	49%
Relationship with Zwolle		
Visiting friends or Family	4%	6%
Going to school in Zwolle	2%	0%
No direct relationship	33%	19%
Working in Zwolle	8%	26%
Living in Zwolle	51%	48%
Car ownership		
Yes, I own 1 car	49%	71%
Yes, I own more than 1 car	8%	22%
No, I do not own a car	41%	7%
Most used transport mode		
Bus, tram or Metro	0%	3%
Private car	14%	67%
Bike	61%	10%
Walking	10%	13%
Train	14%	7%

Cluster features

Table 6 showcases that, with 62% of the sample, Cluster 1 represents *"The flexible mobility optimizers"*. This cluster represents a dynamic group that values shared and sustainable mobility, embracing bike-friendly spaces and community-driven environments to create interconnected, accessible cities. Their spatial preferences reveal a strong emphasis on small shared mobility (0.56) and also on large shared mobility (0.52). This suggests that these individuals prioritize environments that support bike-sharing, e-scooters, and communal transport options over a private car-oriented infrastructure. This is confirmed by their relatively low space allocation towards car parking (0.43 vs. 0.82 in cluster 2).

"Important facility for the first/last part of the journey, which takes up less space. Moreover, it is good to encourage cycling."

Their great appreciation and space allocation for safe bicycle parking (0.59) further reinforces the idea that cycling plays a vital role in their daily transport habits. Interestingly, they also score relatively high on space for meetings and community initiatives (0.52), signaling an engaged and socially active population that values shared urban spaces. As they show moderate interest in commercial facilities (0.37) as well as to working and waiting facilities (0.43), it can be concluded that their preferences lean mainly towards environments that support social interaction and efficient mobility. Demographically, this cluster is significantly younger, with 44% of the cluster between ages 18 and 34. Men are slightly more represented (56%), and a substantial percentage of 80% has finished either university or higher professional education. Their approach to transport is clear: 41% do not own a car, relying on bicycles (61%) as their primary mode of transport, while only 14% use private cars.

"Space for the neighbourhood, literally and figuratively. Especially the new development areas are difficult to connect to the existing neighbourhoods. Hubs can bridge this gap."

Cluster 2 represents the remaining 38% of the respondent sample. Unlike the respondents in cluster 1, these individuals prioritize private transportation and structured spaces, they prefer convenience and independence, shaping urban areas around efficient car access and infrastructure. This cluster is well described as *"The Car-Oriented Space Seekers''*, reflected by their outstanding high score for private car parking (0.82). Rather than embracing shared mobility, this group de-emphasizes smaller and larger shared mobility spaces, with scores of 0.37 and 0.27 respectively. This suggests a strong inclination toward personal transport over communal alternatives.

"Small shared mobility is at the expense of cars for residents and tourists. And walking in the city becomes less safe."

"Nature is important, but I don't associate this with an urban hub."

Their interest in nature walking spaces (0.41) is lower than in Cluster 1, showing that while they appreciate access to outdoor areas, it is not a primary focus. Similarly, their engagement in community initiatives (0.23) is significantly lower, indicating a preference for independent rather than collective spatial use. This cluster represents an older age distribution, with 58% between 45-64, and another 13% aged 65 and above. Women make up a majority (54%), and education levels remain high, with 49% holding university degrees. However, their lifestyle centres around car ownership: 71% own one car, and 22% own more than one, demonstrating a high reliance on private vehicles. Their transport habits reinforce this, as 67% use their own cars, while biking (10%) is far less common.

Overreaching features

"Travelers should be encouraged to travel to the hub by bike. The presence of bicycle parking spaces is crucial."

Despite their differences, both clusters reveal insights into how people interact with urban spaces. One very clear shared priority stands out: safety. Whether through secure bicycle parking (~0.61), or logistic facilities including surveillance, lightning and first aid (~0.53). Both clusters emphasize the importance of well-maintained spaces that enhance security. Regardless of mobility preferences, this common thread suggests that a sense of safety and stability is essential to urban space planning, influencing decisions in both groups. This highlight towards safety will also emerge in the qualitative analysis part of this chapter.

"Takes up little space and is very practical! So it provides a lot of convenience and luxury compared to the amount of land used"

Sub-Question 4. How do different user groups vary in their preferences and trade-offs regarding mobility hub features, based on PVE data?

PVE results show clear contrasts between user groups in the "score" choice task:

- *Bike and Public Transport Enthusiasts (56%)* prioritize integration with public transport and secure bicycle parking, and accessibility. They mainly reject car-related infrastructure, and are have a slightly higher representation of young and male respondents.
- *Practical Providers (22%)* focus on convenience and daily functionality. They prioritize mainly public and facility related attributes like car parking, supermarkets, Wi-Fi and good waiting areas. They show low interest in shared mobility or community features.
- *Car-Oriented Comfort Seekers (22%)* place a very high value on car infrastructure and universal accessibility, and are less interested in digital amenities or sustainability. This group is mainly represented by older, female, and car-dependent respondents

In the “space” choice task, the cluster distribution slightly changes. Cluster 2 and 3 from the previous analysis showcased such great similarities they were bundled into one cluster to gain interpretability.

- *The flexible mobility optimizers (62%)* show priorities that align with their earlier shown preferences towards shared and flexible mobility. They highly value bike parking and all kinds of shared mobility. Representing a younger and bike dependent respondent group.
- *The Car-Oriented Space Seekers (38%)* assign almost all their space to car parking, closely followed by bicycle parking and logistic facilities. The respondents are slightly older and all respondent in this cluster own at least one car, also using this as their main mode.

Across both choice tasks, clear overarching priorities emerge that overrule the differences between the respondent clusters. Social and physical safety stands out as a unifying concern, reflected in the consistent appreciation for lighting, surveillance, secure bicycle parking, and first aid facilities. This strong emphasis indicates a shared demand for mobility hubs that foster a secure and welcoming environment. Additionally, the presence of integral toilets and seamless integration with public transport are highly valued across all clusters, underlining a universal preference for practical and accessible amenities. These findings point to a collective vision for mobility hubs that prioritize safety, convenience, and connectivity.

Qualitative Insights from Open-Ended Responses

In addition to the quantitative choice data, the PVE includes open-ended response fields, allowing participants to elaborate on their preferences and explain why they made certain choices. These qualitative responses offer additional context to the numerical outcomes and help uncover motivations, perceived barriers, and deeper community values that might not be fully captured otherwise. As described in the methodology (Chapter 4), an inductive thematic analysis is conducted to identify recurring patterns and underlying themes in participants' reasoning (Braun & Clarke, 2006). The grouping of qualitative themes provides a richer understanding of the public’s views on the design and function of mobility hubs. The attributes highlighted in this qualitative analysis are shown in table 7 and are divided into 4 categories: high and low scoring attributes with either consensus or differences among the defined clusters.

Table 7. Overview of selected attributes for the qualitative analysis

High scoring attributes with ***consensus*** **among clusters**	**Low** scoring attributes with ***consensus*** **among clusters**	**High** scoring attributes with ***differences*** **among clusters**	**Low** scoring attributes with ***differences*** **among clusters**
Include public toilet and fully accessible restroom	Add charging stations for electric bikes, scooters and cars	Realize parking spots and accessibility for private cars	Provide more shared mobility options
Improve integration with public transport	Offer workspaces or flexible office spaces	Integrate a supermarket or to-go shop	Ensure Wi-Fi and charging points are available
Implement good lighting and CCTV for improved safety	Offer luggage lockers for travelers		

High scoring attributes with consensus among clusters

INCLUDE PUBLIC TOILETS AND FULLY ACCESSIBLE RESTROOMS

Including publicly accessible toilets in mobility hubs is considered important, essential, and necessary by 65% of respondents. There is a widespread feeling that there is a significant shortage of public toilets in the Netherlands in general, and specifically in Zwolle, which is a major problem. Respondents emphasize that it's "one of the most important facilities at a transfer point", and that "there is always someone looking for a toilet", making this a fundamental need and a "prerequisite for an accessible city". Placing them at a central point like a mobility hub is considered logical, particularly in residential areas where public toilets are often lacking.

Toilets are seen as a crucial amenity when travelling, they offer a necessary alternative to having to enter a cafe or restaurant, especially in locations without nearby facilities. Respondents like a "24-hour availability" concept, which makes a journey more pleasant and comfortable. There are even some respondents mentioning the availability of a toilet "can be a direct reason for people to use the hub instead of their car", many conclude that it would make a hub more attractive.

This amenity is also considered critically important for specific user groups. This includes women, older people, children, people with specific medical conditions, visitors to the city, and people without housing. It is viewed as essential for the accessibility and fairness of public space for these groups. However, respondents do also mention that the success and usability of these toilets greatly depend on cleanliness. Many state they would not use them if they are not clean, despite the need. Regular maintenance and cleaning are thus deemed essential. Safety and lighting at the facility locations also mentioned as important accompanying factors.

IMPROVE INTEGRATION WITH PUBLIC TRANSPORT

Based on the provided sources, integrating public transport is viewed as crucial and essential for the success and functionality of mobility hubs. Many respondents feel that a hub is "chanceless" or "can only work" if public transport is available to facilitate multimodal, onward travel. It is considered a "prerequisite" for a hub to be well-used by more people than just those living nearby.

A key benefit highlighted is the ability to enable smooth transfers between different modes of transport. This makes it easier to use public transport if connections are good and not too much time is wasted, leading to a smoother door-to-door journey. Everything being close together and coordinated improves quality. Improving integration makes the alternative to the private car better. It's seen as one of the main items of importance if you want "to get people out of their car". Respondents state this would encourage travelers to leave their car at home, or park them at the edge of the city centre using another mode for last mile travel.

Integrating public transport ensures that "everyone can use the hub and reach their destination, not just those with cars or bikes". Public transport is considered something that "every person uses sometimes", but factors like affordability and frequency are mentioned as important potential burdens. Some respondents expect cost and long waiting times to be a problem. Statements of respondents highlight that public transport or other mode options should be quick, punctual, and safe to be suitable for "last mile" or "first mile" travel. The shorter the transfer times, the better these hubs and their public transport can compete with private cars.

Hubs and their public transport connections need to be easily and quickly accessible from the city centre. Some respondents even suggest that proximity (walkability) towards a hub location might be even more important than the OV network itself. Several respondents also highlight the fact that public transport helps

to keep the hubs (and the city) accessible for all user groups, including elderly and people with decreased mobility.

IMPLEMENT GOOD LIGHTNING AND CCTV FOR IMPROVED SAFETY

Safety around the hubs is considered overwhelmingly important, essential, and fundamental for the successful functioning and use of mobility hubs. Many respondents emphasize that safety is "always important", "crucial", and stating it is a "no doubt, requirement". Both physical safety and the feeling of safety (social safety) are highlighted as primary requirements for the hub to function and are necessary for people to feel comfortable using it. Unsafe environments can be a significant reason for people not to use facilities like parking garages or even walk on the street. Feeling safe is presented as one of the main preconditions to use the mobility hub, good safety is assumed to promote and encourage use.

Good lighting is consistently mentioned as a crucial element for improving safety, as it directly contributes to the feeling of safety, particularly at night. Good lighting is also hoped to reduce vandalism. Camera surveillance, is also viewed by many as a good contribution, it is seen as a way to “secure belongings and vehicles”. In addition respondents mention it will prevent unwanted behavior, vandalism, theft, and criminal activity, making sure the hub from does not become a hangout spot for undesirable individuals.

However, there are also some concerns regarding CCTV. Concerns are raised about privacy and potential misuse of data by authorities. Some respondents feel that “cameras alone might provide a false sense of security”. These people state that having actual people present at the hub, or designing the space in such a way there are no dark, isolated areas is more effective. Thus while some respondents doubt the camera surveillance, good lighting is appreciated and considered necessary by all.

Low scoring attributes with consensus among clusters

ADD CHARGING STATIONS FOR ELECTRIC BIKES, SCOOTERS AND CARS

While adding charging stations for electric bikes, scooters, and cars is seen by many as logical, and potentially contributing to the stimulation of electric mobility and sustainability, there is a significant perspective among respondents that these charging stations are less important or not as critical when compared to other features of a mobility hub.

Several reasons are given for viewing charging stations as having less priority or being less essential. Some respondents explicitly state they are “not as interesting as other primary attributes”. Charging points are seen as "Secundair", and respondents mention they feel like the other attributes “deserve the investment more”. A key reason for this perspective is that many users can already charge their vehicles at home. For electric bikes and scooters, respondents mention noted that "you can charge these smaller electric vehicles inside your home". Additionally, some feel that for electric bikes, they " often have enough capacity to drive back and forth to the destination", suggesting that for shorter distances, charging elsewhere isn't always necessary.

While acknowledging the amount of electric vehicles will increase in the future, some respondents feel that “extensive charging infrastructure might not be needed at this time”. One respondent in particular mentioned they did not see this attribute fit in the energy transition Zwolle is facing at this point.

OFFER WORKSPACES OR FLEXIBLE OFFICE SPACES

The offering workspaces or flexible office spaces at mobility hubs is acknowledged as a "Nice to have", but there is a significant perspective among respondents that these facilities are less important, unnecessary, or not a priority for a mobility hub. Many respondents explicitly state that workspaces are less essential as the core function of a hub is assumed to be a transport and logistics location, not a meeting space.

Respondents mention they feel “funding shouldn't be wasted on this”. Investments should be in practical amenities and safety, rather than functions like workspaces.

A common sentiment is that there are “other, more suitable places for working”. Respondents mention that people can already work from home or go to the library. Furthermore, many respondents feel that workspaces are “not applicable to their personal situation” which decreases their sentiment towards this attribute. Respondents also mention that purely accounting for the waiting time between modes, this “time might be too short to set up a workspace”.

Some respondents feel that adding functions like these could make “the scale of hub too large” and potentially "take away similar opportunities elsewhere". Of course there is also some positive sentiment, some respondents feel that “at larger hubs it is useful if you can work’’ and other view mobility hubs as " nice accessible places to share workspaces, where people come together, at the start and end point of their journey". However, even these positive sentiments are not accompanied by very large scores towards this attribute.

OFFER LUGGAGE LOCKERS FOR TRAVELERS

Offering luggage lockers for travelers is seen by some as "convenient" and assumed to add “add value and comfort to the passenger", allowing users to “explore the city unburdened” or store heavy items temporarily, there is a significant perspective among respondents that these lockers are not a priority for a mobility hub.

Many respondents explicitly state that luggage lockers are “least important in my opinion” or simply “not important enough”. Respondents expect limited use of luggage lockers in small scale mobility hubs and offer insights like “luggage lockers located at central stations seem like a more logical idea to me”. According to the respondents, the utility of luggage lockers is “very dependent of the location”. Another mentioned point is that travelers that arrive to the hub by car could leave their luggage there. Making a case for more parking facilities instead of luggage storage. Finally respondents mention that travelers will most likely “take their luggage with them due to safety concerns”, circling back to a reoccurring theme of trust and security.

Comparable to the previous attribute, also here respondents mention that there should be a distinction between secondary and basic provision. Attributes like luggage lockers are considered “nice, but not necessary” to the basis functioning of a hub. Respondents wonder whether “it adds anything" to the hub.

High scoring attributes with differences among clusters

REALIZE PARKING SPOTS AND ACCESSIBILITY FOR PRIVATE CARS

78% of the respondents took the time to explain their choices when it comes to private car parking and accessibility. For many this attribute is exceptionally important, essential, and a fundamental requirement for mobility hubs to function effectively and achieve their goals. Many see it as a crucial starting point and endpoint for a journey, emphasizing that sufficient space must be available for parking one's vehicle. It is explicitly stated that if this is not possible, the hub “will not function as a hub”. For some, it's considered the "most important part" of a hub. An important consideration is that many of the statement have an underlying motivation, where respondents seem scared creating mobility hubs involves relocating current resident parking. Concerns are raised that residents should not be "negatively affected by mobility hub plans" and that many travelers are not yet ready to “give up using a private car”.

Respondents state that car parking “enables people, particularly those coming from outside the city, to easily reach the hub”. In addition many state that “the car is the primary mode of transport” and that is the only mode used to “reach the hub before potentially switching to another mode for the last mile". According

to many respondents car parking will help with facilitating modal shifts. Offering accessible and appealing car parking at the hub is seen as necessary to "seduce" and “activate" people to use alternative transport modes. The hub needs to be an "attractive alternative" to driving into the city centre.

However, despite this strong support, there are clear differences in perspective among the previously defined clusters. To some respondents, offering parking for private cars is deemed less important or even unnecessary. Few respondents mention they “do not own a car”, or they are not planning to access hubs by car. Others mention that they feel car parking is only necessary at “certain hub locations, particularly those serving as major transfer points”. They deem parking to be less important for smaller hubs focused more on public transport and amenities.

There is also a share of respondents that puts a clear focus on alternatives. They feel “ the emphasis should shift away from private car ownership and use”. While they also understand the need for current car owners. Finally, some respondents feel the mobility transition requires "extra investments in many other options”, stating that "just realizing parking spots will not solve the mobility transition Zwolle is facing.

INTEGRATE A SUPERMARKET OR TO-GO SHOP

For many, the integration of a supermarket is seen as highly convenient and beneficial. It caters to immediate needs like “grabbing food on the go” and "last minute essentials on the road". A key benefit frequently mentioned is the potential to combine trips or have the mobility hubs serve as a "one stop shop" location, thereby "reducing movements and the amount of trips”. For many respondents, it makes sense to "do your shopping at the hub before you go home", especially functional it is “part of the chain mobility concept”.

Beyond mere convenience, these facilities are seen as contributing positively to the hub environment. They can be “good for the liveliness and overall experience/service” and are considered "important to generate social buzz/attraction at larger hubs”. Significantly, the presence of people and activity from shops is believed to “promotes visits and therefore create a sense of safety”. As previously pointed out in this section, safety is a key feature to a lot of the respondents. Finally there are several respondents mentioning that integrating a to-go shop would “increase the livability of a neighborhood”.

However, there is also respondents that view these (commercial) facilities as less essential or even unnecessary. Reasons for this viewpoint include the belief that such facilities might not be financially viable or "work out for an operator”. The concern is raised that realizing these facilities could lead to a “building for vacancy” situation, while it might lose the primary function of the hub. A advice from the respondents is to “make a hub simply what it should be”. A final concern is raised about potential negative impacts, such as supermarkets bringing "a lot of noise from large freight traffic”.

There are also nuanced views suggesting these facilities are only appropriate in specific contexts, stating they “can be better implemented in larger hubs" or are more beneficial "at central stations". Even when desired, the focus for a supermarket is often that “minimal is sufficient”. For residents using the hub to pick up groceries, it's critically important that they simply “continue to reach their own homes” with those groceries, which relates back to the importance of the last mile connection from the hub.

Low scoring attributes with differences among clusters

PROVIDE MORE SHARED MOBILITY OPTIONS

The concept of integrating shared mobility options at mobility hubs receives mixed but often passionate responses. While many view it as a crucial component for a functional hub, others consider it less important or fraught with challenges. For a significant number of respondents, shared mobility is seen as essential for

completing the journey after arriving at the hub, particularly for those coming by car or public transport. It is frequently mentioned as the key for “arriving quickly and more easily at a destination”.

For many, adding shared modes is “necessary to be able to continue the journey after parking the private car”. The ability to seamlessly switch to another mode is highlighted as a the most important for stimulating the transfer between private car/public transport and shared mobility. Respondents mention that shared mobility options are providing flexibility and are “helpful for people that don't have their own bike or scooter”. It is also specifically mentioned as being useful for young adults.

Using shared mobility is seen as a way to potentially “reduce the use of private cars” in or around the city centre. Some respondents are greatly enthusiastic and mention ‘’in case there will be a shared car or mobility hub in my neighborhood, I will get rid of my personal car”. Also the idea of shared cargo bikes is mentioned as a possible replacement for short car trips. Furthermore, having shared mobility available can also reduce waiting time and potentially lessen the perceived need for individuals to purchase their own vehicle. Availability however, brings a positive and negative association. Where some respondents mention they appreciate the fact that “you can use it at any given point”, others are worried “it might not be available when I did count on it”.

In addition to availability, there is a large share of respondents who view shared mobility as significantly less suitable. A direct reason for this is that respondents simply “use their own bike” or prefer not to use a shared car or scooter. A significant concern raised by several respondents is the misuse and poor treatment of shared mobility. They note that vehicles are **“**not always treated neatly and are dumped where they are no longer needed”. Witnessing scooters **“**scattered everywhere” leads to frustration and a feeling that the idea is great but fails in practice due to people's behaviour. Shared bikes and scooters are even referred to by one respondent as becoming **“**a bit too much like disposable items”. This negative experience leads some to believe that shared mobility will never work as people “evidently handle it poorly”.

Ensure Wi-Fi and charging points are available

The provision of Wi-Fi and charging points at mobility hubs has a lower overall priority by many respondents compared to other potential hub features. For those who see value in these attributes, the core arguments revolve around connectivity, convenience, and addressing practical needs. Wi-Fi is deemed “necessary for tasks like planning journeys, booking tickets, making payments, and finding travel information online”. It is particularly highlighted as useful for youth who might have limited data bundles. Running out of phone battery or 4G credit is mentioned as a scenario that can lead to feeling unsafe due to inability to communicate if something goes wrong.

There are several respondents noting that these attributes become increasingly necessary, especially with reliance on mobile train tickets. Conditional support however exists, suggesting Wi-Fi and charging are only convenient and pleasant if combined with other amenities such as good waiting areas. A few respondents also mention that for Wi-Fi to be useful, it needs to be " well-secured Wi-Fi”.

In contrast, a substantial number of respondents consider Wi-Fi and charging points less important, with the most frequently cited reason “the excellent 5G mobile network coverage in the Netherlands”. Some view Wi-Fi as merely a "luxury” and not essential. Several responses explicitly state it's "not needed” and that people are “personally responsible” for these amenities.

Furthermore, there are strong concerns about the potential negative consequences of providing Wi-Fi and charging, particularly related to encouraging prolonged stays. Respondents mention mobility hubs should “only have a practical function and are not a place to stay”. There is a significant fear that providing amenities like Wi-Fi and charging could create a “hang-out spot”, linked to concerns about attracting

"wrong people" and creating feelings of unsafety for residents or other users. Some respondents feel that these attributes could actually become "a risk for vandalism".

Additional consensus in "space" choice task

In addition to the analysis of the attributes in the "score" choice task, there is one notable function in the "space" choice task that scores the highest on average and with great consensus among clusters: *Realizing secure (safe and covered) bicycle parking spaces.*

The provision of safe and secure bicycle parking at mobility hubs emerges as a critically important and widely supported feature, demonstrating a high degree of consensus among respondents. Unlike some other amenities, this is often perceived less as a luxury and more as a basic necessity and a crucial prerequisite for using the hub effectively. Its importance is highlighted by many as the "most important item". The primary motivation cited for this strong support is the pressing need for security and protection against theft and vandalism. Many respondents mention personal negative experiences, such as having a "Bike already stolen twice" or acknowledging that "Bike theft is a big problem" and "enormously annoying". The need for bikes to be parked "well-guarded" and the importance of "social safety" are frequently emphasized. This feeling of security is not just about the bike but also contributes to travelers "feeling safe and choosing public transport more easily".

Addressing the existing problems with current bike parking facilities is another key driver for this requirement. Respondents point out a significant shortage of good safe bike parking facilities and point out that existing facilities are often **"**insufficient", "too small", "located too far from destinations". Hubs are assumed to contribute to this shortage. Besides, secure parking helps prevent the **"**cluttering of city centres with parked bikes", appreciating that is frees up public space.

Respondents frequently link safe and secure bike parking directly to the stimulation and encouragement of bike use to access the hub. It is seen as an attribute that "ensures that more people use the bike to go to the hub". Respondents mention it will lower the threshold for cycling and highlight the importance as the "most used and most sustainable mode of transport in the Netherlands". But while covered parking is seen as a great feature that can make a facility more attractive, it is often explicitly stated that safety is the key feature for the respondents to allocate space this bicycle parking attribute.

Sub-Question 5. What additional insights do the qualitative PVE responses provide, and how do these enrich the interpretation of quantitative results?

The qualitative responses enrich the PVE data by explaining motivations behind preferences. A recurring theme across almost all attributes is safety, not just physical safety, but also the perception of security. Whether discussing good lighting, toilets, bike parking, or even Wi-Fi and shared mobility, respondents consistently link the success of a hub to how safe and trustworthy it feels. Secure bicycle parking is valued for preventing theft, public toilets are mainly appreciated if clean and safe. Also concerns about shared mobility misuse and the genesis of unsafe, unmonitored areas attracting the wrong kind of people emerged. These insights show that beyond functionality, a sense of safety underpins public acceptance and usage, shaping how users interpret and prioritize every hub feature.

8. Expert Interviews

To provide additional depth and insight into the potential of using PVE (and its results) for the design and integration of mobility hubs in urban environments, two expert interviews were conducted. These interviews aim to support the answer to the final sub-research question and to reflect upon the overall analysis with perspectives from professionals directly involved in mobility planning and policy.

The first interview was held with the project manager of Zwolle's Adaptive Development Strategy for Mobility hubs, who also brings extensive experience as a policy advisor in the field of mobility. The second expert is one of Zwolle's official principal for mobility projects, who initiated and commissioned Zwolle's previous multimodal mobility hub projects as well as future hub-related initiatives in the region. Prior to the interviews, both experts were clearly informed about the outcomes and findings of the PVE conducted for this research. This ensured that their reflections and responses could be directly linked to the citizens' input gathered through the evaluation.

The experts provided valuable insights into the current decision-making processes, and their views on the relevance and potential of incorporating PVE as a participatory method and design help for hubs. This chapter presents an overview of the interview questions and summarizes the key points raised by the respondents. Their perspectives help to contextualize the findings of this research within real-world planning practices and offer practical considerations for the use of PVE in this domain.

The interview questions were specifically designed to build on the results of the TIS and PVE analyses. They aimed to explore how the findings could inform policymaking, implementation strategies, and institutional routines. By focusing on the policy dimension behind the data, the questions sought to reveal how expert stakeholders interpret citizen input and whether they see value in integrating these participatory insights into ongoing planning and design processes.

European case studies

In relation to the European case studies that were done for this research (see chapter 5), the experts got the following question: **"WHEN GOING THROUGH YOUR USUAL PLANNING PROCESS FOR MOBILITY HUBS, DO YOU ALSO LOOK AT EXISTING HUBS? EITHER IN THE NETHERLANDS OR IN EUROPE, TO SEE WHAT HAS BEEN DONE THERE, AND WHETHER THOSE CASES COULD INFORM OR INFLUENCE THE CHOICES YOU MAKE FOR NEW HUB DEVELOPMENT HERE?"**

The interviews revealed a nuanced perspective on the extent to which existing mobility hubs, both within the Netherlands and abroad, influence local planning practices. Both experts acknowledged that looking at other cases, particularly successful or innovative hubs, is indeed part of the broader policy process, but their responses suggest this practice is often limited in depth or formality.

One expert emphasized that a scan of existing knowledge is a standard part of these kinds of projects: *"What do we know about it nationally and are there specific points of interest and elements we can take from abroad?"* This information sourcing is mainly done through knowledge depots initialized by the ministry. However, he also highlighted that policymakers, especially under pressure, often move on quickly to focus purely on their own context. There is a sense of: *"Let's not spend too much time on this, because it's all different in another city."* This reflects a tendency to prioritize local relevance over external examples, especially under time constraints.

The second expert was more skeptical about the influence of existing hubs on concrete decision-making. According to him, references to other hubs often serve more as visual or conceptual inspiration than as guiding examples for policy: *"It often sticks to some nice pictures of very cool, often self-contained, unique locations... but whether it's really used as input we base our direction on? I don't think so."*

Overall, while existing mobility hubs do serve as sources of inspiration and knowledge in the planning process, their practical influence on decision-making is very limited. Gaining information from other hubs is quickly disregarded, but could offer insights and prevent mistakes from happening on multiple occasions. Talking to the experts shows there is room to improve the use of broader knowledge networks and lessons learned elsewhere.

Participation and Citizen influence

After the introduction and the question about the European hubs, the experts were asked to give their personal point of view on the influence of consumers into decision-making. **"ON A MORE PERSONAL NOTE, HOW DO YOU VIEW THE ROLE OF CITIZEN INFLUENCE IN DECISION-MAKING? DO YOU THINK IT'S IMPORTANT THAT CITIZENS HAVE THE OPPORTUNITY TO EXPRESS THEIR VIEWS? AND TO WHAT EXTENT DO YOU BELIEVE THEIR INPUT SHOULD OR COULD ACTUALLY INFLUENCE FINAL DECISIONS?"**

Both experts emphasized the importance of citizen involvement in the development of mobility hubs, though they also pointed to certain conditions and limitations that should guide its implementation. According to expert one, the added value of public input depends significantly on the phase of the project. In the early stages, when many decisions are still open, citizen perspectives can offer essential guidance: *"It is certainly valuable to gather the opinions of future users early on, especially when many things are still unclear. It helps to channel ideas and reflect on who we are really doing this for."* He also pointed out that early input can prevent policymakers from prematurely closing off options based on internal assumptions: *"Often, policy staff take a stance too quickly: 'this isn't important' or 'this can't be implemented.' In that sense, citizen input can act as a mirror and help focus the discussion."*

The second expert echoed this view, while also mentioning the need for clear communication as to which extend the public influence reaches. He also highlighted the added value of PVE's structured approach. Unlike traditional surveys that only collect preferences, he appreciated that PVE requires participants to consider trade-offs and consequences: *"What appeals to me is that intrinsic weighing of choices and the fact that it seems to really invite people to motivate their decisions, this sharpens the discussion. That's very valuable, especially since what we're building is meant for the neighborhood and its residents."* However, he also cautioned that citizen perspectives are often grounded in short-term, local concerns, and should be balanced with long-term societal goals: *"People tend to reason from the here and now. The challenge is to broaden that perspective."*

In relation to the experts personal view on the inclusion of consumers opinions, they were asked whether they tend to see tension between the opinions of people and the opinion and the final level of inclusion by policymakers: **"DO YOU OFTEN SEE THAT PROFESSIONALS AND POLICYMAKERS PERCEIVE BARRIERS WHEN IT COMES TO INCORPORATING CITIZEN OPINIONS? DO YOU FOR EXAMPLE EXPERIENCE TENSION BETWEEN THESE PARTIES WHEN THEIR VIEWS DIFFER SIGNIFICANTLY? AND DO YOU THINK SUCH DIFFERENCES MAKE IT MORE DIFFICULT TO ACTUALLY USE CITIZEN INPUT IN PRACTICE?"**

Both experts acknowledged that tension often arises when it comes to incorporating citizen preferences into policy plans, especially when these preferences do not align with professional or political expectations. This tension is particularly evident when decisions are already far along in the planning process or when professionals are closely involved in advising political leadership. One expert explained that *"you can end up in a tight spot if input from residents is requested at a stage when there's no real room left to make choices."* He also mentioned that the involvement of citizens may sometimes be perceived as delaying or complicating progress. *"Questions rise about the effects of incorporating preferences and the importance of this consideration, these are sometimes implicitly considered and sometimes even explicitly."* This

underscores the previously made point to carefully time citizen participation to ensure it is meaningful and not symbolic.

The other expert noted that the tension partly stems from the different perspectives at play. While professionals tend to work from long-term goals and broader societal interests, citizens often respond from their immediate, personal context. The expert emphasized the challenge is to decide *"if what you are doing is right for the here and now, how to ensure that you are also taking the right steps for the future?".* Still, he stressed the importance of embracing this tension rather than avoiding it, arguing that it can lead to more constructive movement: *"It's about shifting from tension to progress, rethinking how we integrate input from the present into powerful steps for the future."*

These insights highlight both the value and the challenges of integrating citizen input into mobility planning. While public preferences can offer important direction and reflection, their impact depends on timing, clear expectations, and a willingness to balance short-term local needs with long-term goals. When done well, this tension can however strengthen the planning process instead of it feeling like a burden or potential delay.

The PVE results

After a few broader questions about the integration of citizen perspectives, the experts were asked their opinion on the actual results of the PVE done for this research. Both experts had the opportunity to read through the results before answering the following questions. At first, a general question was asked about the potential value of the results: **"DO YOU SEE POTENTIAL FOR INTEGRATING THESE RESULTS INTO THE CURRENT PLANNING PROCESSES FOR MOBILITY HUBS IN ZWOLLE? DO YOU BELIEVE THE FINDINGS INSIGHTFUL ENOUGH TO BE OF VALUE AT THIS STAGE?"**

Both experts saw clear potential for integrating the results of the participatory process into the planning of mobility hubs in Zwolle. One expert explained that the municipality is currently at an important decision-making stage. *"The municipality is about to determine the programs of requirements for several hubs and take the next step in the planning process."* In this context, citizen preferences can help shape decisions around key elements such as the number of shared mobility spaces, bicycle parking, or facilities like toilets. He mentions that there are always amenities that *"come along more often and at the same time are threatened to become victim when the project meets their financial budget constraints and decisions are required."* The expert emphasized that *"the user perspective can be a very important benchmark"* when identifying what is essential and where there is room for flexibility.

The other expert emphasized the broader value of embedding this type of citizen input into ongoing urban development. He was already thinking how PVE could be incorporated. *"It could be a valuable tool in the participation strategy, it is interesting to see how it could hitch on to current processes in the existing parts of the city."* The expert mentions his main interest here comes from the deeper layer that seems to be hiding behind the citizen choices in regards to the space they give to certain attributes. The expert expressed his understanding and appreciation for the added value of using digital participation methods to reach a more representative group. However, he mentioned that he sees great fit for PVE as part of a more *"layered participatory approach"* where the digitally gathered data could function as a base layer for a *"focus group style session".*

After gaining some knowledge on the general view of the experts on the PVE results, they were asked about particular results that stood out to them. **"WERE THERE ANY RESULTS THAT STOOD OUT TO YOU AS PARTICULARLY RELEVANT, OR PERHAPS LESS RELEVANT, FOR INFORMING POLICY DECISIONS? WERE THERE OTHER ELEMENTS THAT ARE OFTEN OVERLOOKED OR UNEXPECTEDLY CONSIDERED IMPORTANT?"**

The experts identified several results from the PVE that stood out as unexpected and potentially relevant for informing policy decisions related to mobility hubs. In particular, both experts noted the relatively low importance participants attached to electric vehicle charging infrastructure, which contrasts with current policy assumptions and regulatory obligations in this field. One expert reflected: *"What stood out to me was how little importance was placed on charging points. That's interesting, because there is legislation requiring a certain percentage of charging spots in any new facility. This suggests it might be time to reconsider how critical we believe this feature is for these mobility hubs."*

Similarly, the results surrounding parcel lockers were seen as insightful. One expert noted, *"Those parcel lockers didn't score high either. We've always assumed they're important, especially for businesses and dense neighborhoods, so that's also a surprising finding."* So, although these lockers are often considered essential for hubs, the relatively low scores challenged existing assumptions.

The second expert also noted the interesting reasoning behind the scores the participants assigned to commercial facilities. *"it is interesting they are considered important partly from convenience but also partly from a point of (social) safety."* Additionally, the experts highlighted an interest to the lower ratings for work-related and broader social facilities, raising the question on whether these should remain a focus in future hub planning. The expert concluded, *"These results send some interesting signals. They shouldn't be treated as absolute truth, but they certainly provide reason to reflect and adjust how we shape future development tasks."*

After finding out what deemed to be the most striking results according to the experts, they were asked to give there thought on how the results from the PVE could influence the prioritization of attributes in the hubs. "**WOULD YOU SAY THAT THESE RESULTS HAVE THE POTENTIAL TO INFLUENCE THE PRIORITIZATION OF CERTAIN ELEMENTS IN THE HUB DESIGN? FOR EXAMPLE, COULD THE HIGH SCORES FOR BICYCLE PARKING ACTUALLY LEAD TO ALLOCATING MORE SPACE TO IT?**"

According to the experts, the outcomes of the study indeed hold potential to influence the prioritization of elements within mobility hub planning *"I can't rule out that this provides a few real insights to reconsider certain things. It's important to remain flexible".* Although, as previously mentioned as well, the implementation comes with some limitations depending on the development phase of each hub. For hubs that are already in the final stages of design, the room for adjustment is considered limited. As one expert noted: *"There are two hubs already in the final phase, with preliminary and sketch designs in place. So the influence on those is a bit restricted, at least from what I can see."* However, this does not preclude the study's influence on future planning phases. The expert concludes that for as well upcoming hubs as maybe even citywide decisions, the results could *"give items a higher priority for subsequent developments that will be there."*

The second expert emphasized the value of adaptability in light of these insights. *"it is important to realize that in ten years, priorities towards urban and societal developments might change completely."* He would like to also take these study results as a stepping stone towards a more modular and context-sensitive approach. *"Looking to the future, you need to be flexible with the types of facilities you will or will not realize and you need to be able to easily shift among them as well"*

The expert reflections on these questions regarding the PVE results show the findings are meaningful and to some extend both unexpected and interesting. However, there is an agreement on the limitations for immediate implementation, especially in late-stage projects. Regardless, both experts see great fit for implementing these results and consider them insightful enough to guide future priorities and strategic decisions.

Physical and Social Safety

After the in depth questions on the PVE results, the experts were asked about safety. As seen in chapter 7 of this research, safety and maybe even more the perception and feeling of safety clearly stood out from the qualitative analysis. Besides the more obvious attributes regarding safety (for example: lightning and surveillance), many respondents also mentioned safety in combination with other hub attributes they assigned points. So the experts were asked about the current inclusion of safety in policy processes. **"THE RESULTS SHOW THAT RESPONDENTS ATTACH GREAT IMPORTANCE TO BOTH PHYSICAL AND SOCIAL SAFETY ACROSS MANY OF THE ATTRIBUTES. IS THIS ALREADY SOMETHING THAT IS CONSCIOUSLY AND SYSTEMATICALLY TAKE INTO ACCOUNT IN YOUR CURRENT (PLANNING) PROCESSES, OR DOES IT RECEIVE LESS ATTENTION?"**

The importance of both physical and social safety emerged clearly in the results, according to both experts this aligns with general concerns that are already known, though not always fully addressed. *"It is an important observation, I believe the municipality should take this seriously and actually follow up on it".* The first expert mentioned another example from the city where safety is a known issue, he mentioned the walkways to these city edge hubs can be experienced as unpleasant or even unsafe. He mentions that: *"from a urban planning perspective, suggestions were made to improve safety. However, it is not something that has been taken much further yet."* The expert finally highlights that it is important to incorporate the voices of vulnerable groups and people with strong attachment to (social) safety on a more advanced level.

The second expert reinforced this concern by pointing out the risk of underestimating safety when making practical or budget-driven decisions: *"You notice that when tough choices have to be made, safety elements are often the first to be scaled back."* He mentions that that this research underscores how essential social safety is to whether people will actually use the facilities being built. The results bring up questions about the role social safety should play in urban design. In his view, the PVE findings provide clear justification to prioritize safety: "*The results lead to questions about what the right intervention is when decisions need to be made and it sharpens the case that you probably shouldn't compromise on safety features. It's appears really essential in how people value these hubs."*

Altogether, both experts highlight that a growing awareness of physical and social safety must be more structurally included in the planning and design of mobility hubs. The insights from the PVE could not only reinforce current strategies but also serve as a call to take a look at how safety can play a part in future strategies and planning processes.

The Usefulness of PVE

To finalize the interviews, both experts were asked the, maybe most important, question upon further discussion and research. Namely, whether they think of PVE as a useful tool for the future: **"DO YOU THINK PVE IS A USEFUL TOOL TO INVOLVE CITIZENS IN SPATIAL AND MOBILITY PLANNING? WOULD YOU LIKE TO KEEP USING THIS METHOD IN THE FUTURE, OR WOULD YOU PREFER TO RELY ON MORE TRADITIONAL INSTRUMENTS THAT ARE ALREADY IN USE?"**

From both the expert's perspective, PVE seen as a valuable addition to the existing set of participatory instruments the municipality uses. One of its key strengths lies in its accessibility and reach, allowing a broader and more diverse group of citizens to be involved compared to traditional public meetings. Expert one also highlights once again that PVE can help balance the choices made by policy makers. *"As a policy maker, you can easily catch yourself entering a form of tunnel vision, instead of really keeping an open mind to the outside. PVE can help make more balanced choices, based on how important attributes are deemed".*

The second expert mentions his appreciation of PVE for its ability to help participants understand trade-offs between policy options. *"PVE helps translate the impact of choices. People start realizing: if I choose this, I can't also choose that. That awareness simply doesn't come through in most traditional tools."* Rather

than just expressing preferences, citizens are confronted with real-world constraints, which helps generate more informed input.

Interestingly both expert agree they see much further potential in using PVE not only as a standalone instrument, but a part of a more layered system. *"I think, certainly when you are a bit further along in the planning process, it is very interesting to use these PVE results in smaller groups and physical meetings. Show people what data and information has been collected and ask how they view this".* This allows to see whether or not the broader municipal opinion is something that is recognized by citizens from smaller districts within the city.

As a final input layer both experts highlighted that the addition of a financial constraint next to the space constraint in the second choice task would be of value. Adding just that bit of a deeper layer and perhaps an even more relatable situation for respondents. *"When you add the financial translation, you create a maybe even deeper layer. Respondent will think about the concept as if it is their own wallet, their own money."* He mentions his interest in finding out whether this additional layer would get the PVE organized even closer to the actual experience of people.

Overall, the expert views PVE as a meaningful and promising tool that enriches the participatory process: *"From that perspective, I really see it as a valuable and potential powerful addition to our instruments."*

Sub-Question 6. How can the combined insights from the TIS and PVE results inform policy recommendations for mobility hubs that align with local community needs and promote their usage?

The experts interviews showcased many highlights. Interestingly both experts agreed that currently there is not much time and space embedded in a policy process to consider lessons learned from other, either national or European, hubs. Therefore, there is lots of room to start integrating these insights and prevent making the same mistakes twice. Doing a case study and analyze hubs these hubs according to the TIS framework or any other systematic learning tool can benefit the planning and design assignment of hubs.

Also considering the PVE, there was consensus among the experts. As one of the experts put it: *"I would like to analyze this further and draw more attention to it, because this is an important part of developing hubs."* Both experts see great potential, of course with the needed limitations and marginal notes in regards to the (planning) phase a specific hub is in. PVE can be of great use to policy makers if implemented right. It must be realized at a point in time were the results can still be used / changes can still be made. But at the same time, it must be realized at a time when there is already significant information about space and the budget requirements to include these in the questions. That way you can ask those questions that provide the most valuable insights.

9. Discussion

The following chapter will provide the discussion section of this report. It will highlight the meaning, relevance and importance of the main findings from the analysis. The chapter will explain and evaluate the results in relation to the problem statement, highlights from the literature review and the research (sub)questions.

Interpretation of Analysis Findings – European case study hubs

The analysis of both the Technological Innovation System (TIS) case studies and the Participatory Value Evaluation (PVE) survey reveal a level of misalignment between the current mobility hub implementation and the social and experiential needs of the communities they intend to serve. The SmartHubs project analysis, established in the first section of chapter 5, shows that most hubs lack a significant level of democratic integration. Only 14 out of 159 hubs score a level 1 or higher. A level 1 correspond with the inclusion of at least a consultation process in the planning and design stage of a hub (Geurs et al., 2023). Scoring a level 1 or higher across all integration factors is an essential component for a location to be deemed a “mobility hub” rather than a “single mobility service” (Geurs et al., 2023).

The further research independent analysis of the European case study hubs is done according to the TIS framework. TIS is an analytical framework to understand the development and diffusion of new technologies (Berget et al., 2008; Wieczorek & Hekkert, 2012). The framework is particularly suitable for analyzing mobility hubs, which represent a complex, emerging innovation among transport, technology, and spatial planning (Arnold et al., 2023). TIS allows to identify all structural and functional components within hubs (Bergek et al., 2008; Hekker et al., 2007). The structural and functional components were the foundation for the PVE questionnaire discussed in the next section. The European case studies showed that successful hubs depend on a strong interaction between governance, policy support, and public engagement. Cities like Vienna and Leuven demonstrate how clear strategic visions and cross-sector collaboration can drive scalable, sustainable hub development (Chapter 5). These lessons suggest that Dutch cities should adopt adaptive planning cycles, integrate hubs within broader policy frameworks, and ensure local community participation to improve relevance and acceptance.

Throughout the analysis, several success and failure factors were identified as important and potentially transferable to the Dutch market. To maximize their impact, mobility hubs should be supported by strong regional and national policy alignment. It gives the opportunity to ensure local initiatives contribute to broader strategic goals. The literature review has already shown that policy can have a great influence on user behaviour in the Electric vehicle scene (Mohammadzadeh et al., 2022). Applying this lesson to mobility hub development suggests that consistent, coordinated policies are essential for initial implementation, as well as for fostering sustained public engagement and long-term success

Beyond serving as transport nodes, hubs should be developed as multifunctional spaces that incorporate social, commercial, and environmental functions, broadening their value to different user groups. As came forward in the literature review, accessibility and efficiency for users is one of the main integration features for a sustainable city (Herrera-Acevedo & Sierra-Porta, 2024). In line with this equity feature, another identified SFF is for hubs to be strategically located to improve first- and last-mile connectivity, making them easily accessible from residential and commercial areas and reducing dependence on private vehicles. Seamless digital integration is also key, enabling smooth transitions between transport modes and enhancing the user experience. Whether these factors function as a success or failure factor, of course depends on their implementation level.

The last SFF for this research is the active involvement of local communities in the planning process. This helps tailor mobility hubs to residents' specific needs, increasing public support and relevance. The influence a participatory approach like a PVE can have on decision making and socially accepted policy making is deemed to be credible, legitimate and relevant (Juschten & Omann, 2023)

Interpretation of Analysis Findings – Participatory value evaluation

How to determine the right level of inclusion for structural and functional elements in a specific hub? Public participation (democratic integration) allows to map out what users perceive as necessary for a mobility hub. A participatory approach offers insights into the needs and requirements of specific locations and specific populations allowing failure factors to be turned around into success factors. In addition, it is hypothesized by Geurs et al. (2023) that higher levels of (democratic) integration, result in "smarter" mobility hubs. The smarter the hub, the greater the user value, leading to increased usage and satisfaction, and broader societal impact (Geurs et al., 2023). Mobility hubs with advanced integration across physical, digital, and democratic dimensions are more likely to serve as catalysts for inclusive and sustainable urban mobility and improved accessibility. As previously mentioned, the found structural and functional components among the European case study hubs laid the foundation for the PVE questionnaire. The insights into the full set-up of the PVE can be found in chapter 6.

Quantitative results

The PVE data analysis results confirmed the need to gain more insights in what it is citizens want. Based on the literature research and the expert interview insights, several results were considered unexpected, but interesting towards the design and realization of mobility hubs in Zwolle. Depending on mobility characteristics, respondents prioritized some more expected attributes like bicycle parking and parking opportunities for private cars. The literature review already highlighted the strong dependence on private cars, aligning with this parking and accessibility desire (Liljamo et al., 2020; Fitschen et al. 2024; Zijlstra et al., 2022).

However, on the more unexpected side, features like integral public toilets and both physical and social safety emerged as shared priorities across all respondent segments. This suggests that comfort and inclusivity are not optional, but fundamental to how people perceive the utility of mobility hubs. Safety, in particular, was repeatedly linked to lighting, surveillance, shared mobility and the overall feeling of trust in the environment. This indicates that design features must address more than just transport functionality, something that also came forward from analyzing the Carrick Centre Green Mobility Hub (Chapter 5). One other especially consistent preference was the integration of the mobility hub with public transport. Across clusters, respondents emphasized the importance of seamless connections between transport modes, reinforcing the idea that a hub is only viable if it ensures convenient, reliable multimodal access. So, even though shared transport has trouble attracting more users (Fitschen et al., 2024), potential appears for public transport. Even among the cluster where none of the respondents mentioned using public transport as their most frequent mode, the integration was very important. Indicating room for these respondents to switch modes and become less dependent on their private cars.

The cluster analysis further demonstrates meaningful segmentation in preferences. The "Bike and Public Transport Enthusiasts" prioritize sustainable transport and inclusivity, while the "Car-Oriented Comfort Seekers" strongly favor car access and practical amenities. This segmentation confirms that preferences are shaped by age, mobility patterns, and car ownership. Interestingly, the "space" allocation choice task revealed an even sharper trade-off, with the car-oriented cluster allocating far more space to car parking and far less to shared mobility or community functions. Despite the differences, a few unifying themes stand out, underscoring a common public demand for well-connected, accessible, and safe hub

environments. It is important to consider that the research has a slight respondent bias, which will be explicitly explained in the limitations section. This bias could influence the reliability of the results.

QUALITATIVE RESULTS

In addition to the quantitative responses, a large share of respondents took the time to provide additional information and express the reasoning behind the choices they made (Chapter 7). It became clear that behind a lot of preferences, there is a deeper layer connected to physical, and maybe even more to social safety. Commercial facilities like a supermarket to-go gained high scores, obviously from a convenience point of few, but maybe even more interestingly from a safety point of view. Respondents highlight they like the fact that these services attract people, and that more people in and around hub locations would improve their sense of safety. Several respondents fear that, in case of mediocre design, mobility hubs will become a hang-out spot for the "wrong" people. This decreases their desire to use the hub, and mainly decreases their feeling of safety. In line with this fear, and also strengthening insights behind the lower interest displayed in shared mobility services, respondents highlight that time has proven that shared mobility services clutter public space and that users cannot seem to take care of these facilities like they would take care of their own vehicles.

On the more positive end, there are a lot of tips and insights provided to gain a deeper level of understanding in what makes a hub a success to people. People valued parking spaces for cars and bicycles. Interesting here are the two distinct kinds of reasoning behind this choice. On the one hand, there were respondents who reasoned from their own perspective. They would like to have enough space to park their vehicle safely, to then switch to a provided mobility service for the extend of their journey. On the other hand, there were the respondents reasoning towards others. They felt having parking opportunities was the only way to make it attractive enough for private vehicle users, to considers using a multimodal travel approach. The same arguments came up according to the high value for the integration with public transport. Respondents feel this is necessary toward the success of a mobility hub. Which in retrospect is also one of the main requirements established by the SmartHubs project.

Together, all findings suggest that infrastructure alone cannot ensure the success of mobility hubs. The effectiveness and long-term relevance of such hubs depend on their alignment with the everyday preferences, values, and constraints of local residents.

IMPLICATIONS FOR MOBILITY HUB POLICY AND PLANNING

This research shows the value of citizen participation, not only at the outset but throughout the planning and implementation phases of mobility hubs. Stakeholder engagement is not only helpful but also required through an EU directive and in addition stipulated by multiple international conventions (Lindenau & Böhler-Baedeker, 2014). Many municipalities do already have policy frameworks that mandate participation. Tools like PVE offer a concrete way to enhance policy quality and meet legal requirements, while reaching a broad and versatile audience. The PVE result highlighted interesting insights towards adaptive planning. Learning from previous research that there is a desire and need to create a broad modal shift (Gabrielli et al., 2014; Papadakis et al., 2024), it is important to have an adaptable hub design and keep the potential to switch the offer of transport modes when a significant mode shift is noticed among users.

From the expert interviews it became clear that the development phase of a hub is a crucial determinant for the level in which the insights of the PVE can be incorporated in the planning. Implementing a PVE in an early stage can function as a great tool to set a realistic starting point. Knowing on a broad scale what potential users prefer, allows to start discussions and planning sessions from a citizens perspective instead of from a purely political one. Applying PVE in a later stage offers even clearer and more directed insight

skewed towards several specific hub locations, including more realistic and location related space and budget constraints into a PVE offers more specific design insights, which are useful for the set-up of the requirement programs.

PVE's ability to simulate real-life decision-making under constraints offers policymakers a grounded, data-driven way to include citizens in evaluating true policy trade-offs (Mouter et al., 2020; Mouter et al., 2021). From the policy experts it became clear that this is a significant benefit, as traditional survey methods lack in this department (Callahan, 2007; Juschten & Omann, 2023). Another benefit toward policymaking is the additional insights provided by the qualitative analysis of the PVE's open ended questions (Mouter et al., 2021). The expert interviews and the qualitative data analysis showed that this deeper layer to the data and the analysis of reoccurring themes among attributes and respondents can help policymakers. The experts point out it is easy for policymakers to either purposely or un purposely put on their blinders instead of keeping an open mind toward important themes coming from the outside world (Chapter 8).

Furthermore, the study indicates that for mobility hub development, a one-size-fits-all approach is unlikely to succeed. Both from the European case studies as from the PVE a broad range of interests and design options came forward. So instead of making one design, planning should prioritize modular and context-sensitive designs that can adapt to the values of specific neighborhoods and user groups. Another reason for adaptability is the rapidly changing environment due to mobility developments (Cascetta & Hanke, 2023). The experts suggest that integrating PVE into recurring planning cycles, especially during critical moments such as hub upgrades or expansions could add a very valuable and insightful layer to the process.

Contributions to Theory and Practice

This study contributes to currently accessible theory by demonstrating the added value of combining the TIS functions framework with PVE in urban mobility planning. While TIS traditionally purely focuses on structural and functional dynamics of innovation adoption (Bergek et al., 2008; Hekker et al., 2007), it is not typically used as a learning tool for broader planning. From the expert interviews (Chapter 8) it became clear that it is not considered regular practice to learn from European hub components for actual policy planning. Integrating these structural and functional components in the set-up of a participatory method like PVE introduces a new dimension to both participatory methods and technological innovation research. It enables a deeper understanding of the conditions necessary for much needed successful, socially accepted innovation (Geurs & Münzel; 2022; Geurs et al., 2023; Mohiuddin et al., 2023).

Practically, this research provides a replicable framework for urban mobility planners and policymakers to truly incorporate community preferences into mobility hub design. The results of this research show surprising and useful insights, acknowledged by the experts working close along the hub development. Also within the graduating company, colleagues and other experts in the field are highly interested in potentially applying PVE in a suitable phase of design, while also using the current results as a starting point for mobility hub planning in their cities. It illustrates that data gathered through PVE is not location bounded. By tailoring hub designs to reflect local priorities, planners can reduce implementation risks, improve public support, and increase actual usage rates.

Thus, even though the PVE was conducted with a study focus on Zwolle, the findings are generalizable to other Dutch cities. Particularly to other cities classified as very urbanized (CBS, 2025), as they face similar challenges in multimodal transport integration and space allocation. Moreover, the methodological and thematic insights may also be relevant for European cities more broadly. Urban areas across Europe often face shared planning dilemmas, balancing sustainability, accessibility, and public support as learned from the case studies in chapter 5. This makes it valuable to learn from each other's experiences and avoid repeating known implementation shortcomings. The use of PVE as a participatory planning instrument

offers a scalable approach to embed public values in infrastructure development, enhancing both its legitimacy and long-term success.

Altogether, this study demonstrates how PVE can meaningfully enhance the planning and development of mobility hubs by grounding decisions in citizen preferences and realistic trade-offs. Especially when applied early in the process, PVE helps shift planning discussions from political or technical starting points to those rooted in public values. Its ability to simulate constrained choices offers richer, more actionable input than traditional consultation methods.

Beyond its practical benefits, the research also contributes theoretically by using insights from the TIS functions framework to set-up an even more meaningful participatory approach. This interdisciplinarity brings a learning perspective to innovation in urban mobility, highlighting how insights from structural and functional components can guide more socially accepted and context-sensitive solutions. In practice, the findings offer a replicable approach for municipalities aiming to align hub development with local priorities. By integrating PVE at strategic points along the planning timeline, planners can improve public support, reduce risks, and create hubs that better reflect the evolving needs of specific communities.

10. Limitations and Recommendations

Based on the methodology and findings of this study, this chapter presents research limitations, followed by recommendations for policymakers and urban planners, as well as to academic researchers. The goal of providing these recommendations is to enhance the effectiveness of future mobility hub planning efforts and participatory evaluations, ensuring that both systematic design and community integration are improved in a context-sensitive and methodologically sound manner.

Limitations

While this study provides valuable insights into the integration of community preferences in mobility hub planning, several limitations should be acknowledged. This subsection will elaborate on the main limitations faced by this research and how they influence the results and their level of interpretability. In the next section of this chapter, the limitations will be enhanced by recommendations for further research.

First and foremost, an important consideration is that the PVE results are not statistically representative towards the general population. The group of respondents (82 participants) does not meet the statistically required amount to be representative for Zwolle's amount of inhabitants. Despite efforts to reach a broad and diverse audience the majority of participants were younger individuals with higher education levels. This sampling bias limits the generalizability of the findings and means that certain perspectives, particularly those of elderly adults, people with lower education or digital literacy, may be underrepresented in the results.

The expert interviews, while insightful, involved a limited number of professionals. Due to the scope of this study, perspectives from national policy actors or private-sector stakeholders were not included. The experts have broad experience in the field, also on a national level. However, in these interviews they reflected from local and project-based insights, which could influence the scope of the policy applicability.

Finally, this research is a cross-sectional research, it captures the community preferences and system conditions at this specific moment in time. Mobility hubs are however fast-evolving concepts, influenced by quick shifts in technology, policy priorities, and urban design trends. Features or design elements valued today may lose relevance as new user needs or mobility services emerge.

Recommendations

Learn from existing hubs – national and European

It is recommended that policymakers and planners actively study existing mobility hub projects across the Netherlands and/or Europe. The findings from the case study analysis (Chapter 5) in this research highlight that many failures, such as lack of community integration, not enough consideration towards last-mile connectivity and underused physical as well as digital infrastructure, are recurrent issues that are potentially avoidable. Cities tend to treat their context as so unique that they feel learning points from other cities might not apply for them (Chapter 8). Instead, I recommend investing in comparative learning, adapting known success factors and proactively addressing previously observed failure factors.

Improve the choice architecture of PVE "space" choice tasks

The version of PVE set-up for this research, used an elaborate "score" choice task, and a more generalized "space" choice task. Interestingly, for some of the attributes the amount of value and space assigned did not match one another (Chapter 7). Especially the experts were interested in this apparent exculpation between finding things important, but when it comes to its, not wanting to give them much space (Chapter 8). For further research it could be of value to do only a "space" based choice task. Make the choice options

more detailed and give a more elaborate selection. When this PVE is organized in a more specific context, a bit further ahead in the planning stage of hubs, it can be considered to include the allocations of actual square meters to match a realistic hub blueprint for a specific location. This way the reasoning behind the choices make in this projects PVE might become even more clear, giving a deeper understanding of the factors that move citizens to make certain choices.

Incorporate budget constraints into the PVE

As previously mentioned, the results of this research's PVE sparked an interest to elaborate on the "space" choice task (Chapter 6). Another potential improvement, that can be made in a more advanced planning stage, is the addition of financial constraints. Future applications of PVE could integrate budget-based limitations, enabling participants to evaluate the financial implications of their choices. This "budget" allocation choice task could be integrated in the more elaborate "space" choice task, as this is expected to add the most valuable additional insights. Budget is always something that plays a big role in any policy plan (Chapter 8). Incorporating budget would lead to a more realistic assessment of community priorities and help bridge the gap between design preferences and implementable solutions.

Implement a Two-Tiered Participatory Approach

Expert interviews highlighted the value of a dual participatory process (Chapter 8). The set-up for such a two-tiered approach would include the conduction of a broad PVE at a municipal, or even national level to gather a general understanding of citizens preferences across different contexts. Based on those insights, a few specific hub design proposals can be established. Then, in a second phase, these design options should be presented to local communities through small-scale, physical participation sessions (e.g., workshops or interactive exhibitions) clearly set-up for particular city area's/neighborhoods. This allows for a consumer based initial idea, which is then further elaborated by discovering the appreciation towards design options from citizens that are closest and most likely to use a specific hub.

Collaborate with Professional Institutes for Participant Recruitment

To ensure broad and inclusive representation, municipalities and researchers could consider partnering with specialized survey panel institutes. Consider institutes that have an extensive database of survey takers. From their database a random, democratic characteristics based, selection is made. This method guarantees a respondent panel representative for the population. Participants selected by these panel institutes receive a compensation for their participation. Collaborating with a panel institute could prevent one of the main limitations in this research, as it ensures sufficient sample size, mitigates self-selection bias, and enhances the quality and credibility of participation outcomes.

Design Longitudinal Studies to Track Evolving Preferences

Given the fast evolving nature of mobility hubs and user expectations, future research could explore more longitudinal PVE studies. Tracking how community values shift over time. Consider conducting a PVE according to the previously advised two-tier approach. Then after the hub is realized and in use for a significant period, organize a feedback session with the members of the local community that were involved in the earlier stages to ask how they feel about the hub design in retrospect. It allow to test whether their values of certain attributes have changed after real life implementation and use, and it allows to ask whether they would change things or have changed opinions and insights towards attributes. It potentially offers a deeper insight into behavioral adaptation and long-term policy relevance.

11. Conclusion

This research set out to explore how a Participatory Value Evaluation (PVE) approach can enhance the design and planning of multimodal mobility hubs by integrating community preferences into the decision-making process. The study utilized a case study analysis of European mobility hubs using the Technological Innovation Systems (TIS) framework. The TIS analysis identified important structural and functional hub components, as well as generalizable success and failure factors (SFFs). European case studies show that successful hubs rely on strong governance, policy support, and public engagement. Examples from Vienna and Leuven highlight the value of strategic vision and cross-sector collaboration. For Dutch cities, this suggests adopting adaptive planning, aligning hubs with broader policies, and involving local communities to boost impact and acceptance. All case study insights were incorporated in the question set up of the PVE conducted towards the municipality of Zwolle (Netherlands).

Withing the PVE score choice task, the bike and public transport enthusiasts prioritize integration with public transport, secure bicycle parking, and accessibility, while largely rejecting car-related infrastructure. This group is slightly more represented by young and male respondents. The practical providers focus on convenience and daily functionality, prioritizing attributes like car parking, supermarkets, Wi-Fi, and waiting areas, with little interest in shared mobility or community features. The third cluster, car-oriented comfort seekers, strongly value car infrastructure and universal accessibility but show low interest in digital amenities or sustainability. They are mainly older, female, and car-dependent.

In the PVE space choice task, Cluster 1 maintains a focus mainly on bikes, shared mobility and also prioritizes community initiatives. Clusters 2 and 3 converge into one car-centric group, which assign almost all their space to private car parking and accessibility. Notably, across all segments, safety, clean toilets, and public transport integration remain shared priorities. Despite their differences, the clusters reveal insights into how people interact with urban spaces. One very clear shared priority stands out: safety. Whether through secure bicycle parking, or logistic facilities including surveillance, lightning and first aid. Regardless of mobility preferences, this common thread suggests that a sense of safety and stability is essential to urban space planning, influencing decisions in all groups.

The qualitative feedback added valuable context as a deeper layer to the quantitative insights. They highlighted once more the recurring theme of safety, not just physical safety, but also the perception of security and social safety. Respondents consistently link the success of a hub to how safe and trustworthy it feels. Also concerns about shared mobility misuse and the genesis of unsafe, unmonitored areas attracting the wrong kind of people emerged. These insights show that beyond functionality, a sense of safety underpins public acceptance and usage, shaping how users interpret and prioritize every hub feature.

Expert interviews confirmed the relevance of these insights for real-world planning and underscored the policy potential of PVE to address blind spots in current planning and design processes. Both experts agreed that currently there is not much time and space embedded in a policy process to consider lessons learned from other, either national or European, hubs. Therefore, there is lots of room to start integrating these insights and prevent making the same mistakes twice. Also considering the PVE, there was consensus among the experts. As one of the experts put it: “I would like to analyze this further and draw more attention to it, because this is an important part of developing hubs.” Both experts see great potential, of course with the needed limitations and marginal notes in regards to the (planning) phase a hub is in.

The main Research Question

In what ways can a Participatory Value Evaluation approach enhance the design and planning of multimodal mobility hubs by incorporating community preferences to better align with user needs?

PVE enhances mobility hub planning by translating community values into concrete, context-sensitive design choices. The research shows that respondents take significant time to elaborate on their considerations, adding a layer of depth to their numerical choices. PVE allows policymakers to simulate real policy trade-offs under realistic constraints to capture a deeper sense of what it is the community wants. This could not only improve the technical design of hubs (mode choice and mode infrastructure), but can also increases their social legitimacy (public support, design towards social safety), and usage rates.

PVE can function as a bridge between current political mobility hub planning and the community. The current planning and design process can be limited by narrow politic vision. PVE includes useful community engagement through an efficient platform that reaches a diverse audience, ensuring that mobility hubs are designed not only for communities but with them.

Bibliography

Ambrosius, W. T. (2007). Descriptive Statistics. In Topics in Biostatistics (pp. 33–52). Springer Science & Business Media.

Andersson, J., Hojcková, K., & Sandén, B. A. (2023). On the functional and structural scope of technological innovation systems – A literature review with conceptual suggestions. Environmental Innovation And Societal Transitions, 49, 100786. https://doi.org/10.1016/j.eist.2023.100786

Arnold, T., Dale, S., Timmis, A., Frost, M., & Ison, S. (2023). An exploratory study of Mobility Hub implementation. Research in Transportation Economics, 101, 101338. https://doi.org/10.1016/j.retrec.2023.101338

Aspern Die Seestadt Wiens. (2023, 26 September). *WienMobil in der Seestadt*. from https://www.aspern-seestadt.at/city-news/wienmobil_in_der_seestadt

Aspern Mobil LAB. (2023). *Smart mobility hubs*. from https://www.mobillab.wien/smarthubs/

Axhausen, K. W. (2006). Chapter 11 Concepts of travel behavior research. ETH Zürich Library, 360. https://doi.org/10.3929/ethz-a-005228651

Aydin, N., Seker, S., & Özkan, B. (2022). Planning Location of Mobility Hub for Sustainable Urban Mobility. Sustainable Cities And Society, 81, 103843. https://doi.org/10.1016/j.scs.2022.103843

Bahamonde-Birke, F. J., Geigenmüller, I. M., Mouter, N., Van Lierop, D. S., & Ettema, D. F. (2023). How do I want the city council to spend our budget? Conceiving MaaS from a citizen's perspective . . . (as well as biking infrastructure and public transport). Transport Policy, 145, 96–104. https://doi.org/10.1016/j.tranpol.2023.09.009

Belgian Train. (n.d.). *Home*. BelgianTrain.be. https://www.belgiantrain.be/nl

Belgielex. (2019). *Decreet betreffende de basisbereikbaarheid*. In Vlaamse Codex. het Departement Kanselarij en Buitenlandse Zaken. https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1031764¶m=informatie

Belgielex. (2022). *Besluit van de Vlaamse Regering over de Hoppinpunten en tot wijziging van het besluit van de Vlaamse Regering van 25 januari 2013 tot bepaling van de nadere regels betreffende de financiering en de samenwerking voor het mobiliteitsbeleid*. In Vlaamse Codex. het Departement Kanselarij en Buitenlandse Zaken. https://codex.vlaanderen.be/Zoeken/Document.aspx?DID=1031764¶m=informatie

Bergek, A., Hekkert, M., Jacobsson, S., Markard, J., Sandén, B., & Truffer, B. (2015). Technological innovation systems in contexts: Conceptualizing contextual structures and interaction dynamics. Environmental Innovation And Societal Transitions, 16, 51–64. https://doi.org/10.1016/j.eist.2015.07.003

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research Policy, 37(3), 407–429. https://doi.org/10.1016/j.respol.2007.12.003

Bittner-Krautsack, S., Bauer, T., BSc., MBA., Blust, A., Dinges, M., Dorda, A., Drakulic, C., MIM., Grassegger, E., Hodzic-Srndic, N., Kiener, C., Leihs, D., Mosshammer, L., Pecharda, C., Russ, M., Schneider, W., Wasner, W., Weber, M., MA. (2020, 20 augustus). *FTI-Strategie Mobilität*. In Bundesministerium Für Klimaschutz, Umwelt, Energie, Mobilität, Innovation Und Technologie https://fti-mobilitaetswende.at/resources/pdf/broschueren/BMK_FTI_Strategie_Mobilitaet_final_lang.pdf?m=1684746155&

Blue-bike. (2024). Over ons. Blue-bike.be. https://www.blue-bike.be/over-ons/

Bosman, R., Dijker, J., Van Essen, R., Goodijk, H., De Bruin, R., Marseille, J., & Quené, V. (2024). Mobiliteitshub Weezenlanden Noord Zwolle: ontwerpstudie & vormgeving. In Bestuurlijke Informatie Zwolle. https://zwolle.bestuurlijkeinformatie.nl/Agenda/Document/aea1e994-97db-4e0e-998c-4125a967a637?documentId=2fb82261-8b02-4130-bf2f-eec4842477cf&agendaItemId=8de55c28-851b-44d0-bfcc-70683948dcbe

Bpost. (2025). Vind een Bpost punt in de buurt. Bpost.be. https://www.bpost.be/nl/verkooppunten/Vlaams-Brabant/LEUVEN-3018/AUTOMAAT%20STATION%20WIJGMAAL?center=filter_ac_21&services=

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Burns, R., MacBryde, R., Eisenhower, D., Blane, G., McAdam, J. L., Knox, J., & Niven, W. (2019). *Maybole Community Action Plan*. In North Carrick Community Benefit Company. https://nccbc.org.uk/wp-content/uploads/2019/10/Maybole-Community-Plan-Aug-19-WEB.pdf

Butzin, A., Rabadjieva, M., & Terstriep, J. (2024). Anchoring challenges through citizen participation in regional challenge-based innovation policies. Environmental Innovation And Societal Transitions, 52, 100856. https://doi.org/10.1016/j.eist.2024.100856

Callahan, K. (2007). Citizen Participation: Models and Methods. International Journal Of Public Administration, 30(11), 1179–1196. https://doi.org/10.1080/01900690701225366

Cambio. (2023). Hoe werkt het? Cambio Autodelen | Vlaanderen. https://www.cambio.be/nl-vla/hoe-werkt-het

Cargo, M., & Mercer, S. L. (2008). The Value and Challenges of Participatory Research: Strengthening Its Practice. Annual Review Of Public Health, 29(1), 325–350. https://doi.org/10.1146/annurev.publhealth.29.091307.083824

Carrick Centre. (2022). *Carrick Centre, heart of the Community.* https://www.carrickcentre.co.uk/

Carrick Centre. (n.d.). *Transport - The Carrick Mobility Hub*. https://www.carrickcentre.co.uk/transport

Cascetta, E., & Henke, I. (2023). The seventh transport revolution and the new challenges for sustainable mobility. Journal Of Urban Mobility, 4, 100059. https://doi.org/10.1016/j.urbmob.2023.100059

CBS. (2024). Hoeveel reisden inwoners van Nederland en hoe? Centraal Bureau Voor de Statistiek. https://www.cbs.nl/nl-nl/visualisaties/verkeer-en-vervoer/personen/hoeveel-reisden-inwoners-van-nederland-en-hoe-

CBS. (2025, 25 februari). Gebieden in Nederland 2024: Grootte en stedelijkheid van gemeenten. CBS Statline. https://opendata.cbs.nl/#/CBS/nl/dataset/85755NED/table?dl=455E9

Choudhury, S. (2024, 11 december). *Mind the Gap: Europe's Mobility Hub Challenge | JPI Urban Europe*. JPI Urban Europe. https://jpi-urbaneurope.eu/mind-the-gap-europes-mobility-hub-challenge/

Ciriaco, T. G., & Wong, S. D. (2024). Travel Behaviour and Community Needs for Resilience Hubs. Sustainability Analytics And Modeling, 4, 100030. https://doi.org/10.1016/j.samod.2024.100030

Cycling Scotland. (2025). *Getting more people cycling*. https://cycling.scot/

De Haas, M.C., Kolkowski, L. (2023), *Fietsfeiten 2023* Brochure. Den Haag: Kennisinstituut voor Mobiliteitsbeleid (KiM).

De Lijn. (n.d.). *Routeplanner*. DeLijn.be. https://www.delijn.be/nl/routeplanner/

De Vos, J. (2022). The shifting role of attitudes in travel behaviour research. Transport Reviews, 42(5), 573–579. https://doi.org/10.1080/01441647.2022.2078537

Dekkers, D. (2023, 9 augustus). *EHUBS - Smart Shared Green Mobility Hubs*. Interreg NWE. https://vb.nweurope.eu/projects/project-search/ehubs-smart-shared-green-mobility-hubs/#tab-1

Delucchi, M. (2000). Should We Try To Get The Prices Right? ACCESS Magazine, 1(16), 14-21. Retrieved from https://escholarship.org/uc/item/5zg735f1

M. De Haas, L. Kolkowski. (2023). *Fietsfeiten 2023.* KiM Netherlands Institute for Transport Policy Analysis (2023) https://www.kimnet.nl/publicaties/publicaties/2023/11/28/fietsfeiten-2023

Digitaal Vlaanderen (Red.). (n.d.). Hoppin. Vlaanderen.be. https://www.vlaanderen.be/mobiliteit-en-openbare-werken/hoppin

Faherty, M., McArdle, G., & Tafidis, P. (2024). Envisioning sustainable urban mobility in Dublin: Stakeholder perspectives and system dynamics. Transportation Research Interdisciplinary Perspectives, 28, 101280. https://doi.org/10.1016/j.trip.2024.101280

Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology. (2021). *Austria's 2030 Mobility Master Plan*. In Federal Ministry Republic Of Austria. https://www.bmk.gv.at/dam/jcr:eaf9808b-b7f9-43d0-9faf-df28c202ce31/BMK_Mobilitaetsmasterplan2030_EN_UA.pdf

Fitschen, P., Merfeld, K., Klein, J. F., & Henkel, S. (2024). UNDERSTANDING THE URBAN MOBILITY CHALLENGE: WHY SHARED MOBILITY PROVIDERS FAIL TO ATTRACT CAR DRIVERS. Transport Policy, 158, 104–111. https://doi.org/10.1016/j.tranpol.2024.09.010

Frank, L., Dirks, N., & Walther, G. (2021). Improving rural accessibility by locating multimodal mobility hubs. Journal Of Transport Geography, 94, 103111. https://doi.org/10.1016/j.jtrangeo.2021.103111

Gabrielli, S., Forbes, P., Jylhä, A., Wells, S., Sirén, M., Hemminki, S., Nurmi, P., Maimone, R., Masthoff, J., & Jacucci, G. (2014). Design challenges in motivating change for sustainable urban mobility. Computers in Human Behavior, 41, 416–423. https://doi.org/10.1016/j.chb.2014.05.026

Gemeente Leuven. (2025, 6 januari). Hoppinpunt station Wijgmaal. Stad Leuven. https://www.leuven.be/hoppinpunt-station-wijgmaal

Gemeente Nijmegen. (2021). Ambitiedocument Mobiliteit. Retrieved from https://nijmegen.bestuurlijkeinformatie.nl//Agenda/Index/d44caf3c-5a37-4365-a980-1e9b2b889cb9

Gemeente Zwolle. (2023). Hanza! De Zwolse participatieaanpak. In zwolle.bestuurlijkeinformatie.nl. https://zwolle.bestuurlijkeinformatie.nl/Agenda/Document/9c604bd9-71f7-43eb-84a2-1f3bd786f509?documentId=4d4aed71-979f-4c77-b830-529206b26c33&agendaItemId=70b55a51-162e-47b5-ae98-f05c2a180f59

Gemeente Zwolle. (2022). Adaptieve Ontwikkelstrategie Mobiliteitshubs gemeente Zwolle: Ruimte voor Morgen. In Bestuurlijkeinformatie Zwolle. https://zwolle.bestuurlijkeinformatie.nl/Agenda/Document/e2d62824-db17-4cc5-872f-2ce70931a78b?documentId=2a225e70-7aef-439f-9406-1e9b39d104b4&agendaItemId=479476f7-71d9-4445-a510-44b2aec924af

Gerike, R., Bogenberger, K., Nagel, K., Wagenknecht, S., Ziemke, D., & Waller, T. (2022). From Sustainable Urban Transport to Responsible Urban Mobility: Function, Form, Fairness, Forever. In Elsevier eBooks (pp. 99–114). https://doi.org/10.1016/b978-0-323-90386-8.00022-x

Geurs, K., & Münzel, K. (2022). A multidimensional mobility hub typology and inventory. https://www.smartmobilityhubs.eu/_files/ugd/c54b12_819c85702a6442c6bebb18538fb93516.pdf

Geurs, K., Münzel, K., Duran, D., Gkavra, R., Graf, A., Grigolon, A., Hansel, J., Kirchberger, C., Klementschitz, R., Lluis, M. R., & Pappers, J. (2023). A multidimensional mobility hub typology and inventory. SmartHubs Deliverable D 2.1. repositum.tuwien.at. https://doi.org/10.34726/3567

Gössling, S., & Cohen, S. (2014). Why sustainable transport policies will fail: EU climate policy in the light of transport taboos. Journal Of Transport Geography, 39, 197–207. https://doi.org/10.1016/j.jtrangeo.2014.07.010

Grigorev, A., Mao, T., Berry, A., Tan, J., Purushothaman, L., & Mihaita, A. (2021). How will electric vehicles affect traffic congestion and energy consumption: an integrated modelling approach. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2110.14064

Groene Metropool regio Arnhem Nijmegen [GMR], Provincie Gelderland, Unlimited Urban Management [UUM], & Loendersloot Mobility Connected. (2021). *Mobiliteitshubs in de groene metropoolregio Arnhem Nijmegen: Naar een regionaal netwerk van hubs*. In Strategische Agenda 2025. https://www.gmr.nl/media/qqthz55o/strategische-agenda-2025-mobiliteitshubs-in-de-groene-metropoolregio-arnhem-nijmegen.pdf

Groene metropool regio Arnhem Nijmegen [GMR]. (n.d.). Projecten Mobiliteitshubs en knooppunten. gmr.nl. https://www.gmr.nl/projecten/mobiliteitshubs-en-knooppunten/

Gunton, R. M., Hejnowicz, A. P., Basden, A., Van Asperen, E. N., Christie, I., Hanson, D. R., & Hartley, S. E. (2022). Valuing beyond economics: A pluralistic evaluation framework for participatory policymaking. Ecological Economics, 196, 107420. https://doi.org/10.1016/j.ecolecon.2022.107420

Hached, W., L'Hostis, A., & Gragera, A. (2023). Exploring the concept of " mobility hubs " and assessing their impacts in two European cities. Transportation Research Procedia, 72, 3497–3504. https://doi.org/10.1016/j.trpro.2023.11.763

Hekkert, M., Suurs, R., Negro, S., Kuhlmann, S., & Smits, R. (2007). Functions of innovation systems: A new approach for analysing technological change. Technological Forecasting And Social Change, 74(4), 413–432. https://doi.org/10.1016/j.techfore.2006.03.002

Herrera-Acevedo, D., & Sierra-Porta, D. (2024). Network structure and urban mobility sustainability: A topological analysis of cities from the urban mobility readiness index. Sustainable Cities And Society, 106076. https://doi.org/10.1016/j.scs.2024.106076

Hoppin. (n.d.-a). *Wat is Hoppin?* Hoppin.be. https://hoppin.be/nl/wat-is-hoppin/

Hoppin. (n.d.-b). *Hop naar Leuven*. Hoppin.be. https://hoppin.be/nl/dossier-centrumsteden/hop-naar-leuven/

Huang, Y., Ma, L., & De Vos, J. (2024). Travel behaviour and multimodality: a conceptual framework and critical review of research. Transport Reviews, 44(3), 709–730. https://doi.org/10.1080/01441647.2023.2300088

Hull, A. (2007). Policy integration: What will it take to achieve more sustainable transport solutions in cities? Transport Policy, 15(2), 94–103. https://doi.org/10.1016/j.tranpol.2007.10.004

Iannacci, F., Chari, S., & Papagiannidis, S. (2025). Investigating successful sustainable urban mobility in large cities: A contingency-based, fuzzy-set Qualitative Comparative Analysis. Technological Forecasting And Social Change, 212, 123963. https://doi.org/10.1016/j.techfore.2024.123963

Ilovan, N. O., & Doroftei, N. I. (2017). QUALITATIVE RESEARCH IN REGIONAL GEOGRAPHY. A METHODOLOGICAL APPROACH. https://doi.org/10.23740/qual_methods2017

Informatiepunt Leefomgeving (IPLO), Rijksoverheid, Unie van Waterschappen, VNG, & Interprovinciaal overleg. (2024). *Participatie per fase met het kompas*. Informatiepunt Leefomgeving. https://iplo.nl/regelgeving/omgevingswet/participatie/participatie-per-fase/

Irvin, R. A., & Stansbury, J. (2004). Citizen Participation in Decision Making: Is It Worth the Effort? Public Administration Review, 64(1), 55–65. https://doi.org/10.1111/j.1540-6210.2004.00346.x

Jeyaseelan, T., Ekambaram, P., Subramanian, J., & Shamim, T. (2022). A comprehensive review on the current trends, challenges and future prospects for sustainable mobility. Renewable And Sustainable Energy Reviews, 157, 112073. https://doi.org/10.1016/j.rser.2022.112073

Junyent, I. A., Casanovas, M. M., Roukouni, A., Sanz, J. M., Blanch, E. R., & De Almeida Correia, G. H. (2024). Planning shared mobility hubs in European cities: A methodological framework using MCDA and GIS applied to Barcelona. Sustainable Cities And Society, 106, 105377. https://doi.org/10.1016/j.scs.2024.105377

Juschten, M., & Omann, I. (2023). Evaluating the relevance, credibility and legitimacy of a novel participatory online tool. Environmental Science & Policy, 146, 90–100. https://doi.org/10.1016/j.envsci.2023.05.001

Klaever, A., Roessner, V., Becker, S., & Scheidler, V. (2024). Lived expertise of the structurally disadvantaged: towards a more just participatory transport planning process. Mobilities, 1–18. https://doi.org/10.1080/17450101.2024.2426554

Lane, B. W., Messer–Betts, N., Hartmann, D., Carley, S., Krause, R. M., & Graham, J. D. (2013). Government Promotion of the Electric Car: Risk Management or Industrial Policy? European Journal Of Risk Regulation, 4(2), 227–245. https://doi.org/10.1017/s1867299x00003366

Liljamo, T., Liimatainen, H., Pöllänen, M., & Utriainen, R. (2020). People's current mobility costs and willingness to pay for Mobility as a Service offerings. Transportation Research Part A Policy And Practice, 136, 99–119. https://doi.org/10.1016/j.tra.2020.03.034

Lindenau, M., & Böhler-Baedeker, S. (2014). Citizen and Stakeholder Involvement: A Precondition for Sustainable Urban Mobility. Transportation Research Procedia, 4, 347–360. https://doi.org/10.1016/j.trpro.2014.11.026

Liu, X., Li, R., Cai, J., Li, B., & Li, Y. (2024). Quantifying urban function accessibility and its effect on population mobility based on function-associated population mobility network. International Journal Of Applied Earth Observation And Geoinformation, 135, 104273. https://doi.org/10.1016/j.jag.2024.104273

Luthart, R. (2023, 25 oktober). 10 nieuwe eHUBs in Nijmegen - Regio Online. Regio Online. https://regioonline.nl/regio-arnhem-nijmegen/10-nieuwe-ehubs-in-nijmegen/

Markard, J., Hekkert, M., & Jacobsson, S. (2015). The technological innovation systems framework: Response to six criticisms. Environmental Innovation And Societal Transitions, 16, 76–86. https://doi.org/10.1016/j.eist.2015.07.006

Martinez, L., Macharis, C., & Keserü, I. (2024). Inclusive mobility hubs: An in-depth exploration of the requirements of disadvantaged groups. Transportation Research Part D Transport And Environment, 136, 104447. https://doi.org/10.1016/j.trd.2024.104447

Maybole Town. (2024, 24 april). *Maybole Town Centre Regeneration Project : Investing up to £9.1 million*. Maybole Towncente Regeneration. https://www.regeneratingmaybole.scot/

Meekes, J. (2020). *Operational Plan eHUBS Nijmegen*. In Interreg North West Europe. https://vb.nweurope.eu/media/12483/dt141-operational-plan-nijmegen.pdf

Meekes, J. (2022). *eHUBS implementation report Nijmegen-Arnhem*. In Interreg North West Europe. http://www.nweurope.eu/projects/project-search/ehubs-smart-shared-green-mobility-hubs/

Metz, D. (2013). Peak Car and Beyond: The Fourth Era of Travel. Transport Reviews, 33(3), 255–270. https://doi.org/10.1080/01441647.2013.800615

Ministerie van Infrastructuur en Waterstaat. (2025, 25 februari). *De Omgevingswet*. Rijksoverheid.nl. https://www.rijksoverheid.nl/onderwerpen/omgevingswet

Mobilitätsberatung Seestadt, Wien 3420 Aspern, & Aspern die Seestadt Wiens. (2024). *Mobilitätsberatung seestadt*. https://www.aspern-seestadt.at/jart/prj3/aspern/system/project-docs/Mobilitaetsinfo/2024_07_08_Mobilitaetsinfo_MB.pdf

Mohammadzadeh, N., Zegordi, S. H., Kashan, A. H., & Nikbakhsh, E. (2022). Optimal government policy-making for the electric vehicle adoption using the total cost of ownership under the budget constraint. Sustainable Production And Consumption, 33, 477–507. https://doi.org/10.1016/j.spc.2022.07.015

Mohiuddin, H., Bhuiya, M. M. R., Hasan, M. M. U., & Jamme, H. (2023). How individual perceptions of transportation systems influence mode choice for mobility-challenged people: A case study in Dhaka using an integrated choice and latent variable model. Transport Policy, 147, 259–270. https://doi.org/10.1016/j.tranpol.2023.12.017

Molin, E., Mokhtarian, P., & Kroesen, M. (2015). Multimodal travel groups and attitudes: A latent class cluster analysis of Dutch travelers. Transportation Research. Part A Policy And Practice, 83, 14–29. https://doi.org/10.1016/j.tra.2015.11.001

Mouter, N., Koster, P., & Dekker, T. (2020). Contrasting the recommendations of participatory value evaluation and cost-benefit analysis in the context of urban mobility investments. Transportation Research Part A Policy And Practice, 144, 54–73. https://doi.org/10.1016/j.tra.2020.12.008

Mouter, N. (2021). Willingness to allocate public budget and Participatory Value Evaluation. In Advances in transport policy and planning (pp. 83–102). https://doi.org/10.1016/bs.atpp.2021.01.001

Mouter, N., Shortall, R. M., Spruit, S. L., & Itten, A. V. (2021). Including young people, cutting time and producing useful outcomes: Participatory value evaluation as a new practice of public participation in the Dutch energy transition. Energy Research & Social Science, 75, 101965. https://doi.org/10.1016/j.erss.2021.101965

Mouter, N., Vries, M. D., Munyasya, A., Tuit, C., Hoefsloot, N., Cieraad, F., Lier, F., Tromp, H., Populytics, TU Delft, Decisio, & MOVE Mobility. (2023). Uitkomsten van de Lelylijnraadpleging. https://populytics.nl/wp-content/uploads/2023/05/230515-Rapport-Lelylijn-PWE-raadpleging-Populytics.pdf

Mouter, N., & Mulder, J. (2024). Resultaten van de Nationale Raadpleging Bereikbaarheid. In Populytics. https://populytics.nl/wp-content/uploads/2025/03/20240923_Populytics_Rapportage-Mobiliteitsvisie-IenW_Definitief.pdf

MyWheels. (n.d.). https://mywheels.nl/

Odera, E. L. (2021). Capturing the Added Value of Participatory Evaluation. American Journal Of Evaluation, 42(2), 201–220. https://doi.org/10.1177/1098214020910265

Ortúzar, J.d. Sustainable Urban Mobility: What Can Be Done to Achieve It?. J Indian Inst Sci 99, 683–693 (2019). https://doi.org/10.1007/s41745-019-00130-y

Papadakis, D. M., Savvides, A., Michael, A., & Michopoulos, A. (2024). Advancing sustainable urban mobility: insights from best practices and case studies. Fuel Communications, 20, 100125. https://doi.org/10.1016/j.jfueco.2024.100125

Parkany, E., Gallagher, R., & Viveiros, P. (2004). Are attitudes important in travel choice? Transportation Research Record Journal Of The Transportation Research Board, 1894(1), 127–139. https://doi.org/10.3141/1894-14

Pereira, C. H. T., & Silva, M. E. (2023). Fostering a transition to inclusive sustainability through shared urban mobility. Research in Transportation Business & Management, 51, 101045. https://doi.org/10.1016/j.rtbm.2023.101045

Perree, H. (2025, 31 januari). Burger op de stoel van bestuurder. Binnenlands Bestuur. https://www.binnenlandsbestuur.nl/ruimte-en-milieu/burger-mag-20-minuten-op-de-stoel-van-bestuurder

Populytics. (2023, 28 maart). Rapporten - Populytics. https://populytics.nl/rapporten/

Populytics. (2025, 10 januari). Expertise - Populytics. https://populytics.nl/producten/diensten/

Provincie Gelderland. (2024a). *Beleidskader bereikbaarheid*. In Gelderland Vlot en Veilig Bereikbaar . https://media.gelderland.nl/Beleidskader_bereikbaarheid_augustus_2024_5749a4b312.pdf

Provincie Gelderland. (2024b). Gelders programma bereikbaarheid, uitvoering ambities 2024-2027. In Gelderland vlot en veilig bereikbaar. https://media.gelderland.nl/Gelders_programma_bereikbaarheid_augustus_2024_ce511379b9.pdf

Rahman, M. (2023). Commute mode switch and its relationship to life events, built-environment, and attitude change. Transportation Research Part D Transport And Environment, 120, 103777. https://doi.org/10.1016/j.trd.2023.103777

Rani, S., & Jayapragash, R. (2024). Review on electric mobility: Trends, challenges and opportunities. Results in Engineering, 23, 102631. https://doi.org/10.1016/j.rineng.2024.102631

Regiopact. (2024). Regionaal mobiliteitsplan 2030 voor de vervoerregio Leuven. In Leuven Beleidsplan. https://assets.vlaanderen.be/image/upload/v1715164206/RMP_VVR_Leuven_beleidsplan_v2024-04-09_hqpcru.pdf

Rongen, T., Tillema, T., Arts, J., Alonso-González, M. J., & Witte, J. (2022). An analysis of the mobility hub concept in the Netherlands: Historical lessons for its implementation. Journal Of Transport Geography, 104, 103419. https://doi.org/10.1016/j.jtrangeo.2022.103419

Rosener, J. B. (1978). Citizen Participation: Can we measure its effectiveness? Public Administration Review, 38(5), 457. https://doi.org/10.2307/975505

Sagaris, L. (2014). Citizen participation for sustainable transport: the case of "Living City" in Santiago, Chile (1997–2012). Journal Of Transport Geography, 41, 74–83. https://doi.org/10.1016/j.jtrangeo.2014.08.011

Schmidt, S. (2024, 3 juli). *Mobility Hubs: The Future of Multimodal Transportation in Cities*. PTV Blog. https://blog.ptvgroup.com/en/trend-topics/mobility-hubs-the-future-of-multimodal-transportation-in-cities/

Scottish Government. (2020). *National transport strategy delivery plan 2020-2022*. https://www.transport.gov.scot/media/48839/nts-delivery-plan-2020-2022.pdf

ShareDiMobiHub. (2025). *Shared & digital mobility hubs*. Interreg North Sea. https://www.interregnorthsea.eu/sharedimobihub

SmartHubs Project. (n.d.-a). EHUB Handelskade - SmartHubs. https://data.smartmobilityhubs.eu/wiki/Hubs/71

SmartHubs Project. (n.d.-b). *Hoppinpunt wijgmaal station NMBS - SmartHubs*. https://data.smartmobilityhubs.eu/wiki/Hubs/102

SmartHubs Project. (n.d.-c). *The Carrick Centre in Maybole - SmartHubs.* https://data.smartmobilityhubs.eu/wiki/Draft:Hub-ef4f3d40b8a449a1c9695ec3c9cddd81

SmartHubs Project. (n.d.-d). *WienMobil Station Maria-Tusch-Straße - SmartHubs.* https://data.smartmobilityhubs.eu/wiki/Hubs/62

SmartHubs Project. (n.d.-e). *Integration levels: Detailed Information about Integration Levels*. *SmartHubs.* https://data.smartmobilityhubs.eu/wiki/Integration_Levels

South Ayrshire Community Transport. (2024, 31 oktober). *South Ayrshire Community Transport SACT AyR - Minibus hire*. https://www.sacommunitytransport.org/

South Ayrshire Community Transport. (2024, 31 oktober). *South Ayrshire Community Transport SACT AyR - Minibus hire*. https://www.sacommunitytransport.org/

South Ayrshire Council, JWM, & JMP Consulting. (2019). *South Ayrshire Council Sustainable Travel Plan: Framework and Site Specific Advice*. In South Ayrshire Council. https://archive.south-ayrshire.gov.uk/documents/south%20ayrshire%20sustainable%20travel%20plan.pdf

SP Energy Networks. (2018). *Green Economy Fund (GEF)*. SPEnergyNetworks. https://www.spenergynetworks.co.uk/pages/green_economy_fund_gef.aspx

SP Energy Networks. (2021). *South Ayrshire community transport launches region's first electric community car club*. SPEngergyNetworks. https://www.spenergynetworks.co.uk/news/pages/south_ayrshire_community_transport_launches_regions_first_electric_community_car_club.aspx

Stad Leuven. (2024, 16 december). Nieuwe bestemming stationsomgeving Wijgmaal. Leuven.be. https://leuven.be/station-wijgmaal

Stad Leuven. (n.d.). *Hoppinpunten*. Leuven.be. https://leuven.be/hoppinpunten

Stadnichuk, V., Merten, L., Larisch, C., & Walther, G. (2024). Optimisation of mobility hub locations for a sustainable mobility system. Transportation Research Interdisciplinary Perspectives, 26, 101193. https://doi.org/10.1016/j.trip.2024.101193

Stadt Wien. (2015, 25 november). Das Fachkonzept Mobilitat - Ein uberblick. wien.gv.at. https://www.wien.gv.at/stadtentwicklung/strategien/step/step2025/fachkonzepte/mobilitaet/ueberblick.html

Stadt Wien. (2024). Wien bewegt sich - Mobilitätsvielfalt 2025 - STEP 2025. wien.gv.at. https://www.wien.gv.at/stadtentwicklung/strategien/step/step2025/kurzfassung/bewegt-sich.html

Stoeldraijer, L., Van Duin, C., Feijten, P., Wennekes, M., & Nicolaas, H. (2024, 17 december). Kernprognose 2024–2070: een miljoen inwoners erbij in 2037. Centraal Bureau Voor de Statistiek. https://www.cbs.nl/nl-nl/longread/statistische-trends/2024/kernprognose-2024-2070-een-miljoen-inwoners-erbij-in-2037

SWECO. (2022). *South Ayrshire Active Travel Strategy*. In Ayrshire Roads Alliance. South Ayrshire Council. https://www.ayrshireroadsalliance.org/Resources/pdf/Traffic/active-travel-strategy/south-ayrshire-active-travel-strategy-2022.pdf

Taborda, S., Henriques, F., Carvalho, G., Magalhães, L., & Banza, M. (2023). People-centred design methods in a local decision-making process: masterplan for Lisbon's multimodal mobility hubs. Transportation Research Procedia, 72, 900–907. https://doi.org/10.1016/j.trpro.2023.11.500

Tammaru, T., Sevtsuk, A., & Witlox, F. (2023). Towards an equity-centred model of sustainable mobility: Integrating inequality and segregation challenges in the green mobility transition. Journal Of Transport Geography, 112, 103686. https://doi.org/10.1016/j.jtrangeo.2023.103686

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. New York: United Nations, Department of Economic and Social Affairs, 1, 41.

Vlaanderen. (n.d.). *Subsidies Hoppinpunten*. Vlaanderen.be. https://www.vlaanderen.be/basisbereikbaarheid/combimobiliteit/hoppinpunten/subsidies-hoppinpunten

Wefering, F., Rupprecht, S., Rupprecht Consult, Forschung & Beratung GmbH. (2015). *THEMATIC CONCEPT Urban Mobility Plan Vienna short report Fulfilling the sustainable urban Mobility plan Criteria*. https://sump-central.eu/wp-content/uploads/2020/11/SUMP-Vienna.pdf

Weustenenk, A. G., & Mingardo, G. (2022). Towards a typology of mobility hubs. Journal Of Transport Geography, 106, 103514. https://doi.org/10.1016/j.jtrangeo.2022.103514

Wieczorek, A. J., & Hekkert, M. P. (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. Science And Public Policy, 39(1), 74–87. https://doi.org/10.1093/scipol/scr008

Wiener Linien. (2025). *Mit WienMobil mobile Freiheit genießen*. https://www.wienerlinien.at/wienmobil

Wiener Linien. (n.d.). *WienMobil Stationen - Wiener Linien*. https://www.wienerlinien.at/wienmobil/stationen

Wiener Linien. (n.d.). *WienMobil: Integrated mobility services*. Retrieved February 20, 2025, from https://www.wienerlinien.at/wienmobil/stationen

Witte, J.-J., Alonso-González, M., & Rongen, T. (2021). Verkenning van het concept Mobiliteitshub. In Kennisinstituut Voor Mobiliteitsbeleid (ISBN 978-90-8902-245-5). Ministerie van Infrastructuur en Waterstaat. https://www.kimnet.nl/publicaties/rapporten/2021/05/31/verkenning-van-het-concept-mobiliteitshub

Zhai, W., & Ye, X. (2024). Moving towards climate-resilient mobility: Challenges and emerging trends. Travel Behaviour And Society, 100971. https://doi.org/10.1016/j.tbs.2024.100971

Zijlstra, T., Bakker, S., & Witte, J.-J. (2022). Het wijdverbreide autobezit in Nederland. In Kennisinstituut Voor Mobiliteitsbeleid (KIM) (ISBN: 978-90-8902-263-9). https://www.kimnet.nl/

Appendix A. Scientific Paper

A Participatory Value Evaluation to bridge Mobility and Community in Multimodal Hub planning

Demi Reuvekamp

Abstract **–** Multimodal mobility hubs are increasingly promoted as sustainable solutions to reduce car dependency, yet many do not align with user needs due to limited public involvement in the design process. To see if the planning of hubs can align with community preferences, this study performs a Participatory Value Evaluation (PVE) focused on the Dutch city of Zwolle. PVE makes it accessible for a large and diverse group of citizens to be involved in policy issues and decision making. Through two choice tasks, participants allocated limited resources among various hub design options, reflecting real constraints and trade-offs faced by decision-makers. The PVE set-up is grounded in structural and functional components of four European mobility hubs, innovatively using the Technological Innovation System (TIS) framework as a learning tool. Latent Class Cluster Analysis (LCCA) revealed preference-based user segments, ranging from bike- and public transport enthusiast to mainly car-oriented users. Despite varied priorities, all clusters emphasized the importance of physical and social safety, and core amenities like public toilets, parking and public transport integration. Qualitative analysis showed respondents reasoning behind numerical choices, highlighting once more, concerns about safety. Expert interviews confirmed PVE's relevance as a practical planning tool, especially when implemented in the right phase of hub design. While sample representativeness and expert diversity were limited, the findings suggest that integrating PVE into recurring planning cycles can improve the social legitimacy and effectiveness of mobility hubs. This research offers a replicable framework for embedding community values in urban transport planning, with implications extending to other Dutch and European contexts.

Index terms **– Multimodal Mobility Hubs, TIS, PVE, Urban Mobility Planning, Citizen Engagement**

A. INTRODUCTION

To meet the sustainability goals of the future, the Netherlands must literally shift gears toward active and public transport. In 2023, an average Dutch inhabitant travelled 12.1 thousand kilometers. Over 50% of these travelled kilometers were done by car, and this number is expected to grow in the upcoming 25 years (CBS, 2024; Zijlstra et al., 2022). Car use is associated with a wide range of negative impacts for society, consider traffic congestion, greenhouse gas emissions, and noise pollution (Rahman, 2023). In addition, the increasing use of cars negatively impacts the growth opportunities of other modes of transport (Zijlstra et al., 2022).

A change in the main commuting mode of travelers is usually linked to a significant life event, or a social development among communities (Rahman, 2023; Cascetta & Henke, 2023). This relation offers a chance to analyze the factors that influence commuters to begin or stop using their private cars (Rahman, 2023). The question is how government policies can be adapted to support a shift toward less polluting transport modes and improve the pollution levels of current vehicles within each mode (Cascetta & Henke, 2023). Knowing what drives change can help to direct policies toward appropriate target groups (Rahman, 2023).

Mobility hubs are a promising policy initiative toward more sustainable transport, they are considered physical links between multiple modes of transport (Witte et al., 2021). Hubs offer barrier-free travel by enabling seamless transitions between public and private transport modes, while also offering a platform to scale shared mobility and reduce private car ownership (Witte et al., 2021). In addition they can serve as focal points for spatial development goals. Various types of hubs are considered within this transportation improvement effort (Weustenenk and Mingardo, 2022).

However, simply realizing a mobility hub is not a guarantee for success (Choudhury, 2024). Understanding long-term performance factors is important to shape a policy strategy for successfully integrated hubs that are effectively used by community members (Arnold et al., 2023). The SmartHubs project researched around 160 European mobility hubs and established a disconnect between genuine accessibility and the current way hubs are implemented (Choudhury, 2024). Many mobility hubs are designed to prioritize technical and infrastructural efficiency over community integration (Choudhury, 2024; Rongen et al., 2022). Social desirability and citizen participation are important from a design aspect as they

help to establish needs and requirements of users (Bahamonde-Birke, 2023).

So, while there is extensive research on the technical and environmental benefits of mobility hubs (Arnold et al., 2023; Gerike et al., 2022; Hached et al., 2023; Pereira & Silva, 2023; Zhai & Ye, 2024), there remains to be a knowledge gap concerning their integration of the consumer perspective in the planning and design. Specifically, the absence of community-centered design approaches is likely to limit the hubs ability to meet local needs and desires effectively (Faherty et al., 2024; Geurs et al., 2022; Junyent et al., 2024; Rongen et al., 2022). This gap is magnified by a lack of methodologies to systematically capture and incorporate public preferences into urban mobility planning.

This research focuses on how Participatory Value Evaluation (PVE) can be utilized to bridge this gap. As a relatively new participatory method, PVE makes it accessible for a large and diverse group of citizens to be involved in policy issues and decision making (Mouter et al., 2020). PVE asks participants to allocate limited resources among various policy options, reflecting the real constraints and trade-offs faced by decision-makers. The method allows for collecting detailed data on public values, preferences, and priorities (Mouter, 2021; Mouter et al., 2020). Understanding what drives community engagement and how these insights can be integrated in mobility hub development is important for effectiveness and long-term sustainability (Arnold et al., 2023). Up to this point, the integration of PVE into mobility hub development is not fully explored and the potential to enhance community alignment and policy effectiveness remains unknown for this mobility innovation.

Problem Statement

Despite the growing recognition of mobility hubs as instruments for creating more sustainable urban mobility (Junyent et al., 2024), their success is currently compromised by a lack of community involvement in the planning and design processes (Geurs et al., 2020). To realize mobility hubs that are socially accepted and more effectively used by communities, there is a need to explore how PVE can be integrated into planning and development stages (Geurs et al., 2020; Mohiuddin et al., 2023). This helps to ensure mobility hubs are not only technically efficient but meet consumer requirements (Gunton et al., 2022). Against this background, this study examines how a PVE approach can enhance the design and planning of multimodal mobility hubs by incorporating community preferences and better aligning these hubs with user needs.

Scientific and social relevance

This study advances the understanding of how PVE can be effectively operationalized in the context of mobility hub development. It provides empirical evidence on PVE's capacity to capture community preferences and inform policy decisions. By integrating the TIS as a learning tool for participatory governance, the research offers a novel interdisciplinary contribution. The findings strengthen the theoretical foundation of participatory methods in transport planning and design and expand the scope of PVE as a practical tool for infrastructure design and decision-making.

By emphasizing community participation through PVE, this study aims to influence policy frameworks. To ensure that mobility hubs are designed in ways that reflect the diverse needs of local populations, while promoting more democratic and transparent decision-making processes in urban mobility planning. Ultimately, this contributes to the development of mobility hubs that not only support environmental sustainability but also enhance social cohesion, accessibility, and public trust in transport policies.

The remainder of this paper will be structured as follows. Section B will contain a literature review, while section C will go into the proposed methodology. Section D presents the study results of the PVE, where the methodology is mainly applied. Section E discusses the main results of the implementation, while touching upon limitations and recommendation for further research. Finally, Section F draws the main conclusions of this study.

B. RELATED WORK

The way people move through the current mobility system continues to be unsustainable, but as cities grow, so does the demand for renewed, efficient urban mobility systems (Herrera-Acevedo & Sierra-Porta, 2024; Papadakis et al., 2024). Sustainable urban mobility represents the idea that cities provide environmentally-friendly transportation options that do not harm the environment or cause poor social impacts (Ortúzar, 2019). However, perceived car advantages like accessibility, travel time and marginal utility have interfered with the adoption of sustainable mobility practices and maintain the extensive use of private cars (Metz, 2013; Papadakis et al., 2024).

By raising individuals' awareness of mode choices, their behavioral patterns and the consequences of their trips, researchers strive to create a broad modal shift (Gabrielli et al., 2014; Papadakis et al., 2024). However, Fitschen et al. (2024) explain that sustainable alternative travel modes often fail to attract car users. Regardless of the proposed

cost advantage of shared mobility, it is challenging to create a cost-based encouragement for car users to switch from personal cars to more sustainable shared mobility (Liljamo et al., 2020; Fitschen et al. 2024).

Another reason shared mobility struggles to gain mode share is the rising electric vehicle (EV) ownership, driven by government incentives rooted in risk management and policies lowering operating costs (Lane et al., 2013; Mohammadzadeh et al., 2022). However, EVs do not reduce car dependency (Ortúzar, 2019) or mitigate congestion (Delucchi, 2000). Even limited EV adoption could increase travel time by nearly 5%, highlighting their limited societal mobility benefits (Grigorev et al., 2021; Rahman, 2023).

The maximization of accessibility and efficiency for users is one of the main integration features for a sustainable city (Herrera-Acevedo & Sierra-Porta, 2024). Inequitable transport access for vulnerable groups deepens urban social and economic inequality (Martinez et al., 2024). But, the implementation of mobility hubs present a unique opportunity to improve accessibility (Frank et al., 2021). Mobility hubs, represent shared, sustainable, and multi-modal transport systems that support environmental, social, economic and security objectives (Junyent et al., 2024; Arnold et al., 2023; Hached et al., 2023). Locating mobility hubs in strategic areas can significantly enhance accessibility, while creating inclusive mobility systems to serve diverse user needs (Frank et al., 2021; Stadnichuk et al., 2024).

In the Netherlands, the mobility hub concept has gained traction in both research and policy circles (Rongen et al., 2022). Junyent et al. (2024) describes multimodal mobility hubs as the only alternative to the large share of private cars. The implementation of mobility hubs can create seamless multimodal mobility, as long as there is enough capacity to connect one center of activity to another (Junyent et al., 2024). However, past projects have not yet significantly shifted travel behavior from private car use to multimodal transport (Rongen et al., 2022).

The success of mobility hubs depends, among others, on stakeholder engagement and innovative policy design (Papadakis et al., 2024). It is important to adapt the mobility hub planning to specific area dynamic to enhance effectiveness (Rongen et al., 2022). Arnold et al. (2023) emphasize the need to understand community needs and incorporate them into hub design and operations. Butzin et al. (2024) discuss how regional challenge-based innovation policies, which include citizen participation, can anchor social equity within urban mobility projects. Adopting a holistic approach to urban mobility planning, allows designing mobility hubs that address the specific barriers faced by diverse communities (Gössling & Cohen, 2014; Jeyaseelan et al., 2022; Tammaru et al., 2023; Aydin et al., 2022).

Mobility hubs are inherently people-centric, case studies illustrate how people-centered planning methods, can enhance design and implementation (Taborda et al., 2023; Sagaris, 2024). However, Gunton et al. (2022) establish that current policy tools often over-simplify complex situations. There is the need for an approach that extends beyond economically sound investments that are just functional from a infrastructure perspective. A policy tool must also capture the other ecological and social dimensions of a problem (Gunton et al., 2022; Taborda et al., 2023; Mouter, 2021).

Participatory Value Evaluation (PVE) can add value by capturing diverse stakeholder perspectives, ensuring that mobility policies reflect the priorities of all community groups to help shift travel behaviour. PVE is a participatory mechanism that allows stakeholders to express preferences regarding public policies under resource constraints (Mouter, 2021; Mouter et al., 2021). Based on the principle that individuals are utility maximizers, PVE allows participants to allocate or reject public budget and space for any proposed project (Mouter, 2021). PVE allows to capture multidimensional societal values, making it particularly suitable for complex urban mobility decisions (Mouter et al., 2020). Bahamonde-Birke et al. (2023) utilized PVE to gain a social desirability perspective on multimodal transport, resulting in a shown preference for diversifying investments among mobility options.

Challenges remain in utilizing the full environmental and social potential of mobility hubs. Ciriaco and Wong (2024) discuss the multimodal desires of citizens and found that accessibility is respondents main priority. Further identified barriers for urban mobility development are inadequate funding, regulatory constraints, insufficient public awareness, and insignificant behavioural change (Rani and Jayapragash, 2024; Faherty et al., 2024). Individual perceptions significantly influence mode choice, thus to overcome these challenges the community perspective must be aligned with the policy direction (Faherty et al., 2024; Mohiuddin et al., 2023).

Citizen participation strategies like PVE do not only surface individual preferences but also reveal systemic interdependencies. Another strength is the inclusion of traditionally underrepresented groups. Mouter et al. (2021) highlights how PVE cuts down participation time, attracting a broader scale of participants and producing

actionable outcomes. The influence PVE can have on decision making and socially accepted policy making is deemed to be credible, legitimate and relevant (Juschten & Omann, 2023).

C. METHODOLOGY

I. Experimental procedure and equipment

This research primarily involved the design, execution and analysis of a PVE. The design of the PVE is informed by a multi-faceted analysis. Four European mobility hubs, from the SmartHubs database, are selected for a case study. The SmartHubs Project's categorizes hubs based on their physical, digital, and democratic integration levels. (Geurs and Münzel, 2022). The level of integration defines whether a hub is merely a single mobility service, or a (smart) mobility hub (Geurs et al., 2023). The four selected hubs represent different levels of integration, with a specific focus on the democratic integration. Defined by citizen involvement, democratic integration reflects participatory governance and helps ensure mobility hubs are inclusive and responsive to diverse user needs (Geurs et al., 2023). The hub selection is based on gaining a variety in integration scores, keeping in mind the research scope of this study. This research will focus on the three smallest hub types: Suburban Hubs (Centrumhubs), Neighborhood Hubs (Buurthubs), and Community Hubs (Microhubs). The hub categorization is based on research by Weustenenk and Mingardo (2022) and is comparable to the one by the city council of Zwolle (Gemeente Zwolle, 2022).

The selected mobility hubs are analyzed in relation to the Technological Innovation System (TIS) theory (Berget et al., 2008; Wieczorek & Hekkert, 2012). The analysis of the hubs is performed independently of the SmartHubs integration scores. It provides insight into how hubs are embedded in national and regional policy frameworks, highlighting stakeholder roles, regulatory contexts, and available transport modes. Doing a TIS based case study allows to identify reoccurring mistakes which can be prevented in new design and planning ideas. Throughout the TIS components analysis and creating a generalized innovation loop based on the Functions framework by Hekkert et al. (2007). success and failure factors (SFFs) are identified. Alongside practical observations from Zwolle's existing mobility hubs (Weezenlanden-Noord and Diezerpoort), these points served as the foundational input for selecting the PVE decision attributes.

Grounded in the case study insights, the PVE survey is designed for Mobility hub plans in Zwolle. The PVE is conducted online using the Wevaluate platform developed by Populytics, a spin-off of the TU Delft (Populytics, 2025). The survey collects quantitative data based on participant choices and qualitative insights through respondents reasoning, concerns, and suggestions. The PVE consists of three parts: demographic/personal questions, a “score” choice task and a “space” choice task, each targeting a slightly different but complementary dimension of hub design.

Within the score choice task, respondents are presented with four thematic categories: mobility attributes; public attributes; facility attributes and commercial attributes. Each category presents participants with five hub equipment options. A fixed total of 20 points in each category, can be distributed across the five attributes. The given points represent the assigned importance to each attribute. Every attribute offers a short description clarifying its meaning to the respondents. Within the space choice task respondents are asked to allocate limited space across nine components. The components are reframed from the 20 attributes in the score choice task. Each component is assigned an amount of space that stands in proportion to the total available amount, and all of the other components. Respondents use sliders to indicate which elements they believe should occupy more or less space within the hub's footprint.

To ensure broad participation, the PVE is distributed through several neighborhood platforms, local news pages, and personal as well as professional networks. In addition, printed flyers are distributed in various neighborhoods. This mixed online-offline approach aims to reach both digitally active and less-connected residents for a more inclusive analysis sample.

To complement the PVE’s results and to reinforce the achievement of the research objective in terms of policy relevance, two expert interviews are conducted. These aim to assess how urban mobility professionals view the added value of the TIS and PVE findings, and how they might be integrated into mobility hub planning in Zwolle (and beyond). Among the experts there is one external project manager and consultant, as well as one expert working within the municipality.

Only two experts are consulted due to scope and time constraints. Nevertheless, both provided in-depth insights across a broad range of questions, critically reflecting on the feasibility and utility of PVE results from a policymaking standpoint. Both experts get full access to the PVE results in advance to ensure a well-informed discussion. Interviews follow a semi-structured format (Ilovan & Doroftei, 2017), using open-ended questions with flexibility for deeper discussion.

	"Score" choice task – 2 Clusters model	"Score" choice task – 3 Clusters model	"Score" choice task – 4 Clusters model	"Space" choice task – 2 Clusters model	"Space" choice task – 3 Clusters model	"Space" choice task – 4 Clusters model
LL	-3295.78	-3251.87	-3253.03	-969.06	-910.56	-878.83
BIC (L^2)	7299.23	7422.97	7636.81	1854.65	1920.69	2020.29
AIC (L^2)	6902.13	6910.33	7008.65	1878.71	1855.71	1866.26
Entropy R^2	0.99	0.97	0.99	0.94	0.97	0.99

Table 8. Overview of class model statistics based on the LatentGOLD LCCA analysis for models with 2,3 and 4 clusters

	Analysis Sample	National	Zwolle
All Respondents / Inhabitants			
Total	82		133.839
Gender			
Male	52,4% (43)	49,7%	49,3%
Female	45,1% (37)	50,3%	50,7%
Remaining	1,2% (1)	*No available data*	*No available data*
Age			
18 until 24	14,6% (12)	8,9%	9,5%
25 until 34	17,1% (14)	13,3%	14,0%
35 until 44	18,3% (15)	12,5%	14,7%
45 until 54	20,7% (17)	12,4%	12,4%
55 until 64	18,3% (15)	13,8%	12,1%
Older than 64	9,8% (8)	20,4%	17,3%
Education Level			
Elementary- or Highschool	8,5% (7)	35,9%	29,0%
Practical education (MBO)	12,2% (10)	26,5%	32,0%
Theoretical education (HBO, WO)	78,0% (64)	37,0%	39,0%

Table 9. Distribution of the Socio-Demographic features of the PVE respondents, set off against the national and municipal average as obtained through data from the Central Bureau of Statistics.

II. Data processing and analysis

To provide sound policy advice and ensure the results are as valuable as possible for the design of mobility hubs, it is important to capture heterogeneity in respondent preferences. A Latent Class Cluster Analysis (LCCA) will be used for the classification of respondents into latent (unobserved) groups based on similarities in their response patterns, offering insights into user segments that can inform more tailored policy interventions (Molin et al., 2015). This research uses LatentGOLD 6.0 software to fit models with 2 to 4 classes (Table 1). Final class selection is guided by Bayesian Information Criterion (BIC and AIC), and the relevance of the cluster characteristics, favouring solutions with the highest level of interpretability. The results will present average attribute scores, along with descriptive cluster titles and supporting qualitative justifications from respondents.

The open-ended responses within the PVE will be analyzed using thematic analysis to identify recurring patterns and underlying themes in participants' reasoning (Braun & Clarke, 2006). An inductive coding approach will be applied manually, meaning that themes will emerge from similarities in argumentation, values, and trade-offs expressed in the data. Following the cluster analysis and interpretation, the most striking attributes will be included in the qualitative analysis. Consider attributes with consequent scores, or notable outliers among the clusters

The expert interviews are conducted in Dutch, recorded, and transcribed for analysis. Key quotes are translated into English with care to preserve the experts' original meaning. The interviews are analyzed in such a way they identify important viewpoints, which help contextualize implementation challenges and opportunities of the PVE.

III. Sociodemographic features

Table 2. shows that gender distribution aligns with national figures, though one non-binary respondent had no comparison data. The sample overrepresents theoretically educated (78%) and younger respondents (ages 18-24), and middle aged respondents (ages 45-54). Older (ages > 64) and practically educated individuals are slightly underrepresented. Since most respondents are located in Zwolle, this overrepresentation may be partly explained by the city's demographic profile.

As the PVE focuses on Zwolle's mobility hub plans, it is relevant that 72% of respondents have personal experience with travelling through the city.

	Sample	National
Car Ownership		
I own 1 car	57,3% (47)	47,0%
I own more than 1 car	13,4% (11)	27,0%
I do not own a car	28,0% (23)	26,0%
Most used transport mode		
Private Car	34,1% (28)	68,3%
Train	11,0% (9)	10,1%
Bike	41,5% (34)	8,9%
Bus, tram, metro	1,2% (1)	2,6%
Walking	11,0% (9)	3,5%
Shared mode	0,0% (0)	6,7%

Table 10. Mobility characteristics of the PVE respondents, including car ownership and the most commonly used mode of transport, set off against national averages.

Table 3. shows respondents mobility preferences. There is a large share of bike users, over four times the national average, along with a slight overrepresentation of walkers. Zwolle is, however, considered a very urbanized area (CBS, 2025). This level of urbanization has an average share of 30% in bike kilometers (De Haas and Kolkowski, 2023), a number much more concise with the results from

the PVE. Conversely, private car use is underrepresented. This can be explained as less urbanized areas are more car dependent and all urbanization levels contribute to the national average (Zijlstra et al., 2022). Notably, none of the respondents reported using shared modes as their primary transport.

D. PVE RESULTS

This upcoming section presents the analysis and results of the PVE. Through statistical modeling the chapter uncovers general patterns as well as heterogeneity in preferences across respondent groups. The cluster analysis results are supported by quotes of respondents.

I. Results of the score choice task

This section will go over de results from the score choice task. Table 4. shows the average scores assigned to 20 mobility hub attributes, grouped into four categories for clarity. A baseline score of 4 is used for equal comparison among attributes. The sample mean scores are tested with a 95% confidence interval to account for uncertainty. For example, the integration of public transport scored 5.6, with a confidence range of 4.9 to 6.2.

	Average
Mobility Attributes	
Improve integration with public transport	5.56
Realize parking spots and accessibility for private cars	5.72
Add charging stations for electric vehicles	2.35
Create safer and covered bicycle parking spaces	3.84
Provide more shared mobility options	2.52
Public Attributes	
Offer luggage lockers for travelers	2.38
Create clear and safe walking routes in and around the hub	4.70
Add parcel lockers for online deliveries	4.28
Install a free drink water tap	2.88
Include public and accessible toilets	5.77
Facility Attributes	
Facilities to ensure accessibility for disabled population	4.66
Implement good lighting and CCTV for improved safety	5.38
Install an AED and a first aid station	3.73
Ensure Wi-Fi and charging points are available	2.43
Provide covered and heated waiting areas with seating	3.81
Commercial Attributes	
Include a bike shop or repair service within the hub	4.42
Support meeting areas or community initiatives	3.09
Offer workspaces or flexible office spaces	3.00
Add catering facilities like a café	4.51
Integrate a supermarket or to-go shop	4.99

Table 11. Average score, out of 20, for each of the mobility hub attributes in the score choice task

Three *highest* scoring attributes: Include public toilets and accessible restrooms (5.77); Realize parking spots and accessibility for private cars (5.72); Improve integration with public transport (5.56). On average respondents prioritized basic amenities and accessibility, with a strong focus on inclusivity, comfort, and (social)safety. Results highlight the importance of seamless, multimodal connectivity and user-friendly services.

Three *lowest* scoring attributes: Add charging stations for electric vehicles (2.35); Ensure Wi-Fi and charging points for personal devices (2.43); Offer luggage lockers for travelers (2.38). Many low scoring attributes are seen as secondary to core functions like movement, access, and basic infrastructure. On average respondents appear to prioritize space and usability over digital or energy-related amenities.

Cluster analysis score choice task

To identify distinct respondent groups, a Latent Class Cluster Analysis (LCCA) is conducted. While both two- and three-cluster models are viable, the three-cluster model was chosen to capture more nuanced segment differences relevant to policy and planning. Although its BIC value was slightly higher (~123 on ~7400), this was considered acceptable for improved interpretability. Full cluster analysis statistics are available in the methodology section.

Cluster Size	Cluster1 56%	Cluster2 22%	Cluster3 22%
Indicators			
Mobility Attributes			
Improve integration with public transport	5.78	5.82	4.74
Realize parking spots and accessibility for private cars	2.96	7.54	10.85
Add charging stations for electric vehicles	3.02	2.38	0.65
Create safer and covered bicycle parking spaces	4.95	2.54	2.36
Provide more shared mobility options	3.29	1.71	1.40
Public Attributes			
Offer luggage lockers for travelers	2.82	1.42	2.23
Create clear and safe walking routes in and around the hub	4.77	3.35	5.87
Add parcel lockers for online deliveries	4.19	4.45	4.33
Install a free drink water tap	2.90	4.66	1.03
Include public and accessible toilets	5.32	6.12	6.54
Facility Attributes			
Facilities to ensure accessibility for disabled population	4.91	1.68	7.01
Implement good lighting and CCTV for improved safety	4.97	5.20	6.58
Install an AED and a first aid station	3.90	3.87	3.18
Ensure Wi-Fi and charging points are available	2.34	4.53	0.54
Provide covered and heated waiting areas with seating	3.88	4.72	2.69
Commercial Attributes			
Include a bike shop or repair service within the hub	5.23	2.67	4.12
Support meeting areas or community initiatives	3.67	2.51	2.18
Offer workspaces or flexible office spaces	3.38	3.33	1.69
Add catering facilities like a café	3.87	5.54	5.10
Integrate a supermarket or to-go shop	3.85	5.94	6.90

Table 12. Average score per cluster for each of the mobility hub attributes in the score choice task

Cluster 1, the largest group (56%), can be described as *Bike and Public Transport Enthusiasts.* They strongly prefer sustainable mobility, scoring highest on public transport integration (5.78) and secure bike parking (4.95), while showing low interest in car parking (2.96) and non-transport amenities like Wi-Fi

"Without public transport a mobility hub isn't

"Promoting cycling is always a plus, there should be no arguments against using a bicycle"

(2.34). This group values accessibility for all users (4,91). It includes many bike users (61%) and few car users (15%), which aligns with the shown preferences for bike and public transport infrastructure. Demographically, it skews younger (41% aged 18–34) and is predominantly male (63%).

Cluster 2, representing 22% of respondents, can be described as *Practical Providers*. They prioritize comfort and convenience, scoring high on car parking (7.54), toilets (6.12), and super-markets (5.94), but show low interest in shared mobility (1.71) and community features (2.51). there is a high education level (89%) and a balanced gender split.

"Of course it makes sense if people can park their cars here, otherwise the added value of a hub is very limited."

"Good parking around a hub that has transport hub will entice people to get out of their cars and use less polluting transport"

Interestingly this cluster shows no participants (0%) who use public transport as their most frequent mode, though their relatively high score for its integration (5.82) suggests potential for a mode shift.

Cluster 3 is the most outspoken cluster, representing 22% of respondents. Calling them the *Car-Oriented Comfort Seekers*, they mainly prioritize car parking (10.85) and accessibility (7.01). While also scoring high on super-markets (6.90), and safe walking routes (5.87), while scoring very low on charging stations (0.65), workspaces (1.69), and Wi-Fi (0.54). This older, predominantly female group (72%) is highly car-dependent as 100% owns at least one car, and 67% use it as their main transport mode, with minimal bike use (6%).

"A space that is designed based on the needs of disabled people, children and the elderly is a space that is well-designed for everyone."

"Wi-Fi and electricity are extras that I don't use and don't consider necessary"

Overreaching Features – score

Despite differences between clusters, several priorities are shared across the full sample. Essential amenities like public toilets (~5.99) and public transport integration (~5.45) are consistently valued, highlighting a shared demand for functionality and convenience. Safety also emerges as a key theme, with features like lighting and surveillance (~5.60) widely supported. But also other attributes reflect an emphasis on safety, reflecting a collective need for environments where people feel comfortable and supported. Other items that are simply appreciated as a sense of convenience include package lockers (~4.32) and first aid facilities (~3.65). In contrast, charging stations (~2.02) and workspaces (~2.80) are universally considered less important in mobility hubs.

"Essential for an accessible city. I think it is very important that there are more toilets. They should also be maintained to be clean and fresh."

"When I walk through the station at night, I often feel unsafe because it is dark. I think that cameras and good lighting will contribute to the feeling of safety."

"Charging is not that interesting as a primary facility. Secondary this could be possible, but given the travel distances this is actually not necessary."

II. Results of the space choice task

In addition to the score choice task, respondents completed a space allocation task, using sliders to distribute limited space among hub functions based on their personal priorities. Each slider started at a neutral midpoint (0.5), representing balanced allocation across all functions. Moving the slider toward 0 indicated there is no space assigned, while 1 means the maximum available space for a function is assigned. The results reveal clear trends that align with earlier preferences. Table 6. presents the average space allocated to each function.

	Average
Small shared mobility (e.g. e-bikes)	0.49
Large shared mobility (e.g. e-cars)	0.42
Secure bicycle parking	0.61
Parking for private cars	0.58
Nature and Walking	0.48
Logistic facilities	0.53
Meetings and Community initiatives	0.41
Working and Waiting	0.44
Commercial facilities	0.37

Table 13. Average score, out of 1, for each of the mobility hub functions in the space choice task

Among the highly allocated functions are secure bicycle parking, which received the highest space allocation (0.61). This aligns with previously given high scores, reinforcing its importance as a core hub function. Additionally private car parking ranked high (0.58), indicating that, despite the general hub focus on shared mobility, personal vehicle access remains a priority for many respondents.

Among the below-average allocated function are logistic facilities, small shared mobility, and nature and walking. Commercial functions scored lowest (0.37), a contrasting result compared to its importance in the score task, respondents may prioritize core mobility infrastructure over space-intensive amenities. This highlights the need for compact, multifunctional designs.

Cluster analysis space choice task

	Cluster1	Cluster2
Cluster Size	62%	38%
Indicators		
Small shared mobility (e.g. e-bikes)	0.56	0.37
Large shared mobility (e.g. e-cars)	0.52	0.27
Secure bicycle parking	0.59	0.63
Parking for private cars	0.43	0.82
Nature and Walking	0.51	0.41
Logistic facilities	0.53	0.53
Meetings and Community initiatives	0.52	0.23
Working and Waiting	0.46	0.41
Commercial facilities	0.37	0.37

Table 14. Average score per cluster for each of the mobility hub functions in the space choice task

For the "space" task, a two-cluster solution was selected, as Clusters 2 and 3 from the "score" task merged into a more unified group. This improved interpretability and provided clearer insights into spatial preferences. Cluster details are shown in Table 7.

Cluster 1 represents the *flexible mobility optimizers*, comprising 62% of the sample. They value shared and sustainable mobility, mainly allocating space to shared modes (0.56 small and 0.52 large), while also embracing bike-friendly infrastructure (0.59). This group also supports community initiatives (0.52), but shows a lower interest in commercial facilities (0.37). Many respondents (41%) do not own a car and rely on bikes (61%) as their main mode of transport. Demographically, this cluster is younger (44% aged 18–34) and predominantly male (56%).

"Important facility for the first/last part of the journey, which takes up less space. Moreover, it is good to encourage

"Space for the neighbourhood, literally and figuratively. Especially the new development areas are difficult to connect to the existing neighbourhoods. Hubs can bridge this gap."

Cluster 2 represents 38% of the respondents who are well described as the *Car-Oriented Space Seekers*. Main priorities are car access and structured urban space. They allocate a very high share of space to private car parking (0.82) and the least to shared mobility (0.37 small and 0.27 large), favoring independence over communal alternatives. This older (67% aged over 45), mostly female group (54%) shows limited interest in nature (0.41) and community functions (0.23), again pointing towards a preference for independent spatial use. Car use dominates, with 93% owning at least one vehicle and 67% using it as their main mode.

"Small shared mobility is at the expense of cars for residents and tourists. And walking in the city becomes less safe."

"Nature is important, but I don't associate this with an urban hub."

Overreaching features – space task

"Travelers should be encouraged to travel to the hub by bike. The presence of bicycle parking spaces is

Despite the differences, one very clear shared priority stands out among both clusters: safety. Whether through secure bicycle parking (~0.61), or logistic facilities including surveillance, lightning and first aid (~0.53). Both clusters emphasize the importance of well-maintained spaces that enhance security. Regardless of mobility preferences, this common thread suggests that a sense of safety and stability is essential to urban space planning.

"Takes up little space and is very practical! So it provides a lot of convenience and luxury compared to the amount of land used"

III. Qualitative Insights from Open-Ended Responses

Alongside the quantitative data, the PVE included open-ended responses, offering deeper insight into participants' motivations and values. An inductive thematic analysis was conducted on selected key attributes to capture recurring themes. The attributes highlighted in this qualitative analysis are shown in table 8.

High scoring attributes with ***consensus*** **among clusters**	**Low** scoring attributes with ***consensus*** **among clusters**	**High** scoring attributes with ***differences*** **among clusters**	**Low** scoring attributes with ***differences*** **among clusters**
Include public toilet and fully accessible restroom	Add charging stations for electric bikes, scooters and cars	Realize parking spots and accessibility for private cars	Provide more shared mobility options
Improve integration with public transport	Offer workspaces or flexible office spaces	Integrate a supermarket or to-go shop	Ensure Wi-Fi and charging points are available
Implement good lighting and CCTV for improved safety	Offer luggage lockers for travelers		

Table 15. Hub attributes analyzed in the qualitative thematic analysis

The qualitative responses enrich the PVE data by explaining motivations behind preferences. A very large share of respondents took the time to provide additional information and express the reasoning behind the choices they made. It became clear that behind a lot of preferences, there is a deeper layer connected to physical, and maybe even more to social safety. Commercial facilities like a supermarket to-go gained high scores, obviously from a convenience point of few, but maybe even more interestingly from a safety point of view. Respondents highlight they like the fact that these services attract people, and that more people in and around hub locations would improve their sense of safety. Several respondents fear that, in case of mediocre design, mobility hubs will

become a hang-out spot for the "wrong" people. This decreases their desire to use the hub, and mainly decreases their feeling of safety. In line with this fear, and also strengthening insights behind the lower interest displayed in shared mobility services, respondents highlight that time has proven that shared mobility services clutter public space and that users cannot seem to take care of these facilities like they would take care of their own vehicles.

On the more positive end, there are a lot of tips and insights provided to gain a deeper level of understanding in what makes a hub a success to people. People valued parking spaces for cars and bicycles. Interesting here is the two distinct kinds of reasoning behind this choice. On the one hand, there are respondents who reasoned from their own perspective. They would like to have enough space to park their vehicle safely, to then switch to a provided mobility service for the extend of their journey. On the other hand, there are the respondents reasoning towards others. They felt having parking opportunities was the only way to make it attractive enough for private vehicle users, to considers using a multimodal travel approach. The same arguments came up according to the high value for the integration with public transport, respondents feel this is necessary toward the success of a mobility hub. Which in retrospect is also one of the main requirements established by the SmartHubs project.

Together, all findings suggest that infrastructure alone cannot ensure the success of mobility hubs. The effectiveness and long-term relevance of such hubs depend on their alignment with the everyday preferences, values, and constraints of local residents.

IV. Insights from expert interviews

To provide additional depth and insight into the potential of using PVE (and its results) for the design and integration of mobility hubs in urban environments, two expert interviews are conducted. The first interview was held with the project manager of Zwolle's Adaptive Development Strategy for Mobility hubs, who also brings extensive experience as a policy advisor in the field of mobility. The second expert is one of Zwolle's official principal for mobility projects, who initiated and commissioned Zwolle's previous multimodal mobility hub projects.

The experts interviews showcased many highlights. Interestingly both experts agreed that currently there is not much time and space embedded in a policy process to consider lessons learned from other, either national or European, hubs. Therefore, there is lots of room to start integrating these insights and prevent making the same mistakes twice. Doing a case study and analyze hubs these hubs according to the TIS framework or any other systematic learning tool can benefit the planning and design assignment of hubs.

Also considering the PVE, there was consensus among the experts. As one of the experts put it: "I would like to analyze this further and draw more attention to it, because this is an important part of developing hubs." Both experts see great potential, of course with the needed limitations and marginal notes in regards to the (planning) phase a specific hub is in. PVE can be of great use to policy makers if implemented right. It must be realized at a point in time are the results can still be used / changes can still be made. But at the same time, it must be realized at a time when there is already significant information about space and the budget requirements to include these in the questions. That way you can ask those questions that provide the most valuable insights.

E. DISCUSSION

I. Key Findings

The study used a case study analysis of four European mobility hubs using the Technological Innovation Systems (TIS) framework. The TIS analysis identified important structural and functional hub components, as well as generalizable success and failure factors (SFFs). These insights served as the foundation for the PVE survey.

Within the PVE score choice task, the bike and public transport enthusiasts prioritize integration with public transport, secure bicycle parking, and accessibility, while largely rejecting car-related infrastructure. The practical providers focus on convenience, prioritizing car parking, supermarkets, Wi-Fi, and waiting areas, with little interest in shared mobility or community features. The third cluster, the car-oriented comfort seekers, strongly value car infrastructure and universal accessibility but show low interest in digital amenities or sustainability.

In the PVE space choice task, the *flexible mobility optimizers* maintain a focus on bikes, adding a preference for shared mobility and also community initiatives. Clusters 2 and 3 from the score choice task converge into one group, to improve interpretability. The *Car-Oriented Space Seekers* assign almost all their space to private car parking and accessibility. Notably, all clusters share priorities toward clean, integral toilets, and public transport integration. The clusters reveal insights into how people interact with urban spaces, an important consideration towards hub design. Physical and social safety stand out as overreaching features. Regardless of

mobility preferences, this common thread suggests that a sense of safety and stability is essential to urban space planning, influencing decisions in all groups.

The qualitative feedback highlighted once more the recurring theme of safety. Respondents consistently link the success of a hub to how safe and trustworthy it feels. Also concerns about shared mobility misuse and the genesis of unsafe, unmonitored areas attracting the wrong kind of people emerged. These insights show that beyond functionality, safety underpins public acceptance and usage, shaping how users interpret and prioritize every hub feature.

The expert interviews have underscored the policy potential of PVE to address blind spots in real world planning and design processes. Currently there is not much time and space embedded in a policy process to consider lessons learned from other hubs. Therefore, there is room to integrate these insights and prevent making the same mistakes twice. Both experts appreciate the PVE method: *"I would like to analyze this further and draw more attention to it, because this is an important part of developing hubs."* However, the PVE potential depends on the planning phase a hub is in.

II. Implications

This study contributes to currently accessible theory by combining the TIS insights with PVE in urban mobility planning. TIS purely focuses on structural and functional dynamics of innovation adoption (Bergek et al., 2008; Hekker et al., 2007), and is not typically used as a learning tool for broader analysis. Integrating the structural and functional components in the set-up of a participatory method like PVE introduces a new dimension to both participatory methods and technological innovation research. It enables a deeper understanding of the necessities for successful, socially accepted innovation (Geurs & Münzel; 2022; Geurs et al., 2023; Mohiuddin et al., 2023).

PVE offers policymakers a way to include a broad group of citizens in evaluating realistic policy trade-offs (Mouter et al., 2020; Mouter et al., 2021). Whereas traditional survey methods lack in this department (Callahan, 2007; Juschten & Omann, 2023). Another benefit are the insights provided by the qualitative analysis of the PVE's open ended questions. This additional layer to the data can help policymakers to keep an open mind toward important themes coming from the outside world.

Citizen participation is not only of value in urban development, but also required through an EU directive (Lindenau & Böhler-Baedeker, 2014). PVE offers a concrete way to enhance policy quality and meet legal requirements, while reaching a broad and versatile audience. The PVE result highlighted interesting insights towards modular and context-sensitive designs. Allowing hubs to, e.g. switch mode offerings is important as the need to create a modal shift among commuters, is combined with a rapidly changing environment due to mobility developments (Cascetta & Hanke, 2023; Gabrielli et al., 2014; Papadakis et al., 2024).

The development phase of a hub is a crucial determinant for the level in which the insights of the PVE can be incorporated in the planning. In an early stage PVE can function as a tool to start discussions and planning sessions from a citizens perspective instead of from a political one. Applying PVE in a later stage offers more directed insights skewed toward specific hub locations, offering design insights useful for the set-up of the requirement programs. Experts suggested integrating PVE into recurring planning cycles. Especially during critical moments such as hub upgrades or expansions, PVE could add a very valuable and insightful layer to the process.

This research offers a replicable framework for planners and policymakers to incorporate community preferences into mobility hub design. The PVE findings provide relevant insights, recognized by experts involved in hub development. PVE is seen as useful for future design phases, with current results serving as input for planning in Zwolle and other cities already. The data is not limited to one location and can inform hub designs elsewhere in the Netherlands. Insights may also apply to European cities facing similar planning challenges. PVE offers a scalable way to include public values in infrastructure development, enhancing both its legitimacy and long-term success.

III. Limitations

The most important consideration is that the PVE results are not statistically representative towards the general population. The group of respondents does not meet the statistically required amount to be representative for Zwolle's amount of inhabitants. Additionally, the majority of participants are younger individuals with high levels of education. This sampling bias potentially limits generalizability of the findings and means the perspectives of elderly adults, people with lower education or digital literacy, may be underrepresented in the results.

The expert interviews, while insightful, involved a limited number of professionals. Due to the scope of this study, perspectives from national policy actors or private-sector stakeholders are not included.

Finally, this research is cross-sectional, it captures the community preferences and system conditions at this specific moment in time. Mobility hubs are however fast-evolving concepts, influenced by quick shifts in technology, policy, and urban design trends. Features or design elements valued today may lose relevance as new user needs or mobility services emerge.

IV. Recommendations

It is recommended that policymakers and planners actively study existing mobility hubs across the Netherlands and/or Europe. The case study analysis in this research highlight recurrent issues that are potentially avoidable. Cities tend to treat their context as unique and feel learning points from other cities might not apply for them. Instead, I recommend adapting to known success factors and proactively addressing previously observed failure factors.

The PVE set-up for this research used an elaborate score choice task, and a more generalized space choice task. Interestingly, for some of the attributes the amount of value and space assigned did not match one another. For further research it could be of value to do a single, but more elaborate and detailed space based choice task. When in the right planning phase, a PVE could even include the allocation of actual square meters. This way the reasoning behind the choices will match a realistic hub blueprint.

Another potential improvement to the PVE is the addition of financial constraints. Budget is always of the essence, and it enables participants to evaluate the financial implications of their choices. Allowing for more realistic assessment of community priorities and bridging the gap between design preferences and implementable solutions.

The experts opted for a dual participatory process. The set-up would include the a broad PVE at a municipal, or even national level. From the general citizen preference, a few specific hub design proposals can be established. These design options should be presented to local communities through small-scale, physical participation sessions (e.g., workshops). This allows for a consumer based initial idea, strengthened by opinions from citizens that are closest and most likely to use a specific hub.

To ensure broad and inclusive citizen representation, it is suggested to partner with survey panel institutes. It will prevent one of the main limitations in this research, as it ensures sufficient sample size, mitigates self-selection bias, and enhances the quality and credibility of participation outcomes.

Given the fast evolving nature of mobility hubs and user expectations, future research could explore longitudinal PVE studies. Tracking how community values shift over time. Organizing sessions after hub implementation allow to test whether values toward attributes have changed after real life use. It potentially offers insights into behavioral adaptation and long-term policy relevance.

F. CONCLUSION

This research set out to explore how a Participatory Value Evaluation (PVE) approach can enhance the design and planning of multimodal mobility hubs by integrating community preferences into the design process.

PVE enhances mobility hub planning by translating community values into concrete, context-sensitive design choices. The research shows that respondents take significant time to elaborate on their considerations, adding a layer of depth to their numerical choices. PVE allows policymakers to simulate real policy trade-offs under realistic constraints to capture a deeper sense of what it is the community wants. This could not only improve the technical design of hubs (mode choice and mode infrastructure), but can also increases their social legitimacy (public support, design towards social safety), and usage rates.

PVE can function as a bridge between current political mobility hub planning and the community. The current planning and design process can be limited by narrow politic vision. PVE includes useful community engagement through an efficient platform that reaches a diverse audience, ensuring that mobility hubs are designed not only for communities but with them.

Appendix B. Integration Level Overview - SmartHubs

	Physical Integration	Digital Integration	Democratic Integration
Level 4	Conflict free and place making At least two shared transport modes visible from a public transport stop with no conflicts and information of using the services and at least two services. Universal design principles are considered	Integration of societal goals, policies and incentives Local, regional, and/or national policies and goals are integrated into the service or all modes are bundled, possibly subscription-based.	Social learning Participation takers and givers, including vulnerable users, have networked and integrated into the community, participation becomes permanent and independent
Level 3	Visibility and branding At least two shared transport modes visible from a public transport stop and at least two services (e.g., shop, parcel locker, kiosk), information about the service and potential conflicts, attractive design of the mobility hub including placemaking, branding and aesthetically pleasing scheme. Universal design principles are considered.	Integration of service offers All shared and public transport services at the hub can be found, booked, and paid with the same app. Universal design principles are considered, including simple and intuitive app design and analogue, on-site booking alternatives are available for all modes.	Integration of different knowledge Participation takers, including vulnerable users, argue or deny positions, their input is integrated into the participation process, participation givers create a room for decision making
Level 2	Wayfinding and universal design At least two shared transport modes in acceptable walking distance to public transport with wayfinding and information of using the service and at least two services (e.g., parcel locker, kiosk) in acceptable walking distance. Universal design principles are considered.	Integration of booking and payment and universal design Easy access to services for end users , such as a mobility marketplace or a one-stop shop where the user can find, book, and pay with the same app for at least public transport services and one shared mode at the hub. Universal design principles are considered, including simple and intuitive app design and minimum support for non-digital users.	Deliberative engagement of stakeholders Participation takers, directly including vulnerable users, argue or deny positions, their input is integrated into the participation process, participation givers create a room for decision making.

Level 1	Acceptable walking distance to shared and public transport At least two shared transport modes in acceptable walking distance to public transport and at least one service (e.g., shop, parcel locker, kiosk) in acceptable walking distance. Minimum legal inclusive design requirements are considered	Integration of information Multimodal travel planners can be used to plan at least the public transport services and one shared mode at the hub. Minimum inclusive design requirements are considered such as simple and intuitive app design.	Appropriate representation of stakeholder interests Participation takers got asked into a consultation process, Information are recognized. No or limited attention to involve vulnerable user groups.
Level 0	No physical integration One shared transport mode, not at walking distance to public transport, no integration between the modes. No universal design criteria are considered	No digital integration No digital integration of shared and public transport mode options offered at the hub. There are separate services and platforms for each mode. No universal design criteria are required	No involvement No involvement or consideration of stakeholder interests and user needs.

Table 16. Smart Hubs Integration system (Geurs et al., 2023)

Appendix D. Flyer

Jou mening maakt het verschil!

Wat vind jij belangrijk aan een mobiliteitshubs bij jou in de buurt?

PVE

Mobiliteitshubs Zwolle

TU Delft

Welkom bij dit onderzoek en bedankt dat u even de tijd neemt om deze informatie te lezen!

Mijn naam is Demi en ik ben aan het afstuderen voor mijn Master Transport, Infrastructuur en Logistiek aan de TU Delft.

Ik studeer af bij APPM management consultants, een bedrijf dat samen met de gemeente Zwolle werkt aan toekomstige mobiliteitshubs.

Voor mijn afstudeer onderzoek doe ik een Participatieve waarde evaluatie (PWE) voor de inrichting van de mobiliteitshubs die de gemeente Zwolle op de planning heeft staan.

PWE is ontstaan uit een behoefte van burgers om genuanceerd en tegelijkertijd niet te lang te participeren. Een PWE creëert de ruimte on in een korte tijd van grote waarde te zijn en dat volledig anoniem.

Door mee te doen aan deze PWE kruip je in de huid van een beleidsmaker en geef je jouw mening over de plannen.

Wil je meer ruimte voor fietsen en deelauto's? Of toch liever betere commerciële voorzieningen en wachtruimtes? Jouw keuzes helpen bij het maken van een weloverwogen beleid voor de toekomst van Zwolle, een toekomst waar jij echt wat aan hebt.

Scan de QR code en doe snel mee
Succes met de participatie en bedankt voor uw tijd.

PVE

Mobiliteitshubs Zwolle

TU Delft

Appendix E. PVE questions

Personal Questions

Before starting the choice tasks respondents got several questions about themselves and their mobility choices. All categories in relation to the question in this section are listed below.

- Age
- Gender
- Highest finished education
- Relationship to the municipality of Zwolle
- Car ownership
- Main transport mode

Questions "score" choice task

For the question in the "score" part of the PVE, respondents got to score attributes in four different categories. All categories and questions are listed below.

Mobility Attributes

Provide more shared mobility options such as e-bikes, scooters, and cargo bikes
Create safer and covered bicycle parking spaces
Add charging stations for electric bikes, scooters and cars
Realize parking spots and accessibility for private cars
Improve integration with public transport by location hubs near bus and train routes

Public Attributes

Include public toilets and a fully accessible restroom
Install a free drink water tap
Add parcel lockers for online deliveries
Create clear and safe walking routes in and around the hub
Offer luggage lockers for travelers

Facility Attributes

Provide covered and heated waiting areas with seating
Ensure Wi-Fi and charging points for laptops and phones are available
Install an AED and a first aid station within the mobility hub
Implement good lighting and CCTV for improved safety
Add facilities that ensure accessibility for people with disabilities

Commercial Attributes

Integrate a supermarket or to-go shop
Support meeting areas or community initiatives
Add food and beverage options such as a coffee bar or sandwich shop
Include a bike shop or repair service within the hub
Offer workspaces or flexible office spaces within the hub

Questions “space” choice task

For the questions in the “space” choice task respondents got assign a specific amount of space to each of the functions listed below. Each function came with a short explanation and had a specific amount of space assigned to them. Space details are based on experience from exciting hubs as mentioned in chapter 6.

Secure bicycle parking (assigned occupied space 4/10)

- Secure bicycle parking provides facilities for storing bicycles in locations with monitoring or by means of bicycle lockers, so that bicycles are protected against theft and weather conditions.

Parking for private cars (assigned occupied space 5/10)

- Car parking concerns the availability of parking spaces for vehicles in or around the mobility hub, so that travelers can safely leave their private car and use another mode for last-mile travel.

Small shared mobility (assigned occupied space 3/10)

- Small shared mobility offers the possibility to rent e-bikes or e-cargo bikes for short distances and flexible travel within the city.

Large shared mobility (assigned occupied space 4/10)

- Large shared mobility allows the use of e-shared cars or e-scooters for longer distances or trips outside city limits, without owning a vehicle yourself.

Nature and Walking (assigned occupied space 2/10)

- Nature and walking refers to the opportunities for relaxation and recreation, such as walking trails and green spaces near the mobility hub.

Working and Waiting (assigned occupied space 2/10)

- Working and waiting offers workspaces and comfortable waiting areas for travelers on the go who need a productive or relaxing environment.

Logistic facilities (assigned occupied space 1/10)

- Logistics facilities include practical amenities such as parcel lockers, public toilets, good lighting and a first aid station withing the mobility hub.

Meetings/Community initiatives (assigned occupied space 2/10)

- Meetings and neighborhood initiatives refer to the social functions of the hub, such as communal spaces and events that bring together residents and travelers.

Commercial facilities (assigned occupied space 5/10)

- Commercial facilities include shops, such as a supermarket or café, which allows travelers and locals to do their shopping or relax.

Final questions

To finalize the PVE, respondents got a few question about the survey and how they experienced it. The categories representing the questions in this section are listed below.

- Importance
- Honesty and trustworthiness
- Grading of the survey
- Room for any additional comments

Appendix F. Analysis Results

One sample Test

Table 8 shows the results of the one sample test, used to realize the cumulative figure in chapter 7. Table 8 gives an overview of the main scores on each of the choice attributes as well as their 95% confidence interval.

Table 17. One Sample test for 95% confidence interval

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
IntegratieOV_Score	17.079	81	0.000	5.561	4.91	6.21
ParkeerplekkenAuto_Score	10.991	81	0.000	5.720	4.68	6.75
Oplaadpunten_Score	8.898	81	0.000	2.354	1.83	2.88
VeiligFietsparkeren_Score	10.770	81	0.000	3.841	3.13	4.55
Deelmobiliteit_Score	9.160	81	0.000	2.524	1.98	3.07
Bagagekluizen_Score	10.430	81	0.000	2.378	1.92	2.83
WegwijzersLooproutes_Score	14.746	81	0.000	4.695	4.06	5.33
Pakketkluizen_Score	11.186	81	0.000	4.280	3.52	5.04
Drinkwatertap_Score	10.031	81	0.000	2.878	2.31	3.45
IntegraalToilet_Score	16.411	81	0.000	5.768	5.07	6.47
Mindervalieden_Score	15.002	81	0.000	4.659	4.04	5.28
Veiligheid_Score	20.678	81	0.000	5.378	4.86	5.90
AED/EHBO_Score	15.641	81	0.000	3.732	3.26	4.21
WifiStroom_Score	7.300	81	0.000	2.427	1.77	3.09
Wachtruimte_Score	15.298	81	0.000	3.805	3.31	4.30
Fietsenreparatie_Score	10.770	81	0.000	4.415	3.60	5.23
Buurtinitiatief_Score	10.566	81	0.000	3.085	2.50	3.67
WerkplekkenKantoor_Score	10.784	81	0.000	3.000	2.45	3.55
Horeca_Score	15.505	81	0.000	4.512	3.93	5.09
Supermarkt_Score	14.118	81	0.000	4.988	4.28	5.69

Overview of statistical details LCCA

Table 9 showcases important statistical details about the 2 viable models conducted for the LCCA in the "Score" choice task. According to these results, for the analysis and its interpretability, the 3 Cluster model is chosen as can be seen in chapter 7.

Table 18. LCCA values used to determine which number of cluster would be used for analysis of the "Score" choice task. Values are obtained through LatentGOLD 6.0.

	"Score" choice task – 2 Clusters model	"Score" choice task – 3 Clusters model	"Score" choice task – 4 Clusters model
LL	-3295.78	-3251.87	-3253.03
BIC (L^2)	7299.23	7422.97	7636.81
AIC (L^2)	6902.13	6910.33	7008.65
Entropy R^2	0.99	0.97	0.99

Table 19. LCCA values used to determine which number of cluster would be used for analysis of the "Space" choice task. Values are obtained through LatentGOLD 6.0.

	"Space" choice task – 2 Clusters model	"Space" choice task – 3 Clusters model	"Space" choice task – 4 Clusters model
LL	-969.06	-910.56	-878.83
BIC (L^2)	1854.65	1920.69	2020.29
AIC (L^2)	1878.71	1855.71	1866.26
Entropy R^2	0.94	0.97	0.99

Appendix G. AI Statement

In the development of this paper, AI tools were used to support specific tasks. The cover image was generated using AI-based image generation software within Microsoft Copilot. Additionally, ChatGPT was used primarily for grammar and spelling checks throughout the writing process. For the clustering of qualitative results, NotebookLM was used as an analytical aid to support the identification of themes and patterns. All interpretations, final analyses, and conclusions were made by the author.

A Participatory Value Evaluation to bridge Mobility and Community in Multimodal Hub planning

Demi Reuvekamp

Abstract **–** Multimodal mobility hubs are increasingly promoted as sustainable solutions to reduce car dependency, yet many do not align with user needs due to limited public involvement in the design process. To see if the planning of hubs can align with community preferences, this study performs a Participatory Value Evaluation (PVE) focused on the Dutch city of Zwolle. PVE makes it accessible for a large and diverse group of citizens to be involved in policy issues and decision making. Through two choice tasks, participants allocated limited resources among various hub design options, reflecting real constraints and trade-offs faced by decision-makers. The PVE set-up is grounded in structural and functional components of four European mobility hubs, innovatively using the Technological Innovation System (TIS) framework as a learning tool. Latent Class Cluster Analysis (LCCA) revealed preference-based user segments, ranging from bike- and public transport enthusiast to mainly car-oriented users. Despite varied priorities, all clusters emphasized the importance of physical and social safety, and core amenities like public toilets, parking and public transport integration. Qualitative analysis showed respondents reasoning behind numerical choices, highlighting once more, concerns about safety. Expert interviews confirmed PVE's relevance as a practical planning tool, especially when implemented in the right phase of hub design. While sample representativeness and expert diversity were limited, the findings suggest that integrating PVE into recurring planning cycles can improve the social legitimacy and effectiveness of mobility hubs. This research offers a replicable framework for embedding community values in urban transport planning, with implications extending to other Dutch and European contexts.

Index terms **– Multimodal Mobility Hubs, TIS, PVE, Urban Mobility Planning, Citizen Engagement**

A. INTRODUCTION

To meet the sustainability goals of the future, the Netherlands must literally shift gears toward active and public transport. In 2023, an average Dutch inhabitant travelled 12.1 thousand kilometers. Over 50% of these travelled kilometers were done by car, and this number is expected to grow in the upcoming 25 years (CBS, 2024; Zijlstra et al., 2022). Car use is associated with a wide range of negative impacts for society, consider traffic congestion, greenhouse gas emissions, and noise pollution (Rahman, 2023). In addition, the increasing use of cars negatively impacts the growth opportunities of other modes of transport (Zijlstra et al., 2022).

A change in the main commuting mode of travelers is usually linked to a significant life event, or a social development among communities (Rahman, 2023; Cascetta & Henke, 2023). This relation offers a chance to analyze the factors that influence commuters to begin or stop using their private cars (Rahman, 2023). The question is how government policies can be adapted to support a shift toward less polluting transport modes and improve the pollution levels of current vehicles within each mode (Cascetta & Henke, 2023). Knowing what drives change can help to direct policies toward appropriate target groups (Rahman, 2023).

Mobility hubs are a promising policy initiative toward more sustainable transport, they are considered physical links between multiple modes of transport (Witte et al., 2021). Hubs offer barrier-free travel by enabling seamless transitions between public and private transport modes, while also offering a platform to scale shared mobility and reduce private car ownership (Witte et al., 2021). In addition they can serve as focal points for spatial development goals. Various types of hubs are considered within this transportation improvement effort (Weustenenk and Mingardo, 2022).

However, simply realizing a mobility hub is not a guarantee for success (Choudhury, 2024). Understanding long-term performance factors is important to shape a policy strategy for successfully integrated hubs that are effectively used by community members (Arnold et al., 2023). The SmartHubs project researched around 160 European mobility hubs and established a disconnect between genuine accessibility and the current way hubs are implemented (Choudhury, 2024). Many mobility hubs are designed to prioritize technical and infrastructural efficiency over community integration (Choudhury, 2024; Rongen et al., 2022). Social desirability and citizen participation are important from a design aspect as they help to establish needs and requirements of users (Bahamonde-Birke, 2023).

So, while there is extensive research on the technical and environmental benefits of mobility hubs (Arnold et al., 2023; Gerike et al., 2022; Hached et al., 2023; Pereira & Silva, 2023; Zhai & Ye, 2024), there remains to be a knowledge gap concerning their integration of the consumer perspective in the planning and design. Specifically, the absence of community-centered design approaches is likely to limit the hubs ability to meet local needs and desires effectively (Faherty et al., 2024; Geurs et al., 2022; Junyent et al., 2024; Rongen et al., 2022). This gap is magnified by a lack of methodologies to systematically capture and incorporate public preferences into urban mobility planning.

This research focuses on how Participatory Value Evaluation (PVE) can be utilized to bridge this gap. As a relatively new participatory method, PVE makes it accessible for a large and diverse group of citizens to be involved in policy issues and decision making (Mouter et al., 2020). PVE asks participants to allocate limited resources among various policy options, reflecting the real constraints and trade-offs faced by decision-makers. The method allows for collecting detailed data on public values, preferences, and priorities (Mouter, 2021; Mouter et al., 2020). Understanding what drives community engagement and how these insights can be integrated in mobility hub development is important for effectiveness and long-term sustainability (Arnold et al., 2023). Up to this point, the integration of PVE into mobility hub development is not fully explored and the potential to enhance community alignment and policy effectiveness remains unknown for this mobility innovation.

Problem Statement

Despite the growing recognition of mobility hubs as instruments for creating more sustainable urban mobility (Junyent et al., 2024), their success is currently compromised by a lack of community involvement in the planning and design processes (Geurs et al., 2020). To realize mobility hubs that are socially accepted and more effectively used by communities, there is a need to explore how PVE can be integrated into planning and development stages (Geurs et al., 2020; Mohiuddin et al., 2023). This helps to ensure mobility hubs are not only technically efficient but meet consumer requirements (Gunton et al., 2022). Against this background, this study examines how a PVE approach can enhance the design and planning of multimodal mobility hubs by incorporating community preferences and better aligning these hubs with user needs.

Scientific and social relevance

This study advances the understanding of how PVE can be effectively operationalized in the context of mobility hub development. It provides empirical evidence on PVE's capacity to capture community preferences and inform policy decisions. By integrating the TIS as a learning tool for participatory governance, the research offers a novel interdisciplinary contribution. The findings strengthen the theoretical foundation of participatory methods in transport planning and design and expand the scope of PVE as a practical tool for infrastructure design and decision-making.

By emphasizing community participation through PVE, this study aims to influence policy frameworks. To ensure that mobility hubs are designed in ways that reflect the diverse needs of local populations, while promoting more democratic and transparent decision-making processes in urban mobility planning. Ultimately, this contributes to the development of mobility hubs that not only support environmental sustainability but also enhance social cohesion, accessibility, and public trust in transport policies.

The remainder of this paper will be structured as follows. Section B will contain a literature review, while section C will go into the proposed methodology. Section D presents the study results of the PVE, where the methodology is mainly applied. Section E discusses the main results of the implementation, while touching upon limitations and recommendation for further research. Finally, Section F draws the main conclusions of this study.

B. RELATED WORK

The way people move through the current mobility system continues to be unsustainable, but as cities grow, so does the demand for renewed, efficient urban mobility systems (Herrera-Acevedo & Sierra-Porta, 2024; Papadakis et al., 2024). Sustainable urban mobility represents the idea that cities provide environmentally-friendly transportation options that do not harm the environment or cause poor social impacts (Ortúzar, 2019). However, perceived car advantages like accessibility, travel time and marginal utility have interfered with the adoption of sustainable mobility practices and maintain the extensive use of private cars (Metz, 2013; Papadakis et al., 2024).

By raising individuals' awareness of mode choices, their behavioral patterns and the consequences of their trips, researchers strive to create a broad modal shift (Gabrielli et al., 2014; Papadakis et al., 2024). However, Fitschen et al. (2024) explain that sustainable alternative travel modes often fail to attract car users. Regardless of the proposed

cost advantage of shared mobility, it is challenging to create a cost-based encouragement for car users to switch from personal cars to more sustainable shared mobility (Liljamo et al., 2020; Fitschen et al. 2024).

Another reason shared mobility struggles to gain mode share is the rising electric vehicle (EV) ownership, driven by government incentives rooted in risk management and policies lowering operating costs (Lane et al., 2013; Mohammadzadeh et al., 2022). However, EVs do not reduce car dependency (Ortúzar, 2019) or mitigate congestion (Delucchi, 2000). Even limited EV adoption could increase travel time by nearly 5%, highlighting their limited societal mobility benefits (Grigorev et al., 2021; Rahman, 2023).

The maximization of accessibility and efficiency for users is one of the main integration features for a sustainable city (Herrera-Acevedo & Sierra-Porta, 2024). Inequitable transport access for vulnerable groups deepens urban social and economic inequality (Martinez et al., 2024). But, the implementation of mobility hubs present a unique opportunity to improve accessibility (Frank et al., 2021). Mobility hubs, represent shared, sustainable, and multi-modal transport systems that support environmental, social, economic and security objectives (Junyent et al., 2024; Arnold et al., 2023; Hached et al., 2023). Locating mobility hubs in strategic areas can significantly enhance accessibility, while creating inclusive mobility systems to serve diverse user needs (Frank et al., 2021; Stadnichuk et al., 2024).

In the Netherlands, the mobility hub concept has gained traction in both research and policy circles (Rongen et al., 2022). Junyent et al. (2024) describes multimodal mobility hubs as the only alternative to the large share of private cars. The implementation of mobility hubs can create seamless multimodal mobility, as long as there is enough capacity to connect one center of activity to another (Junyent et al., 2024). However, past projects have not yet significantly shifted travel behavior from private car use to multimodal transport (Rongen et al., 2022).

The success of mobility hubs depends, among others, on stakeholder engagement and innovative policy design (Papadakis et al., 2024). It is important to adapt the mobility hub planning to specific area dynamic to enhance effectiveness (Rongen et al., 2022). Arnold et al. (2023) emphasize the need to understand community needs and incorporate them into hub design and operations. Butzin et al. (2024) discuss how regional challenge-based innovation policies, which include citizen participation, can anchor social equity within urban mobility projects. Adopting a holistic approach to urban mobility planning, allows designing mobility hubs that address the specific barriers faced by diverse communities (Gössling & Cohen, 2014; Jeyaseelan et al., 2022; Tammaru et al., 2023; Aydin et al., 2022).

Mobility hubs are inherently people-centric, case studies illustrate how people-centered planning methods, can enhance design and implementation (Taborda et al., 2023; Sagaris, 2024). However, Gunton et al. (2022) establish that current policy tools often over-simplify complex situations. There is the need for an approach that extends beyond economically sound investments that are just functional from a infrastructure perspective. A policy tool must also capture the other ecological and social dimensions of a problem (Gunton et al., 2022; Taborda et al., 2023; Mouter, 2021).

Participatory Value Evaluation (PVE) can add value by capturing diverse stakeholder perspectives, ensuring that mobility policies reflect the priorities of all community groups to help shift travel behaviour. PVE is a participatory mechanism that allows stakeholders to express preferences regarding public policies under resource constraints (Mouter, 2021; Mouter et al., 2021). Based on the principle that individuals are utility maximizers, PVE allows participants to allocate or reject public budget and space for any proposed project (Mouter, 2021). PVE allows to capture multidimensional societal values, making it particularly suitable for complex urban mobility decisions (Mouter et al., 2020). Bahamonde-Birke et al. (2023) utilized PVE to gain a social desirability perspective on multimodal transport, resulting in a shown preference for diversifying investments among mobility options.

Challenges remain in utilizing the full environmental and social potential of mobility hubs. Ciriaco and Wong (2024) discuss the multimodal desires of citizens and found that accessibility is respondents main priority. Further identified barriers for urban mobility development are inadequate funding, regulatory constraints, insufficient public awareness, and insignificant behavioural change (Rani and Jayapragash, 2024; Faherty et al., 2024). Individual perceptions significantly influence mode choice, thus to overcome these challenges the community perspective must be aligned with the policy direction (Faherty et al., 2024; Mohiuddin et al., 2023).

Citizen participation strategies like PVE do not only surface individual preferences but also reveal systemic interdependencies. Another strength is the inclusion of traditionally underrepresented groups. Mouter et al. (2021) highlights how PVE cuts down participation time, attracting a broader scale of participants and producing

actionable outcomes. The influence PVE can have on decision making and socially accepted policy making is deemed to be credible, legitimate and relevant (Juschten & Omann, 2023).

C. METHODOLOGY

I. Experimental procedure and equipment

This research primarily involved the design, execution and analysis of a PVE. The design of the PVE is informed by a multi-faceted analysis. Four European mobility hubs, from the SmartHubs database, are selected for a case study. The SmartHubs Project's categorizes hubs based on their physical, digital, and democratic integration levels. (Geurs and Münzel, 2022). The level of integration defines whether a hub is merely a single mobility service, or a (smart) mobility hub (Geurs et al., 2023). The four selected hubs represent different levels of integration, with a specific focus on the democratic integration. Defined by citizen involvement, democratic integration reflects participatory governance and helps ensure mobility hubs are inclusive and responsive to diverse user needs (Geurs et al., 2023). The hub selection is based on gaining a variety in integration scores, keeping in mind the research scope of this study. This research will focus on the three smallest hub types: Suburban Hubs (Centrumhubs), Neighborhood Hubs (Buurthubs), and Community Hubs (Microhubs). The hub categorization is based on research by Weustenenk and Mingardo (2022) and is comparable to the one by the city council of Zwolle (Gemeente Zwolle, 2022).

The selected mobility hubs are analyzed in relation to the Technological Innovation System (TIS) theory (Berget et al., 2008; Wieczorek & Hekkert, 2012). The analysis of the hubs is performed independently of the SmartHubs integration scores. It provides insight into how hubs are embedded in national and regional policy frameworks, highlighting stakeholder roles, regulatory contexts, and available transport modes. Doing a TIS based case study allows to identify reoccurring mistakes which can be prevented in new design and planning ideas. Throughout the TIS components analysis and creating a generalized innovation loop based on the Functions framework by Hekkert et al. (2007). success and failure factors (SFFs) are identified. Alongside practical observations from Zwolle's existing mobility hubs (Weezenlanden-Noord and Diezerpoort), these points served as the foundational input for selecting the PVE decision attributes.

Grounded in the case study insights, the PVE survey is designed for Mobility hub plans in Zwolle. The PVE is conducted online using the Wevaluate platform developed by Populytics, a spin-off of the TU Delft (Populytics, 2025). The survey collects quantitative data based on participant choices and qualitative insights through respondents reasoning, concerns, and suggestions. The PVE consists of three parts: demographic/personal questions, a “score” choice task and a “space” choice task, each targeting a slightly different but complementary dimension of hub design.

Within the score choice task, respondents are presented with four thematic categories: mobility attributes; public attributes; facility attributes and commercial attributes. Each category presents participants with five hub equipment options. A fixed total of 20 points in each category, can be distributed across the five attributes. The given points represent the assigned importance to each attribute. Every attribute offers a short description clarifying its meaning to the respondents. Within the space choice task respondents are asked to allocate limited space across nine components. The components are reframed from the 20 attributes in the score choice task. Each component is assigned an amount of space that stands in proportion to the total available amount, and all of the other components. Respondents use sliders to indicate which elements they believe should occupy more or less space within the hub's footprint.

To ensure broad participation, the PVE is distributed through several neighborhood platforms, local news pages, and personal as well as professional networks. In addition, printed flyers are distributed in various neighborhoods. This mixed online-offline approach aims to reach both digitally active and less-connected residents for a more inclusive analysis sample.

To complement the PVE’s results and to reinforce the achievement of the research objective in terms of policy relevance, two expert interviews are conducted. These aim to assess how urban mobility professionals view the added value of the TIS and PVE findings, and how they might be integrated into mobility hub planning in Zwolle (and beyond). Among the experts there is one external project manager and consultant, as well as one expert working within the municipality.

Only two experts are consulted due to scope and time constraints. Nevertheless, both provided in-depth insights across a broad range of questions, critically reflecting on the feasibility and utility of PVE results from a policymaking standpoint. Both experts get full access to the PVE results in advance to ensure a well-informed discussion. Interviews follow a semi-structured format (Ilovan & Doroftei, 2017), using open-ended questions with flexibility for deeper discussion.

	"Score" choice task – 2 Clusters model	"Score" choice task – 3 Clusters model	"Score" choice task – 4 Clusters model	"Space" choice task – 2 Clusters model	"Space" choice task – 3 Clusters model	"Space" choice task – 4 Clusters model
LL	-3295.78	-3251.87	-3253.03	-969.06	-910.56	-878.83
BIC (L^2)	7299.23	7422.97	7636.81	1854.65	1920.69	2020.29
AIC (L^2)	6902.13	6910.33	7008.65	1878.71	1855.71	1866.26
Entropy R^2	0.99	0.97	0.99	0.94	0.97	0.99

Table 1. Overview of class model statistics based on the LatentGOLD LCCA analysis for models with 2,3 and 4 clusters

	Analysis Sample	National	Zwolle
All Respondents / Inhabitants			
Total	82		133.839
Gender			
Male	52,4% (43)	49,7%	49,3%
Female	45,1% (37)	50,3%	50,7%
Remaining	1,2% (1)	*No available data*	*No available data*
Age			
18 until 24	14,6% (12)	8,9%	9,5%
25 until 34	17,1% (14)	13,3%	14,0%
35 until 44	18,3% (15)	12,5%	14,7%
45 until 54	20,7% (17)	12,4%	12,4%
55 until 64	18,3% (15)	13,8%	12,1%
Older than 64	9,8% (8)	20,4%	17,3%
Education Level			
Elementary- or Highschool	8,5% (7)	35,9%	29,0%
Practical education (MBO)	12,2% (10)	26,5%	32,0%
Theoretical education (HBO, WO)	78,0% (64)	37,0%	39,0%

Table 2. Distribution of the Socio-Demographic features of the PVE respondents, set off against the national and municipal average as obtained through data from the Central Bureau of Statistics.

II. Data processing and analysis

To provide sound policy advice and ensure the results are as valuable as possible for the design of mobility hubs, it is important to capture heterogeneity in respondent preferences. A Latent Class Cluster Analysis (LCCA) will be used for the classification of respondents into latent (unobserved) groups based on similarities in their response patterns, offering insights into user segments that can inform more tailored policy interventions (Molin et al., 2015). This research uses LatentGOLD 6.0 software to fit models with 2 to 4 classes (Table 1). Final class selection is guided by Bayesian Information Criterion (BIC and AIC), and the relevance of the cluster characteristics, favouring solutions with the highest level of interpretability. The results will present average attribute scores, along with descriptive cluster titles and supporting qualitative justifications from respondents.

The open-ended responses within the PVE will be analyzed using thematic analysis to identify recurring patterns and underlying themes in participants' reasoning (Braun & Clarke, 2006). An inductive coding approach will be applied manually, meaning that themes will emerge from similarities in argumentation, values, and trade-offs expressed in the data. Following the cluster analysis and interpretation, the most striking attributes will be included in the qualitative analysis. Consider attributes with consequent scores, or notable outliers among the clusters

The expert interviews are conducted in Dutch, recorded, and transcribed for analysis. Key quotes are translated into English with care to preserve the experts' original meaning. The interviews are analyzed in such a way they identify important viewpoints, which help contextualize implementation challenges and opportunities of the PVE.

III. Sociodemographic features

Table 2. shows that gender distribution aligns with national figures, though one non-binary respondent had no comparison data. The sample overrepresents theoretically educated (78%) and younger respondents (ages 18-24), and middle aged respondents (ages 45-54). Older (ages > 64) and practically educated individuals are slightly underrepresented. Since most respondents are located in Zwolle, this overrepresentation may be partly explained by the city's demographic profile.

As the PVE focuses on Zwolle's mobility hub plans, it is relevant that 72% of respondents have personal experience with travelling through the city.

	Sample	National
Car Ownership		
I own 1 car	57,3% (47)	47,0%
I own more than 1 car	13,4% (11)	27,0%
I do not own a car	28,0% (23)	26,0%
Most used transport mode		
Private Car	34,1% (28)	68,3%
Train	11,0% (9)	10,1%
Bike	41,5% (34)	8,9%
Bus, tram, metro	1,2% (1)	2,6%
Walking	11,0% (9)	3,5%
Shared mode	0,0% (0)	6,7%

Table 3. Mobility characteristics of the PVE respondents, including car ownership and the most commonly used mode of transport, set off against national averages.

Table 3. shows respondents mobility preferences. There is a large share of bike users, over four times the national average, along with a slight overrepresentation of walkers. Zwolle is, however, considered a very urbanized area (CBS, 2025). This level of urbanization has an average share of 30% in bike kilometers (De Haas and Kolkowski, 2023), a number much more concise with the results from

the PVE. Conversely, private car use is underrepresented. This can be explained as less urbanized areas are more car dependent and all urbanization levels contribute to the national average (Zijlstra et al., 2022). Notably, none of the respondents reported using shared modes as their primary transport.

D. PVE RESULTS

This upcoming section presents the analysis and results of the PVE. Through statistical modeling the chapter uncovers general patterns as well as heterogeneity in preferences across respondent groups. The cluster analysis results are supported by quotes of respondents.

I. Results of the score choice task

This section will go over de results from the score choice task. Table 4. shows the average scores assigned to 20 mobility hub attributes, grouped into four categories for clarity. A baseline score of 4 is used for equal comparison among attributes. The sample mean scores are tested with a 95% confidence interval to account for uncertainty. For example, the integration of public transport scored 5.6, with a confidence range of 4.9 to 6.2.

	Average
Mobility Attributes	
Improve integration with public transport	5.56
Realize parking spots and accessibility for private cars	5.72
Add charging stations for electric vehicles	2.35
Create safer and covered bicycle parking spaces	3.84
Provide more shared mobility options	2.52
Public Attributes	
Offer luggage lockers for travelers	2.38
Create clear and safe walking routes in and around the hub	4.70
Add parcel lockers for online deliveries	4.28
Install a free drink water tap	2.88
Include public and accessible toilets	5.77
Facility Attributes	
Facilities to ensure accessibility for disabled population	4.66
Implement good lighting and CCTV for improved safety	5.38
Install an AED and a first aid station	3.73
Ensure Wi-Fi and charging points are available	2.43
Provide covered and heated waiting areas with seating	3.81
Commercial Attributes	
Include a bike shop or repair service within the hub	4.42
Support meeting areas or community initiatives	3.09
Offer workspaces or flexible office spaces	3.00
Add catering facilities like a café	4.51
Integrate a supermarket or to-go shop	4.99

Table 4. Average score, out of 20, for each of the mobility hub attributes in the score choice task

Three *highest* scoring attributes: Include public toilets and accessible restrooms (5.77); Realize parking spots and accessibility for private cars (5.72); Improve integration with public transport (5.56). On average respondents prioritized basic amenities and accessibility, with a strong focus on inclusivity, comfort, and (social)safety. Results highlight the importance of seamless, multimodal connectivity and user-friendly services.

Three *lowest* scoring attributes: Add charging stations for electric vehicles (2.35); Ensure Wi-Fi and charging points for personal devices (2.43); Offer luggage lockers for travelers (2.38). Many low scoring attributes are seen as secondary to core functions like movement, access, and basic infrastructure. On average respondents appear to prioritize space and usability over digital or energy-related amenities.

Cluster analysis score choice task

To identify distinct respondent groups, a Latent Class Cluster Analysis (LCCA) is conducted. While both two- and three-cluster models are viable, the three-cluster model was chosen to capture more nuanced segment differences relevant to policy and planning. Although its BIC value was slightly higher (~123 on ~7400), this was considered acceptable for improved interpretability. Full cluster analysis statistics are available in the methodology section.

Cluster Size	Cluster1 56%	Cluster2 22%	Cluster3 22%
Indicators			
Mobility Attributes			
Improve integration with public transport	5.78	5.82	4.74
Realize parking spots and accessibility for private cars	2.96	7.54	10.85
Add charging stations for electric vehicles	3.02	2.38	0.65
Create safer and covered bicycle parking spaces	4.95	2.54	2.36
Provide more shared mobility options	3.29	1.71	1.40
Public Attributes			
Offer luggage lockers for travelers	2.82	1.42	2.23
Create clear and safe walking routes in and around the hub	4.77	3.35	5.87
Add parcel lockers for online deliveries	4.19	4.45	4.33
Install a free drink water tap	2.90	4.66	1.03
Include public and accessible toilets	5.32	6.12	6.54
Facility Attributes			
Facilities to ensure accessibility for disabled population	4.91	1.68	7.01
Implement good lighting and CCTV for improved safety	4.97	5.20	6.58
Install an AED and a first aid station	3.90	3.87	3.18
Ensure Wi-Fi and charging points are available	2.34	4.53	0.54
Provide covered and heated waiting areas with seating	3.88	4.72	2.69
Commercial Attributes			
Include a bike shop or repair service within the hub	5.23	2.67	4.12
Support meeting areas or community initiatives	3.67	2.51	2.18
Offer workspaces or flexible office spaces	3.38	3.33	1.69
Add catering facilities like a café	3.87	5.54	5.10
Integrate a supermarket or to-go shop	3.85	5.94	6.90

Table 5. Average score per cluster for each of the mobility hub attributes in the score choice task

Cluster 1, the largest group (56%), can be described as *Bike and Public Transport Enthusiasts.* They strongly prefer sustainable mobility, scoring highest on public transport integration (5.78) and secure bike parking (4.95), while showing low interest in car parking (2.96) and non-transport amenities like Wi-Fi

"Without public transport a mobility hub isn't viable"

"Promoting cycling is always a plus, there should be no arguments against using a bicycle"

(2.34). This group values accessibility for all users (4,91). It includes many bike users (61%) and few car users (15%), which aligns with the shown preferences for bike and public transport infrastructure. Demographically, it skews younger (41% aged 18–34) and is predominantly male (63%).

Cluster 2, representing 22% of respondents, can be described as *Practical Providers*. They prioritize comfort and convenience, scoring high on car parking (7.54), toilets (6.12), and super-markets (5.94), but show low interest in shared mobility (1.71) and community features (2.51). there is a high education level (89%) and a balanced gender split. Interestingly this cluster shows no participants (0%) who use public transport as their most frequent mode, though their relatively high score for its integration (5.82) suggests potential for a mode shift.

"Of course it makes sense if people can park their cars here, otherwise the added value of a hub is very limited."

"Good parking around a hub that has transport hub will entice people to get out of their cars and use less polluting transport"

Cluster 3 is the most outspoken cluster, representing 22% of respondents. Calling them the *Car-Oriented Comfort Seekers*, they mainly prioritize car parking (10.85) and accessibility (7.01). While also scoring high on super-markets (6.90), and safe walking routes (5.87), while scoring very low on charging stations (0.65), workspaces (1.69), and Wi-Fi (0.54). This older, predominantly female group (72%) is highly car-dependent as 100% owns at least one car, and 67% use it as their main transport mode, with minimal bike use (6%).

"A space that is designed based on the needs of disabled people, children and the elderly is a space that is well-designed for everyone."

"Wi-Fi and electricity are extras that I don't use and don't consider necessary"

Overreaching Features – score

Despite differences between clusters, several priorities are shared across the full sample. Essential amenities like public toilets (~5.99) and public transport integration (~5.45) are consistently valued, highlighting a shared demand for functionality and convenience. Safety also emerges as a key theme, with features like lighting and surveillance (~5.60) widely supported. But also other attributes reflect an emphasis on safety, reflecting a collective need for environments where people feel comfortable and supported. Other items that are simply appreciated as a sense of convenience include package lockers (~4.32) and first aid facilities (~3.65). In contrast, charging stations (~2.02) and workspaces (~2.80) are universally considered less important in mobility hubs.

"Essential for an accessible city. I think it is very important that there are more toilets. They should also be maintained to be clean and fresh."

"When I walk through the station at night, I often feel unsafe because it is dark. I think that cameras and good lighting will contribute to the feeling of safety."

"Charging is not that interesting as a primary facility. Secondary this could be possible, but given the travel distances this is actually not necessary."

II. Results of the space choice task

In addition to the score choice task, respondents completed a space allocation task, using sliders to distribute limited space among hub functions based on their personal priorities. Each slider started at a neutral midpoint (0.5), representing balanced allocation across all functions. Moving the slider toward 0 indicated there is no space assigned, while 1 means the maximum available space for a function is assigned. The results reveal clear trends that align with earlier preferences. Table 6. presents the average space allocated to each function.

	Average
Small shared mobility (e.g. e-bikes)	0.49
Large shared mobility (e.g. e-cars)	0.42
Secure bicycle parking	0.61
Parking for private cars	0.58
Nature and Walking	0.48
Logistic facilities	0.53
Meetings and Community initiatives	0.41
Working and Waiting	0.44
Commercial facilities	0.37

Table 6. Average score, out of 1, for each of the mobility hub functions in the space choice task

Among the highly allocated functions are secure bicycle parking, which received the highest space allocation (0.61). This aligns with previously given high scores, reinforcing its importance as a core hub function. Additionally private car parking ranked high (0.58), indicating that, despite the general hub focus on shared mobility, personal vehicle access remains a priority for many respondents.

Among the below-average allocated function are logistic facilities, small shared mobility, and nature and walking. Commercial functions scored lowest (0.37), a contrasting result compared to its importance in the score task, respondents may prioritize core mobility infrastructure over space-intensive amenities. This highlights the need for compact, multifunctional designs.

Cluster analysis space choice task

	Cluster1	Cluster2
Cluster Size	62%	38%
Indicators		
Small shared mobility (e.g. e-bikes)	0.56	0.37
Large shared mobility (e.g. e-cars)	0.52	0.27
Secure bicycle parking	0.59	0.63
Parking for private cars	0.43	0.82
Nature and Walking	0.51	0.41
Logistic facilities	0.53	0.53
Meetings and Community initiatives	0.52	0.23
Working and Waiting	0.46	0.41
Commercial facilities	0.37	0.37

Table 7. Average score per cluster for each of the mobility hub functions in the space choice task

For the "space" task, a two-cluster solution was selected, as Clusters 2 and 3 from the "score" task merged into a more unified group. This improved interpretability and provided clearer insights into spatial preferences. Cluster details are shown in Table 7.

Cluster 1 represents the *flexible mobility optimizers*, comprising 62% of the sample. They value shared and sustainable mobility, mainly allocating space to shared modes (0.56 small and 0.52 large), while also embracing bike-friendly infrastructure (0.59). This group also supports community initiatives (0.52), but shows a lower interest in commercial facilities (0.37). Many respondents (41%) do not own a car and rely on bikes (61%) as their main mode of transport. Demographically, this cluster is younger (44% aged 18–34) and predominantly male (56%).

"Important facility for the first/last part of the journey, which takes up less space. Moreover, it is good to encourage cycling."

"Space for the neighbourhood, literally and figuratively. Especially the new development areas are difficult to connect to the existing neighbourhoods. Hubs can bridge this gap."

Cluster 2 represents 38% of the respondents who are well described as the *Car-Oriented Space Seekers*. Main priorities are car access and structured urban space. They allocate a very high share of space to private car parking (0.82) and the least to shared mobility (0.37 small and 0.27 large), favoring independence over communal alternatives. This older (67% aged over 45), mostly female group (54%) shows limited interest in nature (0.41) and community functions (0.23), again pointing towards a preference for independent spatial use. Car use dominates, with 93% owning at least one vehicle and 67% using it as their main mode.

"Small shared mobility is at the expense of cars for residents and tourists. And walking in the city becomes less safe."

"Nature is important, but I don't associate this with an urban hub."

Overreaching features – space task

"Travelers should be encouraged to travel to the hub by bike. The presence of bicycle parking spaces is crucial."

Despite the differences, one very clear shared priority stands out among both clusters: safety. Whether through secure bicycle parking (~0.61), or logistic facilities including surveillance, lightning and first aid (~0.53). Both clusters emphasize the importance of well-maintained spaces that enhance security. Regardless of mobility preferences, this common thread suggests that a sense of safety and stability is essential to urban space planning.

"Takes up little space and is very practical! So it provides a lot of convenience and luxury compared to the amount of land used"

III. Qualitative Insights from Open-Ended Responses

Alongside the quantitative data, the PVE included open-ended responses, offering deeper insight into participants' motivations and values. An inductive thematic analysis was conducted on selected key attributes to capture recurring themes. The attributes highlighted in this qualitative analysis are shown in table 8.

High scoring attributes with ***consensus*** **among clusters**	**Low** scoring attributes with ***consensus*** **among clusters**	**High** scoring attributes with ***differences*** **among clusters**	**Low** scoring attributes with ***differences*** **among clusters**
Include public toilet and fully accessible restroom	Add charging stations for electric bikes, scooters and cars	Realize parking spots and accessibility for private cars	Provide more shared mobility options
Improve integration with public transport	Offer workspaces or flexible office spaces	Integrate a supermarket or to-go shop	Ensure Wi-Fi and charging points are available
Implement good lighting and CCTV for improved safety	Offer luggage lockers for travelers		

Table 8. Hub attributes analyzed in the qualitative thematic analysis

The qualitative responses enrich the PVE data by explaining motivations behind preferences. A very large share of respondents took the time to provide additional information and express the reasoning behind the choices they made. It became clear that behind a lot of preferences, there is a deeper layer connected to physical, and maybe even more to social safety. Commercial facilities like a supermarket to-go gained high scores, obviously from a convenience point of few, but maybe even more interestingly from a safety point of view. Respondents highlight they like the fact that these services attract people, and that more people in and around hub locations would improve their sense of safety. Several respondents fear that, in case of mediocre design, mobility hubs will

become a hang-out spot for the "wrong" people. This decreases their desire to use the hub, and mainly decreases their feeling of safety. In line with this fear, and also strengthening insights behind the lower interest displayed in shared mobility services, respondents highlight that time has proven that shared mobility services clutter public space and that users cannot seem to take care of these facilities like they would take care of their own vehicles.

On the more positive end, there are a lot of tips and insights provided to gain a deeper level of understanding in what makes a hub a success to people. People valued parking spaces for cars and bicycles. Interesting here is the two distinct kinds of reasoning behind this choice. On the one hand, there are respondents who reasoned from their own perspective. They would like to have enough space to park their vehicle safely, to then switch to a provided mobility service for the extend of their journey. On the other hand, there are the respondents reasoning towards others. They felt having parking opportunities was the only way to make it attractive enough for private vehicle users, to considers using a multimodal travel approach. The same arguments came up according to the high value for the integration with public transport, respondents feel this is necessary toward the success of a mobility hub. Which in retrospect is also one of the main requirements established by the SmartHubs project.

Together, all findings suggest that infrastructure alone cannot ensure the success of mobility hubs. The effectiveness and long-term relevance of such hubs depend on their alignment with the everyday preferences, values, and constraints of local residents.

IV. Insights from expert interviews

To provide additional depth and insight into the potential of using PVE (and its results) for the design and integration of mobility hubs in urban environments, two expert interviews are conducted. The first interview was held with the project manager of Zwolle's Adaptive Development Strategy for Mobility hubs, who also brings extensive experience as a policy advisor in the field of mobility. The second expert is one of Zwolle's official principal for mobility projects, who initiated and commissioned Zwolle's previous multimodal mobility hub projects.

The experts interviews showcased many highlights. Interestingly both experts agreed that currently there is not much time and space embedded in a policy process to consider lessons learned from other, either national or European, hubs. Therefore, there is lots of room to start integrating these insights and prevent making the same mistakes twice. Doing a case study and analyze hubs these hubs according to the TIS framework or any other systematic learning tool can benefit the planning and design assignment of hubs.

Also considering the PVE, there was consensus among the experts. As one of the experts put it: "I would like to analyze this further and draw more attention to it, because this is an important part of developing hubs." Both experts see great potential, of course with the needed limitations and marginal notes in regards to the (planning) phase a specific hub is in. PVE can be of great use to policy makers if implemented right. It must be realized at a point in time are the results can still be used / changes can still be made. But at the same time, it must be realized at a time when there is already significant information about space and the budget requirements to include these in the questions. That way you can ask those questions that provide the most valuable insights.

E. DISCUSSION

I. Key Findings

The study used a case study analysis of four European mobility hubs using the Technological Innovation Systems (TIS) framework. The TIS analysis identified important structural and functional hub components, as well as generalizable success and failure factors (SFFs). These insights served as the foundation for the PVE survey.

Within the PVE score choice task, the bike and public transport enthusiasts prioritize integration with public transport, secure bicycle parking, and accessibility, while largely rejecting car-related infrastructure. The practical providers focus on convenience, prioritizing car parking, supermarkets, Wi-Fi, and waiting areas, with little interest in shared mobility or community features. The third cluster, the car-oriented comfort seekers, strongly value car infrastructure and universal accessibility but show low interest in digital amenities or sustainability.

In the PVE space choice task, the *flexible mobility optimizers* maintain a focus on bikes, adding a preference for shared mobility and also community initiatives. Clusters 2 and 3 from the score choice task converge into one group, to improve interpretability. The *Car-Oriented Space Seekers* assign almost all their space to private car parking and accessibility. Notably, all clusters share priorities toward clean, integral toilets, and public transport integration. The clusters reveal insights into how people interact with urban spaces, an important consideration towards hub design. Physical and social safety stand out as overreaching features. Regardless of

mobility preferences, this common thread suggests that a sense of safety and stability is essential to urban space planning, influencing decisions in all groups.

The qualitative feedback highlighted once more the recurring theme of safety. Respondents consistently link the success of a hub to how safe and trustworthy it feels. Also concerns about shared mobility misuse and the genesis of unsafe, unmonitored areas attracting the wrong kind of people emerged. These insights show that beyond functionality, safety underpins public acceptance and usage, shaping how users interpret and prioritize every hub feature.

The expert interviews have underscored the policy potential of PVE to address blind spots in real world planning and design processes. Currently there is not much time and space embedded in a policy process to consider lessons learned from other hubs. Therefore, there is room to integrate these insights and prevent making the same mistakes twice. Both experts appreciate the PVE method: *"I would like to analyze this further and draw more attention to it, because this is an important part of developing hubs."* However, the PVE potential depends on the planning phase a hub is in.

II. Implications

This study contributes to currently accessible theory by combining the TIS insights with PVE in urban mobility planning. TIS purely focuses on structural and functional dynamics of innovation adoption (Bergek et al., 2008; Hekker et al., 2007), and is not typically used as a learning tool for broader analysis. Integrating the structural and functional components in the set-up of a participatory method like PVE introduces a new dimension to both participatory methods and technological innovation research. It enables a deeper understanding of the necessities for successful, socially accepted innovation (Geurs & Münzel; 2022; Geurs et al., 2023; Mohiuddin et al., 2023).

PVE offers policymakers a way to include a broad group of citizens in evaluating realistic policy trade-offs (Mouter et al., 2020; Mouter et al., 2021). Whereas traditional survey methods lack in this department (Callahan, 2007; Juschten & Omann, 2023). Another benefit are the insights provided by the qualitative analysis of the PVE's open ended questions. This additional layer to the data can help policymakers to keep an open mind toward important themes coming from the outside world.

Citizen participation is not only of value in urban development, but also required through an EU directive (Lindenau & Böhler-Baedeker, 2014). PVE offers a concrete way to enhance policy quality and meet legal requirements, while reaching a broad and versatile audience. The PVE result highlighted interesting insights towards modular and context-sensitive designs. Allowing hubs to, e.g. switch mode offerings is important as the need to create a modal shift among commuters, is combined with a rapidly changing environment due to mobility developments (Cascetta & Hanke, 2023; Gabrielli et al., 2014; Papadakis et al., 2024).

The development phase of a hub is a crucial determinant for the level in which the insights of the PVE can be incorporated in the planning. In an early stage PVE can function as a tool to start discussions and planning sessions from a citizens perspective instead of from a political one. Applying PVE in a later stage offers more directed insights skewed toward specific hub locations, offering design insights useful for the set-up of the requirement programs. Experts suggested integrating PVE into recurring planning cycles. Especially during critical moments such as hub upgrades or expansions, PVE could add a very valuable and insightful layer to the process.

This research offers a replicable framework for planners and policymakers to incorporate community preferences into mobility hub design. The PVE findings provide relevant insights, recognized by experts involved in hub development. PVE is seen as useful for future design phases, with current results serving as input for planning in Zwolle and other cities already. The data is not limited to one location and can inform hub designs elsewhere in the Netherlands. Insights may also apply to European cities facing similar planning challenges. PVE offers a scalable way to include public values in infrastructure development, enhancing both its legitimacy and long-term success.

III. Limitations

The most important consideration is that the PVE results are not statistically representative towards the general population. The group of respondents does not meet the statistically required amount to be representative for Zwolle's amount of inhabitants. Additionally, the majority of participants are younger individuals with high levels of education. This sampling bias potentially limits generalizability of the findings and means the perspectives of elderly adults, people with lower education or digital literacy, may be underrepresented in the results.

The expert interviews, while insightful, involved a limited number of professionals. Due to the scope of this study, perspectives from national policy actors or private-sector stakeholders are not included.

Finally, this research is cross-sectional, it captures the community preferences and system conditions at this specific moment in time. Mobility hubs are however fast-evolving concepts, influenced by quick shifts in technology, policy, and urban design trends. Features or design elements valued today may lose relevance as new user needs or mobility services emerge.

IV. Recommendations

It is recommended that policymakers and planners actively study existing mobility hubs across the Netherlands and/or Europe. The case study analysis in this research highlight recurrent issues that are potentially avoidable. Cities tend to treat their context as unique and feel learning points from other cities might not apply for them. Instead, I recommend adapting to known success factors and proactively addressing previously observed failure factors.

The PVE set-up for this research used an elaborate score choice task, and a more generalized space choice task. Interestingly, for some of the attributes the amount of value and space assigned did not match one another. For further research it could be of value to do a single, but more elaborate and detailed space based choice task. When in the right planning phase, a PVE could even include the allocation of actual square meters. This way the reasoning behind the choices will match a realistic hub blueprint.

Another potential improvement to the PVE is the addition of financial constraints. Budget is always of the essence, and it enables participants to evaluate the financial implications of their choices. Allowing for more realistic assessment of community priorities and bridging the gap between design preferences and implementable solutions.

The experts opted for a dual participatory process. The set-up would include the a broad PVE at a municipal, or even national level. From the general citizen preference, a few specific hub design proposals can be established. These design options should be presented to local communities through small-scale, physical participation sessions (e.g., workshops). This allows for a consumer based initial idea, strengthened by opinions from citizens that are closest and most likely to use a specific hub.

To ensure broad and inclusive citizen representation, it is suggested to partner with survey panel institutes. It will prevent one of the main limitations in this research, as it ensures sufficient sample size, mitigates self-selection bias, and enhances the quality and credibility of participation outcomes.

Given the fast evolving nature of mobility hubs and user expectations, future research could explore longitudinal PVE studies. Tracking how community values shift over time. Organizing sessions after hub implementation allow to test whether values toward attributes have changed after real life use. It potentially offers insights into behavioral adaptation and long-term policy relevance.

F. CONCLUSION

This research set out to explore how a Participatory Value Evaluation (PVE) approach can enhance the design and planning of multimodal mobility hubs by integrating community preferences into the design process.

PVE enhances mobility hub planning by translating community values into concrete, context-sensitive design choices. The research shows that respondents take significant time to elaborate on their considerations, adding a layer of depth to their numerical choices. PVE allows policymakers to simulate real policy trade-offs under realistic constraints to capture a deeper sense of what it is the community wants. This could not only improve the technical design of hubs (mode choice and mode infrastructure), but can also increases their social legitimacy (public support, design towards social safety), and usage rates.

PVE can function as a bridge between current political mobility hub planning and the community. The current planning and design process can be limited by narrow politic vision. PVE includes useful community engagement through an efficient platform that reaches a diverse audience, ensuring that mobility hubs are designed not only for communities but with them.

G. BIBLIOGRAPHY

Arnold, T., Dale, S., Timmis, A., Frost, M., & Ison, S. (2023). An exploratory study of Mobility Hub implementation. Research in Transportation Economics, 101, 101338. https://doi.org/10.1016/j.retrec.2023.101338

Aydin, N., Seker, S., & Özkan, B. (2022). Planning Location of Mobility Hub for Sustainable Urban Mobility. Sustainable Cities And Society, 81, 103843. https://doi.org/10.1016/j.scs.2022.103843

Bahamonde-Birke, F. J., Geigenmüller, I. M., Mouter, N., Van Lierop, D. S., & Ettema, D. F. (2023). How do I want the city council to spend our budget? Conceiving MaaS from a citizen's perspective . . . (as well as biking infrastructure and public transport). Transport Policy, 145, 96–104. https://doi.org/10.1016/j.tranpol.2023.09.009

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. Research Policy, 37(3), 407–429. https://doi.org/10.1016/j.respol.2007.12.003

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Butzin, A., Rabadjieva, M., & Terstriep, J. (2024). Anchoring challenges through citizen participation in regional challenge-based innovation policies. Environmental Innovation And Societal Transitions, 52, 100856. https://doi.org/10.1016/j.eist.2024.100856

Callahan, K. (2007). Citizen Participation: Models and Methods. International Journal Of Public Administration, 30(11), 1179–1196. https://doi.org/10.1080/01900690701225366

Cascetta, E., & Henke, I. (2023). The seventh transport revolution and the new challenges for sustainable mobility. Journal Of Urban Mobility, 4, 100059. https://doi.org/10.1016/j.urbmob.2023.100059

CBS. (2024). Hoeveel reisden inwoners van Nederland en hoe? Centraal Bureau Voor de Statistiek. https://www.cbs.nl/nl-nl/visualisaties/verkeer-en-vervoer/personen/hoeveel-reisden-inwoners-van-nederland-en-hoe-

CBS. (2025, 25 februari). Gebieden in Nederland 2024: Grootte en stedelijkheid van gemeenten. CBS Statline. https://opendata.cbs.nl/#/CBS/nl/dataset/85755NED/table?dl=455E9

Choudhury, S. (2024, 11 december). *Mind the Gap: Europe's Mobility Hub Challenge | JPI Urban Europe*. JPI Urban Europe. https://jpi-urbaneurope.eu/mind-the-gap-europes-mobility-hub-challenge/

Ciriaco, T. G., & Wong, S. D. (2024). Travel Behaviour and Community Needs for Resilience Hubs. Sustainability Analytics And Modeling, 4, 100030. https://doi.org/10.1016/j.samod.2024.100030

Delucchi, M. (2000). Should We Try To Get The Prices Right? ACCESS Magazine, 1(16), 14-21. Retrieved from https://escholarship.org/uc/item/5zg735f1

M. De Haas, L. Kolkowski. (2023). *Fietsfeiten 2023.* KiM Netherlands Institute for Transport Policy Analysis (2023) https://www.kimnet.nl/publicaties/publicaties/2023/11/28/fietsfeiten-2023

Faherty, M., McArdle, G., & Tafidis, P. (2024). Envisioning sustainable urban mobility in Dublin: Stakeholder perspectives and system dynamics. Transportation Research Interdisciplinary Perspectives, 28, 101280. https://doi.org/10.1016/j.trip.2024.101280

Fitschen, P., Merfeld, K., Klein, J. F., & Henkel, S. (2024). UNDERSTANDING THE URBAN MOBILITY CHALLENGE: WHY SHARED MOBILITY PROVIDERS FAIL TO ATTRACT CAR DRIVERS. Transport Policy, 158, 104–111. https://doi.org/10.1016/j.tranpol.2024.09.010

Frank, L., Dirks, N., & Walther, G. (2021). Improving rural accessibility by locating multimodal mobility hubs. Journal Of Transport Geography, 94, 103111. https://doi.org/10.1016/j.jtrangeo.2021.103111

Gabrielli, S., Forbes, P., Jylhä, A., Wells, S., Sirén, M., Hemminki, S., Nurmi, P., Maimone, R., Masthoff, J., & Jacucci, G. (2014). Design challenges in motivating change for sustainable urban mobility. Computers in Human Behavior, 41, 416–423. https://doi.org/10.1016/j.chb.2014.05.026

Gemeente Zwolle. (2023). Hanza! De Zwolse participatieaanpak. In zwolle.bestuurlijkeinformatie.nl. https://zwolle.bestuurlijkeinformatie.nl/Agenda/Document/9c604bd9-71f7-43eb-84a2-1f3bd786f509?documentId=4d4aed71-979f-4c77-b830-529206b26c33&agendaItemId=70b55a51-162e-47b5-ae98-f05c2a180f59

Geurs, K., & Münzel, K. (2022). A multidimensional mobility hub typology and inventory. https://www.smartmobilityhubs.eu/_files/ugd/c54b12_819c85702a6442c6bebb18538fb93516.pdf

Geurs, K., Münzel, K., Duran, D., Gkavra, R., Graf, A., Grigolon, A., Hansel, J., Kirchberger, C., Klementschitz, R., Lluis, M. R., & Pappers, J. (2023). A multidimensional mobility hub typology and inventory. SmartHubs Deliverable D 2.1. repositum.tuwien.at. https://doi.org/10.34726/3567

Gössling, S., & Cohen, S. (2014). Why sustainable transport policies will fail: EU climate policy in the light of transport taboos. Journal Of Transport Geography, 39, 197–207. https://doi.org/10.1016/j.jtrangeo.2014.07.010

Grigorev, A., Mao, T., Berry, A., Tan, J., Purushothaman, L., & Mihaita, A. (2021). How will electric vehicles affect traffic congestion and energy consumption: an integrated modelling approach. arXiv (Cornell University). https://doi.org/10.48550/arxiv.2110.14064

Gunton, R. M., Hejnowicz, A. P., Basden, A., Van Asperen, E. N., Christie, I., Hanson, D. R., & Hartley, S. E. (2022). Valuing beyond economics: A pluralistic evaluation framework for participatory policymaking. Ecological Economics, 196, 107420. https://doi.org/10.1016/j.ecolecon.2022.107420

Hached, W., L'Hostis, A., & Gragera, A. (2023). Exploring the concept of " mobility hubs " and assessing their impacts in two European cities. Transportation Research Procedia, 72, 3497–3504. https://doi.org/10.1016/j.trpro.2023.11.763

Hekkert, M., Suurs, R., Negro, S., Kuhlmann, S., & Smits, R. (2007). Functions of innovation systems: A new approach for analysing technological change. Technological Forecasting And Social Change, 74(4), 413–432. https://doi.org/10.1016/j.techfore.2006.03.002

Herrera-Acevedo, D., & Sierra-Porta, D. (2024). Network structure and urban mobility sustainability: A topological analysis of cities from the urban mobility readiness index. Sustainable Cities And Society, 106076. https://doi.org/10.1016/j.scs.2024.106076

Ilovan, N. O., & Doroftei, N. I. (2017). QUALITATIVE RESEARCH IN REGIONAL GEOGRAPHY. A METHODOLOGICAL APPROACH. https://doi.org/10.23740/qual_methods2017

Jeyaseelan, T., Ekambaram, P., Subramanian, J., & Shamim, T. (2022). A comprehensive review on the current trends, challenges and future prospects for sustainable mobility. Renewable And Sustainable Energy Reviews, 157, 112073. https://doi.org/10.1016/j.rser.2022.112073

Junyent, I. A., Casanovas, M. M., Roukouni, A., Sanz, J. M., Blanch, E. R., & De Almeida Correia, G. H. (2024). Planning shared mobility hubs in European cities: A methodological framework using MCDA and GIS applied to Barcelona. Sustainable Cities And Society, 106, 105377. https://doi.org/10.1016/j.scs.2024.105377

Juschten, M., & Omann, I. (2023). Evaluating the relevance, credibility and legitimacy of a novel participatory online tool. Environmental Science & Policy, 146, 90–100. https://doi.org/10.1016/j.envsci.2023.05.001

Lane, B. W., Messer–Betts, N., Hartmann, D., Carley, S., Krause, R. M., & Graham, J. D. (2013). Government Promotion of the Electric Car: Risk Management or Industrial Policy? European Journal Of Risk Regulation, 4(2), 227–245. https://doi.org/10.1017/s1867299x00003366

Liljamo, T., Liimatainen, H., Pöllänen, M., & Utriainen, R. (2020). People's current mobility costs and willingness to pay for Mobility as a Service offerings. Transportation Research Part A Policy And Practice, 136, 99–119. https://doi.org/10.1016/j.tra.2020.03.034

Lindenau, M., & Böhler-Baedeker, S. (2014). Citizen and Stakeholder Involvement: A Precondition for Sustainable Urban Mobility. Transportation Research Procedia, 4, 347–360. https://doi.org/10.1016/j.trpro.2014.11.026

Martinez, L., Macharis, C., & Keserü, I. (2024). Inclusive mobility hubs: An in-depth exploration of the requirements of disadvantaged groups. Transportation Research Part D Transport And Environment, 136, 104447. https://doi.org/10.1016/j.trd.2024.104447

Metz, D. (2013). Peak Car and Beyond: The Fourth Era of Travel. Transport Reviews, 33(3), 255–270. https://doi.org/10.1080/01441647.2013.800615

Mohammadzadeh, N., Zegordi, S. H., Kashan, A. H., & Nikbakhsh, E. (2022). Optimal government policy-making for the electric vehicle adoption using the total cost of ownership under the budget constraint. Sustainable Production And Consumption, 33, 477–507. https://doi.org/10.1016/j.spc.2022.07.015

Mohiuddin, H., Bhuiya, M. M. R., Hasan, M. M. U., & Jamme, H. (2023). How individual perceptions of transportation systems influence mode choice for mobility-challenged people: A case study in Dhaka using an integrated choice and latent variable model. Transport Policy, 147, 259–270. https://doi.org/10.1016/j.tranpol.2023.12.017

Molin, E., Mokhtarian, P., & Kroesen, M. (2015). Multimodal travel groups and attitudes: A latent class cluster analysis of Dutch travelers. Transportation Research. Part A Policy And Practice, 83, 14–29. https://doi.org/10.1016/j.tra.2015.11.001

Mouter, N., Koster, P., & Dekker, T. (2020). Contrasting the recommendations of participatory value evaluation and cost-benefit analysis in the context of urban

mobility investments. Transportation Research Part A Policy And Practice, 144, 54–73. https://doi.org/10.1016/j.tra.2020.12.008

Mouter, N. (2021). Willingness to allocate public budget and Participatory Value Evaluation. In Advances in transport policy and planning (pp. 83–102). https://doi.org/10.1016/bs.atpp.2021.01.001

Mouter, N., Shortall, R. M., Spruit, S. L., & Itten, A. V. (2021). Including young people, cutting time and producing useful outcomes: Participatory value evaluation as a new practice of public participation in the Dutch energy transition. Energy Research & Social Science, 75, 101965. https://doi.org/10.1016/j.erss.2021.101965

Ortúzar, J.d. Sustainable Urban Mobility: What Can Be Done to Achieve It?. J Indian Inst Sci 99, 683–693 (2019). https://doi.org/10.1007/s41745-019-00130-y

Papadakis, D. M., Savvides, A., Michael, A., & Michopoulos, A. (2024). Advancing sustainable urban mobility: insights from best practices and case studies. Fuel Communications, 20, 100125. https://doi.org/10.1016/j.jfueco.2024.100125

Pereira, C. H. T., & Silva, M. E. (2023). Fostering a transition to inclusive sustainability through shared urban mobility. Research in Transportation Business & Management, 51, 101045. https://doi.org/10.1016/j.rtbm.2023.101045

Populytics. (2025, 10 januari). Expertise - Populytics. https://populytics.nl/producten/diensten/

Rahman, M. (2023). Commute mode switch and its relationship to life events, built-environment, and attitude change. Transportation Research Part D Transport And Environment, 120, 103777. https://doi.org/10.1016/j.trd.2023.103777

Rani, S., & Jayapragash, R. (2024). Review on electric mobility: Trends, challenges and opportunities. Results in Engineering, 23, 102631. https://doi.org/10.1016/j.rineng.2024.102631

Rongen, T., Tillema, T., Arts, J., Alonso-González, M. J., & Witte, J. (2022). An analysis of the mobility hub concept in the Netherlands: Historical lessons for its implementation. Journal Of Transport Geography, 104, 103419. https://doi.org/10.1016/j.jtrangeo.2022.103419

Sagaris, L. (2014). Citizen participation for sustainable transport: the case of “Living City” in Santiago, Chile (1997–2012). Journal Of Transport Geography, 41, 74–83. https://doi.org/10.1016/j.jtrangeo.2014.08.011

Stadnichuk, V., Merten, L., Larisch, C., & Walther, G. (2024). Optimisation of mobility hub locations for a sustainable mobility system. Transportation Research Interdisciplinary Perspectives, 26, 101193. https://doi.org/10.1016/j.trip.2024.101193

Taborda, S., Henriques, F., Carvalho, G., Magalhães, L., & Banza, M. (2023). People-centred design methods in a local decision-making process: masterplan for Lisbon’s multimodal mobility hubs. Transportation Research Procedia, 72, 900–907. https://doi.org/10.1016/j.trpro.2023.11.500

Tammaru, T., Sevtsuk, A., & Witlox, F. (2023). Towards an equity-centred model of sustainable mobility: Integrating inequality and segregation challenges in the green mobility transition. Journal Of Transport Geography, 112, 103686. https://doi.org/10.1016/j.jtrangeo.2023.103686

Weustenenk, A. G., & Mingardo, G. (2022). Towards a typology of mobility hubs. Journal Of Transport Geography, 106, 103514. https://doi.org/10.1016/j.jtrangeo.2022.103514

Wieczorek, A. J., & Hekkert, M. P. (2012). Systemic instruments for systemic innovation problems: A framework for policy makers and innovation scholars. Science And Public Policy, 39(1), 74–87. https://doi.org/10.1093/scipol/scr008

Witte, J.-J., Alonso-González, M., & Rongen, T. (2021). Verkenning van het concept Mobiliteitshub. In Kennisinstituut Voor Mobiliteitsbeleid (ISBN 978-90-8902-245-5). Ministerie van Infrastructuur en Waterstaat. https://www.kimnet.nl/publicaties/rapporten/2021/05/31/verkenning-van-het-concept-mobiliteitshub

Zhai, W., & Ye, X. (2024). Moving towards climate-resilient mobility: Challenges and emerging trends. Travel Behaviour And Society, 100971. https://doi.org/10.1016/j.tbs.2024.100971

Zijlstra, T., Bakker, S., & Witte, J.-J. (2022). Het wijdverbreide autobezit in Nederland. In Kennisinstituut Voor Mobiliteitsbeleid (KIM) (ISBN: 978-90-8902-263-9). https://www.kimnet.nl/