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Mobility as a Service (MaaS) bundle uptake: a case study in Milan, Italy

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Abstract

Recent applications of Mobility as a Service (MaaS) platforms have highlighted certain limitations in accurately identifying integrated mobility packages (MaaS bundles) that align with users' needs and preferences while also supporting the financial viability of businesses. This study explores the interest of university community members in adopting and paying for MaaS bundles, aiming to determine whether their preferences differ from those of the general population commonly analyzed in existing research. The research method involved the design and administration of a survey instrument, resulting in 1949 completed computer-assisted web interviews collected between May and June 2023. The willingness to pay (WTP) for different MaaS bundles was estimated based on users' responses to stated preference choice tree experiments. Results reveal that 45.2% of respondents showed no interest in any proposed MaaS bundle, 29.5% towards only one specific MaaS bundle. Conversely, 25.3% of respondents expressed interest in two or more MaaS bundles. Public transport (PT) pass holders showed a higher WTP for MaaS bundles compared to PT pass non-holders, with a WTP an additional 17.5–28.3% over what they currently pay for their PT pass. The findings reveal a positive attitude among university community members toward MaaS bundles, especially among PT pass holders. This underscores an opportunity for MaaS providers to target this group with tailored bundles that complement existing transport choices, thereby increasing user satisfaction and financial viability.

Keywords User adoption, Willingness-to-pay, Integrated mobility packages, MaaS bundles design, SP survey

1 Introduction

In recent years, many European urban areas have seen a growing effort to coordinate and integrate Public Transport (PT) services across different modes [26, 59], particularly by linking mass rapid transit (e.g. metro, rail,...) with surface bus services, as well as with private cars (e.g. park&ride facilities) and shared vehicles (e.g. cars, bicycles, scooters, mopeds) within the new concept of multimodal mobility hubs. As shown by Chowdhury et al. [12] and Nosal and Solecka [44], this integration may occur at various levels, including network coordination, service synchronization, and unified fares and ticketing systems. Additionally, the emergence of real-time traveler information systems is enabling seamless multimodal connections for passengers with reduced transfer times. This is improving the overall efficiency and attractiveness of the PT network by allowing users to meet their mobility needs through a wide range of transport options [41, 45, 58]. However, this entails greater complexity for individuals in navigating through the alternatives presented by different transport modes and various mobility operators [28]. In the past, when PT and personal vehicles were the primary modes of mobility, the choices were relatively limited. Nowadays, with the advent of new technologies and innovative services [15, 53], the mobility ecosystem has expanded dramatically, proposing new travel solutions that provide users with greater flexibility. This expansion, while fostering competition and innovation, has simultaneously introduced a degree of confusion for consumers when dealing with travel choices [56].

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For these reasons, in an urban mobility context increasingly characterized by capillary, competing and therefore more accessible and affordable transport services, the concept of Mobility-as-a-Service (MaaS) is gaining increasing attention as a means of providing integrated door-to-door mobility solutions through a single digital platform [39, 57]. In this way, users would be able to plan, book, and pay for these services through a single account and a single digital interface, choosing from time to time among the different options those that best meet their needs and preferences [40, 50]. Thus, MaaS could allow users to travel effortlessly by seamlessly combining different transport services and paying integrated fares overall more conveniently [9, 46, 47].

In this context, this research aims at examining whether university communities, due to their unique characteristics and needs, have the potential to act as catalysts for the advancement of MaaS within cities. Conversely, it also aims at investigating whether MaaS could provide a variety of benefits to university members, making it a compelling proposition.

Despite all these expected benefits, the successful implementation of a (university) MaaS platform requires a thorough understanding of the actual interest and willingness-to-pay (WTP) of potential users [24, 46, 47]. To this end, this research has been focused on analyzing current mobility habits, criticalities, and needs of the members of Politecnico di Milano, Italy, along with their stated preferences regarding the interest to adopt and pay for MaaS bundles (i.e. mobility service packages that integrate various transport solutions into a single, cohesive offering), in order to understand to what extent MaaS could be attractive and convenient for university communities. In essence, the research questions intended to be addressed are: *Which university demand segments are most prone to adopting MaaS? Which MaaS bundles are most appealing and what is their perceived value among potential users?*

The first research question pertains to identifying the specific groups within a university community that are more likely to embrace MaaS, based on determinants such as commuting patterns, travel behaviors, socioeconomic backgrounds, and urban contexts. The second research question focuses on investigating the potential users' interest and WTP for different MaaS bundles. By understanding the needs and preferences of these segments, transport operators and service providers could design tailored strategies, marketing campaigns, and service offerings to encourage MaaS adoption in university communities, ultimately fostering a more sustainable and efficient transport ecosystem for cities.

The rest of the paper is organized as follows. A literature review focused on MaaS bundles design studies is presented in Sect. 2. In Sect. 3, the methods and materials are described. Section 4 focuses on the analysis of the collected data within the context of the case study (i.e. the university community of the Politecnico di Milano, Italy). Section 5 delves into a discussion of the key findings, policy recommendations, limitations of the study and research perspectives. Lastly, Sect. 6 presents the closing remarks of the research.

2 Literature review

From its first introduction to the most recent trials, many researchers believe that MaaS can serve as a primary driver for reinvigorating PT and shared mobility demand [3, 19, 22, 27], and conversely for reducing car dependency [21, 48], given its capacity to facilitate intermodal integration across various dimensions. In the literature, the classification of MaaS solutions into five levels of integration is widely accepted [54], ranging from no integration (Level 0) to integration with social policies aimed at promoting sustainable behaviors (Level 4). These levels include the provision of real-time travel information (Level 1), unified ticketing and payment systems (Level 2), multimodal subscription bundles (Level 3). This progression represents the potential evolution of a MaaS platform, moving from the basic provision of travel information to fundamentally reshaping how individuals access and utilize transport services. As the integration level increases, it enhances the convenience, accessibility, and ease of use of multimodal transport, thereby making sustainable mobility alternatives more appealing to users.

In this paper, the focus lies on the highest levels of integration (i.e. Levels 3 and 4), specifically aiming to comprehend whether and how MaaS bundles can be designed to align with social policies and incentivize the adoption of sustainable transport modes beyond car usage. In particular, the study explores whether the overall attractiveness of public transport can be enhanced through multimodal MaaS bundles (for example, by improving first- and last-mile connections), and examines the interest and willingness to pay for such bundles, even among users who do not currently hold a PT pass or who primarily rely on private vehicles. This involves investigating how such bundles can be structured, priced and promoted to not only provide practical travel solutions but also encourage users to opt for more eco-friendly and cost-effective modes.

A review of studies analyzing potential MaaS bundles and the associated consumers' WTP highlighted several key findings that shaped this research. In particular, the works detailed in Table 1 have served as reference frameworks for the methods proposed in the next section of this paper. Many studies, including those by [23] and [29], indicate that consumers tend to replicate existing

Table 1 Studies investigating individuals' interest and WTP for MaaS bundles

Paper Title and Author(s)	Survey methods	Proposed MaaS bundles	Demand target	Sample size	Key findings
"Potential uptake and willingness-to-pay for Mobility as a Service (MaaS): A stated choice study" [23]	Stated Preference experiment (face-to-face survey)	Premade bundles based on revealed travel patterns	General population of the Sydney Metropolitan area, Australia	252 respondents	Many respondents, when offered the opportunity to create personalized MaaS bundles, largely mirrored their current travel behaviors. This inclination restricts the potential for adopting multimodal transport
"How does transport supply and mobility behaviour impact preferences for MaaS bundles? A multi-city approach" [29]	Stated Preference experiment (online survey)	Premade bundles generated with a D-efficient approach	Holders of a driving license living in 83 large cities in Germany	444 respondents	Individuals tend to stick with their current mobility habits when using MaaS bundles A strong PT infrastructure and availability of shared mobility are essential to make MaaS bundles attractive, potentially reducing car dependence
"Bundling, pricing schemes and extra features preferences for mobility as a service: Sequential portfolio choice experiment" [9]	Sequential portfolio choice experiment (online survey)	Varying bundles based on respondents' preferences	General population of the Amsterdam and Eindhoven areas, the Netherlands	1078 respondents	PT is favored among transport modes, suggesting its importance within MaaS platforms Subscription decisions and the choice of transport modes in bundles are significantly influenced by socio-demographic profiles and individual transport-related characteristics
"The potential of mobility as a service bundle as a mobility management tool" [39]	Stated Preference experiment (online survey)	Premade bundles based on revealed travel patterns	General population of the Greater London, United Kingdom	1068 respondents	Only PT showed to be attractive for users An increase in the offerings of car sharing and bike sharing services led to a worsening of bundle adoption
"MaaS users: Who they are and how much they are willing-to-pay" [55]	Sequential portfolio choice experiment (online survey)	Varying bundles based on respondents' preferences	General population of the Greater Manchester, United Kingdom	574 respondents	Respondents tend to favor MaaS plans that include unlimited access to PT options over bundles that do not The probability of choosing a MaaS plan increases with more car-sharing hours and taxi trips offered
"Public preferences for mobility as a service: Insights from stated preference surveys" [24]	Stated Preference experiment (face-to-face survey)	Premade bundles based on revealed travel patterns	General population of the Tyneside area, United Kingdom	290 respondents	Frequent PT users are the most likely to subscribe to a MaaS plan Daily usage of smartphones and internet and being under 24 years old could help in identifying MaaS-friendly segments

Table 1 (continued)

Paper Title and Author(s)	Survey methods	Proposed MaaS bundles	Demand target	Sample size	Key findings
"Heterogeneity in transport mode choice of college students at a university based on the MaaS concept" [31]	Stated Intention questionnaire (online survey)	No bundle has been evaluated	University students of Budapest University of Technology and Economics, Hungary	687 respondents	Three clusters of students can be identified: one group primarily using PT, walking, trains, and coaches; another group utilizing PT, bicycles, and shared transport modes; and a third group relying on private cars. The second group is the most likely to adopt MaaS solutions
The present study	Stated Preference experiment (online survey)	Premade PT-based bundles	University employees and students of Politecnico di Milano, Italy	1873 respondents	See Sects. 4 and 5

travel habits when offered MaaS bundles, limiting the potential for adopting multimodal bundled travel solutions. Additionally, Caiati et al. [9] found that respondents show reluctance to subscribe to MaaS bundles due to factors such as subscription cost and social influence.

The study by [35] examined the WTP for MaaS bundles in comparison to respondents' current mobility costs, cautioning that people's WTP for a mobility package remains significantly below the prices of existing MaaS services that bundle multiple mobility options. Moreover, they also highlight substantial uncertainties in MaaS studies related to WTP estimations. First, as MaaS and mobility service packages are still relatively unfamiliar concepts for most users, there are ambiguities in people's understanding of what these services entail and how they function. Secondly, mobility needs vary widely across individuals, meaning that the ideal combination of services in MaaS bundles to meet these needs also differs significantly. As a result, it is important to consider the limitation that no existing survey method can fully account for the diverse mobility preferences of users and the varying costs of mobility packages to accurately capture the impact of subscription fees on travelers' WTP for MaaS bundles [14].

Previous research, such as [39] and [55], emphasized the importance of including unlimited PT options in MaaS bundles to increase their appeal, though the inclusion of bike-sharing or car-sharing can diminish desirability for some users. In contrast, [43] found that possessing a PT pass positively influences the use of bike-sharing and car-sharing, suggesting that these services complement public transport. However, a negative relationship was observed for ride-hailing, indicating that ride-hailing services may substitute public transport. Ho et al. [24] observed that WTP for MaaS bundles also varies according to the underlying PT fare system and the user satisfaction with current transport options. Furthermore, younger and educated individuals emerge as a target demographic aligned with the values and propositions of MaaS, since these demand segments exhibit a greater inclination towards adopting multimodal travel patterns and are more open to experimenting with new transport possibilities.

However, research gaps remain in MaaS bundle design based on context [51]. These include understanding the impact of emerging modes, such as electric scooters, and exploring the needs of specific groups of individuals (e.g., students, elderly) and travelers (e.g., commuters, tourists). While studies like those by [30–32] have examined MaaS acceptance among students in Hungary using Structural Equation Models (SEM), they did not investigate the specific interest and WTP of individuals regarding potential MaaS bundles. Another study conducted by [16] investigated the potential uptake of MaaS within a university community using discrete choice behavioral models, but did not include any analysis of the WTP among potential users. These gaps leave an important aspect of user adoption unexplored, as understanding WTP can provide information on the pricing strategies and economic feasibility of MaaS bundles, allowing for a more comprehensive assessment of user preferences and the factors that drive adoption. In this regard, the present paper aims to bridge the research gaps concerning a specific category of users (i.e. the members of a university community, in the diverse forms of students and employees), providing evidence that is distinct from findings influenced by the preferences of the general population.

3 Methods

3.1 Survey design and administration

The first research phase involved an accurate design of the survey instrument. This encompassed formulating questions that probe into individuals' travel habits, preferences, attitudes, and stated behavioral intentions concerning the adoption of hypothetical MaaS bundles. The design of the survey had to find a balance between comprehensiveness, clarity, and the time required to complete the questionnaire, ensuring that the collected data accurately captures users' perspectives on various aspects of bundled mobility options.

For these reasons, a pilot survey was initially conducted from January 2023 to March 2023, consisting of 153 face-to-face Paper-And-Pencil Interviews (PAPI) with individuals randomly approached at their destinations (i.e., within university premises of various departments in the engineering, architecture, and design fields) in two separate sites (i.e. Leonardo and Bovisa campuses) of Politecnico di Milano, an Italian university institute of scientific and technological nature located in the urban area of Milan, Italy. In designing the questionnaire, specific characteristics of the study area were carefully considered, such as the locations of the two university campuses within the relevant geographical context and the transport and mobility services available in the metropolitan area of Milan and the surrounding provinces. As shown in Fig. 1, it should be noted that the Bovisa campus is well-connected by mass rapid transit, ensuring easy access from various parts of the city. The nearest train station, Milano Bovisa-Politecnico, is served by multiple suburban lines, including S1, S2, S3, S4, S12 and S13, providing frequent connections to major stations across Milan. Tram lines 2, 12, and 19 operate nearby, with stops within walking or cycling distance of the campus (less than 2 km). While there is no direct metro station at the campus, the metro lines connect with stations like Milano Porta Garibaldi, Milano Cadorna and Milano

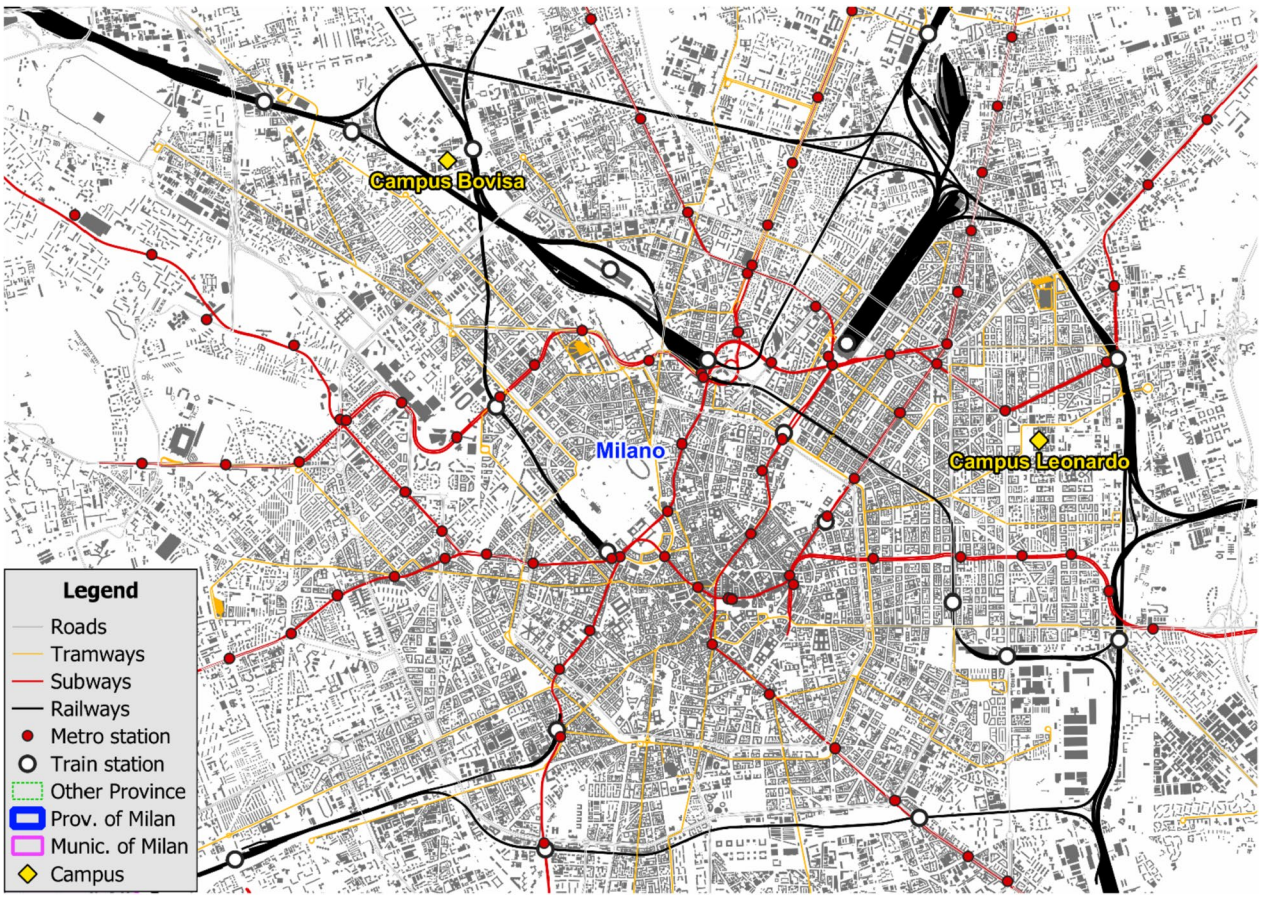


Fig. 1 Location of Politecnico di Milano university campuses and mass rapid transit network of the city of Milan

Repubblica, where passengers can transfer to suburban lines to reach Milano Bovisa-Politecnico.

The Leonardo campus is likewise highly accessible with PT services. The nearby Piola station on the M2 metro line provides direct access to the campus. Tram lines 19 and 33 also serve the area, with stops within walking distance. Additionally, the Milano Lambrate train station, offering both regional and suburban connections, is close by and accessible via a short bus ride or a twenty-minute walk. In both the Bovisa and Leonardo cases, first-mile access to or last-mile egress from train or metro stations near the campuses could be achieved using available shared mobility vehicles such as cars, mopeds, bicycles, or electric scooters. However, these options are not widely used, as such shared mobility services are often perceived as expensive and not integrated with public transport subscriptions. The same applies to access to and egress from train or metro stations at the remote origins of commuting trips.

It is also important to highlight that the Metropolitan City of Milan (formerly the Province of Milan) shares border and has significant commuting and economic interactions with several adjacent provinces (see Fig. 2), namely Como, Monza-Brianza, Lecco, Bergamo, Cremona, Lodi, Pavia, Novara, and Varese. In fact, a significant portion of university students and workers of Politecnico di Milano come from municipalities bordering the Municipality of Milan or even from other provinces. The study area features an integrated fare system (i.e., Sistema Tariffario Integrato del Bacino di Mobilità, STIBM), designed to streamline the use of public transport across the metropolitan area. The STIBM allows passengers to use a single PT ticket or pass across multiple services, including buses, trams, metro lines, suburban and regional trains within designated zones. Shared mobility services and parking facilities at interchange hubs are excluded from this fare integration. The metropolitan area is divided into concentric zones, each identified by a code (e.g., Mi1, Mi3, Mi4). Fares are calculated based on the number of concentric zones crossed during a journey. The integrated fare system encompasses the entire Metropolitan City of Milan, the Province of Monza and Brianza, and select municipalities in the provinces of Como,

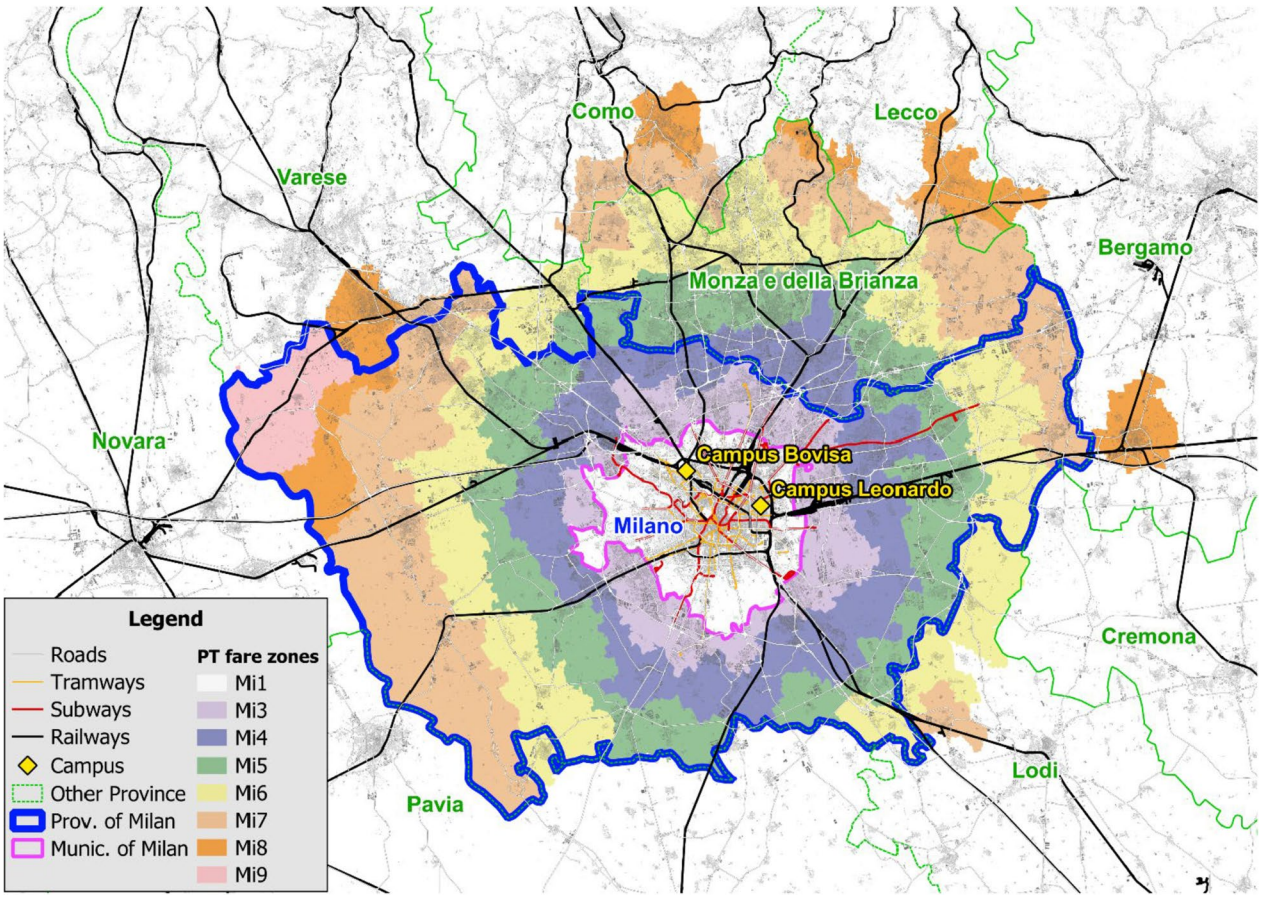


Fig. 2 Geographical context and zoning of the integrated Public Transport fare system

Lecco, Bergamo, Lodi and Varese, facilitating seamless travel across these areas.

The pilot survey allowed for the refinement of questions and response options, as well as identifying the most requested MaaS bundles by respondents. This focus aimed to streamline the subsequent final large-scale survey, ensuring the duration remained acceptable (thus increasing the likelihood of completion) and avoiding distortions due to respondent fatigue. Therefore, in the final survey, respondents were not given the option to choose the composition of the bundles to prevent them from replicating their current mobility habits, as highlighted by [23]. Instead, premade PT-based MaaS bundles were provided to investigate their initial interest and potentially their willingness to pay (WTP) for packages that may even include mobility services significantly different from those experienced in their daily routine.

The final survey consisted of a total of 1949 completed computer-assisted web interviews (CAWI) collected between May and June 2023. Respondents belonging to low represented groups (i.e., those reaching the university sites outside the city of Milan) were excluded, leading to a final sample of 1873 individuals. Participants were randomly recruited through an invitation, which was sent through the official university mailing lists of students, faculty members, and technical-administrative staff.

In Appendix A, the complete survey questionnaire is provided. It consists of three main sections.

In the first section, respondents' actual commuting patterns (e.g. travel weekly frequency, used transport mode, etc.) as well as personal information (e.g. age, gender, etc.) were collected. In the second section, respondents' attitudes and perceptions on MaaS solutions were assessed using Likert scales, with scores ranging from 1 to 5 (e.g. where 1 means "Not at all important" and 5 means "Very important"). By way of example, respondents were asked how important is that a MaaS app integrates some functionalities, such as: real-time updates of estimated arrival times of PT vehicles at stops; location of sharing means of transport; payments in a single transaction; or having rewards for sustainable mobility choices. Finally, in the third section, respondents' interest in three different MaaS bundles was assessed, each coupled with a choice tree Stated Preference (SP) experiment

aiming at measuring their WTP (see Figs. 3 and 4). A choice tree is a technique used to analyze individuals' preferences and choices in hypothetical scenarios. In this type of SP experiment, participants are presented with structured options, where each level of the tree represents a successive decision based on previous choices. The choice options are thus organized in a hierarchical structure to better identify individuals' trade-offs. This approach reduces hypothetical bias, a common issue in WTP estimation where respondents may overestimate or underestimate their true willingness-to-pay, by providing more granularity than a direct WTP question. In fact, a single direct question often forces respondents to provide an immediate and arbitrary estimate of how much they would be willing to pay. In contrast, the choice tree approach progressively adjusts the cost in response to user choices and helps identify the point at which the user no longer perceives the added value as worth the cost, providing a more accurate WTP estimate.

In detail, the MaaS bundles featured either a combination of PT with Bike/Scooter-sharing services (Bundle 1); PT with Car/Moped-sharing services (Bundle 2); or PT with reserved Parking lots near subway or railway stations (Bundle 3). The three proposed bundles have been designed to cater to different mobility needs, encompassing factors such as: (a) the requirement of urban dwellers to conveniently access rapid transit metro stations, thereby reducing the need for bus transfers or long walks; (b) the necessity of individuals commuting from neighboring municipalities to facilitate their daily commutes by utilizing shared motorized modes to reach railway stations; (c) the need for residents from rural areas, devoid of any shared mobility services, to access designated parking near railway stations, thereby reducing their dependency on personal vehicles. The additional percentage or absolute cost levels in the choice tree were determined through the pilot survey to ensure a realistic spectrum of WTP responses. By incorporating incremental cost increases, the structure provides a balanced range of options that captures various levels of price sensitivity. Furthermore, these specific increments allow to pinpoint the exact threshold at which respondents switch from "Yes" to "No" as prices increase (or vice versa), offering a detailed view of their decision-making boundaries.

3.2 WTP estimation

The next research phase involved analyzing the gathered responses. The aim was to extract meaningful patterns,

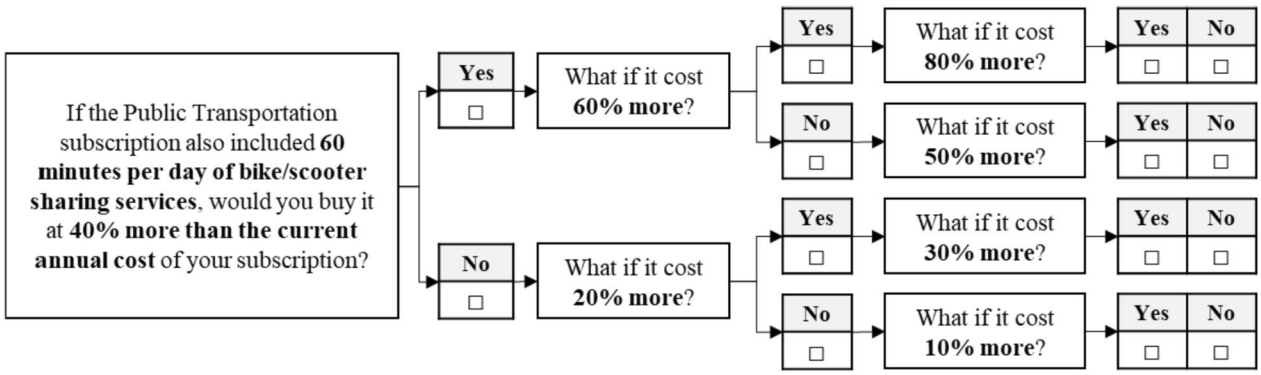


Fig. 3 Example of a choice tree SP experiment for PT pass holders for Bundle 1

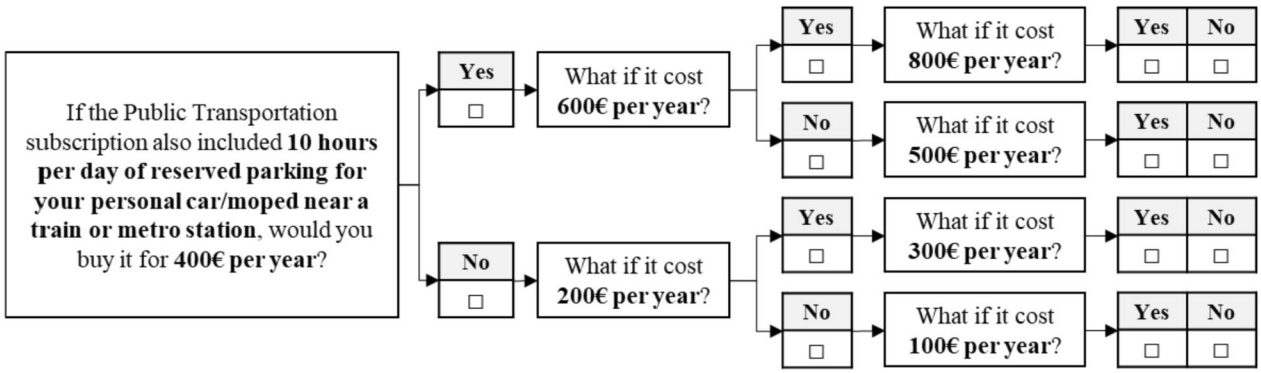


Fig. 4 Example of a choice tree SP experiment for PT pass non-holders for Bundle 3

preferences, and trends from the collected data. The WTP for different MaaS bundles was estimated based on user stated preference to the choice tree experiments, providing insights into how different demand segments perceive differently the value of the MaaS bundles.

As respondents were repeatedly queried about their WTP for a certain MaaS bundle at a specific price, with the price being adjusted based on the preceding response, an iterative approach was adopted. This entailed that an affirmative response consistently led to an increment in the bundle's price, whereas a negative response resulted in a decrease in the bundle's price (see Figs. 3 and 4). Afterwards, to analyze the results, assuming that if a respondent found a higher price acceptable, then logically a slightly lower price would also be acceptable, the WTP thresholds of each respondent have been computed. Therefore, as in Eq. 1, the average willingness-to-pay ($\overline{WTP}_s^b$) of the demand segment (s) for a specific MaaS bundle (b) is calculated by multiplying the percentage share (w_i^b) of willing-to-pay respondents (i) belonging to that particular demand segment (s) by their price thresholds (p_i^b).

$$\overline{WTP}_s^b = \sum_{i \in s} w_i^b p_i^b \tag{1}$$

4 Results

4.1 Sample distribution statistics

The final sample of 1873 respondents consists of 42.4% females and 57.6% males (see Table 2). Most of the respondents are less than 26 years old (44.8%), followed by respondents between 26 and 45 years old (30.4%) and respondents over 45 years old (24.9%). Regarding the role in the university community, 41.9% are bachelor's degree and master's degree students and 58.1% are employees (i.e. faculty members or technical-administrative staff). Respondents with a high education level (i.e., Master's Degree or Doctor of Philosophy) are 50.5% of the sample. Most of the respondents attend university at least five times per week (43.8%), while the remaining 56.2% are split as follows: 29.7% attending four times per week, 18.4% attending three times per week and the remaining 8.0% attending twice or once per week. The majority of respondents start their home-to-university trip from the inner Municipality of Milan (48.0%). The 17.3% of respondents live in the greater Metropolitan City of Milan (i.e. the ex-Province of Milan), and lastly, 34.7% live in other Italian Provinces (34.7%) in the surrounding of the Lombardy Region, Italy. A great share of respondents rely exclusively on PT (54.9%) (i.e. bus, tram, metro, or suburban train services), while another 29.7% make use of private motorized vehicles (i.e. cars or mopeds), either exclusively (11.3%) or in combination with PT (18.4%). The remaining portion reaches the university on foot, using a personal bicycle or scooter or through shared mobility services. In addition, 23.4% of respondents are not holders of a PT pass, meaning that 76.6% of respondents are subscribed to either an urban or a regional pass. Furthermore, only 28.7% of respondents report having a private vehicle always available.

As shown in Table 2, by comparing the aforementioned percentages with the distributions of the university population [49], the sample is highly representative of this population, both in terms of demographic characteristics such as gender and age group, and travel habits, such as travel origins and transport modes used. The only significant deviations are in the percentage of respondents by employment status, where the sample appears almost evenly split, while the population consists predominantly of students. In contrast, a comparison with the distributions of the general Italian population [25] highlights how the segment of university commuters differs greatly from the general population, thus underscoring the need for specific studies on this group of potential MaaS users.

4.2 Respondents' stated intentions and interest towards MaaS solutions

The bar chart in Fig. 5 illustrates the importance respondents attribute to the integration of various transport modes within a MaaS application. The transport modes under consideration include PT, bike-sharing, scooter-sharing, car-sharing, car-pooling, moped-sharing, and taxi services. Respondents rated the importance of integrating each mode on a scale from 1 to 5, where 1 signifies "Not at all important" and 5 denotes "Very important". As in [9, 29], PT emerges as an essential component for integration within a MaaS platform for the university community of Politecnico di Milano, with a significant portion of respondents rating it as "Very important", highlighting its essential role for a broad user base. This is not surprising since PT services are already frequently used by the majority of respondents. Bike-sharing services are also deemed critical. Other shared mobility options, such as car-sharing and moped-sharing services, as well as micro-mobility and ride sharing options, like scooter-sharing and car-pooling services, have balanced distribution across the importance scale. Finally, taxi services cater to specific user preferences, with a notable portion of respondents considering it "Not at all important," while there is a niche that finds it "Very important". Very similar results are found in the research conducted by [1] on the trial of a MaaS pilot in Budapest. The alignment between these findings suggests that core transport preferences within MaaS may be consistent across different urban contexts.

Table 2 Sample socio-economic characteristics and travel habits

Variable		Number of respondents	Sample (%)	Politecnico di Milano population* (%)	Italian population** (%)
Gender	Female	794	42.4	36.3	48.9
	Male	1079	57.6	63.7	51.1
Age group	Less than 26 years old	838	44.8	59.1	22.9
	Between 26 and 35 years old	392	20.9	31.4	10.6
	Between 36 and 45 years old	177	9.5	3.7	13.2
	Between 46 and 55 years old	268	14.3	3.1	15.6
	Between 56 and 65 years old	162	8.7	2.1	15.0
	More than 65	36	1.9	0.6	22.8
Employment status	Students	784	41.9	88.7	11.8
	Workers	1089	58.1	11.3	58.1
	Other	–	–	–	30.1
Education Level	Middle school diploma	5	0.2	–	29.7
	High school diploma	670	35.8	–	30.0
	Bachelor's degree	252	13.5	–	27.9
	Master's degree	551	29.4	–	10.2
	Doctor of Philosophy	395	21.1	–	2.2
Origin zone	Municipality of Milan	898	48.0	45.1	–
	Metropolitan City of Milan	324	17.3	54.9	–
	Other Provinces	651	34.7		–
Availability of a private vehicle	Yes, always	538	28.7	–	–
	Sometimes, because I share it with family members or others	231	12.3	–	–
	No, never	1104	58.9	–	–
Ownership of a PT pass	Yes	1434	76.6	–	–
	No	439	23.4	–	–
Number of days per week in university	Once or less	66	3.5	–	–
	Twice	84	4.5	–	–
	Three times	345	18.4	–	–
	Four times	557	29.7	–	–
	Five times or more	821	43.8	–	–
Most frequently used transport mode	Public transport (bus, tram, metro, suburban train)	1026	54.9	51.2	–
	Private and Public transport (park&ride)	344	18.4	20.7	–
	Private transport (car or moped)	211	11.3	12.8	–
	Car or moped sharing	16	0.8		–
	Foot	113	6.0	9.0	–
	Private bicycle or scooter	148	7.9	6.3	–
	Bicycle or scooter sharing	15	0.7		–

*Source: [49]. **Source: [25]

As shown in Fig. 6, respondents place a very high importance on all the investigated functionalities that enhance the efficiency, convenience, and sustainability of a MaaS application. Time- and cost-optimized route search and real-time updates of traffic and PT timetables are the most preferred features, reflecting the users' need for reliable and efficient travel information. The ability to book and ensure the availability of shared transport vehicles, along with the convenience of single-account registration and unified electronic payment, are also highly valued, indicating a preference for streamlined and integrated service experiences. Additionally, offering discounts for sustainable transport choices is highly desirable and thus may represent an effective strategy to promote environmentally friendly behaviors among users. In this sense, therefore, all levels of integration

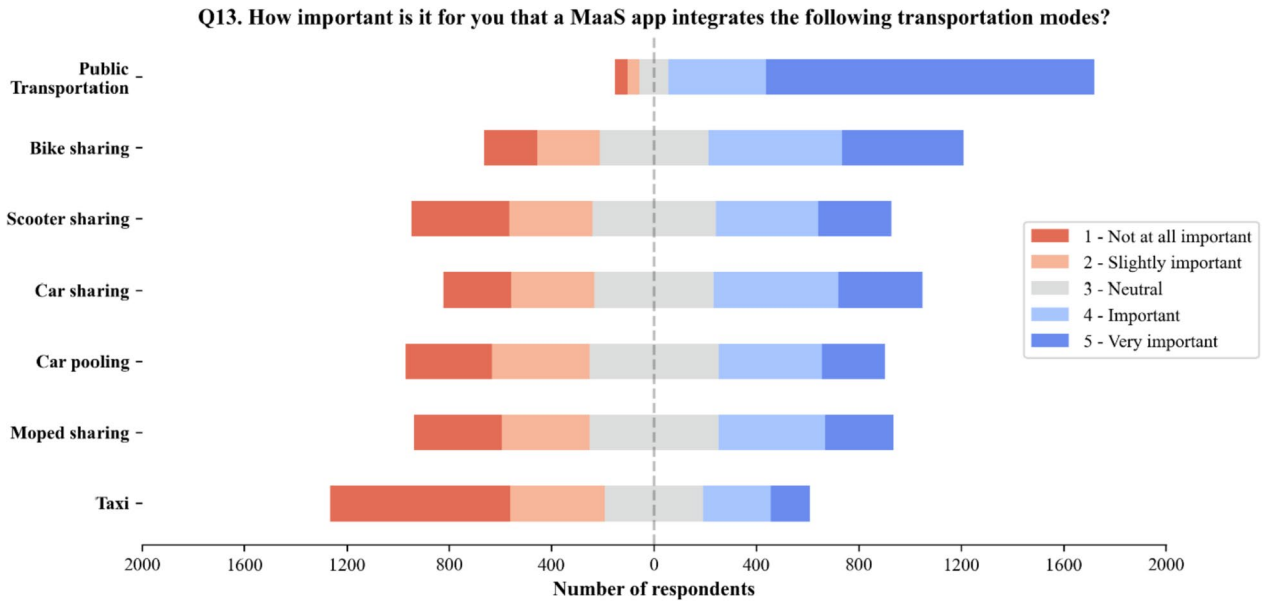


Fig. 5 Perceived importance of integrating certain transport modes into a MaaS platform

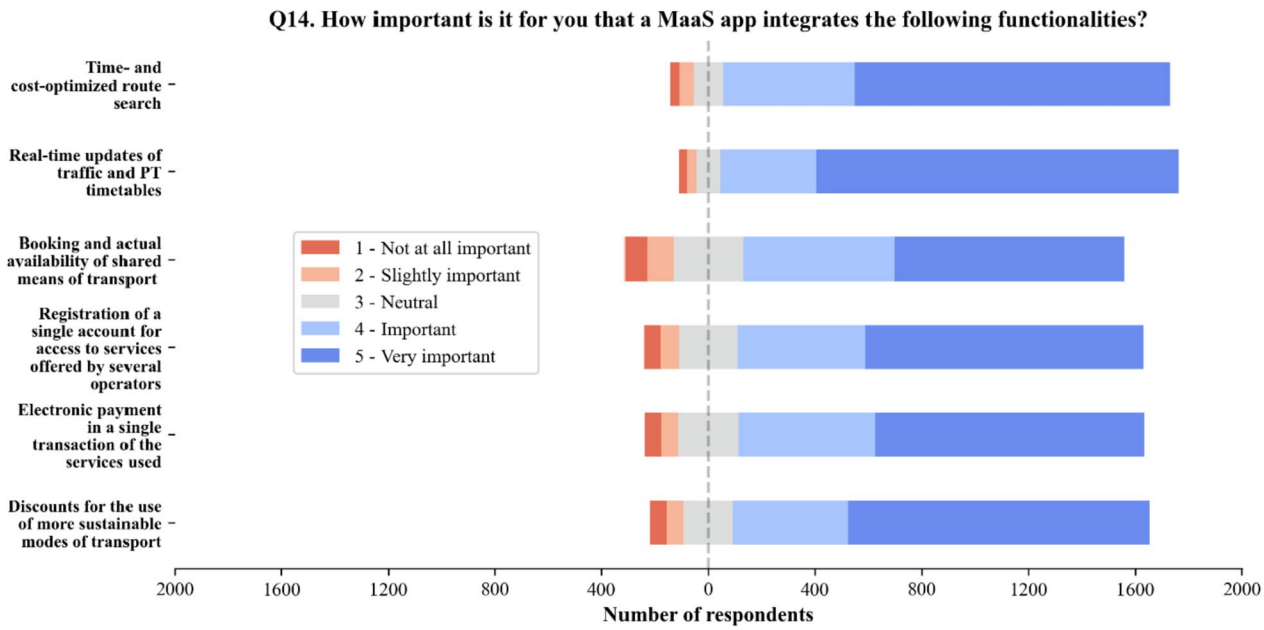


Fig. 6 Perceived importance of integrating certain functionalities into a MaaS platform

suggested with the taxonomy of [54] seem to be desired by potential users, with none emerging above the others.

As regards the respondents' stated interest in the different MaaS bundles, the values in Table 3 report that nearly half of the sample (45.2%) shows no interest in any of the bundles. Bundle 1 is the most popular bundle with 17.3% of respondents interested only in it and an overall 39.3% of respondents interested either only in it or along with one or both of the other two proposed bundles. This indicates a strong preference for active and micro-mobility options among respondents. Bundle 2 has the lowest individual interest (3.0%) and the lowest total interest (23.9%), showing that fewer respondents find car/moped sharing services as an addition to PT appealing. Bundle 3 has a moderate level of interest both individually (9.1%) and in total (24.8%). This suggests that reserved parking

Table 3 Respondents' interest towards the proposed MaaS bundles

	Number of respondents	Percentage of respondents (%)
Not interested in any of the bundles	847	45.2
Interested only in Bundle 1	324	17.3
Interested only in Bundle 2	57	3.0
Interested only in Bundle 3	170	9.1
Interested in Bundle 1 and Bundle 2	180	9.6
Interested in Bundle 1 and Bundle 3	85	4.5
Interested in Bundle 2 and Bundle 3	64	3.4
Interested in all the bundles	146	7.8
Total interest in Bundle 1 (PT + Bike/Scooter sharing)	735	39.3
Total interest in Bundle 2 (PT + Car/Moped-sharing)	447	23.9
Total interest in Bundle 3 (PT + reserved Parking)	465	24.8

lots near subway or railway stations are significant for a specific group of respondents. Only 7.8% of respondents are interested in all three proposed bundles.

In detail, results reported in Table 4 shows that males generally have a higher interest in MaaS bundles than females, particularly with respect to Bundle 1 (43.7% compared to 33.2% of females). Moreover, respondents less than 36 years old are more interested in all bundles than those 36 years old and above. Students have a general higher interest in MaaS bundles than employees. The breakdown by origin zone shows that respondents starting their travels from the Municipality of Milan have a high interest in Bundle 1 (45.2%) and lower interest in Bundle 2 (29.4%) and Bundle 3 (19.0%). On the other hand, respondents coming from the Metropolitan City of Milan and other Provinces have a moderate interest in Bundle 1 and Bundle 3 and a low interest in Bundle 2. Respondents without a private vehicle available exhibit the highest interest in Bundle 1, while those who have access to a private vehicle show the highest interest in Bundle 3. Finally, PT pass non-holders have significantly lower interest in Bundle 1 and a similar interest in Bundle 2 and Bundle 3 compared to PT pass holders.

4.3 Respondents' WTP for MaaS bundles

The charts in Fig. 7 illustrate the distributions of respondents' WTP for each MaaS bundle by different origins (Municipality of Milan, Metropolitan City of Milan, and other Provinces) of their travel to reach the university. The distributions are shown separately for PT pass holders and non-holders to highlight any variations in preferences, as these bundles mainly consist of integrating PT with ancillary mobility services. Moreover, the distinction by origin zone is necessary because the current cost for an urban or regional PT pass increases if it is valid over a larger area.

The first point of each line corresponds to the percentage of respondents who are not interested in a certain bundle. Subsequently, the points correspond to the percentage of interested users according to the additional percentage (for PT pass holders) or the amount (for PT pass non-holders) they would be willing to pay for that bundle. As previously discussed, across all bundles and respondent groups, there is a high initial percentage of respondents not interested in paying extra for the bundles. For those interested, the willingness to pay drops sharply as the additional cost increases, with very few respondents willing to pay higher amounts or percentages. The trends are consistent across the Municipality of Milan, the Metropolitan City of Milan, and other Provinces, indicating similar preferences irrespective of origin zones. The exceptions are PT pass holders' WTP for Bundle 1, which is significantly higher for those residing in the Municipality of Milan, and PT pass non-holders' WTP for Bundle 3, which is significantly higher for those residing in the Metropolitan City of Milan or other Provinces.

Table 5 provides a comparison of the estimated average WTP for the proposed MaaS bundles among different groups of respondents (i.e. by origin zone and PT pass ownership). In all cases, PT pass holders are willing to pay more for the MaaS bundles compared to non-holders, which may suggest that those already investing in PT see greater value in enhanced mobility options, as also highlighted in [24]. The additional percentage that PT pass holders are willing to pay hovers around 20%, which equates to a perceived value of the bundles of about 330 € for those residing in the Municipality of Milan, 680 € for those residing in the Metropolitan City of Milan, and 1135 € for those residing in other Provinces. Although respondents' WTP from outside the Municipality of Milan is also higher than the current PT pass costs, the

Table 4 Respondents' interest towards the proposed MaaS bundles, by socioeconomic characteristics and travel habits

		Bundle 1	Bundle 2	Bundle 3
Gender				
Male	Not interested	608 (56.3%)	800 (74.1%)	808 (74.8%)
	Interested	472 (43.7%)	280 (25.9%)	272 (25.2%)
Female	Not interested	530 (66.8%)	626 (78.9%)	600 (75.7%)
	Interested	263 (33.2%)	167 (21.1%)	193 (24.3%)
Age group				
Less than 36 years old	Not interested	676 (54.9%)	907 (73.7%)	903 (73.4%)
	Interested	555 (45.1%)	324 (26.3%)	328 (26.6%)
Greater than or equal to 36 years old	Not interested	462 (72.0%)	519 (80.8%)	505 (78.7%)
	Interested	180 (28.0%)	123 (19.2%)	137 (21.3%)
Occupation				
Student	Not interested	461 (58.8%)	584 (74.5%)	565 (72.1%)
	Interested	323 (41.2%)	200 (25.5%)	219 (27.9%)
Employee	Not interested	677 (62.2%)	842 (77.3%)	843 (77.4%)
	Interested	412 (37.8%)	247 (22.7%)	246 (22.6%)
Origin zone				
Municipality of Milan	Not interested	493 (54.8%)	635 (70.6%)	728 (81.0%)
	Interested	406 (45.2%)	264 (29.4%)	171 (19.0%)
Metropolitan City of Milan	Not interested	210 (64.8%)	251 (77.5%)	224 (69.1%)
	Interested	114 (35.2%)	73 (22.5%)	100 (30.9%)
Other Provinces	Not interested	435 (66.9%)	540 (83.1%)	456 (70.2%)
	Interested	215 (33.1%)	110 (16.9%)	194 (29.8%)
Availability of a private vehicle				
Yes, always	Not interested	369 (68.6%)	405 (75.3%)	350 (65.1%)
	Interested	169 (31.4%)	133 (24.7%)	188 (34.9%)
Sometimes, because I share it with others	Not interested	139 (60.2%)	175 (75.8%)	150 (64.9%)
	Interested	92 (39.8%)	56 (24.2%)	81 (35.1%)
No, never	Not interested	630 (57.1%)	846 (76.6%)	908 (82.2%)
	Interested	474 (42.9%)	258 (23.4%)	196 (17.8%)
Ownership of a PT pass				
Yes	Not interested	835 (58.2%)	1097 (76.5%)	1078 (75.2%)
	Interested	599 (41.8%)	337 (23.5%)	356 (24.8%)
No	Not interested	303 (69.0%)	329 (74.9%)	330 (75.2%)
	Interested	136 (31.0%)	110 (25.1%)	109 (24.8%)

increase is less pronounced compared to those residing in the Municipality of Milan. This might reflect the difference in the availability of shared mobility services in these regions. The perceived value of the bundles by PT pass non-holders varies more modestly, ranging from 266 to 363 € depending on the bundle and the respondents' origin.

5 Discussion

Recent MaaS applications have often struggled to succeed due to the challenge of achieving a balanced alignment between the demand for MaaS platforms that meet users' preferences and needs and the supply of integrated mobility packages that ensure the financial sustainability of businesses [20, 36, 37]. Focusing on specific communities, such as university members, may offer a valuable starting point for achieving this balance.

University campuses are considered ideal living hubs for the market penetration of MaaS platforms within cities for several reasons. First, they bring together students, faculty members and technical-administrative staff with diverse commuting patterns that align well with the concept of MaaS, which emphasizes customization and flexibility [16, 33]. By embracing MaaS, universities could better address the varied mobility needs of their community members. Secondly, university populations tend to

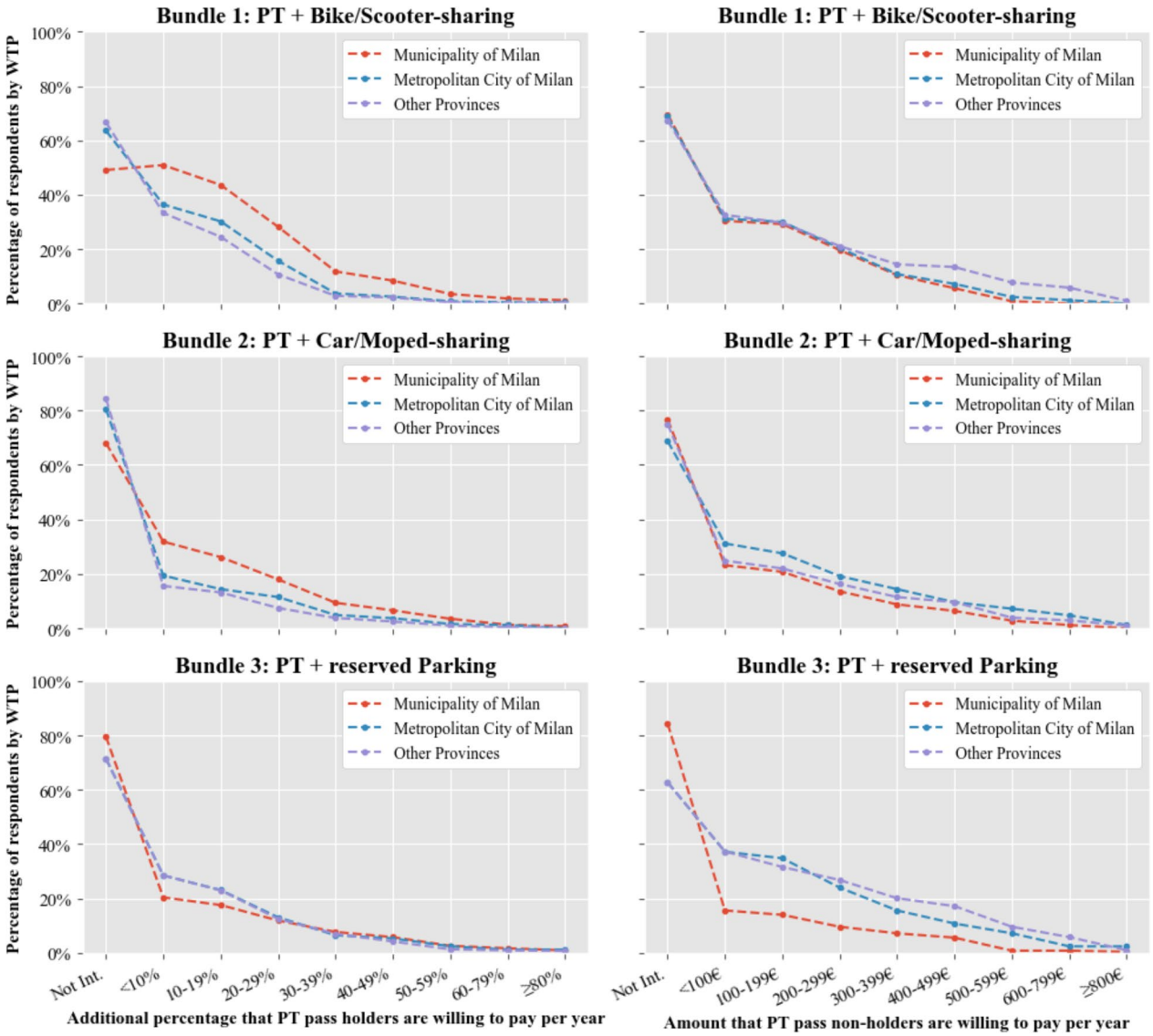


Fig. 7 WTP distributions of the full sample by MaaS bundle type, origin zone, and PT pass ownership

Table 5 Estimated average WTP by bundle type and respondents

Subsample	Bundle 1: PT + Bike/Scooter sharing		Bundle 2: PT + Car/Moped sharing		Bundle 3: PT + reserved Parking	
	PT pass holders	PT pass non-holders	PT pass holders	PT pass non-holders	PT pass holders	PT pass non-holders
Municipality of Milan	326 € (+ 22.0%)	266 €	323 € (+ 20.9%)	284 €	343 € (+ 28.3%)	304 €
Metropolitan City of Milan	675 € (+ 17.5%)	283 €	699 € (+ 21.8%)	335 €	687 € (+ 19.7%)	327 €
Other Provinces	1121 € (+ 18.1%)	321 €	1152 € (+ 21.3%)	333 €	1140 € (+ 20.1%)	363 €

The percentage increase in parentheses relates to the current cost of the PT pass

be more tech-savvy and open to adopting innovative digital mobility solutions [30]. Moreover, university members have a higher-than-average environmental awareness and seek sustainable transport options [32]. MaaS could facilitate access to a range of eco-friendly modes of transport, such as shared electric bikes, scooters, mopeds and cars, aligning with the values of these communities and contributing to the growth of sustainable mobility operators. Finally, MaaS could help people with tight budgets (e.g. students) to save money by providing access to cost-effective transport options, such as a combination of PT and shared mobility services, with integrated and discounted fares [4, 38].

Nevertheless, the results of this study do not clearly indicate whether a MaaS platform could provide a variety of benefits to university members, making it a compelling proposition. In fact, while MaaS has the potential to offer cost-effective, flexible, and eco-friendly transport solutions tailored to the needs of a university community, the findings of this research suggest that these benefits may not be universally perceived or recognized by all users. Differences in commuting patterns, transport preferences, and levels of engagement with digital mobility solutions may limit the MaaS platforms' appeal or effectiveness for certain segments within the university.

In addition to aligning with many results from existing studies on the general population (rather than on specific demand subgroups), this research also reveals significant differences that shed light on the shades of users' preferences and willingness to pay for MaaS solutions across diverse user groups. These discrepancies suggest that generalized approaches to designing MaaS bundles may overlook the varied mobility needs present within different segments of the population.

Particularly, the following are the findings consistent with other existing studies in literature. For instance, unlimited access to public transport emerges as a crucial component of a MaaS bundle, aligning with studies by [1, 6, 10, 39, 55]. In metropolitan areas with extensive public transport coverage and high service quality, PT-oriented bundles hold significant appeal for users [18, 29]. Furthermore, younger individuals are more likely to subscribe to MaaS bundles than older demographics, a trend also noted by [17, 23]. Additionally, as observed in [5, 43], males generally exhibit a higher level of interest in MaaS bundles than females. Another trend consistent with previous studies is that private vehicle owners demonstrate the greatest interest in bundling public transport with reserved parking at interchange facilities, as indicated by [5]. Similarly, PT users show strong interest in combining public transport with shared mobility services, as reported by [2, 43]. Additionally, university students appear more likely to subscribe to MaaS bundles compared to workers, an observation consistent with findings from [24].

However, the present study diverges from prior research on some important aspects, which provides new insights into MaaS adoption patterns. For example, contrary to findings by [23], this research reveals that MaaS bundles are particularly attractive to individuals who are already public transport users, suggesting a stronger inclination towards MaaS adoption within this group than previously reported. Moreover, in contrast to the findings of [8, 35], it is observed that users' WTP for MaaS bundles is, on average, higher than their current mobility expenses, with the exception of individuals who do not own a PT pass. This discrepancy implies that PT users perceive MaaS bundles as offering significant added value and suggests that in communities already heavily oriented towards public transport usage (such as the one in this study), PT-based MaaS bundles could be marketed effectively, even at price points that ensure the economic sustainability of the service offering. In fact, given the established reliance on public transport, users in these communities are likely to recognize the added value of integrated MaaS bundles, perceiving them as an enhancement to their existing mobility routines rather than an entirely new or optional service.

5.1 Study limitations and research perspectives

The present research provides findings on the preferences of a specific university community, yet generalizing these results to other academic settings requires caution. Each university has unique characteristics, such as location, transport infrastructure, and demographic composition, that can significantly affect preferences for MaaS bundles. Nevertheless, the methodology remains applicable to similar studies across diverse academic contexts. Replicating this approach at other universities could yield comparable insights; accordingly, the questionnaire of the SP survey of this study has been included in Appendix A to support such efforts.

Furthermore, this study focuses on the adoption potential and value perception of MaaS bundles specifically for university-related commuting. While this scope provides an understanding of the mobility preferences and needs of university commuters, it does present limitations in terms of generalizing these findings to other types of trips, such as non-routine travel or leisure activities. Research indicates that users often choose transport modes based on trip purposes [11]. For instance, [42] show that public transport is predominantly used for regular commuting, while options like car-sharing are more commonly reserved for occasional trips. Other authors have found that usage varies based on the specific service model provided. Becker et al. [7] and Shaheen and

Chan [52] reported that station-based and one-way car sharing is frequently used for commuting and tends to complement PT services by facilitating first- and last-mile connections. In contrast, free-floating and round-trip car sharing is seen as a flexible alternative that can substitute for PT on occasional trips, especially at night or in poor weather conditions [13, 34]. Thus, the relationship between PT and shared mobility services is complex, influenced by local conditions and provided service model. This suggests, however, that the appeal and willingness to pay for MaaS bundles may vary considerably when other types of travel are considered. If the scope were broadened beyond commuting trips, it is likely that a more diverse set of preferences would emerge, potentially increasing the demand for flexible, multimodal MaaS bundles. Such bundles could better accommodate a wider range of mobility needs, reflecting the full scope of users' daily lives. Future studies should consider this expanded focus to provide a comprehensive view of MaaS bundle viability across various travel purposes.

Finally, the survey underpinning this research was conducted at a time when no MaaS providers were operating in the metropolitan area of Milan. Now that five operators are actively offering pay-as-you-go MaaS solutions in the city, it would be valuable to repeat the SP survey to assess whether exposure to MaaS platforms has made the public more familiar with the fundamental concepts, functioning, and benefits of MaaS solutions. Such a follow-up study could reveal whether firsthand experience with MaaS has influenced public perceptions, potentially increasing both understanding and acceptance of these innovative mobility options. Additionally, future research should explore the interest and willingness to pay for pay-as-you-go MaaS solutions rather than subscription-based models. In so doing, MaaS could provide users with greater flexibility by allowing them to pay only for the transport services they actually use, attracting more people who would prefer to make occasional use of MaaS platforms, such as those who occasionally have access to their own car or moped.

5.2 Policy implications

Based on the evidence from this study, it may be argued that the university demand segments most inclined to adopt MaaS bundles are those who perceive its potential to improve their access/egress conditions to public transport hubs (e.g. metro and train stations) through shared mobility options, whether they involve micro-mobility (in urban areas) or road vehicles (in suburban areas). This also includes those residing in peripherical and rural areas not covered by shared mobility services, who mainly need park-and-ride facilities near major mass rapid transit stations.

Despite that, on the one hand, the high percentage of individuals not interested in any bundle (45.2%) highlights a potential challenge in convincing a large segment of the university population to adopt mobility service packages. This may be due to the fact that a significant portion of the respondents is either satisfied with their current transport options or uninterested in the provided bundles, as these may not fully align with their needs. On the other hand, the interest in two or more bundles (25.3%) indicates that a multi-faceted approach to integrated transport solutions could attract more users. MaaS providers should consider exploring combined bundle options that more effectively meet respondents' diverse preferences and improve the overall appeal of MaaS. For example, users living in more rural areas might be interested in a bundle that allows them to drive their private car for the initial segment of the trip, park and ride (take public transport, such as a metro or suburban train) to enter the city of Milan, and finally use shared bikes or e-scooters for the last mile to reach their destination.

Additionally, the study reveals notable preference heterogeneity in how the proposed MaaS bundles are perceived in terms of value. Since the current average cost of the PT pass borne by respondents residing in the Municipality of Milan is 267 €, while it is 574 € for those residing in the wider Metropolitan City of Milan, and 949 € for those residing in other Provinces, two considerations can be made:

1. The average WTP of PT pass holders is higher than what they currently pay. This suggests that PT pass holders see substantial value in the integration of ancillary services in their current subscription, indicating a positive reception to the proposed multimodal bundled solutions. However, it would be necessary to identify what price can be considered feasible by the transport operators involved in the fare integration of services.
2. The average WTP of PT pass non-holders is significantly lower than the current average cost incurred by PT pass holders. This is probably due to a misperception of the value offered by the bundles and an underestimation of the transport costs incurred by those who currently use private vehicles and do not hold a PT pass. Hence, awareness campaigns, additional incentives, government subsidies, or introductory pricing strategies might be necessary to attract this group.

Therefore, for MaaS to achieve large-scale success, it must remain cost-competitive, as willingness to pay is relatively low among PT pass holders and even lower among non-holders when compared to current mobility

expenses. Existing research by [35] also highlights uncertainties around WTP estimation accuracy, noting that users' limited awareness of their actual mobility costs may skew their WTP. These uncertainties suggest that WTP estimates should be interpreted cautiously, as they may not fully capture users' actual financial commitment to MaaS bundles.

6 Conclusions

This study contributes to the literature on MaaS bundles adoption by shedding light on the interest and willingness to pay among potential users within the university community of Politecnico di Milano, Italy. By focusing on this group, the research uncovers underexplored demand segments and preferences that can inform more effective transport policies and business strategies. The research demonstrated a favorable attitude among university community members (students, faculty members and technical-administrative staff) towards MaaS bundles, particularly among PT pass holders, signifying their willingness to pay more for enhanced transport options. However, for PT pass non-holders, further strategies are needed to increase their adoption rates. Addressing these differences through tailored pricing and policy measures can help successfully implement multimodal transport solutions that cater to diverse user needs and preferences. Future research could expand on these findings by exploring long-term behavioral changes associated with MaaS adoption, particularly as more providers enter the market and users become more familiar with these platforms. Additionally, studying other community segments beyond universities could provide further insights into MaaS platforms' broader applicability, contributing to a more inclusive and adaptable urban mobility ecosystem.

Appendix A: Questionnaire of the survey

Q1. Which is your role at Politecnico di Milano?

Bachelor student	Master student	PhD student/Research Associate/Research Fellow	Professor/Researcher	Technical-Administrative staff	Other
☐	☐	☐	☐	☐	☐

Q2. How many times a week do you go to university on average?

Once or less	Twice	Three times	Four times	Five times or more
☐	☐	☐	☐	☐

Q3. Where do you generally start your journey to university?

Municipality of Milano	Metropolitan City of Milan	Bergamo (Municipality or Province)	Brescia (Municipality or Province)	Como (Municipality or Province)	Cremona (Municipality or Province)	Lecco (Municipality or Province)
☐	☐	☐	☐	☐	☐	☐

Lodi (Municipality or Province)	Monza e Brianza (Municipality or Province)	Novara (Municipality or Province)	Pavia (Municipality or Province)	Piacenza (Municipality or Province)	Varese (Municipality or Province)	Other (specify)
☐	☐	☐	☐	☐	☐	_____

Q4. Where do you generally end your journey to university?

Milano Bovisa campus	Milano Leonardo campus	Cremona campus	Lecco campus	Mantova campus	Piacenza campus
☐	☐	☐	☐	☐	☐

Q5. Do you have available your own car/moped to get to the university?

Yes, always	Sometimes, because I share it with family members or others	No, never
☐	☐	☐

Q6. Starting from home, which of the following transportation modes of transport do you mainly use during this period?

	On foot	Bus, Tram or Metro	Train	Private car/moped (as a driver or a passenger)	Shared car/moped (as a driver or a passenger)	Private bike/ scooter	Shared bike/ scooter
1st leg/unique	☐	☐	☐	☐	☐	☐	☐
2nd leg	☐	☐	☐	☐	☐	☐	☐
3rd leg	☐	☐	☐	☐	☐	☐	☐
4th leg	☐	☐	☐	☐	☐	☐	☐
5th leg	☐	☐	☐	☐	☐	☐	☐
6th leg	☐	☐	☐	☐	☐	☐	☐
7th leg	☐	☐	☐	☐	☐	☐	☐

Q7. Does the choice of the used transportation modes change according to the season?

Yes	No
☐	☐

Q8. How important are the following factors in choosing the transportation modes for your home-university journey?

	1—Not at all important	2—Slightly important	3—Neutral	4—Important	5—Very important
Monetary cost	☐	☐	☐	☐	☐
Travel time	☐	☐	☐	☐	☐
Comfort	☐	☐	☐	☐	☐
Safety	☐	☐	☐	☐	☐
Environmental sustainability	☐	☐	☐	☐	☐
Wellness / Physical activity	☐	☐	☐	☐	☐

Q9. Are you fully satisfied with the different transportation modes used to reach university?

Yes	No
☐	☐

Q10. Before going to university, do you plan your journey using smartphone apps?

1—Never	2—Rarely	3—Sometimes	4—Often	5—Always
☐	☐	☐	☐	☐

Q11. During the trip, do you use smartphone apps to check congestion levels or possible delays of PT services?

1—Never	2—Rarely	3—Sometimes	4—Often	5—Always
☐	☐	☐	☐	☐

Q12. While traveling to the university, in case of traffic or delay, do you use smartphone apps to re-plan and change your route?

1—Never	2—Rarely	3—Sometimes	4—Often	5—Always
☐	☐	☐	☐	☐

Q13. How important is it for you that a MaaS app integrates the following transportation modes?

	1—Not at all important	2—Slightly important	3—Neutral	4—Important	5—Very important
Car sharing	☐	☐	☐	☐	☐
Car pooling	☐	☐	☐	☐	☐
Moped sharing	☐	☐	☐	☐	☐
Public Transport	☐	☐	☐	☐	☐
Bike sharing	☐	☐	☐	☐	☐
Scooter sharing	☐	☐	☐	☐	☐
Taxi	☐	☐	☐	☐	☐

Q14. How important is it for you that a MaaS app integrates the following functionalities?

	1—Not at all important	2—Slightly important	3—Neutral	4—Important	5—Very important
Time- and cost-optimized route search	☐	☐	☐	☐	☐
Real-time updates of traffic and PT timetables	☐	☐	☐	☐	☐
Booking and actual availability of shared means of transport	☐	☐	☐	☐	☐
Registration of a single account for access to services offered by several operators	☐	☐	☐	☐	☐
Electronic payment in a single transaction of the services used	☐	☐	☐	☐	☐
Discounts for the use of more sustainable modes of transport	☐	☐	☐	☐	☐

Q15. If there is a MaaS app that offer all the above-described functionality, how often would you use it to…

	1—Never	2—Rarely	3—Sometimes	4—Often	5—Always
…travel to the university	☐	☐	☐	☐	☐
…undertake other travels (leisure, shopping)	☐	☐	☐	☐	☐

Q16. Which of the following MaaS solutions would you prefer?

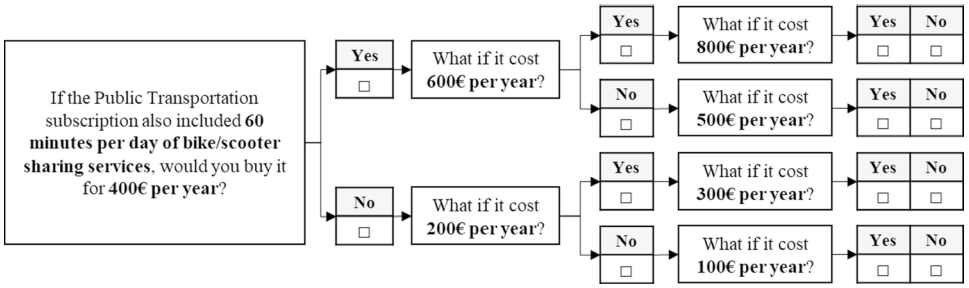
Pay-as-you-Go	Subscription to a bundle
☐	☐

Q17. Do you have a PT pass?

No	Yes, an urban pass	Yes, a regional pass
☐	☐	☐

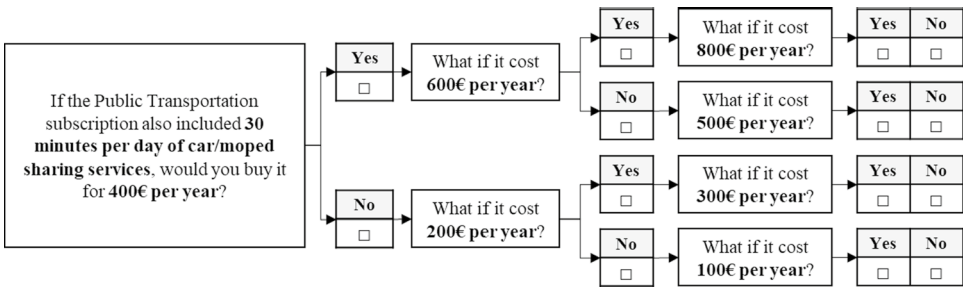
Q18. Only in case the answer to Q17 is "No": Would you be interested in purchasing a MaaS bundle consisting of PT and bike/scooter-sharing services?

Yes	No
☐ → if the answer is "Yes", go to the choice tree	☐ → if the answer is "No", skip to the next question

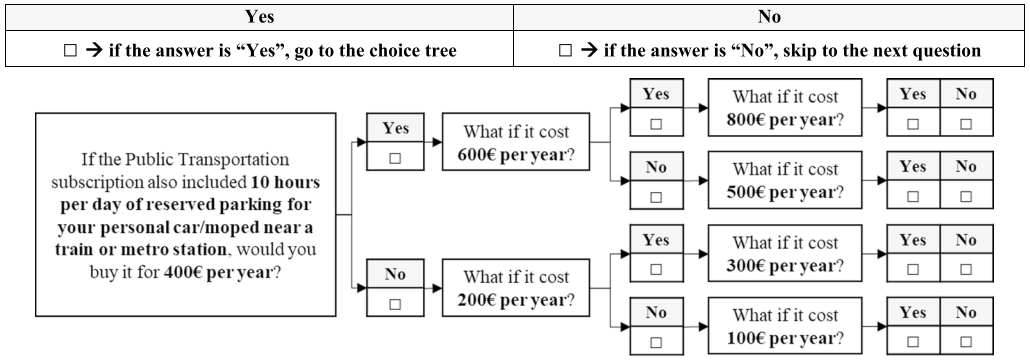


Q19. Only in case the answer to Q17 is "No": Would you be interested in purchasing a MaaS bundle consisting of PT and car/moped-sharing services?

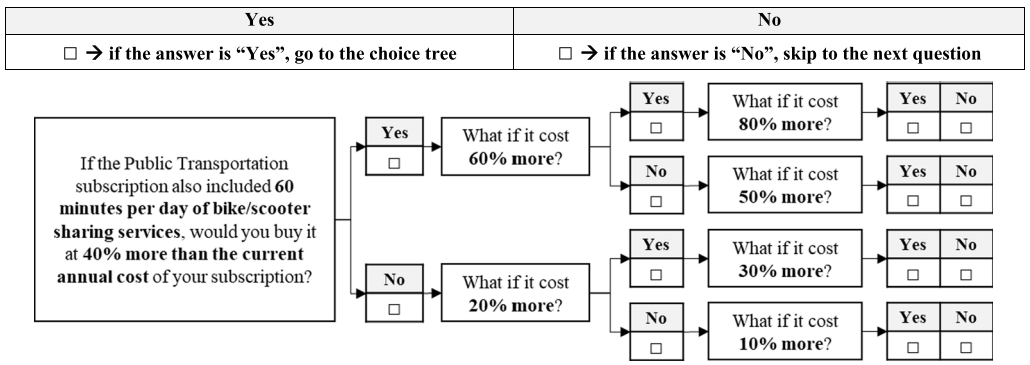
Yes	No
☐ → if the answer is "Yes", go to the choice tree	☐ → if the answer is "No", skip to the next question



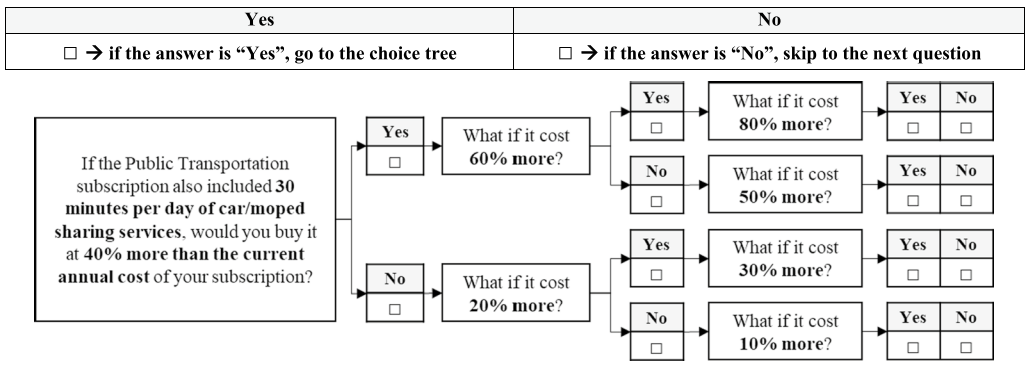
Q20. Only in case the answer to Q17 is "No": Would you be interested in purchasing a MaaS bundle consisting of PT and reserved parking lots near stations or stops?



Q21. Only in case the answer to Q17 is "Yes": Would you be interested in purchasing a MaaS bundle consisting of PT and bike/scooter-sharing services?

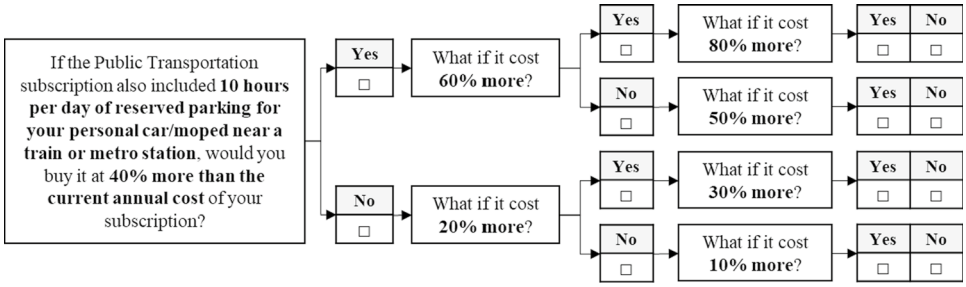


Q22. Only in case the answer to Q17 is "Yes": Would you be interested in purchasing a MaaS bundle consisting of PT and car/moped-sharing services?



Q23. Only in case the answer to Q17 is "Yes": Would you be interested in purchasing a MaaS bundle consisting of PT and reserved parking lots near subway or railway stations?

Yes	No
☐ → if the answer is "Yes", go to the choice tree	☐ → if the answer is "No", skip to the next question



Q24. Which is your gender?

Male	Female	Non-binary	I prefer to not answer	Other
☐	☐	☐	☐	☐

Q25. Which age-group do you belong to?

< 26 years	26–35 years	36–45 years	46–55 years	56–65 years	> 65 years
☐	☐	☐	☐	☐	☐

Q26. What is your household condition?

Single	With parents and/or siblings	With colleagues and/or friends	With partner and/or children
☐	☐	☐	☐

Q27. What is your highest educational level already acquired?

None	Primary school certificate	Secondary school certificate	High school diploma	Bachelor's degree	Master's degree	Doctor of Philosophy
☐	☐	☐	☐	☐	☐	☐

Q28. What is your working condition?

Student	Part-time worker	Full-time worker	Unoccupied/Inactive	Retired	Other
☐	☐	☐	☐	☐	☐

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Author contributions
All authors reviewed the results and approved the final version of the manuscript. The contribution to the paper is as follows. Fulvio Silvestri: Formal analysis, Investigation, Methodology, Validation, Visualization, Writing—original draft. Federico Silvestri: Data curation, Formal analysis, Writing—original draft. Pierluigi Coppola: Conceptualization, Supervision, Writing—review and editing.

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Availability of data and materials
Most datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Competing interests
The authors declare that they have no competing interests.

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