Mobility and behavior

User Perception and Behavioural Response to the Nieuwe Delft Mobility Hub

Isabella Teeuwen
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by

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Preface

This thesis has been written as part of the Bachelor End Project in Civil Engineering at Delft University of Technology, within the department of Transport and Planning. The research explores the influence of shared mobility infrastructure on travel behaviour and has been conducted from April to June 2025.

I would like to express my sincere gratitude to my supervisors, Yufei Yuan and Srinath Mahesh, for their valuable weekly feedback, encouragement, and constructive guidance throughout the process. I am also thankful to my fellow students for their support, collaboration, and helpful discussions during various stages of the project.

Finally, I would like to thank all survey respondents who took the time to participate in the research. Their input has been essential for the development of this thesis.

Isabella Teeuwen
Delft, June 2025

Summary

This thesis investigates whether the temporary mobility hub in Nieuw Delft has influenced the travel behaviour and perceptions of nearby residents. As many Dutch cities aim to adopt car-light policies, shared mobility hubs are introduced to reduce private car use and encourage more sustainable transport alternatives. The central research question is: *To what extent has the Nieuw Delft mobility hub influenced travel behaviour among residents and users in the area?*

To answer this question, a theoretical framework was developed based on literature about shared mobility and behavioural change. A structured survey was then distributed among residents living near the hub, yielding 56 valid responses. The survey included questions on awareness, usage, car ownership, motivations and barriers, satisfaction, and distance to the hub. The results were analysed using descriptive statistics and non-parametric hypothesis tests, including Chi-square, Wilcoxon Signed-Rank, Mann–Whitney U, Kruskal–Wallis, and Spearman correlation tests.

The results show that awareness of the hub is high (86%), but regular use remains limited. A significant relationship was found between car ownership and hub usage: non-car owners were more likely to use the hub. A small but statistically significant decrease in private car use was also observed among a subset of respondents, suggesting modest behavioural change.

Motivations to use the hub were primarily practical, including vehicle availability, cost savings, and ease of use. The most frequently cited barrier was a preference for using one's own car. Satisfaction with the hub was generally neutral to slightly positive. However, no statistically significant differences were found between users living closer or further from the hub, nor between those who used it more or less frequently. This suggests that satisfaction may be shaped more by personal habits than by accessibility.

Taken together, the findings indicate that while the mobility hub may contribute to modest changes in behaviour, physical infrastructure alone is not enough to drive widespread adoption. For future hubs to be more effective, supportive strategies such as clear communication, attractive pricing, and efforts to address behavioural resistance are essential. The results also led to practical recommendations, suggesting that future hubs should offer clear communication, services that match what users need, and supportive policies to help people keep using them in the long term. These insights can help inform future implementations of shared mobility infrastructure in Delft and similar urban settings.

While the study is limited by its sample size and reliance on self-reported data, it offers useful insights into how shared mobility infrastructure is received at the neighbourhood scale. Further research could build on this by combining self-reported data with usage records, or by examining long-term behavioural shifts over time.

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1

Introduction

Cities are becoming more crowded due to population growth. As urban areas expand, daily travel increases for work, school, shopping, and recreation. This puts pressure on transport systems, causes heavier traffic, and increases pollution. A major factor in these problems is the strong dependence on private cars in many cities, which has been reinforced by traditional transport planning approaches. [2].

To deal with these challenges, cities are looking for more sustainable and flexible transport solutions. One of these solutions is a mobility hub. A mobility hub is defined as a physical location where a convenient transfer is offered between available transport modes, including shared mobility. The goal is to make it easier for people to switch between modes of transport and to reduce the need for private car ownership [3].

Mobility hubs are often placed near busy areas, public transport connections, or new residential developments. They are designed to promote a shift in travel behavior by offering visible and convenient alternatives. Hubs can help reduce emissions, improve accessibility, and free up space that would otherwise be used for car parking [6].

In the Netherlands, both the national government and municipalities support the development of mobility hubs as part of sustainable urban mobility strategies [17]. In late 2020, the Municipality of Delft introduced the *Mobiliteitsprogramma Delft 2040*, a long-term mobility strategy. The city expects significant growth in population and jobs by 2040, which will increase traffic and put pressure on space in the city. The plan focuses on reducing car use, creating more space for walking and cycling, and improving accessibility through shared, electric, and flexible mobility solutions. Shared mobility and hubs are mentioned as key elements of this shift [12].

In line with this strategy, a temporary mobility hub was set up in the Nieuw Delft area, at the corner of Abtswoudseweg and Engelsestraat.

Figure 1.1: The temporary mobility hub in Nieuw Delft (Image source: Google Earth, accessed April 2024).

The hub, which opened in September 2021, currently hosts four electric shared cars from JustGo and an additional four shared e-bikes from Urbee. These vehicles can be accessed via mobile apps.

JustGo is a platform offering electric shared cars that can be booked and unlocked through their app. The cars are designed for flexible use and aim to provide a sustainable alternative to car ownership [14].

Urbee provides lightweight electric bikes for short urban trips. Their bikes can be picked up and returned at designated parking locations, and are intended to support first- and last-mile mobility [23].

Both providers contribute to improving accessibility and reducing the need for private cars in the neighbourhood.

Figure 1.2: Electric shared car from JustGo (image from [14]).

Figure 1.3: Shared e-bike from Urbee (image from [23]).

Although the hub is currently located in a temporary spot, there are plans to move it to a permanent location in the future [7]. The hub's main purpose is to reduce private car use and to support sustainable travel. However, it remains unclear whether the hub has actually changed how people in the area travel. While mobility hubs are often promoted as a promising solution, there is still limited research on their real-world impact, especially in smaller cities like Delft.

1.1. Research Question and Subquestions

This research investigates how the Nieuwe Delft mobility hub has influenced the travel behavior of residents and users in the area. The central research question is:

> **To what extent has the Nieuwe Delft mobility hub influenced travel behavior among residents and users in the area?**

To answer this question, the research is divided into six subquestions. Each subquestion focuses on a specific aspect of the main question and will be answered using a different research method, as explained in the methodology.

1. **What was the intended impact of the Nieuwe Delft mobility hub on travel behavior, according to the municipality?**
   This question examines the goals and expectations the Municipality of Delft had when introducing the hub. Understanding these intended outcomes is important for evaluating the outcomes. The answer will be based on an analysis of policy documents, planning reports, and other publicly available sources such as municipal strategies and communications from mobility-service providers like JustGo.
2. **To what extent do residents and users currently use the shared mobility options provided at the hub?**
   This question focuses on the actual use of the hub in daily life. It looks at how often the shared cars and bikes are used, by whom, and for what purposes.
3. **To what extent has the frequency of car use changed among users since the introduction of the hub?**
   This question focuses specifically on the use of private cars before and after the introduction of the mobility hub. The aim is to explore whether the hub has encouraged residents to use their cars less frequently.
4. **What factors influence the decision to use or not use the mobility hub?**
   This question explores the motivations and barriers that shape people's choices. Key aspects include convenience, price, car ownership, and perceived accessibility. These are analysed using survey results and background variables such as distance to the hub.
5. **How satisfied are users with the mobility hub, and how does this relate to the distance from their home and their frequency of use?**
   This question looks at satisfaction levels and how they relate to practical aspects such as proximity and usage frequency, based on survey ratings and user characteristics.
6. **What lessons from this temporary hub can inform the development of future mobility hubs in Delft?**
   This final question reflects on the broader implications. Based on the results and an interview with the municipality, it explores how future hubs could be improved or adapted.

By answering these subquestions, the research will be able to assess whether the Nieuwe Delft mobility hub has led to noticeable changes in travel behavior and how its actual effects compare to its original goals.

1.2. Goal and Scope

The main goal of this research is to evaluate whether the Nieuwe Delft mobility hub has had a measurable effect on the travel behaviour of local residents and users. This includes understanding how often the hub is used, whether it has changed people's travel choices, and how it is perceived in terms of accessibility, ease of use, and value it offers.

The research also aims to compare the intended policy goals of the Municipality of Delft with the actual user experiences, in order to assess whether the hub delivers on its promise as a sustainable mobility solution. Insights from this study can help inform future decisions about the design, placement, and communication of mobility hubs in Delft and other cities.

The scope of this study is limited to the temporary mobility hub located at the corner of Abtswoudseweg

and Engelsestraat in the Nieuw Delft area. It includes both residents who live near the hub and/or have used the shared vehicles. The mobility hub was introduced in 2021. This thesis is based on a short, exploratory study conducted in 2025. The research was carried out over an eight-week period and draws on survey responses collected during that time. These include questions about travel behaviour before and after the hub's introduction.

Because this is a small-scale exploratory study, the results will not be statistically representative. However, the study is intended to identify trends, motivations, and perceptions that can inform further research and local policy decisions.

1.3. Stakeholder analysis

To better understand the context and dynamics of the temporary mobility hub in Nieuw Delft, his section identifies the main stakeholders involved in or affected by the initiative. Analyzing their interests, roles and levels of influence provides a valuable insight into how decisions are made, how the hub is used, and how it may develop in the future.

Table 1.1 gives an overview of the key stakeholders and their roles in relation to the hub in Nieuw Delft.

Table 1.1: Key stakeholders and their role in the mobility hub

Stakeholder	Role and involvement
Municipality of Delft	Responsible for planning, policy, and coordination of the mobility hub.
JustGo and Urbee	Service providers offering shared cars and bikes at the hub.
Local residents	Residents of Nieuw Delft who may use the hub or be affected by it.
Mobility project manager	Oversees implementation and monitoring on behalf of the municipality.
National policy level	Sets legal framework and national goals for sustainable mobility.
CROW / mobility experts	Provides guidelines, technical advice, and best practices.

The stakeholders listed in Table 1.1 differ in both their level of interest and the influence they hold over the mobility hub project.

The Municipality of Delft holds the most strategic influence, as it initiated the hub and links it to long-term sustainable transport goals, as described in its *Mobiliteitsprogramma Delft 2040*. The mobility project manager is responsible for implementation and coordination on behalf of the municipality and acts as a link between policy and practice.

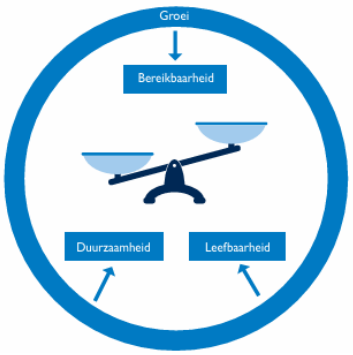

Figure 1.4: The Municipality of Delft's mobility challenge [13].

As Figure 1.4 illustrates, Delft's mobility policy framework aims to find a new balance between urban growth, accessibility, sustainability, and liveability. This shapes the municipality's interest in promoting

shared mobility as a means to reduce car dependency while improving space efficiency and environmental quality.

The service providers JustGo and Urbee are responsible for offering shared vehicles at the hub. They provide access to electric cars and bikes via their apps, and play a key role in enabling daily use of the mobility hub. In addition to serving users, they can also supply data and insights to the municipality about the hub's performance. Local residents are the main users and are directly affected by the hub's visibility, accessibility, and convenience. Their perception and behavior provide essential feedback for evaluating the hub's effectiveness.

At the national level, the Ministry of Infrastructure sets the legal and financial framework for shared mobility. While it is not directly involved in the implementation of hubs in Delft, national ambitions to reduce car dependency and promote more efficient use of public space guide local policies. The municipality of Delft refers to these goals in its *Mobiliteitsprogramma Delft 2040*, which aligns with the national transition towards more sustainable and flexible mobility systems.

CROW and other mobility knowledge institutions offer technical guidelines and best practices for the design and integration of hubs. Their input serves as a reference for municipalities.

To visualise the varying degrees of power and interest among the identified stakeholders, a Power–Interest Matrix has been created (Figure 1.5). This matrix categorises stakeholders into four quadrants based on their relative influence over the project and their level of involvement or concern.

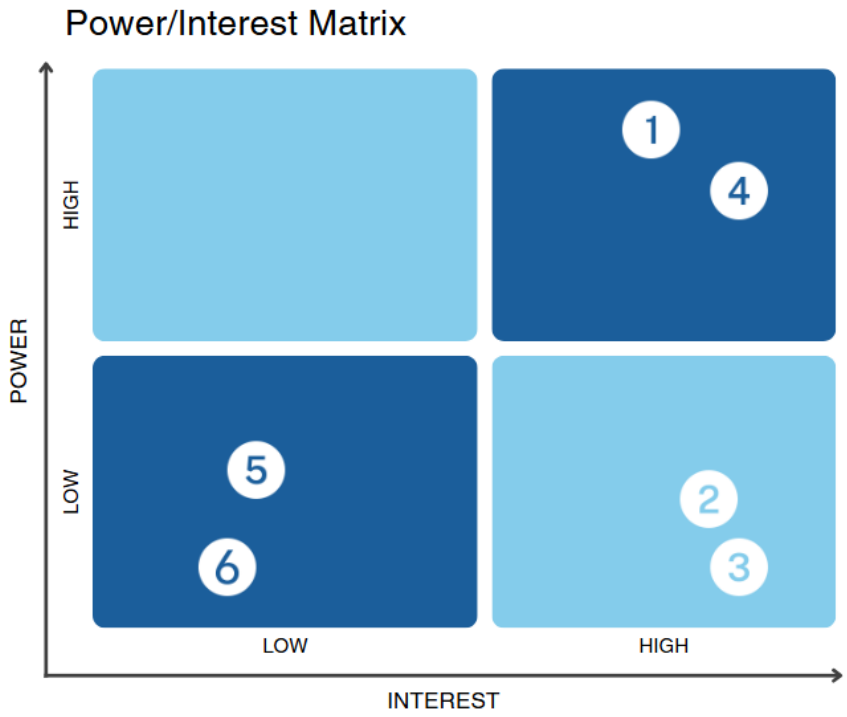

Figure 1.5: Power–Interest Matrix of stakeholders in the Nieuw Delft mobility hub

In Figure 1.5 the six stakeholders are positioned according to their level of power and interest in the mobility hub project.

Stakeholder **1** (Municipality of Delft) has both high power and high interest, as it initiated the hub and links it to the city's long-term mobility plans. Similarly, stakeholder **4** (Mobility project manager) is directly involved in the coordination, giving them both high interest and substantial influence.

Stakeholders **2** (JustGo and Urbee) and **3** (Local residents) are placed in the high interest but low power quadrant. They are closely affected by the success of the hub, but do not control its implementation or

strategy. JustGo and Urbee operate the shared vehicles, and local residents are the primary users of the service.

Stakeholder **5** (National policy level) has relatively high power due to its role in setting policy frameworks and funding, but shows less direct involvement in this specific local project in Delft, placing it in the lower-left quadrant.

Finally, stakeholder **6** (CROW / mobility experts) contributes with technical knowledge and best practices. Their influence and interest are limited in the context of this specific hub, which also places them in the lower-left quadrant.

2

Theoretical Framework and Literature Review

The aim of this chapter is to provide a clear theoretical foundation for the study. It introduces the key concepts and context that help to understand how and why mobility hubs may influence travel behaviour. The chapter starts by explaining what mobility hubs are and what they aim to achieve. It then outlines the Dutch policy context, both at the national and local level. After that, relevant academic literature on travel behaviour and shared mobility is reviewed. Finally, the chapter explains how these insights are used to support the sub-questions and guide the research approach.

2.1. What are mobility hubs?

In recent years, cities have increasingly invested in mobility hubs to support more sustainable and flexible travel behaviour. This shift is partly driven by growing populations in urban areas [22], which contribute to space limitations and environmental pressure such as air pollution [1]. In response, many governments promote shared and public transport as an alternative to private car ownership [1].

A mobility hub is generally understood as a physical location where different shared and public transport options come together. CoMoUK [5] define a mobility hub as “a recognisable place with an offer of different and connected transport modes, supplemented with enhanced facilities and information features to both attract and benefit the traveller.”

While some hubs are large, multimodal stations serving thousands of users per day, others are small neighbourhood-based nodes offering only shared bikes and cars. What they share is the goal to make it easy for people to switch between transport modes, so that people can choose flexible, sustainable transport options instead of relying on private cars [4, 1].

Mobility hubs are also closely connected to the broader concept of Mobility-as-a-Service (MaaS), in which various modes of transport are bundled in a combined digital service, allowing users to plan, book, and pay for their trips. The physical location of the hub supports the digital services by increasing the visibility and availability of shared mobility options, which can help promote behavioural change [1, 4].

In the Netherlands, mobility hubs are increasingly supported at both national and local levels [18]. They are considered a promising tool to reduce car dependency, promote healthier and greener urban environments, and to support the development of car-light neighbourhoods [6]. One example of such a car-light neighbourhood is Nieuw Delft, where a temporary mobility hub has been established to support shared and sustainable travel options [7].

2.2. Dutch Policy Framework for Mobility Hubs

In the Netherlands, mobility hubs are increasingly recognised as part of the national policy to promote sustainable and efficient urban transport. Dutch planning policy has consistently focused on lowering car dependency in growing cities, and mobility hubs are seen as a tool to contribute to this change [18].

At the national level, organizations such as CROW provide detailed guidance for municipalities on how to plan, design, and manage mobility hubs. Their framework encourages cities to integrate hubs with public transport, make shared mobility options more noticeable, and ensure accessibility and safety. CROW identifies several types of mobility hubs, from large regional train stations to smaller neighbourhood-based facilities, each designed to meet specific mobility needs while supporting flexible travel behaviour [6].

This research focuses specifically on the city of Delft, wwhich is trying to follow national advice on shared mobility in its city planning. In the *Delft 2040 vision*, the municipality explicitly aims to create a compact, car-light city with more space for pedestrians, cyclists, and public transport. One of the key development areas is Nieuw Delft, a newly built neighbourhood designed with limited private parking and a strong emphasis on shared mobility. As part of this approach, a temporary mobility hub was established at the corner of Engelsestraat and Abtswoudseweg, offering shared electric cars and bikes via the JustGo and urbee platforms [12, 7].

Despite this institutional support, the implementation of mobility hubs in the Netherlands often still faces challenges. Rongen et al. [18] highlight common issues such as poor coordination between different government levels, competing interests in urban planning, and weak links between transport and land use. In general, making transport in the Netherlands more sustainable has not been easy. Barriers include a lack of infrastructure, doubts or confusion among users, and resistance from existing systems and interests[9]. These challenges underline the importance of evaluating whether hubs like the one in the Nieuw Delft area are truly effective in shaping local travel behaviour.

2.3. Behaviour change in mobility

Encouraging behavioural change is a key challenge in efforts to create more sustainable urban mobility systems. Even when shared transport options are available, many people continue to rely on private cars. This is often due to a combination of convenience, habit, cost, and the lack of trust in the shared transport options [11, 4].

Studies show that simply increasing the supply of shared vehicles is not enough to trigger large-scale change. Instead, behaviour is influenced by how these services are perceived in everyday life. Visibility, ease of use, and good integration with other transport modes help make shared mobility feel like a reliable and realistic alternative [4, 1].

In many cities, mobility hubs are designed to influence behaviour by offering more accessible alternatives to private car use. They do not only serve as transport facilities, but also as tools to influence travel behaviour, helping people to discover new transport modes and making it easier to combine them through apps and smart pricing systems [1, 4].

This is also visible in Dutch case studies. A stated-preference survey in Den Bosch found that public transport users were far more willing to try Mobility-as-a-Service (MaaS) platforms than regular car users. The main barriers among car drivers were routine and perceived inconvenience [11]. Similarly, other studies show that even in areas where shared cars and bikes are widely available, car ownership often remains high. This suggests that shared mobility alone does not automatically lead to behaviour change [4].

These examples are in line with broader literature on how people choose their mode of transport and behavioural change in mobility. Research shows that personal preferences, perceptions of convenience, and habitual routines play a crucial role in determining whether individuals switch from private car use to shared options [26, 16]. This shows that infrastucture alone is not enough to promote shared mobility[2, 4].

In summary, these findings highlight that change depends not only on infrastructure, but also on personal attitudes, daily routines, and perceived trade-offs. For this reason, the present study includes

survey questions on travel habits and perceptions to better understand how residents experience and respond to the shared mobility options provided at the Nieuw Delft hub.

2.4. Motivations and barriers

The decision to use shared mobility services is shaped by a combination of practical, financial, and psychological factors. While some users are drawn to shared vehicles because of convenience or cost savings, others hesitate due to habits, uncertainty, or concerns about availability. Understanding these motivations and barriers is essential for evaluating the effectiveness of mobility hubs.

One of the reasons people adopt shared mobility is the potential to save money. Compared to owning a private car, shared options offer flexibility without long-term commitment. Especially in urban areas with limited parking space, this financial advantage can be attractive [16].

Convenience can also be an important motivator, especially for people who do not need a car every day or who do not have a private parking space available. In busy urban areas, the hassle of finding parking can outweigh the benefits of ownership. Some also appreciate the freedom of not having to own a vehicle, particularly younger people or those who already combine different modes such as walking, cycling, and public transport [26]. In the Zuidas case study, van den Bogaerdt [4] found that some residents chose to rely on shared mobility because it fit well with their lifestyle and housing context, especially those who live in car-light neighborhoods with good access to public transport.

Not all residents are equally open to shared mobility. Regular car users are often more reluctant, mainly due to habits, uncertainty about vehicle availability, or the convenience of owning a private car [11]. Some also perceive the per-ride costs as too high, especially for frequent use, or may find app systems and pricing models confusing. In addition, car ownership is often associated with personal freedom or status. [26].

Car owners and non-car owners often differ in how they perceive shared mobility. While car owners tend to compare new services directly with the comfort and control of their own vehicle, non-car owners are generally more open to trying alternatives.

The main motivations and barriers found in the literature are summarised in Table 2.1.

Table 2.1: Overview of motivations and barriers for shared mobility adoption

Factor	Type	Explanation	Source
Cost savings	Motivation	Reduces parking costs and ownership expenses	[16]
Convenience	Motivation	Offers flexibility, especially for non-car owners	[16]
Habit and routine	Barrier	People are used to their own car	[11, 4]
Attachment to ownership	Barrier	Cars represent comfort, freedom or status	[11, 4]
Availability concerns	Barrier	Doubts about vehicle availability when needed	[11, 4]
App complexity	Barrier	Users may find new apps unclear or difficult	[11]

2.5. Relevance for this research

This literature review has shown that mobility hubs are not only physical infrastructure, but also part of a broader strategy to change travel behaviour. Understanding how and why people switch, or do not switch, from private cars to shared alternatives is therefore essential when evaluating the impact of such mobility solutions.

These insights provide a foundation for evaluating whether the Nieuwe Delft mobility hub has influenced travel behaviour. They also inform Subquestion 1, which focuses on the intended goals behind the hub's introduction.

Policy documents such as the *Mobiliteitsprogramma Delft 2040* indicate that the Municipality of Delft aims to reduce private car use and promote shared, electric, and flexible modes of transport. The development of the Nieuw Delft area plays a key role in this strategy, with limited parking, strong public transport links, and dedicated infrastructure for shared mobility. The temporary mobility hub at the corner of Abtswoudseweg and Engelsestraat was introduced to support these ambitions by offering local residents access to shared cars and bikes. Its intended impact is to encourage behavioural change by making sustainable alternatives more accessible and convenient.

The literature also helped shape the design of the survey questions. Studies on shared mobility adoption highlight behavioural barriers such as habit, perceived cost, and uncertainty about availability, as well as motivations like affordability, convenience, and lifestyle fit. These factors are reflected in the survey questions addressing user motivations and barriers, and directly support the investigation of Subquestion 4. The review also supports the decision to compare car owners and non-car owners, as these groups often differ in their travel behaviour and openness to shared services.

Finally, Dutch case studies provide reference points to interpret the findings in the context of Nieuw Delft. They show that the success of a hub depends not only on the availability of shared modes, but also on how well it aligns with user preferences, routines, and lifestyle.

By identifying the intended goals behind the hub's introduction, this research creates a basis for comparison with the actual user experiences and behavioural patterns observed in the survey. This will help assess whether the mobility hub has fulfilled its intended role, and to what extent the municipality's ambitions for shared, car-light mobility have been realised in practice.

2.6. Summary

This chapter has reviewed the theoretical and policy context for evaluating the impact of mobility hubs on travel behaviour. Mobility hubs are designed to reduce car dependency by offering visible, accessible, and integrated shared transport options. However, their effectiveness depends not only on infrastructure, but also on behavioural factors such as perceptions of convenience, habit, and routine.

Dutch national and local policies actively promote shared mobility, as seen in the development of Nieuw Delft. Yet, behavioural barriers such as attachment to private cars and uncertainty about shared services continue to influence travel choices.

The literature highlights key motivations and obstacles that shape mobility behaviour, such as trust, affordability, and lifestyle fit. These insights informed the design of the survey used in this study and provide a basis for interpreting whether and how the mobility hub in Nieuw Delft may be influencing local travel patterns.

3

Methodology

This research uses a mixed-methods approach to answer the central research question: *"To what extent has the Nieuwe Delft mobility hub influenced travel behavior among residents and users in the area?"*

The research is structured around six subquestions, each addressing a different dimension of behavioural impact, motivation, satisfaction, and policy implications.

3.1. Research Design

A mixed-methods approach was chosen because the research aims to understand both policy intentions (qualitative) and behavioural outcomes (quantitative). The combination of a literature review and a structured survey among residents provides a reliable basis for evaluating whether the hub has influenced travel behaviour.

3.2. Literature Study

A literature study was conducted to build the theoretical framework presented in Chapter 2. The aim of this review was to understand what mobility hubs are, how they relate to urban policy, and what behavioural responses they may trigger. The findings informed the formulation of the research questions, particularly Subquestion 1 and Subquestion 4.

In addition, insights from the literature were used to shape the design of the survey questions.

Academic sources were mainly retrieved from the TU Delft library and repository, alongside Google Scholar. In addition, national and local policy documents (e.g. the Delft 2040 Mobility Plan and CROW guidelines) were consulted to provide contextual understanding.

3.3. Survey Design and Sampling

A survey was conducted among residents in and around the Nieuw Delft area to understand their use and perception of the local mobility hub. Surveys are commonly used in transport research to gather structured data on opinions and behaviours [20].

The survey consists of 14 questions formulated for this research and divided into thematic sections, including demographics, awareness and use, behavioural change, motivations and barriers, and perception. It includes common survey formats, including closed-ended, multiple-choice, and Likert-scale questions. These formats allow for structured responses and are well suited to descriptive statistics and non-parametric analysis [21]. One open-ended item was added to allow for qualitative feedback.

Respondents who indicated that they were not familiar with the mobility hub (based on Question 3) received an alternative set of 6 follow-up questions, focusing on their openness to shared mobility and

potential future use. As a result, the total number of questions per respondent varied between 9 and 14, depending on their awareness of the hub.

Questions were designed to support Subquestions 2 to 5. Demographic items (e.g. age, car ownership) allow for subgroup analysis. Awareness and usage questions address whether respondents are familiar with the hub and have used its services (SQ2). Behavioural change is examined through before-and-after questions on car use (SQ3). Motivations and barriers are based on existing literature on shared mobility adoption (SQ4). Perception and satisfaction questions assess how accessible users find the hub and how satisfied they are with the service (SQ5).

The questionnaire was pre-tested among peers to ensure clarity. Table 3.1 summarises the survey structure and its relation to the subquestions. The full questionnaire is in Appendix A.

Table 3.1: Survey questions and related subquestions

Theme	Question	SQ
Demographics	What is your age?	2, 3
Awareness	Are you aware of the mobility hub?	2
Usage	Have you used a shared vehicle at the hub?	2
Car use (before)	How often did you use a car before the hub?	3
Car use (now)	How often do you currently use a car?	3
Motivations	What would encourage you to use the hub more?	4
Barriers	What prevents you from using the hub more?	4
Distance to hub	How far is the hub from your home?	5
Willingness	What is the max distance you'd walk to a hub?	5
Satisfaction	How satisfied are you with the services?	5
Open feedback	Do you have any comments or experiences?	6

A sample size of around 50 respondents was targeted. While this number is not statistically representative, such small samples are considered acceptable in exploratory research and pilot studies, where the goal is to identify general trends or subgroup patterns rather than to draw population-wide conclusions [24, 15].

The survey was distributed via printed flyers with a QR code linking to a digital Qualtrics questionnaire. These flyers were delivered to households near the hub to reach residents likely familiar with its location and services. QR codes offer a low-barrier way to participate and have been shown to improve response rates in urban settings with high smartphone usage [8]. A short explanation of the study and a clear note on anonymity were included to increase trust and engagement (see Appendix B).

3.4. Data Analysis Survey

The analysis of the survey data addresses Subquestions 2 to 5, each of which targets a specific aspect of the Nieuw Delft mobility. These topics are explored through a combination of descriptive statistics and non-parametric hypothesis tests.

Given the exploratory nature of the study and the relatively small sample size, non-parametric methods are preferred. These tests are appropriate for ordinal and categorical data and do not require assumptions of normal distribution. Descriptive statistics are used to summarise general trends in the responses, while hypothesis testing is applied to assess whether observed differences or associations are statistically significant.

For each subquestion, a clear hypothesis-testing framework is defined. This includes a null hypothesis **(**H_0**)**, typically representing the absence of a significant effect or association, and an alternative hypothesis **(**H_a**)**, reflecting the expected relationship based on theory or prior findings. The aim of the analysis is to determine whether there is sufficient statistical evidence to reject H_0 in favour of H_a.

All statistical tests are conducted using IBM SPSS Statistics at a standard significance level of $\alpha = 0.05$. This threshold balances the risk of Type I error (rejecting H_0 when it is actually true) with the need to detect meaningful effects [10]. Each test produces a test statistic and an associated p-value. If the p-value falls below the significance threshold, the null hypothesis is rejected:

$$\text{Reject } H_0 \text{ if } p < \alpha \tag{3.1}$$

The subsections that follow outline the specific hypotheses, corresponding survey items, and chosen statistical methods used to address each subquestion. Each subquestion is addressesd in a consistent structure: relevant survey items are identified, an appropriate statistical test is selected, hypotheses are stated and the results are interpreted in light of the research objectives.

An overview of all tests and variables is provided in Table 3.6.

Subquestion 2 – Awareness and Use of the Mobility Hub

To what extent do residents and users currently use the shared mobility options provided at the hub?

This subquestion investigates the extent to which local residents are aware of the Nieuw Delft mobility hub and whether this awareness is linked to actual use of the shared cars and bikes offered at the site. Two survey items are used: one measuring awareness of the hub's existence, and one asking whether respondents have ever used a shared vehicle at the hub.

In addition, the relationship between car ownership and hub usage is examined to test whether residents without a private car are more likely to make use of the hub. Both variables are categorical, and the association is tested using a Chi-square test of independence.

Table 3.2: Hypotheses for Subquestion 2

Null hypothesis (H_0)	There is no association between car ownership and the use of the mobility hub.
Alternative hypothesis (H_a)	There is an association between car ownership and the use of the mobility hub.

A statistically significant result would indicate that car ownership is linked to differences in hub use. This could suggest that the hub primarily serves as a substitute for those without access to private transport, aligning with policy aims to encourage shared mobility and reduce car dependency.

Subquestion 3 – Change in Private Car Use

To what extent has the frequency of car use changed among users since the introduction of the hub?

This subquestion examines whether the mobility hub has led to a change in residents' private car use. Respondents who had used the hub were asked to indicate how often they used a private car *before* and *after* the introduction of the hub, using a five-point Likert scale.

Since the data is ordinal and consists of repeated measures for the same individuals, the Wilcoxon Signed-Rank Test is applied. This non-parametric method is appropriate for detecting differences between two related samples without assuming a normal distribution.

Table 3.3: Hypotheses for Subquestion 3

Null hypothesis (H_0)	There is no difference in private car use before and after the hub's introduction.
Alternative hypothesis (H_a)	There is a difference in private car use before and after the hub's introduction.

A statistically significant outcome would suggest that the availability of shared mobility options may have influenced behaviour. If car use has decreased, this supports the idea that the hub contributes to the transition away from private vehicle dependency in Nieuw Delft.

Subquestion 4 – Motivations and Barriers

What factors influence the decision to use or not use the mobility hub?

This subquestion examines the reasons why some residents choose to use the mobility hub while others do not. Two aspects are considered: the motivations that encourage use and the barriers that discourage it. These are assessed using multiple-choice questions covering themes such as convenience, affordability, environmental concerns, and preference for private transport.

In addition, respondents were asked to indicate the maximum distance they would be willing to walk to a mobility hub. This question was used to analyse whether perceived accessibility differs between users and non-users. As responses are ordinal and based on two independent groups, the Mann–Whitney U test is applied to test for statistically significant differences.

Table 3.4: Hypotheses for Subquestion 4

Null hypothesis (H_0)	There is no difference in acceptable walking distance between users and non-users of the mobility hub.
Alternative hypothesis (H_a)	There is a difference in acceptable walking distance between users and non-users of the mobility hub.

A significant result would suggest that physical proximity plays a role in the decision to use the hub. This insight can help inform future decisions about where to place mobility hubs within neighbourhoods.

Subquestion 5 – Satisfaction and Accessibility

How satisfied are users with the mobility hub, and how does this relate to their distance or frequency of use?

This subquestion examines whether satisfaction with the mobility hub is associated with two practical factors: distance to the hub and frequency of use. Only respondents who had used the hub at least once were asked to rate their satisfaction on a five-point Likert scale.

Two survey items are used: one measuring self-reported distance from the hub in ordinal categories, and one measuring usage frequency. To analyse the data, two non-parametric tests are applied. The Kruskal–Wallis test assesses whether satisfaction differs significantly across distance groups, while the Spearman rank correlation examines whether there is a monotonic relationship between satisfaction, distance, and usage frequency.

Table 3.5: Hypotheses for Subquestion 5

Null hypothesis (H_0)	There is no monotonic relationship between satisfaction and distance or frequency of use. Satisfaction levels do not differ between distance groups.
Alternative hypothesis (H_a)	There is a monotonic relationship between satisfaction and distance or frequency of use. Satisfaction levels differ between distance groups.

A significant outcome would suggest that either distance or habitual use plays a role in how the service is evaluated by users. Understanding these patterns is important for improving the hub's accessibility and inclusivity.

The table below provides an overview of the statistical methods used to analyse each subquestion, including the variables involved and the type of relationship or difference that is being tested. This

summary supports the transparency and traceability of the analysis process.

Table 3.6: Overview of variables and statistical methods per subquestion

Subquestion	Variables	Statistical Test
Awareness and Use	Hub usage (categorical) Car ownership (categorical)	Chi-square test
Car Use Change	Car use before (ordinal) Car use after (ordinal)	Wilcoxon Signed-Rank Test
Motivations and Barriers	Walking distance to hub (ordinal) User status (user / non-user)	Mann–Whitney U test
Satisfaction and Accessibility	Satisfaction (ordinal) Distance to hub (ordinal) Usage frequency (ordinal)	Kruskal–Wallis test Spearman correlation

3.5. From Survey Findings to Recommendations

Subquestion 6 asks: *"What lessons from this temporary hub can inform the development of future mobility hubs in Delft?"*

This subquestion is addressed through reflective interpretation of the survey results in combination with the theoretical insights presented in Chapter 2. These findings are then translated into practical recommendations for future hubs in Chapter 5.

3.6. Summary

This chapter has outlined the methodology used to investigate the behavioural impact of the Nieuw Delft mobility hub. A mixed-methods strategy was adopted, combining a literature review with a structured survey among local residents. The literature review informed the design of the questionnaire and a better formulation of the subquestions, while the survey provided quantitative data for analysis.

The survey addressed Subquestions 2 to 5, covering awareness and usage, changes in private car use, motivations and barriers, and satisfaction with the hub. The survey was distributed, using a flyer-based distribution strategy with a digital QR code. Depending on their awareness of the hub, respondents received a tailored set of questions.

Given the ordinal and categorical nature of the data, non-parametric methods were used to analyse the results. These included Chi-square tests, Wilcoxon Signed-Rank tests, Mann–Whitney U tests, Kruskal–Wallis tests, and Spearman correlations. Hypotheses were formulated per subquestion to structure the analysis.

In addition, Subquestion 6 focuses on drawing broader lessons from the research. While it is not addressed through statistical testing, it is based on a reflective interpretation of the survey findings, supported by the theoretical framework.

Together, the methods described in this chapter provide a clear and systematic basis for answering the central research question about the mobility hub's influence on travel behaviour in Nieuw Delft.

4

Results

To understand how the mobility hub is used and perceived, a survey was distributed among residents living near the area. The results are structured according to the subquestions of the research. Each section presents descriptive statistics, followed by hypothesis testing when applicable. Where useful, tables and figures are included to support the findings.

4.1. Respondent Demographics

To assess how representative the sample is, the age distribution of survey respondents was compared to that of the general population in Delft [19]. Table 4.1 shows this comparison in percentage terms across five age categories.

The figure reveals that younger residents (18–24) are underrepresented in the sample, while older age groups (50–64 and 65+) are overrepresented. Despite these differences, all age groups are represented in the sample, allowing for diverse perspectives in the analysis.

Table 4.1: Age group distribution: survey sample vs. Delft population

Age Group	Survey (%)	Delft Population (%)
18–24	5.4	22.15
25–34	14.3	15.58
35–49	23.2	16.95
50–64	32.1	17.23
65+	25.0	15.17

In total, 56 responses were collected. Given the exploratory nature of the study, this sample size is sufficient to identify general trends. However, the results should be interpreted critically when drawing conclusions about the entire Delft population.

4.2. Subquestion 2 – Awareness and Use of the Mobility Hub

Awareness of the hub

Out of the 56 total respondents, 48 (85.7%) indicated that they are aware of the mobility hub at the corner of Abtswoudseweg and Engelsestraat. Figure 4.1 visualises this distribution.

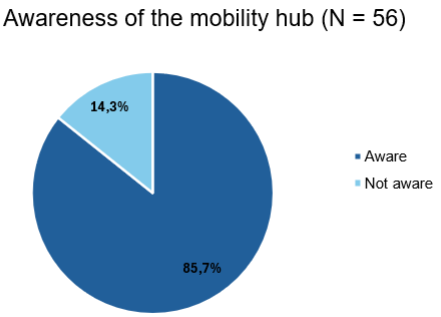

Figure 4.1: Distribution of respondents who are aware of the mobility hub at Abtswoudseweg/Engelsestraat (N = 56).

This suggests that the visibility and communication around the hub have been relatively effective, as the vast majority of local residents are familiar with its existence.

Use of the hub

Out of the 56 total respondents, 48 (85.7%) reported that they are aware of the mobility hub (see Figure 4.1). Among these 48, only 11 respondents (22.9%) had ever used the hub, while 37 (77.1%) reported never using it.

Figure C.7 shows this distribution of hub use among those who are aware of the facility. Although awareness is high, the actual use of the hub remains relatively low.

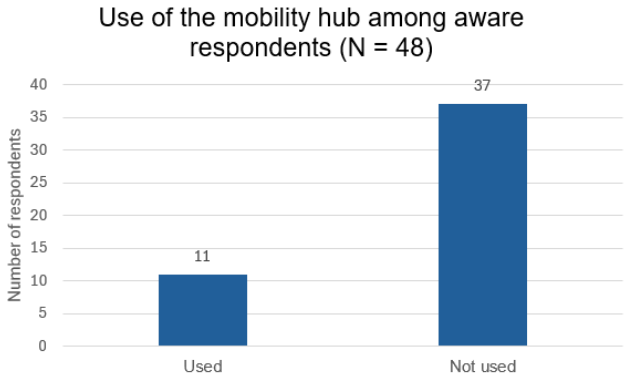

Figure 4.2: Use of the mobility hub among respondents who are aware of its existence (N = 48).

Relationship with car ownership

To investigate whether hub usage is associated with car ownership, a cross-tabulation is presented in Table 4.2. This includes only the 48 respondents who are aware of the hub.

Table 4.2: Hub usage by car ownership among those aware of the hub (N = 48)

	Used hub	Did not use hub	Total
Own car	4	29	33
No car	7	8	15
Total	11	37	48

Statistical test: Chi-square

A Chi-square test of independence was conducted to examine the relationship between car ownership and the use of the hub among those aware of it. The test result was statistically significant:

$$\chi^2(1, N = 48) = 6.97,\ p = 0.008$$

Summary
There is a statistically significant association between car ownership and the use of the mobility hub. Respondents without a private car are more likely to use the hub compared to those who do own one. This suggests that the hub may provide an important alternative for residents without access to a private vehicle.

4.3. Subquestion 3 – Behavioural Change in Car Use

Reported change in car use
Respondents who were aware of the mobility hub (N = 48) were asked to indicate how often they used a private car before the hub was introduced and how often they use it now. The response scale ranged from 1 (“Daily”) to 5 (“Never”).

A comparison of these two distributions is shown in Figure 4.3, which visualises the number of respondents for each answer category before and after the introduction of the hub.

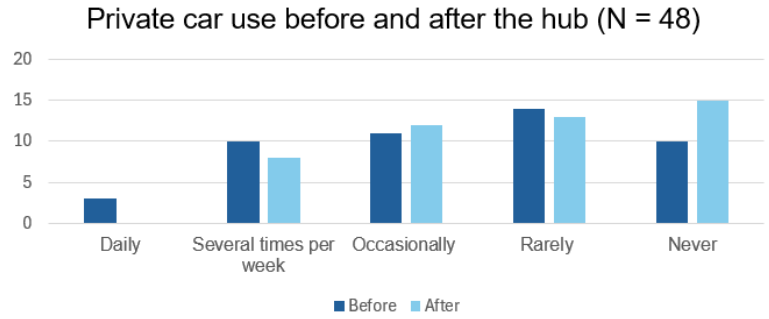

Figure 4.3: Reported frequency of car use before and after the introduction of the mobility hub (N = 48).

As shown in the figure, most respondents reported no change, but a small group indicated they use the car less frequently. A formal statistical test was used to assess whether this observed change is statistically significant.

Statistical test: Wilcoxon Signed-Rank Test
The Wilcoxon Signed-Rank Test was used to examine whether there was a statistically significant change in private car use before and after the hub was introduced. This non-parametric test is appropriate for paired ordinal data.

The result was statistically significant:

$$Z = 2.801,\ p = 0.005$$

Out of the 48 respondents, 11 reported a decrease in car use, 1 reported an increase, and 36 reported no change.

Summary
The results suggest that the mobility hub may have contributed to a small but statistically significant reduction in private car use among those who are aware of it. While the majority of respondents did not change their travel behaviour, the observed decrease among a subset is meaningful in the context of the city’s car-light mobility ambitions.

4.4. Subquestion 4 – Motivations and Barriers to Hub Use
This section investigates why some residents choose to use the mobility hub while others do not.

Self-reported motivations and barriers

A total of 48 respondents indicated they were aware of the mobility hub and were therefore asked follow-up questions about either their motivations for using the hub, or their reasons for not using it.

Figure 4.4 presents the most frequently reported motivations among users. The most common responses included the availability of more vehicles (28 respondents) and cheaper pricing options (24). Convenience-related factors, such as an easier booking process or better communication, were mentioned less frequently.

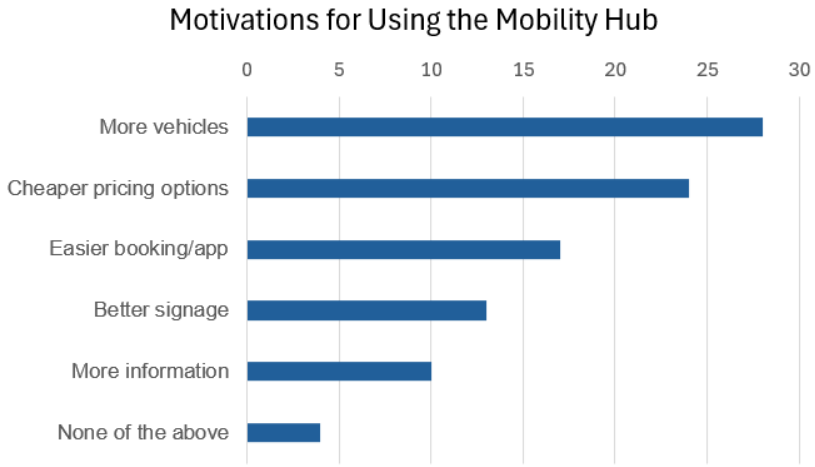

Figure 4.4: Top reported motivations for using the mobility hub (N = 48). Respondents could select multiple answers.

Respondents who had not used the hub were asked what prevented them from doing so. As shown in Figure 4.5, the most frequently cited barrier was a preference for using one's own car (26 respondents). Other common barriers included perceived cost and lack of necessity.

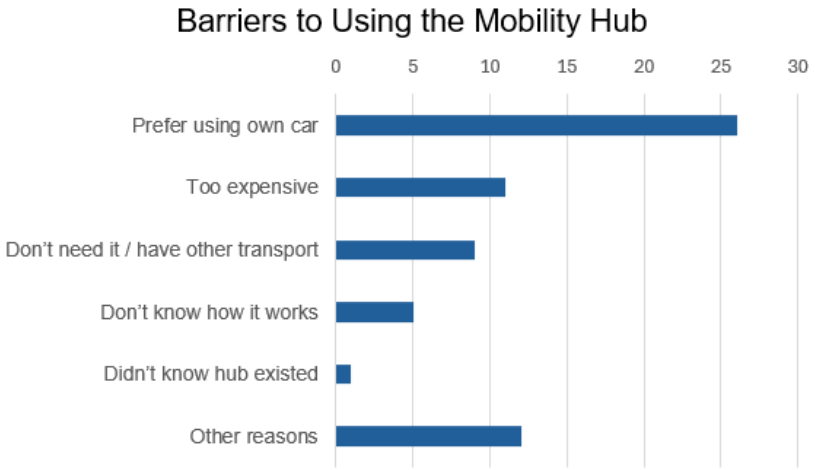

Figure 4.5: Top reported barriers to using the mobility hub (N = 48). Respondents could select multiple answers.

Perceived maximum distance to the hub

To investigate whether prior use of the mobility hub influences how far residents are willing to travel to access it, a Mann–Whitney U test was conducted. The test compared responses on the maximum acceptable distance to the hub between users and non-users, as defined by the binary variable *gebruik_bina* (1 = user, 0 = non-user).

The results revealed no statistically significant difference in acceptable distance between users (Mean Rank = 22.68, N = 11) and non-users (Mean Rank = 29.92, N = 45):

$$U = 183.5,\ Z = -1.388,\ p = 0.165$$

This suggests that prior experience with the mobility hub does not substantially affect how far residents are willing to walk to access it.

Summary

The results show that motivations to use the hub are primarily practical, such as vehicle availability and cost. The main barrier for non-users is a strong preference for using their own car. Although hub users were willing to walk slightly further on average, this difference was not statistically significant.

4.5. Subquestion 5 – Satisfaction and Accessibility

This section explores how satisfied residents are with the mobility hub, and whether their satisfaction is associated with either their distance to the hub or how often they use it.

Satisfaction levels

All respondents who were aware of the mobility hub (N = 48) were presented with a question asking how satisfied they were with it on a 5-point Likert scale ranging from “Very dissatisfied” to “Very satisfied”. However, only 42 respondents answered this final survey question.

Figure 4.6 shows the distribution of satisfaction scores among these 42 respondents. Most responses were neutral (score 3), followed by slightly positive (score 4). Only a few respondents gave a very low or very high score.

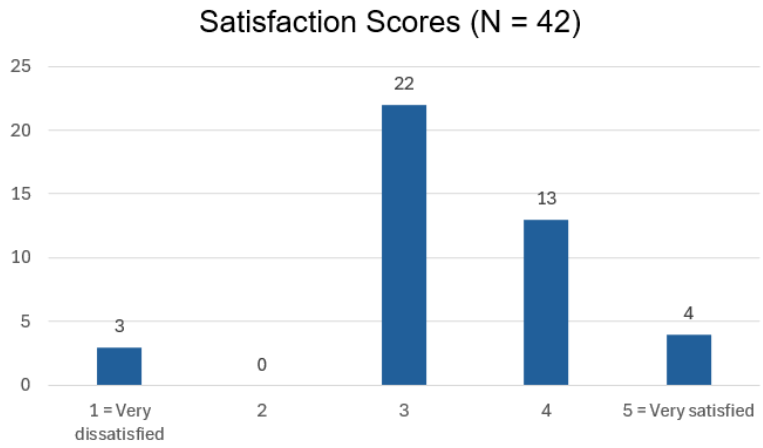

Figure 4.6: Distribution of satisfaction scores among respondents who were aware of the mobility hub (N = 42).

Statistical analysis: Kruskal–Wallis test

To explore whether satisfaction levels differ depending on how far respondents live from the hub, a Kruskal–Wallis H test was conducted using three distance categories.

Table 4.3 presents the average satisfaction scores per distance group. No responses were recorded for residents living more than 500 metres from the hub.

Table 4.3: Average satisfaction score per distance category (N = 42). Only categories with at least one response are shown.

Distance to hub	Mean satisfaction
Less than 100 m	3.33
100–250 m	3.32
250–500 m	3.45

To explore whether satisfaction differs significantly between distance groups, a Kruskal–Wallis H test was conducted using three distance categories: less than 100 meters, 100–250 meters, and 250–500 meters. The test revealed no statistically significant difference in satisfaction levels:

$$H(2) = 0.079,\ p = 0.961$$

This result suggests that satisfaction with the mobility hub is not noticeably associated with the distance from a respondent's home. The very high p-value indicates that the observed differences in average satisfaction scores across distance categories are likely due to random variation.

Correlation with usage frequency

Table 4.4 shows the average satisfaction scores per usage frequency group. Although frequent users appear slightly more satisfied, the differences are small and do not reach statistical significance.

Table 4.4: Average satisfaction score per usage frequency (N = 42). Only categories with valid responses are shown.

Usage frequency	Mean satisfaction
Occasionally (1–2 days/week)	3.50
Rarely (less than once/week)	3.50
Never	3.32

A Spearman rank-order correlation test was conducted to examine the relationship between usage frequency and satisfaction. The correlation was not statistically significant:

$$\rho = -0.077,\ p = 0.630$$

Although the average satisfaction scores per usage group show a very slight upward trend, the overall rank-order correlation was slightly negative. This may be explained by small differences in group means and the fact that satisfaction was measured across both users and non-users.

Summary

This analysis shows that satisfaction with the mobility hub does not significantly differ between distance groups, nor is it meaningfully correlated with how often the hub is used. Although average satisfaction scores were slightly higher among respondents who used the hub occasionally or rarely, these differences were minimal and not statistically significant. The weak overall correlation and non-significant group differences may partly be explained by the relatively small number of valid responses (N = 42).

4.6. Overview of Statistical Test Results

The data analysis in Chapter 3 introduced formal hypotheses (H_0 and H_a) for each subquestion where statistical testing was applied. The results presented in this chapter include five hypothesis tests across four subquestions.

Table 4.5 provides an overview of these tests, including the test statistic, the corresponding p-value, and whether the result was statistically significant, that is, wether the null hypothesis was rejected. This summary helps clarify which hypotheses were supported by the data and which were not.

Table 4.5: Overview of statistical tests and results per subquestion

Subquestion	Test	Test statistic	p-value	Result
2 – Awareness and Use	Chi-square test	$\chi^2(1) = 6.97$	$p = 0.008$	Significant
3 – Car Use Change	Wilcoxon Signed-Rank	$Z = 2.801$	$p = 0.005$	Significant
4 – Max walking distance	Mann–Whitney U	$U = 183.5$	$p = 0.165$	Not significant
5a – Satisfaction by distance	Kruskal–Wallis	$H(2) = 0.079$	$p = 0.961$	Not significant
5b – Satisfaction by frequency	Spearman correlation	$\rho = -0.077$	$p = 0.630$	Not significant

4.7. Summary of Results

The survey results provide insights into how the mobility hub is perceived and used by local residents. Most respondents were aware of the hub, but actual usage was limited. A statistically significant relationship was found between car ownership and hub usage, suggesting that the hub serves as a valuable alternative for residents without a private car.

A small but significant reduction in car use was reported among some users, indicating a modest behavioural impact. Motivations for using the hub included availability and cost, while the main barrier was a preference for private transport. Although hub users were willing to walk slightly further on average, no statistically significant difference was found in how far users and non-users were willing to walk to the hub. Satisfaction with the hub was generally neutral to slightly positive, and did not vary significantly by distance or usage frequency.

Out of five formal hypothesis tests, two yielded statistically significant results. In both cases, the null hypothesis (H_0) was rejected. These outcomes related to the association between car ownership and hub usage (Subquestion 2), and the change in private car use among users (Subquestion 3).

The remaining three tests did not reach statistical significance, meaning the null hypotheses for those cases could not be rejected. These tests corresponded to Subquestions 4 and 5 and involved comparisons of walking distance (user vs. non-user), satisfaction by distance to the hub, and satisfaction by usage frequency. This suggests that these factors are not strongly linked within the current user base.

Overall, the findings suggest that while awareness is high and there is some evidence of behavioural change, broader adoption may require improved service offerings and stronger motivators.

5

Discussion

This chapter reflects on the results presented in Chapter 4 and discusses their meaning. It summarises the key findings, interprets them in the context of the shared mobility research, and considers possible explanations for the observed trends. In addition, it outlines the limitations of the study and provides suggestions for future research. Together, these reflections aim to assess how the findings contribute to understanding the potential of mobility hubs in shaping urban travel behaviour.

5.1. Overview of key findings

The survey results offer insight into how residents of Nieuw Delft perceive and use the mobility hub. Overall, the following patterns were observed:

- **Awareness:** A majority of respondents (48 out of 56) were aware of the hub, suggesting that its presence in the neighbourhood is relatively well-known.
- **Usage patterns:** Despite high awareness, use remains limited. Most respondents reported using the hub only occasionally or rarely. The Chi-square test showed a significant relationship between car ownership and hub usage, with non-car owners more likely to use the hub.
- **Behavioural change:** A small but statistically significant reduction in car use was observed among those who were aware of the hub. The Wilcoxon Signed-Rank Test showed that 11 respondents reported using their car less often, while only 1 reported an increase.
- **Motivations and barriers:** Users were mainly motivated by practical improvements such as vehicle availability, lower pricing, and easier booking. The most frequently cited barrier was a preference for private car use. Although users were willing to walk slightly further on average, a Mann–Whitney U test showed that this difference in acceptable travel distance between users and non-users was not statistically significant.
- **Satisfaction:** Satisfaction with the hub was generally neutral to slightly positive. A Kruskal–Wallis test found no significant differences between distance groups, and a Spearman correlation test showed no meaningful link between usage frequency and satisfaction.

5.2. Interpretation and reflection

The results of this study provide mixed insights into the mobility hub's potential to promote behavioural change. Although both shared cars and shared e-bikes are available at the hub, the analysis in this thesis focuses primarily on the car-sharing component. This is because only two respondents reported having used the shared e-bikes (Urbee), suggesting that their influence on behaviour in this context is minimal.

On the one hand, awareness of the hub was relatively high, and a small but statistically significant decrease in reported private car use was observed after the hub's introduction. This suggests that the

presence of shared mobility options may have encouraged some respondents to reconsider their travel behaviour.

Despite the observed behavioural shift among a small group, most respondents reported no change in their car use. This indicates that the hub's overall impact remains modest. This is consistent with earlier research that highlights the difficulty of changing mobility habits solely through infrastructure [11, 9]. Previous studies have found that shared mobility services are typically more effective when combined with active policy support, such as pricing incentives, parking restrictions, or targeted information campaigns [4, 9]. The findings indicate that without such supportive interventions, adoption may stay limited to individuals who already open to reducing their car use.

Respondents' motivations match this pattern: the most frequently mentioned factors were practical, such as vehicle availability, lower pricing, and ease of use. This suggests that residents are willing to consider shared mobility when it provides direct functional benefits, instead of a conscious choice to give up private car use. The Nieuw Delft mobility hub appears to function more as a convenient addition to existing travel options than as a trigger for changing travel habits. Meanwhile, the most frequently mentioned barrier was the preference for using one's own car, confirming the importance of personal routines and perceptions in travel decisions [26, 11].

This also helps explain why none of the tested relationships involving distance or frequency showed statistical significance. There was no significant difference in satisfaction between users who lived closer or further from the hub, nor between those who used it more or less frequently. In addition, although users were on average willing to walk slightly further, this difference was not statistically significant. These findings suggest that people's satisfaction and willingness to use the hub depend more on their mindset and travel habits than on how close they live or how often they use it.

Together, this highlights that while the mobility hub has some positive effects on behaviour and perception, its broader impact may remain limited unless it is supported by more active engagement, targeted communication, and integration into users' daily routines.

5.3. Limitations

Several limitations should be considered when interpreting the results of this thesis.

First, the sample size was relatively small (N = 56), and not all respondents answered every question. For example, only 42 respondents completed the final question about satisfaction. Although the target number of responses (50) was met, the effective sample size per subquestion varied, which may weaken the validity of some of the statistical analyses.

Second, the survey relied entirely on self-reported data, which can lead to certain biases, such as giving socially desirable answers or not remembering things accurately, especially for questions about past behaviour and mobility changes before and after the hub was introduced.

Third, the hypotheses were mostly formulated after the survey was designed and distributed. As a result, some survey questions may not have fully alligned with what was needed to test each hypothesis. In future studies, predefining hypotheses and aligning the survey questions accordingly could improve the validity of the results and make the analysis easier.

Fourth, the survey was distributed physically to households in the surrounding neighbourhood. Although this method aimed to reach a location-specific sample, there is still a risk of self-selection bias. Residents who were more interested in mobility issues, or who had stronger opinions about the hub, may have been more likely to respond, which could limit how representative the sample is.

Finally, the study lacked access to objective usage data from the mobility provider. For example, the company JustGo confirmed informally that their shared cars are increasingly being used at the Nieuw Delft hub. However, they were not able to share any concrete usage data due to privacy and policy restrictions. As a result, this information could not be used in the analysis. All findings about behavioural change are therefore based on the self-reported data from the survey and could not be cross-checked against actual usage records.

5.4. Implications and recommendations

These reflections also address Subquestion 6, which asked what lessons can be drawn from the Nieuw Delft case to inform the development of future mobility hubs in Delft and similar urban areas. Based on the findings, three key insights can help shape future implementations.

First, practical benefits are the main reason why residents chose to try the service initially. The study shows that residents are primarily motivated to use the mobility hub when it offers clear functional benefits. These findings align with earlier research suggesting that shared mobility adoption is often driven by convenience rather than environmental concerns or deliberate lifestyle change. For future hubs, this means that the service offering must be competitive and clearly advantageous compared to private car use.

Second, infrastructure alone is not enough to change behaviour. While the mobility hub provides visible and accessible alternatives, its influence on behaviour remains modest. This shows that new infrastructure should be combined with clear strategies to make it easier for people to try shared mobility and change their usual travel behaviour. Without such complementary measures, adoption is likely to remain limited.

Third, it is important to consider who the users are and where the hub is placed. The hub was most attractive to respondents who do not own a private car, suggesting that future mobility interventions are likely to succeed in neighbourhoods with limited parking, strong public transport connections, and a high proportion of residents already open to flexible transport options. Placing the hub in the right location and adapting it to local needs can make it more successful. This means that the service should be tailored to the daily routines and priorities of different user groups. For example, students and young adults may value flexibility and low costs, while families might look for larger vehicles or child-friendly options. Understanding these local preferences can help improve both the design and promotion of the hub.

In short, the Nieuw Delft case shows that shared mobility hubs can play a role in supporting car-light mobility, but only if they are part of a wider plan that also focuses on behaviour and policy. For cities like Delft, this means looking beyond just building infrastructure, and also working actively to support long-term changes in how people travel, through clear communication, good service, and a focus on what users need.

6

Conclusion

This thesis investigated whether the temporary mobility hub in Nieuw Delft has influenced local travel behaviour. Through a combination of literature review and a structured survey, the research examined the hub's visibility, usage, impact on car use, user motivations and barriers, satisfaction levels, and broader lessons for future implementation.

The results show that while awareness of the hub is high, over 85% of respondents were familiar with it, actual usage remains limited. People without a private car were more likely to use the hub, and a small but statistically significant decrease in private car use was observed among a subset of users. This suggests that the hub may contribute to behavioural change, particularly for residents who already have fewer alternatives.

Motivations to use the hub were mainly practical, including vehicle availability, cost savings, and ease of use. A strong preference for using one's own car remained the most common barrier, highlighting the importance of habits and convenience in travel decisions. Satisfaction levels were generally neutral to slightly positive and did not appear to depend on how far people lived from the hub or how frequently they used it, suggesting that personal attitudes and routines may outweigh practical factors like distance.

These findings indicate that while mobility hubs can play a role in encouraging sustainable travel, physical infrastructure alone is not enough to drive long-term behavioural change. To be more effective, future hubs should be supported by clear communication, practical benefits such as attractive pricing and easy booking, and services that align with the needs and daily routines of local users.

Despite the study's limitations, such as its small sample size and reliance on self-reported data, it provides valuable insight into the early-stage impact of shared mobility infrastructure in a Dutch urban setting. Future research could build on these results by combining survey data with usage statistics or by tracking behavioural change over time.

In summary, the Nieuw Delft mobility hub has made a modest but measurable contribution to Delft's car-light ambitions. For such hubs to have a lasting impact, they must be part of a broader strategy that not only builds infrastructure but also actively supports behavioural change. This can includes clear communication campaigns, attractive pricing and booking systems, and services that match the daily routines and needs of different user groups. By aligning practical incentives with users' habits, future mobility hubs can more effectively encourage sustainable travel choices.

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A

Survey Questionnaire

1. What is your age?
    - Under 18
    - 18–24
    - 25–34
    - 35–49
    - 50–64
    - 65+
2. What is your household composition?
    - I live alone
    - I live with a partner
    - I live with housemates or family
3. Do you currently own a private car?
    - Yes
    - No
4. Have you heard of the mobility hub at the corner of Abtswoudseweg and Engelsestraat?
    - Yes
    - No
5. Have you ever used any of the shared vehicles at this hub?
    - Yes, a shared car (JustGo)
    - Yes, a shared bike (Urbee)
    - Yes, both
    - No
6. How often do you currently use the hub?
    - Multiple times per week
    - Once per week
    - A few times per month
    - Rarely
    - Never

7. Has your travel behaviour changed since the hub was introduced?
    - Yes, I use shared mobility more
    - Yes, I use my own car less
    - No change
    - I don't know
8. How often did you use a private car *before* the hub?
    - Daily
    - Several times per week
    - Rarely
    - Never
9. How often do you use a private car *now*?
    - Daily
    - Several times per week
    - Rarely
    - Never
10. What would encourage you to use the mobility hub more? (Select all that apply)
    - Lower costs
    - More availability of vehicles
    - Easier to use app
    - Better parking or visibility
    - Environmental reasons
    - I already use it often
    - Other: _____
11. What stops you from using the hub more often? (Select all that apply)
    - I prefer my own car
    - I didn't know about it
    - It's too expensive
    - Not sure how it works
    - I don't need it
    - Other: _____
12. How accessible is the hub for you?
    - 1 = Not accessible
    - 2
    - 3
    - 4
    - 5 = Very accessible
13. How satisfied are you with the current shared mobility services in your area?
    - 1 = Very dissatisfied
    - 2
    - 3
    - 4

- 5 = Very satisfied

14. (Optional) Do you have any suggestions or experiences you would like to share?
15. _____

16. _____

B

Flyer

Survey Flyer (Dutch version)

Figure B.1: Flyer used to distribute the survey among residents (Dutch version).

Survey Flyer (English version)

Figure B.2: Flyer used to distribute the survey among residents (English version).

C

SPSS Output

Subquestion 2: Awareness and Use – Chi-square Test

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6,967[a]	1	,008		
Continuity Correction[b]	5,148	1	,023		
Likelihood Ratio	6,570	1	,010		
Fisher's Exact Test				,022	,013
Linear-by-Linear Association	6,822	1	,009		
N of Valid Cases	48				

a. 1 cells (25,0%) have expected count less than 5. The minimum expected count is 3,44.

b. Computed only for a 2x2 table

Figure C.1: SPSS output of Chi-square test on the association between car ownership and mobility hub usage (N = 48).

Subquestion 3: Change in Car Use – Wilcoxon Signed-Rank Test

Related-Samples Wilcoxon Signed Rank Test

Hoe vaak gebruikte u een privéauto voordat de hub werd geïntroduceerd?, Hoe vaak gebruikt u momenteel een privéauto?

Related-Samples Wilcoxon Signed Rank Test Summary

Total N	48
Test Statistic	73,000
Standard Error	12,140
Standardized Test Statistic	2,801
Asymptotic Sig.(2-sided test)	,005

Figure C.2: SPSS output of Wilcoxon Signed-Rank test on reported change in private car use before and after hub introduction (N = 48)

Subquestion 4: Motivations and Barriers – Mann–Whitney U Test

Independent-Samples Mann-Whitney U Test Summary

Total N	56
Mann-Whitney U	183,500
Wilcoxon W	249,500
Test Statistic	183,500
Standard Error	46,125
Standardized Test Statistic	-1,388
Asymptotic Sig.(2-sided test)	,165

Figure C.3: SPSS output of Mann–Whitney U test on perceived walking distance between hub users and non-users (N = 48).

Subquestion 5: Satisfaction and Accessibility – Kruskal–Wallis Test

Independent-Samples Kruskal-Wallis Test

Hoe tevreden bent u over de huidige deelmobiliteitsdiensten in uw buurt? across Ho e ver is de mobiliteitshub (Abtswoudseweg / Engelsestraat) ongeveer van uw woning ?

Independent-Samples Kruskal-Wallis Test Summary

Total N	42
Test Statistic	,079[a]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	,961

a. The test statistic is adjusted for ties.

Figure C.4: SPSS output of Kruskal–Wallis test comparing satisfaction levels across distance categories from the mobility hub (N = 42).

Subquestion 5: Satisfaction and Accessibility – Spearman Correlation

Correlations

			Hoe vaak maakt u momenteel gebruik van de mobiliteitshub ?	Hoe tevreden bent u over de huidige deelmobiliteits diensten in uw buurt?
Spearman's rho	Hoe vaak maakt u momenteel gebruik van de mobiliteitshub?	Correlation Coefficient	1,000	-,077
		Sig. (2-tailed)	.	,630
		N	48	42
	Hoe tevreden bent u over de huidige deelmobiliteitsdiensten in uw buurt?	Correlation Coefficient	-,077	1,000
		Sig. (2-tailed)	,630	.
		N	42	42

Figure C.5: SPSS output of Spearman correlation between satisfaction and usage frequency (N = 42).

Descriptive Statistics – Car Ownership

Frequencies

Statistics

Bezit u momenteel een eigen auto?

N	Valid	56
	Missing	0

Bezit u momenteel een eigen auto?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ja	41	73,2	73,2	73,2
	Nee	15	26,8	26,8	100,0
	Total	56	100,0	100,0	

Figure C.6: Distribution of car ownership among respondents (N = 56)

Descriptive Statistics – Frequency of Mobility Hub Use

Frequencies

Statistics

Hoe vaak maakt u momenteel gebruik van de mobiliteitshub?

N	Valid	48
	Missing	8

Hoe vaak maakt u momenteel gebruik van de mobiliteitshub?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Af en toe (1–2 dagen per week)	5	8,9	10,4	10,4
	Zelden (minder dan één keer per week)	4	7,1	8,3	18,8
	Nooit	39	69,6	81,3	100,0
	Total	48	85,7	100,0	
Missing	System	8	14,3		
Total		56	100,0		

Figure C.7: Self-reported frequency of mobility hub use (N = 48)

Descriptive Statistics – Current Private Car Use

N	Valid	48
	Missing	8
Mean		3,73
Median		4,00
Minimum		2
Maximum		5

Hoe vaak gebruikt u momenteel een privéauto?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Meerdere keren per week (3–6 dagen per week)	8	14,3	16,7	16,7
	Af en toe (1–2 dagen per week)	12	21,4	25,0	41,7
	Zelden (minder dan één keer per week)	13	23,2	27,1	68,8
	Nooit	15	26,8	31,3	100,0
	Total	48	85,7	100,0	
Missing	System	8	14,3		
Total		56	100,0		

Figure C.8: Self-reported frequency of current private car use (N = 48)

Descriptive Statistics – Satisfaction with Shared Mobility Services

Statistics

Hoe tevreden bent u over de huidige deelmobiliteitsdiensten in uw buurt?

N	Valid	42
	Missing	14
Mean		3,36
Median		3,00
Minimum		1
Maximum		5

Hoe tevreden bent u over de huidige deelmobiliteitsdiensten in uw buurt?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 = Zeer ontevreden	3	5,4	7,1	7,1
	3	22	39,3	52,4	59,5
	4	13	23,2	31,0	90,5
	5 = Zeer tevreden	4	7,1	9,5	100,0
	Total	42	75,0	100,0	
Missing	System	14	25,0		
Total		56	100,0		

Figure C.9: Satisfaction with shared mobility services (N = 42)

D

AI Statement

In the process of writing this thesis, I made limited use of AI-assisted tools, specifically OpenAI's ChatGPT (GPT-4), for support in structuring, formulating, and proofreading English-language sections of the text. These tools were used in the following ways:

- To improve the clarity and flow of sentences.
- To check grammar and consistency in terminology.
- To support the writing of LaTeX code snippets, such as table formatting, figure captions, and appendices.

All research design decisions, literature selection, data analysis (including SPSS tests), interpretation of findings, and final writing were done independently by the author. The AI tool was not used to generate content or arguments, nor to interpret statistical outputs.

The author remains fully responsible for the content, structure, and academic integrity of this thesis.