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Mobility-as-a-Service of Integrating Shared Micro-Mobility with Public Transit

Master's Thesis in Infrastructure and Environmental Engineering

Hani Shaat

DEPARTMENT OF ARCHITECTURE AND CIVIL ENGINEERING
DIVISION OF GEOLOGY AND GEOTECHNICS

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2025
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MASTER'S THESIS 2025

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Cover:
Illustration of a MaaS interface integrating public transit, shared e-scooters, bikes, cars, and trains in a single app. This concept is further explained in section 2.2.
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ABSTRACT

This thesis explores how the public transport provider can offer Mobility as a Service (MaaS) solutions that include shared micromobility such as shared e-scooters. The goal is to understand what users value in these kinds of offers and how pricing and features can be designed to attract more users to use MaaS, which supports more sustainable travel and reduce car use in the region.

To investigate this, a stated preference survey was conducted to see how different parts of a MaaS bundle affect people's willingness to choose it. The survey tested factors like price, free ride time, and free unlocks, and was divided into two types of travel situations: single tickets and monthly passes. Each respondent answered scenarios designed to simulate real travel decisions.

The responses were analyzed using a multinomial logit model, which helped estimate the influence of each feature. The results show that people care most about ease and flexibility. For single ticket users, the most important feature was unlimited ride time. For monthly pass users, the ability to avoid repeated unlock fees was most appreciated. While price had some impact, convenience and simplicity mattered more.

Based on these results, two MaaS bundle proposals are presented. One is a single ticket add-on with some included shared e-scooter minutes, designed for occasional users or tourists. The other is a monthly pass that includes unlimited unlocks and a set number of ride minutes, aimed at regular commuters. These proposals are grounded in user preferences and are meant to guide Västtrafik in designing effective and user-friendly MaaS services.

Keywords: Mobility-as-a-Service, micromobility, shared e-scooters, multimodal transport, public transit integration

Mobilitetstjänst för Integration av delad mikromobilitet med kollektivtrafiken i Göteborg

Examensarbete inom mastersprogrammet Infrastructure and Environmental Engineering

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Sammanfattning

Detta examensarbete undersöker hur Mobility as a Service (MaaS)-lösningar kan utvecklas genom att inkludera delad mikromobilitet, exempelvis elsparkcyklar. Syftet är att förstå vad resenärer värdesätter i sådana erbjudanden och hur biljetter kan utformas för att främja hållbart resande och minska bilberoendet i regionen.

För att undersöka detta genomfördes en stated preference-enkät där respondenter fick ta ställning till olika biljettpaket. Undersökningen testade faktorer som pris, fria minuter och fria upplåsningar, och delades upp i två resesituationer: enkelbiljett och periodkort. Varje respondent fick svara på scenarion som speglade verkliga resesituationer.

Svarsfrekvenserna analyserades med hjälp av en multinomial logit-modell för att skatta hur mycket varje attribut påverkade valen. Resultaten visar att enkelhet och flexibilitet är viktigast. För användare av enkelbiljetter var obegränsad körtid den mest uppskattade funktionen. För regelbundna användare värderades obegränsade upplåsningar högst. Priset hade viss betydelse, men smidighet vägde tyngre.

Utifrån resultaten presenteras två förslag på biljettpaket. Det ena är ett tillval till enkelbiljetten med inkluderade minuter för elsparkcykel, riktat till tillfälliga användare eller turister. Det andra är ett månadskort med obegränsade upplåsningar och ett antal fria körminuter, anpassat för dagliga pendlare. Förslagen grundar sig i användarnas preferenser och är tänkta som stöd i Västtrafiks vidare utveckling av attraktiva MaaS-tjänster.

Nyckelord: Mobilitettjänst, mikromobilitet, elsparkcykel, multimodala resor, kollektivtrafik

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Preface

Göteborg May 2025

HANI SHAAT

List of Acronyms

MaaS	Mobility-as-a-Service
CO_2	Koldioxid (Carbon Dioxide)
SEK	Svenska kronor (Swedish Krona)
EEA	European Environment Agency
EU	Europeiska unionen (European Union)
ITF	International Transport Forum
DRT	Demand-Responsive Transport
MNL	Multinomial Logit
MLE	Maximum Likelihood Estimation

Nomenclature

ASC	Alternative Specific Constant; captures systematic preference for an option.
β	Parameters that measure the influence of each attribute on utility.
C_n	Choice set; the set of all available alternatives for individual n.
Discrete Choice Model	Statistical model used to analyze decision-making between mutually exclusive options.
ε_{in}	Error term representing unobserved influences on choice behavior.
First-/Last-mile problem	The challenge of connecting travelers at the beginning or end of a trip.
Fractional Factorial	An experimental design method that reduces the number of combinations while maintaining statistical validity.
MaaS	A concept that integrates various mobility services.
MLE	A statistical technique used to estimate model parameters by maximizing the likelihood of observed choices.
MNL	The model type used to analyze choice behavior in this study.
Micro-mobility	Short-distance transport solutions.
Multimodal Travel	Using multiple transportation modes within a single journey.
Ngene Software	Used for designing stated preference experiments with balanced attribute combinations.
P_{in}	Probability that individual n chooses alternative i, calculated using the logit model.
Stated Preference	A survey-based method using hypothetical scenarios to identify individual preferences.
U_{in}	Utility of alternative i for individual n

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1. Introduction

According to the United Nations (2021), transportation is a significant contributor to global greenhouse gas emissions, with the transportation sector accounting for approximately 23% of total energy related CO_2 emissions worldwide. Within this sector, road transport is the predominant source responsible for about 75% of transportation-related CO_2 emissions (Climate Trace, 2023).

Transportation is a major contributor to climate change, accounting for 21% of global CO_2 emissions, with road transport alone responsible for over 75% due to private car dependency (Ritchie, 2020). European Environment Agency (2024) reports that urban transport remains one of the most difficult sectors to decarbonize, as demand for mobility continues to grow despite sustainability efforts.

The European Parliament (2024) states that the transport sector's emissions have increased by 33.5% since 1990, making it the only sector where greenhouse gas emissions have continued to rise despite climate policies. Sweden follows this trend, with transport accounting for nearly 30% of total greenhouse gas emissions, posing a challenge for the country's goal to achieve net-zero emissions by 2045 (Naturvårdsverket, n.d).

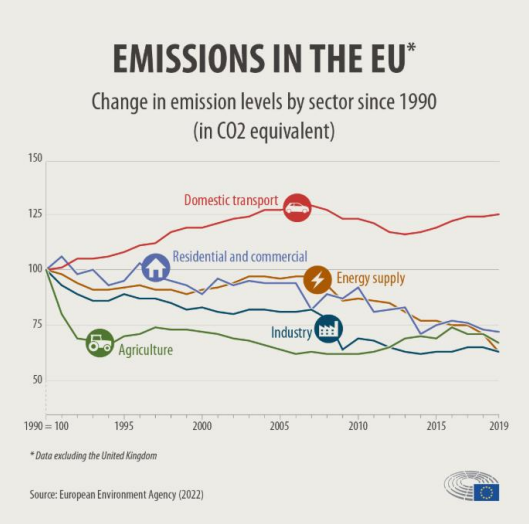

Figure 2. 1: Diagram showing change in emission levels in Europe since 1990 (European Parlament, 2024)

To reduce emissions, Swedish cities are investing in sustainable mobility alternatives, including public transport expansion, Mobility-as-a-Service (MaaS) based on micro-mobility solutions such as e-scooters and bike-sharing. These solutions aim to reduce car dependency, improve accessibility, and lower emissions.

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In urban areas, a significant portion of vehicle trips are short-distance journeys. For instance, in the United States, more than 50% of all daily trips are less than three miles (Sax & Lautrup, 2024). These short trips offer a significant opportunity for emission reductions through the adoption of alternative transportation modes. The integration of micro-mobility services such as e-scooters and bike-sharing, with public transportation systems as one type of MaaS, has been identified as a promising strategy to address first- and last-mile connectivity challenges. Studies suggest there are incentives, such as implementing parking spots for shared e-scooters near public transportation stations, which is one way to enhance the convenience of multimodal travel, potentially reducing reliance on private vehicles (Kythreotis, 2024).

In Gothenburg, Sweden, the regional public transport operator, Västtrafik, plays a fundamental role in the city mobility landscape. According to two sustainable operation managers in Västrafik, there is a potential benefit of shared micro-mobility, by initiating ticket cooperation with shared scooter providers to facilitate seamless multimodal travel experiences for users (Giöbel & Björk, 2023). However, challenges remain in fully integrating these services to maximize their impact on reducing urban congestion and emissions.

This thesis aims to explore the potential for integrating the public transit ticketing system with shared micro-mobility services in Gothenburg. By examining the factors influencing ticket offers, the study seeks to identify strategies that encourage the adoption of multimodal transport solutions, thereby contributing to reduced traffic congestion and lower greenhouse gas emissions in the city.

1.1 Aim

The aim of this study is to explore how integrating shared e-scooters into the existing public-transport services operated by Västtrafik can increase users' willingness to purchase transit passes. We will first identify and analyze the key factors that influence individuals' decisions to adopt a combined shared e-scooter with public -transport service. Based on those insights, develop and evaluate targeted MaaS offerings designed to enhance the attractiveness, convenience, and overall appeal of- multimodal service by Västtrafik.

1.2 Research Questions

- How can MaaS bundles that integrate public transit and shared micro--mobility options (e.g., e-scooters) be designed to increase public transport usage?
- Which factors included in the bundle influence the customers' willingness to pay?
- How can a feasible scheme be designed?

1.3 Research delimitations

This study is limited to the Gothenburg region and its surrounding municipalities within the Västtrafik network. While MaaS is a broad concept, this research specifically examines the integration of public transport services with shared mobility options, such as e-scooters (VOI, ~~Tier~~TIER). Other transport modes, such as private car use and car-sharing services, are excluded unless they are directly linked to the MaaS bundles.

This research concentrates on pricing strategies and MaaS bundle attractiveness, evaluating how different ticketing models that combine public transport with shared micro-mobility services can encourage more people to choose MaaS However, the study does not develop new

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pricing models for individual companies (e.g., VOI, Bolt, or Västtrafik alone) but instead proposes realistic and, market-based offers that align with existing business models.

Furthermore, while the study aims to support sustainable urban mobility, it does not include detailed environmental impact assessments or CO_2 emission calculations for different transport modes. Instead, it focuses on the potential for mode shift from private cars to MaaS-based solutions.

Due to time constraints, the study will be based on survey data and stated preference analysis, and no interviews will be conducted. While interviews could have provided deeper insights into travel behavior and personal preferences, the chosen method allows for a broader data collection within the limited timeframe. Additionally, this research does not involve real-world MaaS trials or large-scale implementation testing. The findings will therefore be theoretical and conceptual, offering insights into how MaaS bundles could be structured but without measuring the applicability of them.

2. Literature Review

The integration of shared mobility services, such as e-scooters and taxis, with public transport is increasingly studied to reduce car dependency and support more sustainable urban travel. Research in the field of MaaS highlights the importance of pricing models, subscription options, and digital integration to improve the appeal and accessibility of public transport. This section integrates findings from Yan et al. (2023), Sochor et al. (2018), Smith et al. (2019), and Jittrapirom et al. (2017) and other sources to explore how shared mobility can be included in public transport through MaaS bundles, pricing strategies, and system design. Jittrapirom et al. (2017) also present a framework that defines key features of MaaS, such as integration of transport modes, one digital platform, flexible payment models, and cooperation between different service providers.

2.1 Mobility-as-a-Service: Integrating Public Transport and Shared Mobility

MaaS is an emerging concept that integrates multiple transportation modes into a unified digital platform, allowing users to plan, book, and pay for multimodal journeys. By combining public transport with shared mobility options such as e-scooters, bike-sharing, and ride-hailing services, MaaS aims to offer seamless, flexible, and more sustainable mobility solutions (Sochor, et al., 2017)

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The core idea behind MaaS is to shift travelers away from private car dependency by making public transport more convenient. Through subscription-based or pay-as-you-go models, MaaS platforms provide users with a single access point to different mobility services, reducing the need for car ownership (Jittrapirom, et al., 2017). European Commission (2024) highlights that well-designed MaaS ecosystems can enhance urban mobility by improving accessibility, reducing congestion, and lowering emissions related to transport.

2.1.1 Case Studies of MaaS Implementation in Europe

Several European cities have implemented MaaS platforms to enhance public transport networks, with varying degrees of success. The Whim app in Helsinki, launched in 2017 by MaaS Global, was one of the first large-scale MaaS platforms. It allowed users to access public transport, taxis, car rentals, and shared micro-mobility services through different pricing plans (Geraldine, 2024). While the app demonstrated potential for increasing multimodal transport adoption, it struggled with long-term financial sustainability, leading MaaS Global to face financial difficulties in 2024. The case of Whim illustrates the challenge of ensuring viable business models for MaaS while balancing affordability for users and profitability for operators.

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Similarly, Berlin's Jelbi platform, developed by Berliner Verkehrsbetriebe (BVG), integrates buses, trams, metro, shared bikes, e-scooters, and car-sharing into one application (Peci & Ali, 2022). Jelbi has been more stable than Whim due to its strong backing from the public transport authority, but challenges remain in user adoption and ensuring seamless payment integration among different providers. Likewise, WienMobil in Vienna has successfully provided

multimodal travel options, though it remains limited in scope, primarily functioning as a trip-planning service rather than a fully integrated MaaS system.

2.1.2 The State of MaaS Development in Sweden

In Sweden, MaaS is still in its initial stages, with various stakeholders exploring how to integrate shared mobility with public transport effectively. Västtrafik, the public transport authority in Gothenburg, has considered MaaS approaches to improve multimodal connectivity, particularly for first- and last-mile solutions. While some early-stage projects have been discussed, large-scale MaaS adoption remains limited due to challenges related to pricing models, contractual agreements with private operators, and user adoption barriers (Smith, et al., 2018)

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Several Swedish cities have piloted projects to inspire MaaS, including initiatives to integrate ticketing and mobility hubs. However, long-term viability depends on finding a sustainable business model that balances affordability for users and profitability for service providers (Sochor, et al., 2018). Further research is needed to determine how MaaS solutions can be effectively structured within the Swedish transport ecosystem, particularly in collaboration with public transport authorities like Västtrafik.

2.2 E-Scooters as First- and Last-Mile Connections

Studies show that shared e-scooters can ~~serve~~serve as well as first- and last-mile solutions when combined with public transit. Yan et al. (2023) found that many e-scooter trips in cities like Washington D.C. and Los Angeles began or ended near transit stops. This suggests that users often use e-scooters to connect to, ~~not~~ rather than replace, public transport. E-scooters can extend the reach of transit services, especially in areas where walking distances are too long.

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Sochor et al. (2018) and Smith et al. (2019) support this through their analysis of MaaS trials in Sweden and Finland. Their work shows that adding shared micromobility, like e-scooters or bikes, into MaaS bundles can make multimodal travel easier and reduce the need for private cars. These effects are stronger when services are well-integrated into trip planning tools. Jittrapirom et al. (2017) found similar results when reviewing international MaaS schemes. They argue that combining different travel ~~modes, and~~modes and allowing users to plan and pay through a single app, is central to effective MaaS systems.

Yan et al. (2023) also show that pricing has a major impact on whether people use both transit and e-scooters. When bundles removed unlock fees or gave large discounts, users were more likely to choose multimodal travel. For example, a transit pass combined with free unlocks and a discount on scooter rides led to higher adoption. Smith et al. (2019) observed the same effect in their study, noting that simple and inclusive subscriptions increased usage and improved how people viewed affordability and ease of use.

Real-time service info and easy payment systems were also key. When users could find and pay for nearby scooters in the same app they used for public transport, they were more likely to combine the two. Jittrapirom et al. (2017) confirm that one of the key parts of MaaS is offering

all services such as planning, booking, and payment on a single platform. This lowers barriers and increases trust that services will be available when needed.

2.3 Subscription Models and User Behaviour

Several studies stress the need to design MaaS subscriptions that match different travel habits and preferences. Sochor et al. (2018) show that basic plans with unlimited public transport were popular among cost-sensitive users, while more flexible packages that included e-scooters, ride-hailing, or bikes attracted people who valued time savings and convenience.

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Both Sochor et al. (2018) and Smith et al. (2019) note that people are more likely to switch from car use when MaaS bundles offer a clear advantage. For regular drivers, the shift often depends on whether the bundle can provide the same level of convenience without the fixed costs of owning a car. To support this, Sochor et al. (2018) suggest using a monthly mobility credit system, where users can spend a set value across different services based on their needs. This also helps providers manage pricing and flexibility.

Smith et al. (2019) propose hybrid models, where users subscribe to basic public transport and choose add-ons for shared mobility. This allows casual users to avoid paying for services they don't use, while giving regular users access to more options. Yan et al. (2023) support this, showing that capped daily pricing was especially attractive to users who wanted to stick to a budget.

Jittrapirom et al. (2017) underline that personalization and customization are important features in MaaS design. Their review of case studies shows that when users can choose and adjust their bundle based on personal habits, satisfaction increases. Features like saving preferences, past trip history, and flexible plan options help make MaaS more appealing and easier to use.

Together, these studies show that flexible, user-focused models work better than fixed plans. When users feel that they are getting good value, and can control their travel choices, they are more willing to leave their cars behind.

2.4 Pricing Strategies and Integration Features

Pricing that is simple, fair, and predictable is seen as essential for successful MaaS. Smith et al. (2019) found that flat-rate models worked well for frequent users, since they removed the need to calculate daily travel costs. This made it easier for users to travel across different modes without worrying about price each time. However, these models need to be designed carefully to remain cost-effective for both users and providers.

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For less frequent users, pay-per-use models work better. Both Smith et al. (2019) and Yan et al. (2023) found that dynamic pricing, combined with first- and last-mile discounts, helped attract new users. Yan et al. (2023) showed that daily price caps for combined transit and e-scooter use improved satisfaction and made users more willing to try multimodal travel.

Jittrapirom et al. (2017) highlight pricing as one of the core design areas in MaaS. They suggest that offering both fixed and flexible plans allows more people to find an option that suits them.

They also stress the role of digital tools in helping users understand and manage their costs. The clearer and more user-friendly the pricing is, the more likely people are to use the system.

Integration of services is just as important as pricing. Real-time tracking, shared payment systems, and single-app access help users plan and travel smoothly. These features were often named as key drivers for adoption across the studies reviewed. Jittrapirom et al. (2017) support this, pointing out that technology, coordination between providers, and user access through one digital channel are essential for a working MaaS system.

In short, pricing and integration need to be developed together. A bundle of good value is not enough if users have to switch apps or payment systems. And a well-integrated app will not succeed if prices are confusing or unfair. Studies agree that both must be simple and easy to use.

2.5 Micro-Mobility's Influence on Travel Behavior

The rise of e-scooter services in Gothenburg has transformed urban mobility, but its impact on reducing car dependency remains uncertain. While shared micro-mobility services provide an efficient first- and last-mile solution, studies indicate that e-scooters often replace walking and cycling rather than private car trips (Peci & Ali, 2022). An analysis of shared e-scooter usage in Gothenburg found that only a small percentage of trips substituted car journeys, raising concerns about whether micro-mobility contributes to sustainability goals (European Environment Agency, 2024).

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However, shared micro-mobility can play a significant role in improving public transport accessibility when properly integrated. Research on MaaS models shows that e-scooters and bike-sharing services are frequently used for first- and last-mile connections to transit hubs, demonstrating their potential to enhance multimodal transport efficiency (Arnestad, 2023). In Gothenburg, demand-responsive transport initiatives have successfully linked shared micro-mobility with bus services, increasing ridership and reducing car dependency (Giöbel & Björk, 2023). The strategic placement of shared micro-mobility stations near public transport nodes, combined with fare integration, is of importance for maximizing these benefits (Business Region Göteborg, 2022).

One underexplored area in MaaS research is how different types of MaaS bundles such as public transport subscriptions with shared micro-mobility credits affect travel behavior. Some cities have successfully implemented subscription-based MaaS models, offering users a set number of e-scooter unlocks or discounted taxi rides within their transit pass (Geraldine, 2024). Studies suggest that well-designed pricing incentives can encourage users to shift from private car usage to different MaaS solutions (Padam Mobility, 2024).

2.6 Identifying Research Gaps and Justification for the Study

The integration of public transport and emerging mobility services through MaaS has been widely discussed as a strategy to promote sustainable urban mobility. While several cities have piloted MaaS solutions, widespread adoption remains limited due to challenges in governance,

pricing models, and user behavior. In Gothenburg, efforts to implement MaaS are ongoing, but significant barriers prevent seamless multimodal integration.

2.6.1 Key Barriers to MaaS Adoption in Gothenburg

Despite ongoing efforts to integrate public transport with emerging mobility solutions, several challenges remain in developing a fully functional MaaS ecosystem in Gothenburg. One of the primary obstacles is the lack of cooperation between public and private mobility providers (European Commission, 2024). Public transport authorities, such as Västtrafik, operate under strict regulatory frameworks, whereas private operators, including e-scooter and ride-hailing services, have more flexible business models. This regulatory divide gets in the way of fully joining the services, particularly in terms of ticketing, pricing, and data sharing (European Commission, 2024; Sochor, et al., 2018).

A key barrier to MaaS adoption is the absence of integrated ticketing and pricing models, which makes multimodal journeys less convenient for users. Currently, Västtrafik's ticketing system does not include private shared mobility services such as e-scooters or taxis, requiring users to manage multiple payment methods (Västtrafik, n.d). This fragmentation discourages people from using multimodal travel options, reducing the effectiveness of MaaS (Business Region Göteborg, 2022). Research indicates that introducing bundled MaaS subscriptions such as public transport bundles with included e-scooter unlocks or discounted taxi fares. This could encourage greater adoption of both public transport and shared mobility services (Arnestad, 2023).

Another challenge is data-sharing limitations. A fully functional MaaS system relies on real-time data access across multiple transport modes, allowing for accurate trip planning and seamless multimodal journeys. However, many mobility providers remain hesitant to share data due to concerns over competition and business confidentiality (Jittrapirom, et al., 2017). Establishing standardized agreements for data exchange remains a critical challenge in MaaS implementation (International Transport Forum, 2023)

2.6.2 Future Strategies for MaaS and Micro-Mobility in Gothenburg

To overcome these challenges and maximize the potential of MaaS, several strategic actions should be considered. First, MaaS bundles must be tailored to user preferences to increase transit ridership. Research shows that offering combined ticketing options such as public transport passes that include shared micro-mobility credits or discounted first-mile/last-mile connections can significantly boost multimodal travel adoption (Kythreotis, 2024)

Second, investment in digital payment and booking systems is necessary to support the expansion of MaaS. A digital platform that connects multiple transport modes, enables real-time journey planning, and allows frictionless payments would greatly enhance the user experience and encourage widespread MaaS adoption (International Transport Forum, 2023)

Finally, pilot programs and user trials should be conducted to assess which MaaS bundles are most effective in increasing public transport ridership. By analyzing user preferences and real-world travel data, policymakers and transport authorities can refine pricing models to best suit Gothenburg's transport landscape (Sochor, et al., 2017)

3 Method

This chapter describes the methodology used in this master thesis. After building a theoretical foundation, a stated preference survey was developed to gather insights into user preferences and their willingness to adopt MaaS bundles integrating public transport with shared micro-mobility services such as e-scooters. The survey focused on residents, particularly students, in Gothenburg and its surrounding municipalities within the Västtrafik network, ensuring representation across different demographic groups and travel habits.

The collected survey data forms the basis for estimating potential adoption rates of various MaaS pricing models. The analysis, conducted using statistical and computational modeling techniques in Python, examines how different pricing structures such as integrated ticketing and bundled subscriptions impact mode choice and the likelihood of reducing private car use.

To complement the survey findings, an empirical case study within the Gothenburg area assesses the practical feasibility of MaaS adoption. This includes examining how existing shared mobility services interact with public transport and identifying key challenges to seamless integration. Insights from both the survey and case study contribute to the final analysis, comparing different MaaS scenarios to evaluate their effectiveness in encouraging sustainable urban mobility.

The methodological framework and key steps are summarized in Figure 4.1.

Figure 4. 1: An outline of the methodological framework

~~2.7~~3.1 Study Area

This study focuses on Gothenburg and its suburban areas, particularly those located outside the city's tram and trunk bus network but within the express bus and commuter train network. Gothenburg, Sweden's second-largest city, has a population of 609,182, while the larger metropolitan area, known as Greater Gothenburg, has approximately 1,087,898 residents (Göteborgs Stad, 2025) The city serves as a major economic and transport hub on the west coast, with an extensive public transport system operated by Västtrafik, consisting of trams, buses, ferries, and commuter trains**.** To get an overview of the Västtrafik's network see Figure 2.

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Figure 4. 2: This map displays the majority of Västtrafik's network. The three different colours resemble the three different zones. (Västtrafik, 2025).

In the central parts of Gothenburg, the public transport network is well-developed, with trams and trunk buses providing frequent service. However, in suburban areas, public transport access is more limited. These areas rely on express buses and commuter trains to connect to the city center. A key challenge is that many residents in suburban municipalities live at a considerable distance from their nearest express bus or commuter train station. This lack of first- and last-mile connectivity increases travel time and often discourages the use of public transport, leading to a high dependency on private cars for commuting.

To reduce car dependency and improve multimodal travel efficiency, MaaS solutions integrating shared mobility services such as e-scooters, bike-sharing, and ride-hailing could play a central role in closing the first- and last-mile gap. By enabling seamless connections to express buses and commuter trains, these solutions have the potential to make public transport more accessible, attractive, and efficient for suburban residents. This, in turn, could reduce congestion, lower emissions, and improve urban mobility in the Gothenburg region. An overview of the e-scooters services in the study area is displayed in Figure 4.3, where zone A and B with the colors blue and purple are included in this study.

The study will analyze how MaaS integration with public transport can improve accessibility in these suburban areas by examining user preferences, pricing models, and travel behavior**.** The findings aim to support the development of sustainable urban mobility solutions, ultimately contributing to a more efficient and environmentally friendly transport system in Gothenburg.

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Figure 4. 3: This map displays the zones where Voi operates within the Gothenburg area. This coverage generally aligns with the service areas of other providers such as Tier, Ryde, and others (Voi, 2025).

~~3.1~~3.2 Västtrafik and the Evolution of Gothenburg's Transport System

Västtrafik is the regional public transport authority responsible for planning and operating public transportation in Gothenburg and the Västra Götaland region. The network consists of trams, buses, ferries, and regional trains, making it one of Sweden's most extensive public transport systems. Västtrafik's primary objective is to provide efficient and sustainable mobility solutions that reduce car dependency and enhance accessibility (Västtrafik, n.d). To promote public transport use, Västtrafik has implemented digital solutions such as the Västtrafik To Go app, which enables passengers to purchase and manage tickets via their smartphones. Additionally, the authority engages in several projects aimed at improving multimodal integration, including efforts to incorporate shared micro-mobility options into the public transport network.

~~3.1.1~~3.2.1 Integrating Shared Mobility: Västtrafik's MaaS Initiatives

Västtrafik has actively explored MaaS initiatives to enhance intermodal travel. One of the key efforts in this direction is the development of a digital map for combined journeys, which integrates shared mobility options with the public transport system. The initiative aims to provide passengers with real-time information on the availability of rental bikes, e-scooters, and other shared micro-mobility services near major transit hubs. By incorporating providers such as Voi, Bolt, Styr & Ställ, and Ryde, this digital tool enables users to easily locate shared micro-mobility options that can facilitate first- and last-mile connectivity (Västtrafik, n.d). This effort aligns with broader MaaS goals by making it easier for passengers to combine multiple modes of transport seamlessly.

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While the focus has primarily been on digital integration, Västtrafik has also been involved in pilot projects exploring the potential for shared micro-mobility hubs and improved multimodal infrastructure. One such initiative was the Lindholmen Integrated Mobility Arena (LIMA) project, which aimed to develop mobility hubs that combined public transport with car sharing and rental bicycles to create seamless multimodal travel options (Giöbel & Björk, 2023). These hubs were designed to facilitate a shift away from private car use by enhancing the connectivity between different modes of transport. While large-scale shared micro-mobility hubs or dedicated parking stations have yet to be implemented, these projects demonstrate Västtrafik's ongoing interest in improving accessibility and intermodal transport solutions (Giöbel & Björk, 2023).

Another key initiative within MaaS development, including big actors in the Swedish public transport system as Västtrafik, is the MaaS for Sustainable Cities project. This program acted as a support initiative under Drive Sweden that ran between 2021 and 2023. The project focused on three core areas: MaaS Framing, MaaS Sandpit, and MaaS Node, all aimed at fostering dialogue, innovation, and knowledge-sharing within public transport and MaaS (Arnestad, 2023). Through organized events, workshops, and collaborative discussions, the initiative sought to address systemic challenges in MaaS adoption. The challenges included the integration of shared mobility services with public transport, regulatory hurdles, and public-private cooperation. Additionally, the project played a key driver in shaping future MaaS strategies by contributing to broader industry discussions on the evolution of public transport into a more comprehensive mobility ecosystem (Arnestad, 2023).

Furthermore, Västtrafik has introduced on-demand public transport services, such as Buss on Demand, which has been implemented in Ulricehamn and Mark. This Demand-Responsive Transport (DRT) service is designed to improve public transport access in rural areas by adapting routes to real-time passenger demand. By reducing reliance on private vehicles, the service contributes to lowering CO_2 emissions and increasing public transport efficiency (Padam Mobility, 2024).

~~3.2~~3.3 Research Design

For this study, a survey-based approach was chosen to gather insights into travel behavior, preferences for Västtrafik ticketing options, and the potential impact of MaaS bundles on public transport usage. The survey was designed to explore key questions related to pricing models, user preferences, and the willingness to adopt integrated mobility solutions in Gothenburg.

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The survey was created using Office Forms, which allows for structured data collection and easy export for further analysis. It consisted of 27 questions, primarily multiple-choice, where respondents selected predefined options. The survey also included two sections focused on ticket add-on preferences, where respondents were presented with different offers and asked to choose between them. A total of eight offers were designed, four for monthly ticket add-ons and four for single ticket add-ons, each with different content and pricing. How these offers were structured will be discussed further in the following sections.

The survey consisted of four main sections:

Background information – Collected demographic details such as age, gender, and employment status, as well as general travel habits. It also examined respondents' current use of public transport, reliance on private cars, and familiarity with shared mobility services.

Preferences for monthly ticket add-ons – Explored interest in additional services that could be integrated into Västtrafik's monthly public transport passes, such as e-scooter credits, taxi discounts, or bike-sharing memberships.

Preferences for single ticket add-ons – Presented different MaaS offers with varying features and prices, allowing respondents to compare and select the most attractive option.

Additional information – Gathered further insights into factors influencing travel choices, barriers to adopting MaaS solutions, and potential improvements that could make public transport more attractive.

Since students represent an important user group for MaaS, the survey was primarily distributed through university networks, including Chalmers University and other institutions in Gothenburg. To reach a broader audience, it was also shared via social media platforms such as Facebook and Instagram, targeting residents in both Gothenburg and suburban areas within the Västtrafik network.

~~3.2.1~~3.3.1 Attributes

The survey aimed to assess how different MaaS ticketing models and e-scooter add-ons influence travel behavior and the adoption of public transport. Respondents were presented with various ticketing options, including monthly ticket add-ons and single ticket add-ons, each integrating shared mobility services such as e-scooters. The offers regarding the single ticket were included in Block 1 and the ones regarding the monthly ticket were included in Block 2. The objective was to understand which offers were most attractive to different user groups, particularly students and commuters within Gothenburg and its surrounding suburbs.

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When choosing between different MaaS bundles, respondents considered specific attributes related to e-scooter services, namely:

- Free ride time – The number of minutes an e-scooter could be used at no extra cost.
- Free unlocks – Whether the offer included a waived unlock fee for e-scooter trips.
- Price – The total cost of the offer, which included the price of either a single public transport ticket or a period ticket, depending on the type of bundle.

The choices are summarized in Table 4.1.

These attributes were carefully selected to reflect relevant decision-making factors for travelers when considering whether to integrate shared mobility into their journeys. Instead of assessing the impact of weather conditions, as done in previous studies, this survey focused on pricing structures and service integration, ensuring relevance for both frequent travelers and occasional users.

A total of eight different MaaS offers were designed, four for monthly ticket add-ons and four for single ticket add-ons. Each offer varied in terms of included e-scooter benefits and pricing, allowing respondents to compare and choose the most appealing option. The results from this section provide insights into user preferences for integrated mobility services and help determine which pricing models could increase public transport ridership and reduce car dependency in both central and suburban areas of Gothenburg.

Table 4. 1: The attributes for the two blocks.

Block 1 (Single ticket)	Free time	(0, 5, 10, 15) min
	Free unlock	(0, 1, 2, 3) unlocks
	Price	(50, 67, 85) Sek

Block 2 (Period ticket)	Free time	(0, 60, 80, 100) min
	Free unlock	(0, 10, 15, 20) unlocks
	Price	(1050, 1130, 1210) Sek

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~~3.2.2~~3.3.2 Ngene Results and Offer Creation

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To systematically design the MaaS bundles presented in the survey, Ngene software was used to generate structured and balanced groups. Ngene is widely used for designing stated preference experiments, particularly for transport studies, as it allows for the estimation of key parameters with minimal correlation between attributes. By utilizing orthogonal designs, Ngene ensures that the different levels of each attribute (such as price, free ride time, and free unlocks) are independently varied, allowing respondents to evaluate trade-offs between different options without bias.

For this study, Ngene was used to generate groups that balanced attribute levels, ensuring that each offer was systematically designed to test user preferences. The total number of possible combinations of pricing models, free ride time, and free unlocks was too large to present to a single respondent in a reasonable survey length. To address this, a fractional factorial design was applied to reduce the number of groups while still capturing key differences between alternatives.

From this design, eight distinct groups were generated, four for monthly ticket add-ons and four for single ticket add-ons, see Table 4.2 for a display of the different groups. These groups were structured to test how different levels of free ride time and free unlocks influenced respondents' willingness to purchase MaaS-integrated Västtrafik tickets. Since it would be impractical for each participant to evaluate all eight options at once, the options were divided into two separate blocks to ensure a clear structure for the respondents.

Furthermore, it is important to emphasize that the prices and offers presented in the survey do not necessarily reflect actual market conditions. The pricing is intentionally fictional, and the purpose of the survey is not to evaluate the realism of the prices themselves. Instead, the focus lies on the relative differences between the offers and the attractiveness of their contents. The respondents' choices and preferences will serve as input data in the stated preference model.

This model will then be used to analyze what elements travelers value most when considering MaaS bundles. Ultimately, the results of this analysis will form the basis for developing realistic and user-friendly ticket solutions in the future, tailored to the needs and preferences of travelers in Gothenburg.

Some minor adjustments were made to the original offers generated by Ngene to ensure that the pricing was aligned with the content of each offer. Specifically, adjustments were made to avoid situations where an offer with fewer benefits had a higher price than one with more benefits. This was done to make the differences between the offers more logical and coherent from a user perspective. For example, pricing levels were adjusted to better reflect the value of the included elements, and the distribution of benefits within the offers was fine-tuned to ensure that respondents were not presented with offers where they would receive less for a higher cost. These modifications were necessary to allow respondents to make meaningful and reasonable choices based on plausible and internally consistent ticketing options.

Table 4. 2: The table shows the eight options generated by the software Ngene without any modifications.

		Minutes	Unlocks	Sek
Block 1	**Option 1**	10	2	67
		10	∞	80
		∞	1	80
	Option 2	20	3	85
		15	∞	80
		∞	2	90
	Option 3	5	1	50
		10	∞	60
		∞	1	70
	Option 4	20	2	85
		15	∞	70
		∞	2	90
Block 2	**Option 1**	100	10	1130
		100	∞	1210
		∞	20	1150
	Option 2	60	10	1050
		60	∞	1130
		∞	20	1200
	Option 3	80	20	1000
		100	∞	1180
		∞	15	1250
	Option 4	60	15	1130
		80	∞	1210
		∞	30	1150

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This approach allowed respondents to compare realistic ticketing options without the survey becoming overwhelming. By structuring the groups in a balanced way, the survey provides a reliable basis for analyzing how different MaaS bundles might influence travel behavior in Gothenburg. The results will help identify which combinations of ticketing options and shared mobility services are most attractive to users and how they might contribute to increasing public transport usage while reducing reliance on private cars.

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~~3.2.3~~3.3.3 Final Design of the Groups

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In the survey, the different ticketing options were visually presented in tables to help respondents compare and select the most attractive offer. Each table represented a choice set where respondents had to pick their preferred option. The survey initially included eight different groups, with four designed for monthly ticket add-ons and four for single ticket add-ons. However, to avoid overwhelming the respondents and to ensure that the survey remained manageable, the number of groups was reduced to six in total, resulting in three groups for each block. The two tables shown in Figure 4.4 and Figure 4.5 are two examples, one from each block.

Each group contained three alternatives Option A, Option B, and Option C, which varied in terms of free ride time (minutes), free unlocks, and total price in SEK. This structured layout allowed respondents to evaluate trade-offs between different benefit combinations and costs, making it easier to assess which offer was most appealing.

To ensure clarity, a consistent color scheme was used, with a green background for option labels and a blue header for attribute categories. The use of bold text for the option names helped highlight the choices, making the table easier to navigate. Since respondents naturally read from left to right, the layout was structured accordingly to facilitate smooth comparisons.

The tables were presented in English, as the survey targeted students which include exchange students. This ensured wider accessibility and ease of understanding. By structuring the scenarios in this way, the survey provided a clear and intuitive way for respondents to evaluate different MaaS bundles, helping to gather valuable insights on which pricing models and shared mobility features are most attractive.

	Free time (min)	Free unlocks	Price (SEK)
Option A:	10	1	70
Option B:	10	Unlimited	90
Option C:	Unlimited	1	90

Figure 4. 4: This figure shows one example of a group of offers from block 1.

	Free time (min)	Free unlocks	Price (SEK)
Option A:	100	10	1130
Option B:	100	Unlimited	1210
Option C:	Unlimited	20	1250

Figure 4. 5: This figure shows one example of a group of offers from Block 2.

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~~3.3~~3.4 Model Specification and Estimation

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In this study, a discrete choice model was used to analyze the preferences of respondents regarding the different MaaS bundles presented in the survey. Specifically, a Multinomial Logit (MNL) model was used due to its suitability for modeling discrete choices among mutually exclusive alternatives. The model is based on random utility theory, which assumes that individuals make rational decisions and select the alternative that provides them with the highest utility.

The choice situation in the survey was simplified to focus on a single decision-making process: selecting one of the presented MaaS bundle offers within a choice set. Each respondent was presented with two blocks, one for single ticket add-ons and one for monthly ticket add-ons. Each block contained three groups, and within each group, three alternatives were presented.

~~3.3.1~~3.4.1 Utility Specification

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The utility associated with each alternative *j* was modeled as a linear function of its attributes. In this case, the attributes included:

- **Price**: The total cost of the MaaS bundle, including the Västtrafik ticket and the shared e-scooter add-on.
- **Free ride time**: The number of free minutes for shared e-scooter usage included in the offer.
- **Free unlocks**: The number of free unlocks for shared e-scooter trips included in the offer.
-

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The utility function for individual *n* choosing alternative *j* is defined as below

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$$U_j = \beta_{Cost} * price_j + \beta_{Time} * time_j + \beta_{lock} * ulock_j + \beta_{U\_lock} * I_{free\_lock,j} + \beta_{U_{time},j} * I_{free\_time,j} \quad (j = 1,2,3) \quad (4.1)$$

where:

$$I_{free\_lock,j} = \begin{cases} 1, & j = 2 \\ 0, & j \neq 2 \end{cases} \qquad I_{free\_time,j} = \begin{cases} 1, & j = 3 \\ 0, & j \neq 3 \end{cases}$$

- U_j: Marginal utility of free ride time, capturing how additional free minutes of shared e-scooter use affects the attractiveness of a bundle.
- β_{Lock}: Marginal utility of free unlocks, measuring the value respondents place on not paying unlock fees.
- β_{Time}: Marginal utility of free ride time, measuring the value respondents place on not paying for ride time.
- β_{Cost}: Disutility of cost, reflecting the negative impact of higher prices on utility.
- β_{U_lock}: Additional utility associated with having unlimited unlocks, modeled as a binary effect.
- β_{U_time}: Additional utility associated with having unlimited ride time, modeled as a binary effect.

These parameters were estimated using Biogeme, a widely adopted tool for discrete choice modeling. The variables for time, unlocks, and price were coded based on each alternative. Binary indicators were manually assigned to reflect the presence of unlimited features in each bundle. This structure captures both quantitative differences in the number of unlocks or minutes and qualitative distinctions introduced by unlimited-use features.

~~3.3.2~~3.4.2 Choice Probability

The probability that respondent n chooses alternative j from the choice set C_n is determined by the standard logit formula:

$$P_{in} = \frac{e^{U_{in}}}{\sum_{j \in C_n} e^{U_{jn}}} \quad (4.2)$$

where:

- P_{in} is the probability that respondent n chooses alternative n.
- U_{jn} is the utility of all alternatives j in the choice set C_n, meaning all the available options the respondent can choose from in that specific choice situation.
- C_n is the complete set of alternatives available to respondent n in a specific choice situation.

This probability function assumes that the error terms ε_{in} follow a Gumbel distribution and are independently and identically distributed across alternatives and individuals.

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~~3.3.3~~3.4.3 Model Estimation

The model parameters $\beta_{Lock}, \beta_{Cost}, \beta_{Time}, \beta_{U\_lock}, \beta_{U\_time}$: were estimated using the Maximum Likelihood Estimation (MLE) method. The likelihood function for all respondents is defined as:

$$L(\beta) = \prod_{n=1}^{N} P(c_n|C_n) \quad (4.5)$$

where:

- $L(\beta)$ measures how well your model with a specific set of parameter values, explains the choices that people made in the survey.
- N is the total number of respondents.
- c_n is the chosen alternative by respondent n.

The survey responses were processed in Excel and subsequently imported into Python for analysis. The estimation of the model parameters was performed using the Biogeme software package, which is widely used in discrete choice modeling due to its efficiency and flexibility in handling MNL models.

The estimated parameters will provide insights into how sensitive respondents are to changes in the price of the MaaS bundles, as well as the inclusion of free ride time and free unlocks. The results from this analysis will serve as a foundation for identifying which combinations of attributes are most attractive to users. This will contribute to the development of MaaS ticket solutions that promote increased public transport usage and a reduction in private car dependency in Gothenburg.

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4 Results

This chapter presents the findings of the study in two main parts. First, the results from the online survey are summarized, offering insights into respondents' current travel behaviors, attitudes toward public transport and shared micro-mobility, and preferences for various MaaS bundle options. This includes both quantitative data and qualitative reflections from open-ended responses. The second part presents the outcomes of two MNL models used to analyze stated preference data for single and monthly ticket bundles. These results reveal how different ticket attributes such as price, free unlocks, and ride time influence the likelihood of bundle selection. Together, the findings provide a data-driven foundation for evaluating how MaaS offerings can be designed to increase public transport ridership within the Västtrafik system.

4.1 Survey

The online survey received a total of 152 responses, targeting individuals living in or around the Gothenburg region, particularly focusing on students, commuters, and residents in suburban municipalities within the Västtrafik network. The responses provide a rich overview of current travel behaviors, attitudes toward public transport and shared micro-mobility, and stated preferences for MaaS bundles.

4.1.1 Demographics & Background information

The target group for the survey was students. This is shown by the fact that 80% of the participants were students, some of whom also had part-time jobs alongside their studies. In terms of residence, 90% lived in Gothenburg, while 10% lived in nearby municipalities such as Mölndal, Partille, Ale, and Lerum. Although the respondents were spread across Gothenburg, a large share around 45% lived in different parts of the city centre.

This is also reflected in their travel habits, see the distribution in Figure 5.1. 65% travelled less than five kilometres, which makes sense considering that most of the respondents were students at Chalmers University of Technology and the University of Gothenburg.

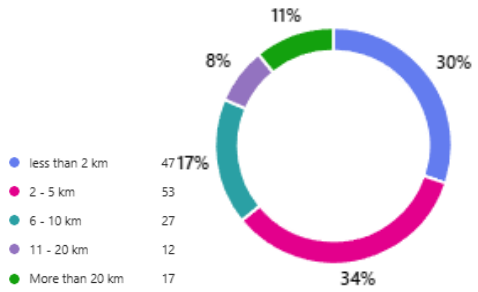

Figure 5. 1: Distribution of respondents' typical daily travel distances presented as both percentages and number of individuals.

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The most common travel modes were public transport (39%) and walking (30%). Taxi services and rental bikes like Styr & Ställ were the least used. About 9% used e-scooters as their regular way of getting around, the distribution of how the respondents travel is visualized in Figure 5.2. Public transport was used daily by 43%, and at least a few times per month by 57%. Only 13% said they rarely or never used it.

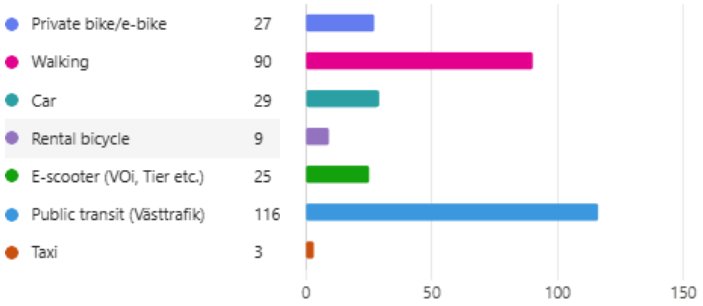

Figure 5. 2: Primary modes of everyday travel among respondents. The distribution is presented in number of individuals.

When it comes to Västtrafik tickets, 88% used either a monthly or a single ticket. 7% said they didn't use Västtrafik regularly. Regarding combining multimodal travelling, 64% said they never combined public transport with e-scooter trips, this is displayed as the green part of the circle in Figure 5.3. This is also visible in how much they spend as 65% said they spend zero SEK per month on e-scooter services.

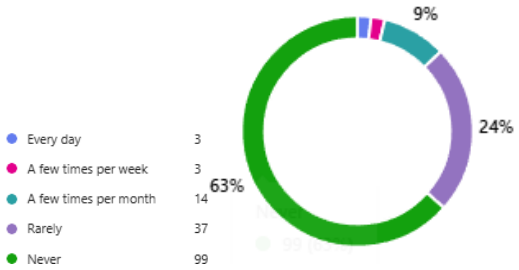

Figure 5. 3: Frequency of combining public transport with e-scooter services among respondents. The distribution is presented in both percentages and number of individuals.

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4.1.2 Preferences for Monthly Tickets Add-ons

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When assessing the proposed monthly MaaS bundles, respondents consistently favored two distinct types of offers: one that featured a lower price with limited ride time and unlocks, and another that offered unlimited free unlocks. These two options demonstrated comparable popularity, with each emerging as the most selected choice in one scenario and receiving equal preference in the third. This indicates a balance in user priorities between affordability and convenience, as illustrated in Figure 5.4.

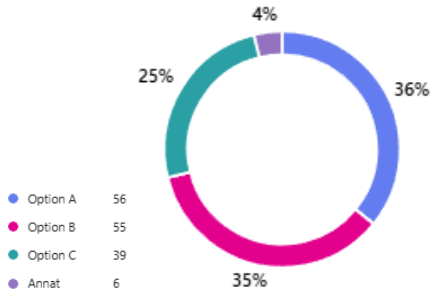

Figure 5. 4: Respondents' preferences for monthly ticket add-ons in one of the scenarios, presented as both percentages and number of individuals.

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A clear pattern which emerged was that free unlocks were seen as more attractive than free ride minutes. This summary provides a general picture, but the preferences and trade-offs will be examined in more detail in the modelling section. Respondents were also asked whether an e-scooter benefit would make them more likely to purchase a monthly public transport ticket. 35% answered yes, while 26% were unsure and responded with "maybe."

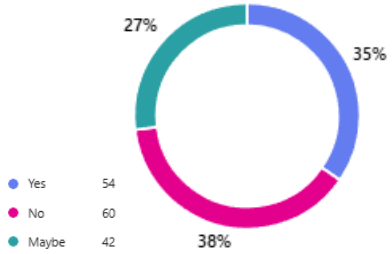

Figure 5. 5:Illustrates whether respondents would be more likely to purchase a Västtrafik ticket if it included e-scooter services. The distribution is presented in both percentages and absolute numbers of respondents.

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4.1.3 Preferences for Single Tickets Add-ons

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Price sensitivity was clearly observed in the scenarios involving single tickets. In two out of three cases, respondents chose the cheapest option. The alternative that included free minutes was the most popular in one scenario while the option including free unlocks was of low interest for the single ticket add-ons.

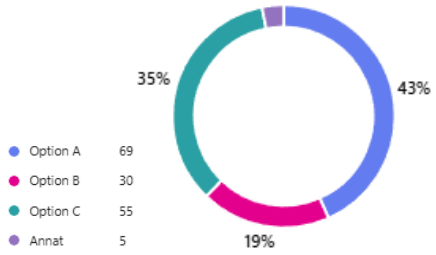

Figure 5. 6: Respondents' preferences for monthly ticket add-ons in one of the scenarios, presented as both percentages and number of individuals.

When asked whether access to e-scooters would make them more likely to buy a single public transport ticket, 41% responded positively. This indicates that price and added value play a key role even for occasional users.

Figure 5.6 shows the respondents' likelihood of purchasing a single ticket if it includes access to e-scooter services. In contrast to the monthly ticket question, this item excluded the "Maybe" response option in order to observe whether those who previously selected "Maybe" would lean toward either "Yes" or "No" in this context. Since the number of respondents selecting "No" increased compared to those selecting "Yes," it can be inferred that a significant portion of those who previously answered "Maybe" likely leaned toward "No" or alternatively, that integrated e-scooter services are simply less appealing when bundled with single tickets compared to monthly tickets.

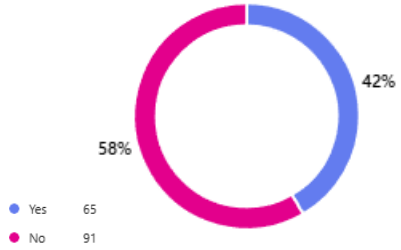

Figure 5. 7: Illustrates whether respondents would be more likely to purchase a Västtrafik ticket if it included e-scooter services. The distribution is presented in both percentages and absolute numbers of respondents.

These results suggest that even travelers who don't commute daily are open to combining different transport modes, provided the offer is perceived as cost-effective and convenient.

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4.1.4 Additional insights of MaaS Integration

If shared e-scooter access was integrated into Västtrafik's ticket system, 27% of respondents stated that they would use public transport more often. Meanwhile, 41% said it would not influence their travel behavior, and 32% were uncertain about whether it would have any effect.

Regarding preferred shared micro-mobility options, 30% expressed interest in having access to both e-scooters and rental bikes, indicating a desire for flexibility. Interestingly, 29% preferred rental bikes over e-scooters, even though bike-sharing services were among the least commonly used modes in this group. In contrast, 41% were only interested in e-scooter services.

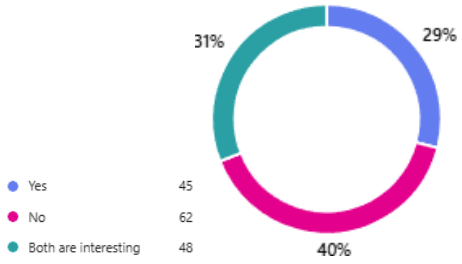

Figure 5. 8:Distribution of respondents' preferences between e-scooter services and rental bikes for integration with public transport.

The age distribution among respondents was heavily skewed toward younger individuals. 96% were between 18 and 34 years old, confirming that this demographic is central when designing future MaaS solutions.

The survey also included an open-ended question where respondents could share their thoughts on improving the integration between public transport and e-scooters. Several recurring themes and suggestions emerged from these responses.

One of the most frequently mentioned improvements was the placement of designated parking zones for e-scooters near public transport hubs such as bus stops, tram stations, and train stations. Easy access to shared scooters at transfer points was seen as key to enabling smooth, multimodal journeys. As one respondent emphasized, *"Maybe try to combine the bus stops with a parking space for the e-scooters or rental bikes to make it more accessible for the passengers."*

Another common theme was pricing. Many respondents felt that the current e-scooter services are too expensive relative to the value they offer. Several stated the need for lower or more integrated prices, ideally without increasing the cost of existing public transport tickets. One participant noted, *"I really like the suggestion, but I clicked 'not interested' in all of the boxes because in my opinion all the prices were too high."* Others proposed more flexibility, such as

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"the option to also buy without scooter" or offering *"free scooter rides as compensation for public transport delays."*

Ease of use was also emphasized. Suggestions included better integration of public transport tickets and scooter access within a single app, as well as the possibility of using redeemable codes tied to a Västtrafik ticket. *"Make it simple to use. Ideally all in the same app... If you buy a ticket and get a code to redeem in any of the e-scooter apps that would be nice,"* one respondent suggested.

Several respondents raised concerns about safety and sustainability. Issues such as reckless riding, scooters blocking sidewalks, and their environmental footprint were highlighted. *"Make scooters a more sustainable and safer mode of transport. As it is today, I don't use them at all because of this,"* one participant wrote. Others proposed a shift in focus toward rental bikes like Styr & Ställ, which were seen as more sustainable and healthier alternatives: *"Sway focus from e-scooters to rental bikes... since they are an environmentally and health-wise friendlier option."*

A few respondents also pointed out the need to maintain order in public spaces. They suggested stricter parking management to reduce visual clutter and avoid blocked walkways: *"There will be a lot of scooters and people walk less... there will be chaos of scooters laying in piles."*

Other notable suggestions included integrated route planners combining scooter and public transport navigation, expanded service areas, especially in suburban locations and branding collaborations to build trust and visibility: *"It would be a plus if Voi, Tier and the like had marked text on their scooters like 'Västtrafik,' so users see that it's in cooperation."*

Finally, a small number of respondents expressed skepticism toward integrating e-scooters at all. Instead, they called for a greater focus on improving the affordability and reliability of public transport: *"Just make the damn public transport cheaper through better variety of tickets so I wouldn't need to VOI."*

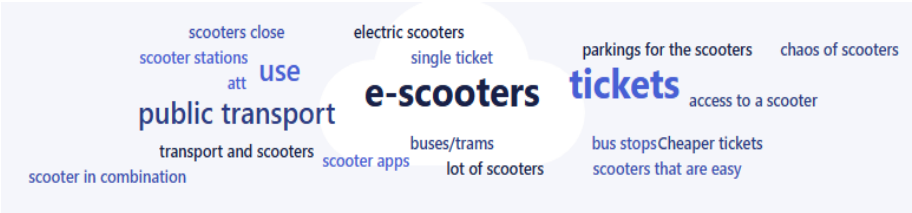

Figure 5. 9: Highlights the most frequently occurring keywords from the open-ended survey responses.

4.2 Model Results

This section presents the results of the MNL models used to evaluate respondents' preferences for MaaS bundles that integrate public transport with e-scooter services. Two separate models were estimated: one for single ticket bundles and one for monthly ticket bundles, based on 139 respondents contributing a total of 417 observations per model.

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Although the survey initially received 156 responses, only 139 were retained in the final sample. This exclusion was due to early responses being based on an outdated version of the stated preference design. Removing these responses ensured all participants faced consistent and comparable choice sets.

4.2.1 Single Ticket Model

In the single ticket model, each respondent evaluated three choice sets, each with three bundled options differing in price, included ride time, and number of free unlocks. The estimation results are shown in Table 5.1.

Table 5. 1: MNL Estimation Results - Single Ticket Bundles

Parameter	***Estimate (β)***	***Std. Error***	***t-test***
Price	-0.060 ***	0.022	-2.745
Free Unlocks	0.234**	0.181	1.293
Free Minutes	0.080***	0.040	2.030
Unlimited Unlocks	0.259*	0.670	0.386
Unlimited Minutes	1.510****	0.387	3.903

*****p<0.001 ***p<0.1 **p<0.5 *p<1*

The price coefficient is negative and statistically significant ($p < 0.01$), indicating that higher costs reduce the likelihood of a ticket bundle being chosen. This aligns with economic theory and confirms that price remains a decisive factor in users' decision-making.

The coefficient for unlimited minutes is large, positive, and highly significant ($\beta = 1.510$, $p < 0.001$), suggesting that this feature is particularly valued by respondents. The magnitude of the coefficient indicates that access to unlimited e-scooter ride time has a substantially greater impact on utility than minor gains such as a few extra free minutes or unlocks.

Free minutes show a smaller but still statistically significant effect ($\beta = 0.080$, $p < 0.1$). This implies that respondents appreciate added ride time, although its influence is relatively modest compared to unlimited access.

Free unlocks ($\beta = 0.234$) and unlimited unlocks ($\beta = 0.259$) both show positive effects, but neither coefficient is statistically significant. This may suggest that while users prefer bundles that remove unlock fees, these features do not consistently drive choice to the same extent as ride time or price.

Figure 5.10 presents a visual comparison of the marginal utilities for each attribute, highlighting the dominant role of unlimited ride time in shaping respondents' preferences for single ticket bundles.

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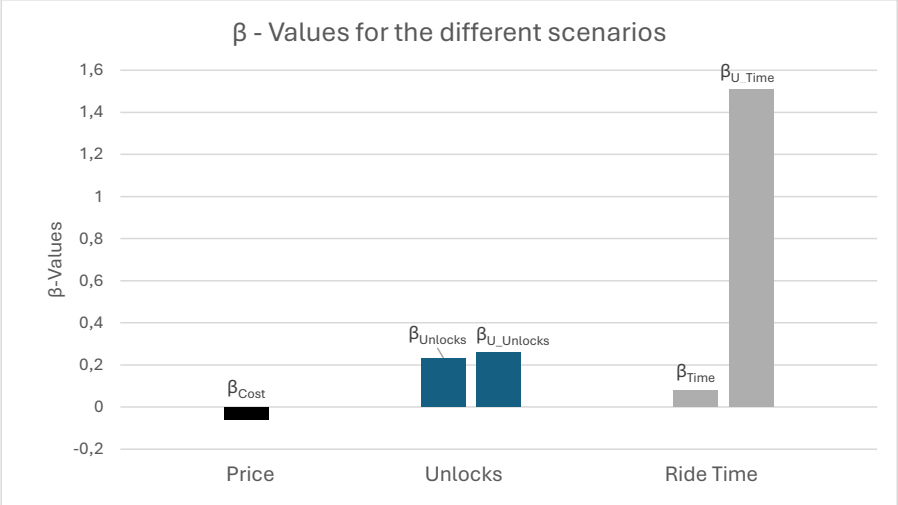

Figure 5. 10: Marginal utility of attributes - Single Ticket Bundles

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4.2.2 Monthly Ticket Model

For the monthly ticket model, the same respondents evaluated bundles designed for longer-term use. Again, each bundle varied in price, free unlocks, and free ride time. The estimation results are presented in Table 5.2.

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Table 5. 2: MNL Estimation Results - Monthly Ticket Bundles

Parameter	***Estimate (β)***	***Robust Std. Error***	***t-test***
Price	-0.004**	0.004	-1.163
Free Unlocks	0.024**	0.024	1.012
Free Minutes	0.000*	0.008	0.000
Unlimited Unlocks	0.885***	0.317	2.803
Unlimited Minutes	0.000*	0.910	0.000

*****p<0.001 ***p<0.1 **p<0.5 *p<1*

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The strongest effect is observed for unlimited unlocks, with a large and statistically significant positive coefficient ($\beta = 0.885$, $p < 0.001$). This indicates that respondents find considerable value in avoiding per-trip unlock fees when making frequent trips, as is common with monthly usage patterns.

Free unlocks also have a positive coefficient (β = 0.024), but the effect is modest and only weakly significant (p < 0.5). This suggests that while users appreciate avoiding unlock fees, the impact is less pronounced compared to the unlimited version of the feature.

Both free minutes and unlimited minutes have coefficients close to zero and t-values of 0.000, indicating no statistically significant influence on bundle choice. This reinforces the finding that the length of ride time does not play a central role in shaping preferences among monthly users, who may primarily use e-scooters for short, first-mile/last-mile travel.

The price coefficient is negative as expected (β = -0.004), but not statistically significant (p > 0.1). This may indicate that users evaluating monthly bundles are more tolerant of price variations, expecting broader value and convenience as part of a longer-term commitment.

Figure 5.11 presents a visual summary of the estimated marginal utilities across all bundle attributes.

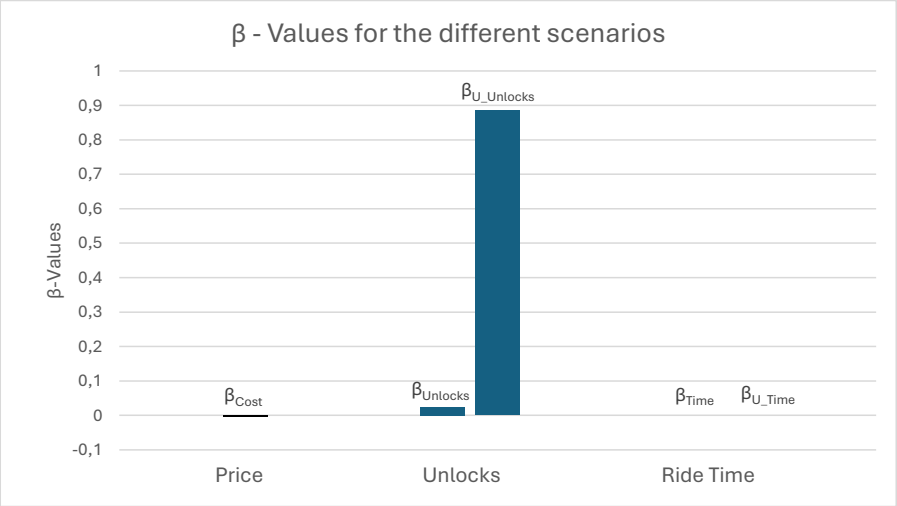

Figure 5. 11: Marginal utility of attributes - Monthly Ticket Bundles

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4.2.3 Summary of Key Findings

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The results of both MNL models reveal notable differences in how respondents evaluate bundled ticket options, depending on the type of ticket. In the single ticket model, respondents demonstrated clear price sensitivity and a strong preference for bundles that included unlimited ride time. This suggests that users purchasing single-use tickets value flexibility and the ability to ride without time constraints.

In contrast, the monthly ticket model produced a more limited result. Only the number of free unlocks showed a statistically significant impact, and the effect size was relatively small. This

implies that long-term users may be less influenced by extended ride time or minor cost differences and more focused on predictability and reducing recurring per-trip fees.

In both models, free ride time as a discrete quantity failed to reach statistical significance, suggesting that users regardless of ticket type do not place strong value on a limited number of included minutes. Instead, utility increases are more clearly associated with broader features such as unlimited use or elimination of small but repeated costs.

These insights form the empirical foundation for the discussion in the following chapter, where the implications for MaaS product design and transport policy will be explored in detail.

5 Discussion

This chapter interprets the findings from both the stated preference survey and the discrete choice models, linking them to the background context, literature, and theories discussed earlier. Also, reflections on sample limitations and methodological considerations are provided. The discussion lays the foundation for recommendations that follow in the next chapter.

~~6.1~~5.1 Interpretation of Model Results

The MNL models revealed important patterns regarding how respondents evaluate MaaS bundles that integrate public transport with shared micro-mobility services. The single ticket and monthly ticket models produced results that were consistent in some respects but also displayed critical differences in user behavior depending on the temporal nature of the purchase.

In the single ticket context, the findings showed a statistically significant sensitivity to price. The price coefficient was negative (β = -0.060, p = 0.001), confirming that as the cost of the bundled offer increased, the likelihood of it being selected decreased. This behavior aligns well with fundamental economic theory and previous findings in the MaaS literature (Sochor et al., 2018), where short-term users typically demonstrate high sensitivity to marginal cost changes.

More notably, the attribute with the strongest impact was unlimited minutes (β = 1.510, p < 0.001), highlighting that users highly value flexibility and the removal of usage restrictions in short-term contexts. Free ride time (β = 0.080, p = 0.043) also had a significant positive effect, although more modest. This suggests that when choosing a bundle for single use, users place more emphasis on how much time they have access to the service than on minor per-use fees.

Interestingly, the attributes related to unlocks free unlocks (β = 0.234, p = 0.196) and unlimited unlocks (β = 0.259, p = 0.700) were not statistically significant. This contrasts with prior expectations and earlier literature, where unlock fees were emphasized as psychologically salient (Smith et al., 2019). It is possible that for short, one-time trips, users focus more on having uninterrupted ride time than on avoiding unlock costs.

In the monthly ticket model, user behavior appeared different. The price coefficient was statistically insignificant (β = -0.005, p = 0.858), indicating that users choosing monthly bundles are less price sensitive. Free ride time (β = 0.046, p = 0.436) and unlimited minutes (β = 0.035, p = 0.938) were also insignificant, suggesting that added value in the form of extra minutes does not substantially influence monthly purchase decisions.

The only statistically significant attribute was free unlocks (β = 0.155, p = 0.009), although the magnitude was small. This indicates that removing recurring minor charges, such as unlock fees, may slightly increase the appeal of long-term bundles. However, the limited significance and smaller coefficients across the board imply that monthly users are likely to consider broader factors, such as reliability and integration, rather than attribute-specific differences.

In summary, the modeling results suggest a hierarchy of preferences that varies depending on the ticket type. For single tickets, users respond strongly to time flexibility, particularly

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unlimited ride time, and show moderate sensitivity to cost. For monthly users, per-use attributes matter less, and the impact of free unlocks is present but weaker. The overall results support a differentiated design strategy for MaaS bundles depending on short- or long-term usage contexts.

~~6.2~~5.2 Connections to Survey Insights

The survey responses collected alongside the stated preference experiment reinforce and contextualize the discrete choice modeling results. Several recurring themes emerged particularly around cost perception, user expectations, and attitudes toward shared micro-mobility that align with statistical findings.

First, many respondents expressed frustration with per-use costs, especially unlock fees. Although these did not show statistical significance in the single ticket model, user comments such as “the unlock fees are what stops me from using scooters” suggest that these charges act as a psychological deterrent. In contrast, the monthly model showed that free unlocks had a small but statistically significant effect, mirroring this sentiment and supporting the idea that predictable, bundled pricing may ease this friction.

Second, the modeling revealed that unlimited ride time was the most influential factor for single ticket users. This finding is supported by qualitative survey responses that highlighted a desire for flexibility and uninterrupted access, especially among users combining scooters with public transport for short, spontaneous trips. This supports prior literature (Sochor, et al., 2018) emphasizing that perceived ease and availability often outweigh marginal cost differences in short-term mobility decisions.

Third, the lack of price sensitivity in the monthly model corresponds with survey feedback indicating that long-term users prioritize convenience, integration, and simplicity over cost-saving. Many respondents expressed a strong preference for accessing all mobility services through a single app, suggesting that service predictability and ease of use may be more influential than incremental financial differences in long-term bundle choices. This finding is in line with research by (Smith, et al., 2019) who noted that habitual travelers value frictionless, dependable access over price optimization.

Furthermore, some respondents raised concerns about the actual sustainability impact of e-scooters, questioning whether these services genuinely reduce car dependency or merely displace walking. This skepticism is an important context for interpreting the relatively weak influence of ride time attributes across both models’ users may not perceive longer ride durations as beneficial if their use cases are mostly limited to short-distance. It also reflects broader academic concerns about the environmental trade-offs of shared micro-mobility (Peci & Ali, 2022).

Lastly, recurring themes around safety, urban clutter, and environmental impact suggest that broader perceptions of shared micro-mobility still affect MaaS acceptance. Although these concerns were not explicitly part of the choice models, they likely influence overall willingness to adopt bundled options and should be addressed in any future implementation strategy.

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~~6.3~~5.3 Methodological Reflections

Despite the robustness of the models, several methodological limitations must be acknowledged. First, the sample was primarily composed of younger individuals, particularly university students between the ages of 18 and 34. This limits the generalizability of the findings, as older commuters, families, or other demographic groups may have different mobility behaviors and priorities.

Second, the study relied on stated preference data, meaning that all choices were made in hypothetical scenarios. Although such methods are widely accepted and allow for controlled experimentation, hypothetical bias remains a concern. Actual choices involving real payments or commitments might differ, potentially affecting the external validity of the results.

Third, the model specification was limited to a MNL framework, which assumes preference homogeneity and the Independence of Irrelevant Alternatives. While this model offered flexibility and clear interpretation, it does not capture individual-level variation or account for potential correlation between alternatives. Future research could employ more flexible models, such as Mixed Logit or Latent Class models, to uncover deeper insights, especially if a larger and more diverse sample is available

~~6.4~~5.4 Implications for MaaS Development in Gothenburg

The results have several implications for the design of MaaS offerings in Gothenburg. For single ticket users, flexibility in the form of unlimited ride time is highly valued. Bundles that provide this feature are more likely to be chosen than those that simply reduce price.

Monthly users do not respond significantly to price or time limits but do value the elimination of per-trip unlock fees. This suggests that pricing strategies for long-term bundles should prioritize frictionless experience over cost-cutting.

Integration alone is not enough, users want simplicity, reliability, and trust. Addressing external issues like parking regulations, safety measures, and cross-provider coordination will be key to building user confidence.

Finally, the option to opt in or out of shared micro-mobility services within the bundle should be maintained. Given the mixed perceptions about e-scooters, customizable bundles can cater to individual preferences without alienating skeptical users.

In sum, the findings support a differentiated design approach where short-term bundles emphasize flexibility and long-term bundles prioritize convenience. This balance is essential to making MaaS both appealing and scalable in Gothenburg's evolving transport landscape.

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~~6.~~6 Conclusion and Recommendation

This study set out to explore how integrated MaaS bundles combining public transport and shared micro-mobility services could be designed to attract users, ultimately enhancinge sustainable travel behavior in Gothenburg. Through a combination of stated preference modeling and user surveys, the research investigated which ticket attributes are most valued and how pricing models could be structured to encourage a shift toward multimodal transport use.

The findings highlight that the integration of shared micro-mobility into public transport ticketing holds significant potential, but that success depends critically on addressing users' key priorities: maximizing time flexibility, removing per-use restrictions, and minimizing friction in usage. In the single ticket model, unlimited ride time emerged as the most influential attribute, followed by a moderate sensitivity to price and a weaker but still positive valuation of limited free minutes. In the monthly ticket model, the strongest effect was observed for unlimited unlocks, with a large and statistically significant coefficient, while free unlocks had only a weak impact, and ride time and price showed no significant effect.

This suggests that travelers prioritize flexibility and simplicity over insignificant cost details, especially when committing to a longer-term product. While price remains relevant in the context of one-time use, long-term adoption focuses more on seamless integration and removal of recurring friction points like unlock fees. Survey responses reinforced this, emphasizing the mental burden of unlock fees, the desire for one-app solutions, and concerns about safety and environmental impact.

Taken together, the results underline that an effective MaaS integration strategy must balance convenience, simplicity, and user autonomy. Bundles should reduce barriers to adoption without overcomplicating the experience, and they must present clear value propositions that resonate across diverse user segments.

~~7.1~~6.1 Recommendation: Proposed MaaS Bundles

This section presents two recommended MaaS bundle designs based on the survey results, discrete choice modeling, and previous MaaS literature. The goal is to improve first- and last-mile connectivity, reduce car dependency, and make public transport more appealing, especially to the target group, students.

The recommendations align with the success factors highlighted by Sochor, et al. (~~–~~2018), Smith, et al. (2019) and Jittrapirom, et al. (2017) affordability, integration, personalization, and ease of use. They also reflect user preferences revealed in the stated preference survey, where price, unlimited ride time, and elimination of unlock fees significantly increased the probability of choosing multimodal options.

Single Ticket Add-On Bundle

- Add 1 or 2 free e-scooter unlocks to a standard Västtrafik single ticket.

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- Include a short ride time, up to 10 minutes per unlock, to encourage quick trips to or from transit stops.
- Available as a voluntary "add-on" when purchasing a ticket through Västtrafik To Go.

This bundle responds directly to findings from the choice model, which showed a strong positive effect of time-based flexibility (β for unlimited minutes = 1.510) on utility and adoption likelihood. It also reflects user segments who indicated in the open responses that they "might try scooters if it's included" or "don't want to install multiple apps just to unlock once." These casual users often need a low-risk, low-effort introduction to shared micro-mobility.

The model also suggests that discounts alone are less motivating unless paired with value-enhancing features. This reinforces the importance of removing friction at the entry point, especially for short trips around city centers and hubs like Brunnsparken, Korsvägen, or Centralstationen.

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Monthly Pass shared Micro-Mobility Integration

- Add unlimited free unlocks and up to 60 free e-scooter minutes per month to a standard monthly transit pass.
- Minutes could be divided into smaller blocks (e.g., six 10-minute rides) to promote more frequent multimodal trips.
- Total cost should remain competitive with current pricing. Shared micro-mobility could be framed as a "bonus benefit" rather than a separate item, making the value more visible and psychologically appealing.

This recommendation is supported by the model result showing that unlimited unlocks ($\beta = 0.885$, $p < 0.001$) have the strongest impact on monthly bundle attractiveness. Free unlocks showed only a weak effect ($\beta = 0.024$), while ride time and price were statistically insignificant. These insights suggest that frequent users benefit most from frictionless, unrestricted access.

This aligns with literature showing that frequent users value predictability over complexity (Jittrapirom, et al., 2017). A commuter who can plan an entire month's travel without extra apps or calculations is more likely to stick with public transport.

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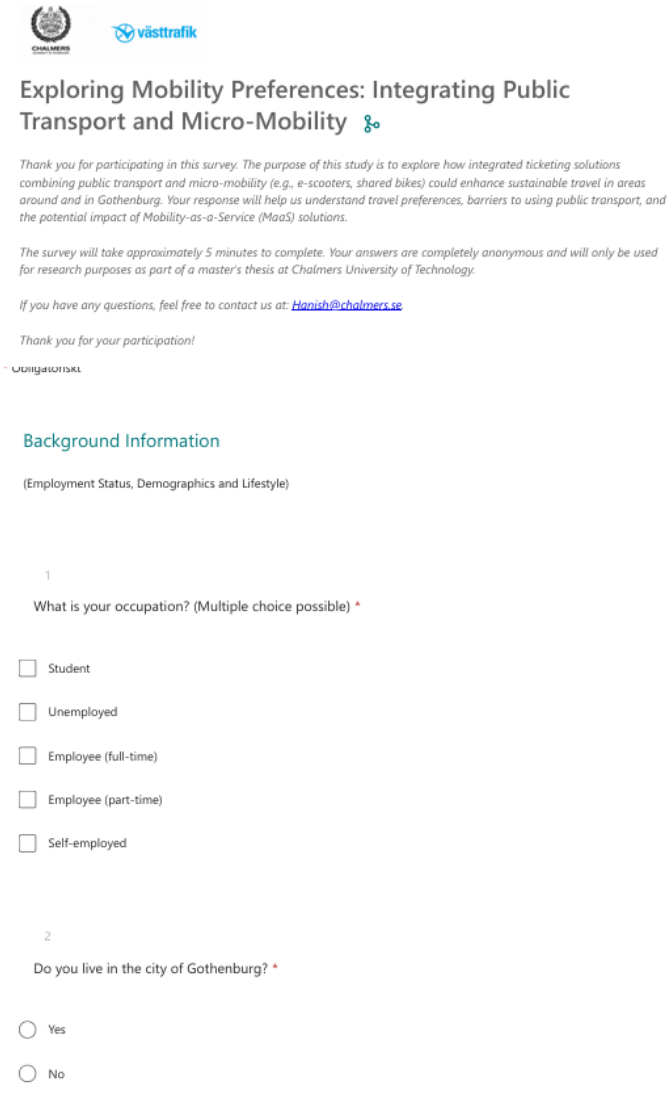
Appendix A – The Survey



Exploring Mobility Preferences: Integrating Public Transport and Micro-Mobility

Thank you for participating in this survey. The purpose of this study is to explore how integrated ticketing solutions combining public transport and micro-mobility (e.g., e-scooters, shared bikes) could enhance sustainable travel in areas around and in Gothenburg. Your response will help us understand travel preferences, barriers to using public transport, and the potential impact of Mobility-as-a-Service (MaaS) solutions.

The survey will take approximately 5 minutes to complete. Your answers are completely anonymous and will only be used for research purposes as part of a master's thesis at Chalmers University of Technology.

If you have any questions, feel free to contact us at: Hanish@chalmers.se

Thank you for your participation!

Obligatoriskt

Background Information

(Employment Status, Demographics and Lifestyle)

1

What is your occupation? (Multiple choice possible) *

- [ ] Student
- [ ] Unemployed
- [ ] Employee (full-time)
- [ ] Employee (part-time)
- [ ] Self-employed

2

Do you live in the city of Gothenburg? *

- ( ) Yes
- ( ) No

3

Which district in Gothenburg do you live in?

- ◯ Hisingen
- ◯ Bergsjön/Kortedala/Angered
- ◯ Centrum (Vasastan, Heden, Haga)
- ◯ Östra Göteborg (Östra sjukhuset, Gamlestaden, Olskroken)
- ◯ Västra Göteborg (Majorna, Sandarna, Frölunda)
- ◯ Other

4

In which municipality do you live?

- ◯ Mölndal
- ◯ Partille
- ◯ Ale
- ◯ Kungälv
- ◯ Lerum
- ◯ Härryda
- ◯ Other

5

If you live in another municipality, which one?

6

If you live in another disctrict, which one?

7

How far do you usually commute on a daily basis? *

- ◯ less than 2 km
- ◯ 2 - 5 km
- ◯ 6 - 10 km
- ◯ 11 - 20 km
- ◯ More than 20 km

8

How do you usually travel in your everyday life? (Multiple choice possible) *

- ☐ Private bike/e-bike
- ☐ Walking
- ☐ Car
- ☐ Rental bicycle
- ☐ E-scooter (VOi, Tier etc.)
- ☐ Public transit (Västtrafik)
- ☐ Taxi

9

How often do you commute with public transit? *

- ◯ Daily
- ◯ A few times per week
- ◯ A few times per month
- ◯ Rarely
- ◯ Never

10

What type of Västtrafik ticket or subscription do you usually use when travelling with public transport? (Mulitpe choice possible) *

- [ ] Monthly period ticket
- [ ] Singel tickets
- [ ] Day tickets
- [ ] None

11

How often do you combine public transport and e-scooters during the same trip? *

- ◯ Every day
- ◯ A few times per week
- ◯ A few times per month
- ◯ Rarely
- ◯ Never

12

How much do you spend on e-scooter services per month? *

- ◯ 0 SEK (I don't use e-scooter services)
- ◯ 1–99 SEK
- ◯ 100–249 SEK
- ◯ 250–499 SEK
- ◯ 500–999 SEK
- ◯ 1,000 SEK or more

Preferences for Västtrafik ticket add-ons related to period tickets

We are aware that the prices and offers presented may not reflect real-world conditions. However, that is not the purpose of this survey. The prices are fictional, and what truly matters are the differences between the offers and how appealing you find their contents. Your input will be used as data for our model to help us better understand what elements travelers like you value most. This, in turn will support the development of more attractive and user-friendly ticket solutions in the future.

Please note that the add-ons are only active while your ticket is valid.

13

If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik monthly ticket, which type of option would you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.
*

	Free time (min)	Free unlocks	Price (SEK)
Option A:	60	10	1050
Option B:	60	Unlimited	1150
Option C:	Unlimited	20	1200

- ◯ Option A
- ◯ Option B
- ◯ Option C

14

If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik monthly ticket, which type of option would you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.

*

	Free time (min)	Free unlocks	Price (SEK)
Option A:	80	20	1000
Option B:	100	Unlimited	1180
Option C:	Unlimited	15	1250

- ◯ Option A
- ◯ Option B
- ◯ Option C

15

If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik monthly ticket, which type of option would you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.
*

	Free time (min)	Free unlocks	Price (SEK)
Option A:	60	15	1130
Option B:	80	Unlimited	1210
Option C:	Unlimited	30	1250

- ◯ Option A
- ◯ Option B
- ◯ Option C

16

Would you be more likely to buy a Västtrafik monthly ticket if it included an e-scooter benefit? *

- ◯ Yes
- ◯ No
- ◯ Maybe

Preferences for Västtrafik ticket add-ons related to single tickets

We are aware that the prices and offers presented may not reflect real-world conditions. However, that is not the purpose of this survey. The prices are fictional, and what truly matters are the differences between the offers and how appealing you find their contents. Your input will be used as data for our model to help us better understand what elements travelers like you value most. This, in turn, will support the development of more attractive and user-friendly ticket solutions in the future.

Please note that the add-ons are only active while your ticket is valid.

17

If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik single ticket, which type of option would you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers. *

	Free time (min)	Free unlocks	Price (SEK)
Option A:	15	1	60
Option B:	20	Unlimited	80
Option C:	Unlimited	2	90

- ◯ Option A
- ◯ Option B
- ◯ Option C

18

If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik single ticket, which type of option would you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.
*

	Free time (min)	Free unlocks	Price (SEK)
Option A:	10	1	70
Option B:	10	Unlimited	90
Option C:	Unlimited	1	90

- ◯ Option A
- ◯ Option B
- ◯ Option C

19

If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik single ticket, which type of option would you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.
*

	Free time (min)	Free unlocks	Price (SEK)
Option A:	10	3	80
Option B:	10	Unlimited	90
Option C:	Unlimited	3	90

- ◯ Option A
- ◯ Option B
- ◯ Option C

20

Would you be more likely to buy a Västtrafik single ticket if it included an e-scooter benefit? *

- ◯ Yes
- ◯ No

Additional Insights

21

If e-scooter benefits were included in your Västtrafik ticket, would you use public transport more often?

- ◯ Yes
- ◯ No
- ◯ Maybe

22

Would you be interested in an offer that includes rental bikes instead of e-scooters?

- ◯ Yes
- ◯ No
- ◯ Both are interesting

23

What is your age group?

- ◯ Under 18
- ◯ 18 - 24
- ◯ 25 - 34
- ◯ 35 - 44
- ◯ 44 - 65
- ◯ 65+

24

What is your gender?

- ◯ Woman
- ◯ Man
- ◯ Prefer not to say

25

What specific improvements or features would you suggest to enhance the integration between public transport and e-scooters?

Det här innehållet har inte skapats och stöds inte av Microsoft. Data du skickar kommer att skickas till formulärets ägare.

Microsoft Forms

Appendix B – Tables Regarding Ngene

Table 4. 3: The attributes for the two blocks.

Block 1 (Single ticket)	Free time	(0, 5, 10, 15) min
	Free unlock	(0, 1, 2, 3) unlocks
	Price	(50, 67, 85) Sek
Block 2 (Period ticket)	Free time	(0, 60, 80, 100) min
	Free unlock	(0, 10, 15, 20) unlocks
	Price	(1050, 1130, 1210) Sek

Table 4.2: The table shows the eight options generated by the software Ngene without any modifications.

		Minutes	Unlocks	Sek
Block 1	**Option 1**	10	2	67
		10	∞	80
		∞	1	80
	Option 2	20	3	85
		15	∞	80
		∞	2	90
	Option 3	5	1	50
		10	∞	60
		∞	1	70
	Option 4	20	2	85
		15	∞	70
		∞	2	90
Block 2	**Option 1**	100	10	1130
		100	∞	1210
		∞	20	1150
	Option 2	60	10	1050
		60	∞	1130
		∞	20	1200
	Option 3	80	20	1000
		100	∞	1180
		∞	15	1250
	Option 4	60	15	1130
		80	∞	1210
		∞	30	1150

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Appendix C – Model Code

```
B_TIME = Beta('B_TIME', 0, 0, None, 0)
B_LOCK = Beta ('B_LOCK',0, 0, None, 0)
B_U_LOCK = Beta ('B_U_LOCK',0, 0, None, 0)
B_U_TIME = Beta ('B_U_TIME',0, 0, None, 0)
B_COST = Beta('B_COST', 0, None, 0, 0)

V1 = B_TIME * time_1 + B_LOCK * ulock_1 + B_COST * price_1 + B_U_LOCK*0 + B_U_TIME*0
V2 = B_TIME * time_2 + B_LOCK * 0 + B_COST * price_2 + B_U_LOCK*1 + B_U_TIME*0
V3 = B_TIME * 0 + B_LOCK * ulock_3 + B_COST * price_3 + B_U_LOCK*0 + B_U_TIME*1
```

Appendix D – Model Results

Single ticket

Table 5. 3: MNL Estimation Results - Single Ticket Bundles

Parameter	***Estimate (β)***	***Std. Error***	***t-test***
Price	-0.060 ***	0.022	-2.745
Free Unlocks	0.234**	0.181	1.293
Free Minutes	0.080***	0.040	2.030
Unlimited Unlocks	0.259*	0.670	0.386
Unlimited Minutes	1.510****	0.387	3.903

*****p<0.001 ***p<0.1 **p<0.5 *p<1*

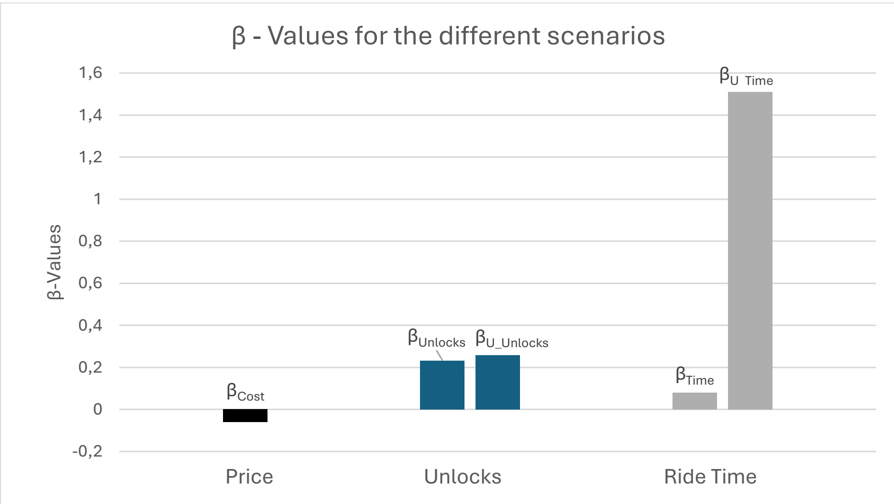

Figure 5. 10: Marginal utility of attributes - Single Ticket Bundles

Monthly ticket

Table 5. 4: MNL Estimation Results - Monthly Ticket Bundles

Parameter	***Estimate (β)***	***Robust Std. Error***	***t-test***
Price	-0.004**	0.004	-1.163
Free Unlocks	0.024**	0.024	1.012

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Free Minutes	0.000*	0.008	0.000
Unlimited Unlocks	0.885***	0.317	2.803
Unlimited Minutes	0.000*	0.910	0.000

*****p<0.001 ***p<0.1 **p<0.5 *p<1*

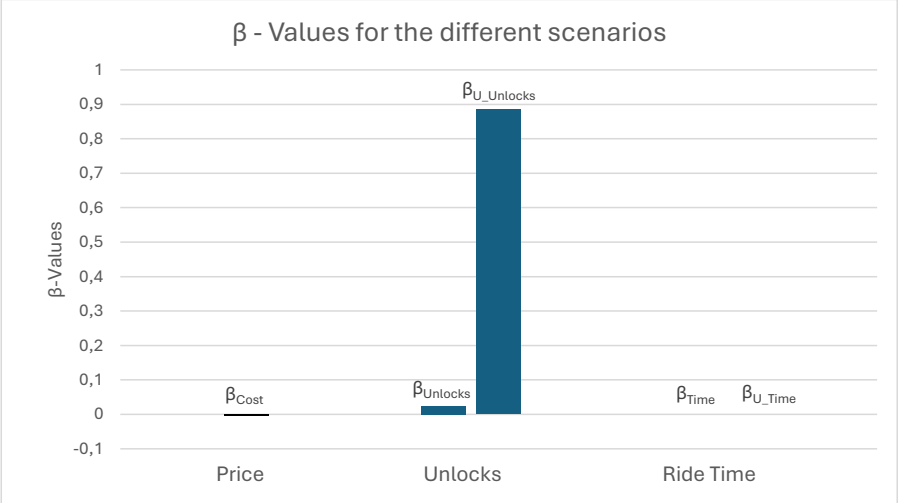

Figure 5. 11: Marginal utility of attributes - Monthly Ticket Bundles

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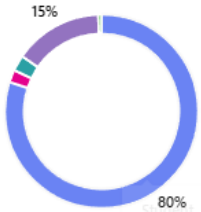
Appendix E – Survey Results

1. What is your occupation? (Multiple choice possible) (0 poäng)

Student	151
Unemployed	4
Employee (full-time)	5
Employee (part-time)	28
Self-employed	1

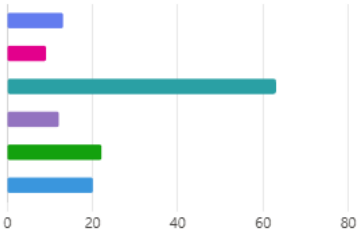


2. Do you live in the city of Gothenburg? (0 poäng)

Yes	139
No	17

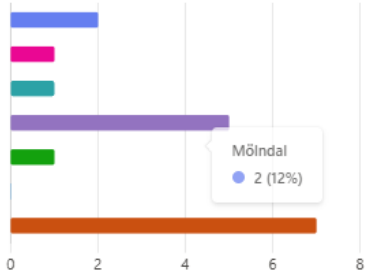
3. Which district in Gothenburg do you live in? (0 poäng)

Hisingen	13
Bergsjön/Kortedala/Angered	9
Centrum (Vasastan, Heden, Haga)	63
Östra Göteborg (Östra sjukhuset, Gamlestaden, Olskroken)	12
Västra Göteborg (Majorna, Sandarna, Frölunda)	22
Other	20



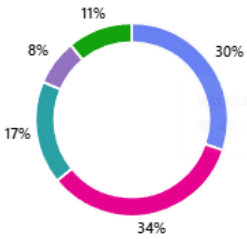
4. In which municipality do you live? (0 poäng)

Mölndal	2
Partille	1
Ale	1
Kungälv	5
Lerum	1
Härryda	0
Other	7



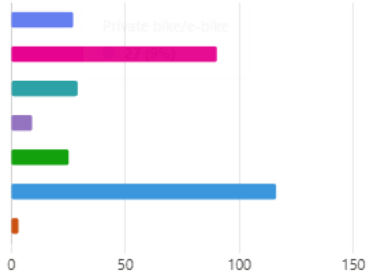
7. How far do you usually commute on a daily basis? (0 poäng)

less than 2 km	47
2 - 5 km	53
6 - 10 km	27
11 - 20 km	12
More than 20 km	17



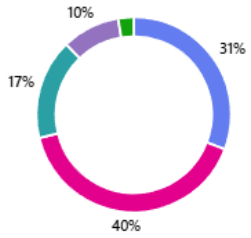
8. How do you usually travel in your everyday life? (Multiple choice possible) (0 poäng)

Private bike/e-bike	27
Walking	90
Car	29
Rental bicycle	9
E-scooter (VOi, Tier etc.)	25
Public transit (Västtrafik)	116
Taxi	3



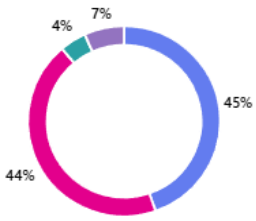
9. How often do you commute with public transit? (0 poäng)

Daily	48
A few times per week	63
A few times per month	26
Rarely	15
Never	4



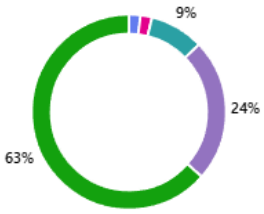
10. What type of Västtrafik ticket or subscription do you usually use when travelling with public transport? (Mulitpe choice possible) (0 poäng)

Monthly period ticket	80
Singel tickets	79
Day tickets	8
None	12



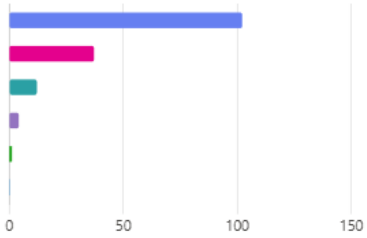
11. How often do you combine public transport and e-scooters during the same trip? (0 poäng)

Every day	3
A few times per week	3
A few times per month	14
Rarely	37
Never	99



12. How much do you spend on e-scooter services per month? (0 poäng)

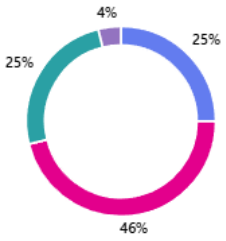
0 SEK (I don't use e-scooter services)	102
1–99 SEK	37
100–249 SEK	12
250–499 SEK	4
500–999 SEK	1
1,000 SEK or more	0



13. If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik monthly ticket, which type of option woul d you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.
(0 poäng)

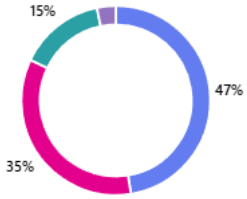
Option A	39
Option B	72
Option C	39
Annat	6



14. If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik monthly ticket, which type of option woul d you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.
(0 poäng)

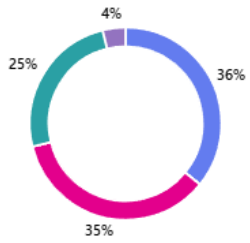
Option A	74
Option B	54
Option C	23
Annat	5



15. If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik monthly ticket, which type of option woul d you prefer?

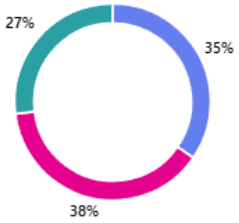
Please note: the prices are fictional and only included to explore your preferences between different types of offers. (0 poäng)

Option A	56
Option B	55
Option C	39
Annat	6



16. Would you be more likely to buy a Västtrafik monthly ticket if it included an e-scooter benefit? (0 poäng)

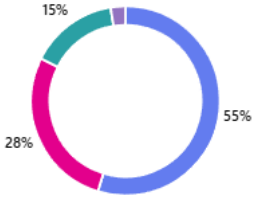
Yes	54
No	60
Maybe	42



17. If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik single ticket, which type of option would y ou prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers. (0 poäng)

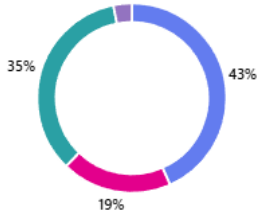
Option A	87
Option B	44
Option C	24
Annat	4



18. If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik single ticket, which type of option would you prefer?

Please note: the prices are fictional and only included to explore your preferences between different types of offers.
(0 poäng)

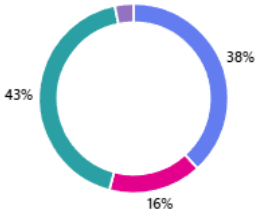
Option A	69
Option B	30
Option C	55
Annat	5



19. If e-scooter (Voi, Tier etc.) access could be integrated into your Västtrafik single ticket, which type of option would you prefer?

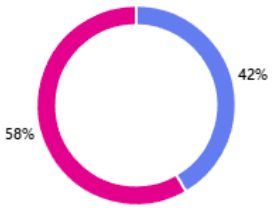
Please note: the prices are fictional and only included to explore your preferences between different types of offers.
(0 poäng)

Option A	60
Option B	25
Option C	67
Annat	5



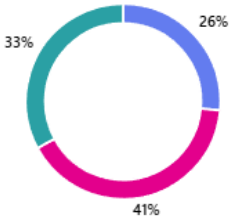
20. Would you be more likely to buy a Västtrafik single ticket if it included an e-scooter benefit? (0 poäng)

Yes	65
No	91



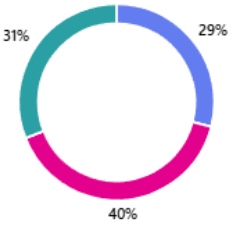
21. If e-scooter benefits were included in your Västtrafik ticket, would you use public transport more often? (0 poäng)

Yes	41
No	63
Maybe	51



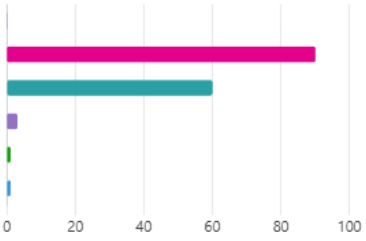
22. Would you be interested in an offer that includes rental bikes instead of e-scooters? (0 poäng)

Yes	45
No	62
Both are interesting	48



23. What is your age group? (0 poäng)

Under 18	0
18 - 24	90
25 - 34	60
35 - 44	3
44 - 65	1
65+	1



24. What is your gender? (0 poäng)

Woman	67
Man	86
Prefer not to say	2