

# Mobility as a service (MaaS) adoption: Assessing heterogeneity across university communities

Fulvio Silvestri<sup>a,\*</sup>, Valentina Costa<sup>b</sup>, Luca Pastorelli<sup>a</sup>

<sup>a</sup> Politecnico di Milano, Department of Mechanical Engineering, Via Giuseppe La Masa 1, 20156, Milano Italy

<sup>b</sup> Università di Genova, Centro Italiano di Eccellenza sulla Logistica, i Trasporti e le Infrastrutture (CIELI), Via Francesco Vivaldi, 5, 16126 Genova, Italy

## ARTICLE INFO

### Keywords:

Stated intentions survey  
Discrete choice analysis  
Behavioral models  
Ordered logit  
User acceptance  
Willingness to adopt

## ABSTRACT

This study investigates the willingness to adopt (WTA) Mobility as a Service (MaaS) solutions among members of Italian university communities, based on over 4000 responses collected through two survey campaigns at the Politecnico di Milano and the University of Genoa. Ordered logit models were estimated to assess the influence of socio-demographic characteristics, travel habits, and individual perceptions on MaaS adoption. Identified key determinants include travelers' satisfaction with current transport options, which is negatively associated with WTA, in line with existing findings that satisfied users are less likely to change travel behavior. Results partially align with prior studies that identify private car ownership as a barrier. Use of journey planning apps is positively associated with MaaS adoption, reinforcing prior research on the importance of digital familiarity. This study also presents findings that diverge from previous literature: age does not significantly influence WTA, and services such as bike sharing and car sharing do not yield measurable utility in the adoption decision. The analysis reveals substantial heterogeneity in preferences both across and within the two university contexts, as confirmed by the significance of several random parameters capturing individual-level variation. These results underscore the importance of developing flexible, context-sensitive MaaS strategies. Given the diversity of preferences and influencing factors, a one-size-fits-all approach is unlikely to be effective.

## 1. Introduction

Mobility as a Service (MaaS) has been identified as a strategical tool to support the digital and green transition of urban transport systems [1]. The availability of a one-stop-shop solution that facilitates multi-modal travel planning, booking and purchasing has been recognized as a significant driver for promoting modal shifts toward sustainable modes of transport [2,3]. Nevertheless, as highlighted by de Viet and Molin [4], Zhang and Zhang [5] and Pritchard [6], achieving a shared vision regarding these outcomes remains elusive, and the potential benefits for the green transition of transport systems continue to be debated. Furthermore, large-scale MaaS implementations have faced persistent challenges for nearly a decade [7], despite relevant exceptions worldwide – with Helsinki, Finland, standing out as a prominent example, albeit also a striking case of bankruptcy [8]. Additionally, the Covid-19 pandemic posed a significant setback in advancing these initiatives [9].

Relevant barriers to MaaS planning and implementation have been identified across several dimensions [10], including institutional,

regulatory, social, technical, and financial aspects. As Karlsson et al. [11] highlighted, institutional commitment on both the legislative and financial fronts proves to be necessary to develop structured MaaS-related initiatives: a coherent policy framework and dedicated resources [12] are essential prerequisites.

In this direction, several steps have been taken within the Italian context to foster and support the implementation of similar actions. In 2021, the Italian National Recovery and Resilience Plan (namely, PNRR – *Piano Nazionale di Ripresa e Resilienza*) [13] –launched as part of the NextGeneration EU (NGEU) initiative to support post-Covid19 pandemic recovery– included a relevant MaaS-related action: the “Mobility as a Service for Italy” project [14]. The main concept was to engage and coordinate Metropolitan Areas and Regions in the implementation of MaaS pilots. This action represented the first spark for progressive institutional commitment. A public consultation process was subsequently launched to gather technical data and information on the implementation of a national open back-end platform, the so-called *Data Sharing and Service Repository Facilities* (DS&SRF), to deliver digital services to MaaS Operators and transport providers, thus supporting

\* Corresponding author.

E-mail addresses: [fulvio.silvestri@polimi.it](mailto:fulvio.silvestri@polimi.it) (F. Silvestri), [valentina.costa@edu.unige.it](mailto:valentina.costa@edu.unige.it) (V. Costa), [luca.pastorelli@polimi.it](mailto:luca.pastorelli@polimi.it) (L. Pastorelli).

MaaS for Italy pilots' integration and data-sharing. As for the DS&SRF, necessary prerequisites were investigated in terms of [15]: i. Platform design and digital development; ii. Level of service; iii. User account management; iv. Secure and automated interactions among operators and with Public Administrations; v. Transport and mobility data standardization; vi. Fares-related data; vii. Travel planning support; viii. Travel confirmation and registration processes; ix. Performance monitoring.

The results of the consultation finally led to the definition of multiple scenarios regarding data-sharing among the partners involved and the potential to modify and integrate platform architecture. Moreover, the establishment of a National Access Point (NAP) to deliver open mobility and transport data, in compliance with European Union legislation requirements [16], as well as the progressive standardization of data collection based on the NeTeX profile [17], created favorable conditions for widespread and effective implementation [18].

Nevertheless, it should be highlighted that, given the novelty of the solution [19], and the significant behavioral changes required by the MaaS paradigm [20], institutional commitment and a coherent framework alone may not be sufficient. Users' willingness to adopt (WTA) may indeed constitute a significant barrier to MaaS implementation and up-scaling [21]. Consequently, a growing interest in users' acceptance has emerged among researchers, focusing on the investigation of the most influential factors [22] affecting MaaS-related choices. In addition to exogenous variables, such as travel features, service quality and urban environment characteristics, users' individual features have proven to be key factors. Specifically, elements such as age [23], gender [24], education [25], as well as ownership of vehicles, public transport (PT) passes or driver's licenses [26], have been identified as pivotal in driving or hindering individuals' WTA MaaS solutions.

In this regard, several MaaS-related initiatives have been launched in Italy to engage young users [27–29], as they are generally considered more environmentally conscious and open to new experiences [30,31], as well as more prone to embracing innovative technologies [32]. Existing studies suggest that university communities are ideal contexts for such initiatives, as they gather young, highly-educated, environmentally aware, and tech savvy users [33–36]. However, universities remain particularly compelling case studies for MaaS implementation not only due to their demographic characteristics, but also because of their spatial, organizational, and institutional features. University campuses typically have well-defined geographic boundaries, centralized governance structures, and offer several monomodal and multimodal mobility options to commuters [37–39], such as shuttles, bike-sharing schemes, and partnerships with local public transit providers, which make them ideal testbeds for integrated mobility solutions. Moreover, universities are hubs of innovation and research, offering fertile ground for the co-development, monitoring, and iterative improvement of MaaS initiatives. These settings also provide access to a concentrated population of early adopters who can offer meaningful feedback and generate valuable usage data, thereby contributing to the refinement and scalability of MaaS models.

Previous considerations also guided the actions of the Mobility Working Group of the Italian University Network for Sustainable Development (namely, RUS - *Rete delle Università per lo Sviluppo sostenibile*) [40], which gathers 86 Italian universities to promote mobility management strategies and actions. In details, within the RUS institutional initiative to coordinate universities in enabling their respective Mobility Managers to provide dedicated surveys to investigate students and staff mobility behaviors and their willingness to shift to innovative sustainable mobility options – required by Italian legislation [41] in order to define Home-University Commuting Plans (namely, PSCL – Piano degli Spostamenti Casa-Lavoro) – a decision was made to explore the potential interest in the development of MaaS options dedicated to university communities. Such standardization efforts could constitute a relevant opportunity to overcome another research gap concerning university contexts and MaaS: the lack of comparative studies. Since

academic communities are highly unique in terms of size, age groups, and scientific fields, and are often site-specific, they are rarely involved in research studies focusing on user behavior through a comparative approach, unlike what has been done by other scholars [42] for broader urban contexts.

In summary, this research aims to comparatively investigate the WTA MaaS solutions among university community members, focusing on two major institutions in Italy: the University of Genoa (UniGe) and the Politecnico di Milano (PoliMi). This work builds upon previous studies, including Coppola et al. (2025) [31] and Silvestri et al. (2025) [35], which examined the case of Politecnico di Milano in isolation, and Caballini et al. (2022) [43], which offered a territorial comparison across Rome, Turin, and Genoa, although without focusing specifically on university contexts.

The present study addresses this gap by conducting a targeted investigation of MaaS acceptance within academic communities in North-Western Italy. This approach not only extends prior case studies but also aligns with the objectives of the RUS. In fact, this research represents a first step in a broader effort, as the extension of the survey to other Italian universities within the RUS network is currently underway. In doing so, this study aims at developing a more comprehensive understanding of user preferences and to explore potential heterogeneity across different institutional and urban contexts.

This study also contributes to a growing body of international research, such as the works of Kriswardhana and Esztergár-Kiss (2023, 2025) [33,44] at the University of Budapest (Hungary) and Le Pira et al. (2023) at the University of Catania (Italy), which highlight the relevance of local factors in shaping MaaS adoption.

Finally, most existing studies on MaaS adoption in university settings focus primarily on service preferences within predefined MaaS configurations [33], or on users' willingness to share mobility-related data [34]. In contrast, the present work contributes with a comparative analysis aimed at assessing whether and how individual socio-demographic characteristics, travel habits and transport supply-related variables influence users' WTA. Building on the literature that highlights the unique features of university communities, this study seeks to expand current knowledge not only on desired service features within MaaS platforms, but also on broader factors shaping sustainable mobility behavior and MaaS adoption dynamics.

The remainder of the manuscript is structured as follows. **Section 2** examines the key features of the large-scale survey campaigns conducted in both cities, highlighting potential similarities and differences between the two contexts. Additionally, the modeling approach is outlined. In **Section 3**, the collected data are thoroughly analyzed, focusing on the sample composition within each community, and the estimated Ordered Logit models are presented. **Section 4** discusses the findings and the policy implications for MaaS implementation both within and beyond university communities. This section also addresses the study's limitations and suggests directions for future research. **Section 5** provides concluding remarks on the importance of MaaS platforms for communities and their wider impact.

## 2. Materials and methods

### 2.1. Data collection

To assess the willingness of university members to adopt MaaS solutions, sample surveys were conducted among the communities of the University of Genoa and Politecnico di Milano. In terms of community size, UniGe has approximately 39,000 members, including 36,000 students, 1500 professors and researchers, and 1300 technical and administrative employees. Despite the university's presence in all four provinces of the Liguria region, its main campus is located in Genoa and is divided into 22 departments, which can be grouped into three clusters:

- The Eastern cluster encompasses the scientific departments of Engineering, Medical Studies, Chemistry, Physics, and Natural Sciences. This area is less accessible by PT services, as it is located approximately 4 km from the nearest railway station, and it offers a limited but nonetheless significant number of parking options.
- The Central cluster includes the Departments of Architecture and Design, Education, and Psychology. It is well-connected by PT options, including bus alternatives and the metro line. The two main railway stations in the city are located within 1 to 3 km. However, parking facilities are almost non-existent.
- The Western cluster houses the Humanities and Social Sciences departments. This area is located <1 km from one of the main train stations and is well-served by PT services, including buses and the metro line. Park-and-ride facilities are available.

PoliMi community, on the other hand, consists of approximately 60,000 members, of whom 52,000 are students. Its 12 campuses are distributed across six provinces in the Lombardy region, with two located in Milan: Bovisa and Leonardo. Both campuses are centrally located, with Milano Bovisa situated 6 km from Milan Central Station and Milano Leonardo just 2 km away. Both campuses are well-served by PT services, including metro lines, buses, urban railways, and ample parking facilities.

The dispersed layout of UniGe facilities poses a significant challenge to the promotion of a shift toward sustainable mobility compared to PoliMi. In this regard, it is noteworthy to compare Fig. 1, which depicts UniGe, with Fig. 2, illustrating the configuration of PoliMi facilities. This comparison highlights the differences between the two contexts in terms of campus structures and the availability of local transport system. Indeed, PoliMi campuses are well served by PT, while UniGe campuses, due to their dispersed layout, are less accessible by public transport.

Regarding shared mobility services, the city of Genoa relies primarily on two operators: Zena-By-Bike, a municipal station-based bike-sharing

service, and Elettra Car Sharing, a fully electric car-sharing system. Zena-By-Bike stations are mainly concentrated in the city center, while Elettra operates both as a free-floating service within central areas and as a station-based service in peripheral zones. In contrast, the city of Milan offers a significantly broader range of shared mobility services, supported by twelve different providers. These include car sharing, moped sharing, bike sharing, and e-scooter sharing, with coverage that is widespread and relatively uniform across the city. Given the wide availability of shared mobility services in Milan, no substantial differences exist among the PoliMi campuses in terms of access to these services. Similarly, in Genoa, due to the limited overall modal share of shared mobility, campuses are not differentiated based on the supply of such services.

The survey campaigns in Genoa and Milan were conducted during different timeframes. In particular, the survey at PoliMi was conducted first, before the launch of the MaaS for Italy pilot in Milan, from May to June 2023, while the survey at UniGe was conducted in February 2024. The survey collected a total of 2247 responses from individuals affiliated with the University of Genoa and 1873 from the Politecnico di Milano, including faculty members, technical-administrative staff, and students. At UniGe, the sample corresponds to approximately 4 % of the student population (1357 respondents out of 31,631 invited) and 33 % of the employee population (890 out of 2662 invited). At PoliMi, the response rate was approximately 2 % for students (958 out of 49,138 invited) and 15 % for employees (915 out of 6287 invited).

Despite these differences, the surveys shared a similar structure, comprising two main sections: the “Personal details and Travel habits” section aimed to profile respondents according to their socio-economic characteristics, the frequency of their home-university trips, their origin and destination, vehicle availability, and modal choices; the “Stated Intentions” section focused on personal attitudes and interest in shifting to alternative options, such as MaaS solutions, according to different travel purposes, as well as on the perceived usefulness of the



Fig. 1. – Main road network, interchange parking facilities, PT network, and UniGe campuses spread across the city of Genoa (Italy).

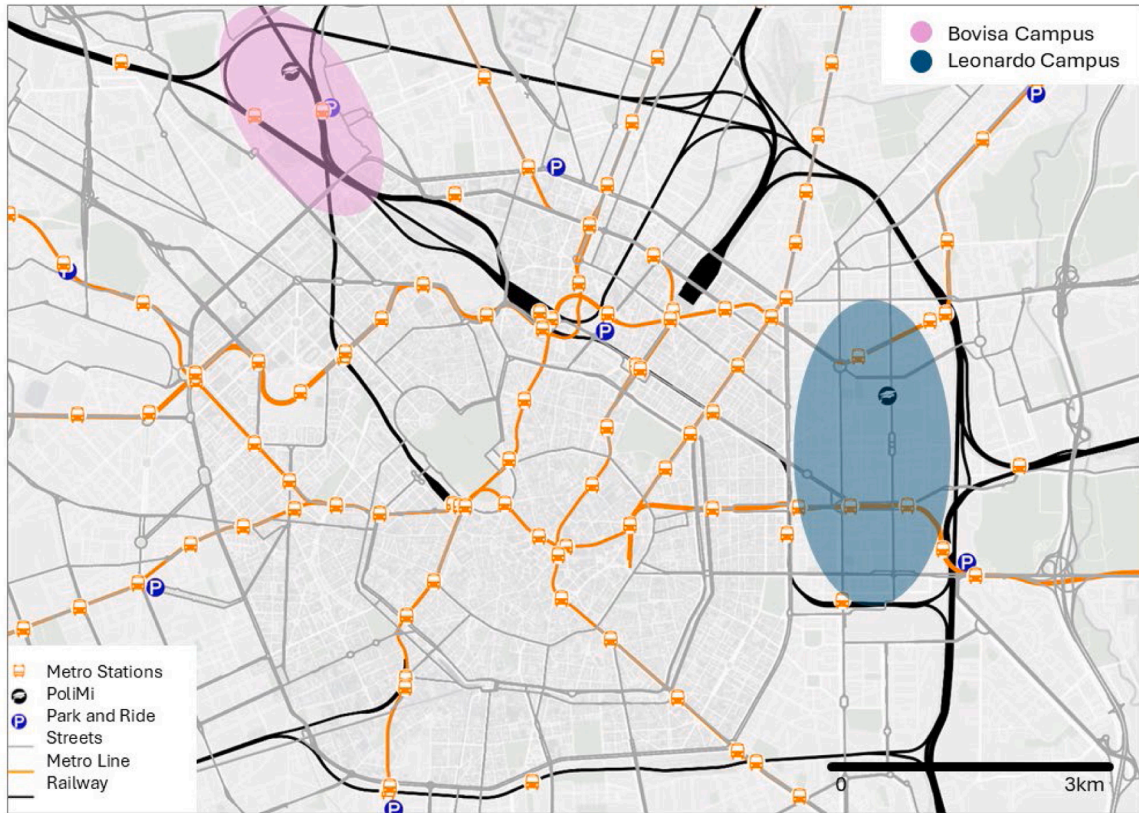


Fig. 2. – Main road network, interchange parking facilities, PT network, and PoliMi campuses spread across the city of Milan (Italy).

functionalities of a MaaS platform. The process followed to define the survey questions to ensure accurate and consistent respondent understanding and a detailed description of the survey design, including its structure, content, and the full questionnaire, is available in a previously published article by the authors [35], where the complete instrument is provided in the appendix.

In both cases, the surveys were distributed using the Computer Assisted Web Interviewing (CAWI) method. Staff members, including both professors, researchers and technical-administrative employees, and students were reached through random sampling via official mailing lists.

## 2.2. Ordered choice analysis

The Stated Intentions section of the survey allowed for the evaluation of individuals' perceptions and attitudes toward MaaS. In particular, the WTA MaaS solutions for traveling for different purposes (i.e. commuting to university or leisure activities) was tested through a specific question requiring responses on a Likert scale from 1-Very Unlikely to 5-Very Likely. After analyzing this aspect through aggregate statistics, to investigate the sociodemographic characteristics and the behavioral intentions that determine willingness to adopt MaaS solution, Ordered Logit Models were estimated. This choice is due to the study's focus on the influence of observable socio-demographic and perception-based variables on users' willingness to adopt MaaS solutions, which is assumed to be shaped primarily by the perceived importance of specific service features. While methods such as latent class analysis or structural equation modeling are typically applied to explore latent attitudes in the context of technology acceptance (e.g., see the studies of Kim and Rasouli, 2022 [45]; Kriswardhana and Esztergár-Kiss, 2025 [46]; Chen and He, 2023 [47]), this research aligns more closely with literature on perceived service quality in mobility systems (e.g., see the works of dell'Olio et al., 2010 [48]; Coppola and Silvestri, 2020 [49]; Eboli and

Mazzulla, 2008 [50]). For this reason, Likert-scale items were used directly as explanatory variables in the analysis rather than constructing latent constructs, and an Ordered Logit Model was adopted as an appropriate method for analyzing their relationship with the ordinal dependent variable.

An Ordered Logit Model is formulated on the basis of a latent random utility function  $y_i^*$  (1), that represents the measure of the observed discrete outcomes  $y_i$ , that in the present case is an ordinal variable from 1 to 5, and a censoring mechanism (2), for each respondent  $i = 1, \dots, n$ :

$$y_i^* = V_i + \epsilon_i = \alpha + \beta_i x_i + \epsilon_i \quad (1)$$

where, on the one hand,  $V_i$  represents the systematic component of utility, given by the intercept  $\alpha$  and the linear combination of  $x_i$ , being the vector of explanatory variables that may influence the choice (i.e. individuals' sociodemographic characteristics, or travel habits, such as age, gender, employment status, education level, origin zone, transfer mode, or travel frequency), and  $\beta_i$ , being the vector of parameters to be estimated associated to the vector of explanatory variables. On the other hand,  $\epsilon_i$  is the continuous random disturbance characterized by a cumulative distribution function  $F(\epsilon_i|x_i) = F(\epsilon_i)$ , being independent from the variables  $x_i$  and following a logistic distribution;

$$\begin{cases} y_i = 1 & \text{if } y_i^* \leq \tau_1, \\ y_i = 2 & \text{if } \tau_1 < y_i^* \leq \tau_2, \\ y_i = 3 & \text{if } \tau_2 < y_i^* \leq \tau_3, \\ y_i = 4 & \text{if } \tau_3 < y_i^* \leq \tau_4, \\ y_i = 5 & \text{if } y_i^* > \tau_4 \end{cases} \quad (2)$$

where the unknown parameters  $\tau_j$ , being  $j = 1, \dots, 4$ , that define the range of values that the measure  $y_i^*$  of the observed variable  $y_i$  could take, are the so-called threshold parameters to be estimated from the

$n$  observations. In the case where fixed parameters are assumed, the associated parameter of the  $k - th$  variable takes on an identical mean value ( $\mu_k$ ) for all respondents  $i$ , and the following holds:

$$\beta_{ik} = \mu_k \tag{3}$$

whereas in the case of random parameters, it is common to estimate parameter weights that vary randomly around the mean, such that:

$$\beta_{ik} = \mu_k + \sigma_k n_{ik} \tag{4}$$

where  $\mu_k$  represents the mean of the distribution of marginal utilities held by the sampled population,  $\sigma_k$  represents a deviation or spread of preferences among sampled respondents around the mean marginal utility, and  $n_{ik}$  represents random draws (e.g. Modified Latin Hypercube Sampling, MLHS, draw method [51]) taken from a pre-specified distribution (e.g. normal distribution) for each respondent  $i$  and explanatory variable  $k$  [52].

The ordered probability associated with the observed outcomes are (5):

$$\begin{aligned} P[y_i = j | x_i] &= P[\tau_{j-1} < y_i^* \leq \tau_j] = P[\tau_{j-1} < \alpha + \beta_i x_i + \varepsilon_i \leq \tau_j] = P[\varepsilon_i \\ &\leq \tau_j - \alpha - \beta_i x_i] - P[\varepsilon_i \leq \tau_{j-1} - \alpha - \beta_i x_i] \\ &= F(\tau_j - \alpha - \beta_i x_i) - F(\tau_{j-1} - \alpha - \beta_i x_i) \end{aligned} \tag{5}$$

For the estimation of parameters, some normalizations are needed to guarantee the positivity of all probabilities and avoid model identification issues:  $\tau_j > \tau_{j-1}$ ;  $\tau_1 = 0$ ;  $Var[\varepsilon_i | x_i] = \frac{\sigma^2}{3}$ . Note that when the parameters are fixed, the Maximum Likelihood (ML) estimation method is used, while when parameters are random, the Simulated Maximum Likelihood (SML) estimation method is employed. The SML allows for the integration over the distribution of the random parameters, enabling the estimation of models that account for unobserved heterogeneity among individuals.

### 3. Results

#### 3.1. Samples statistics

The present section aims at defining the profiles of respondents within the two contexts, with particular attention to the representativeness of the sample in relation to the university population [53] (Table 1).

In terms of gender, respondents from UniGe are primarily female, representing 56 % of the total sample. In contrast, respondents from PoliMi are predominantly male, comprising 61 % of the sample.

**Table 1**  
– PoliMi and UniGe sample statistics, compared to universities population data.

	Variable	Number of respondents		University sample (%)		University population* (%)	
		PoliMi	UniGe	PoliMi	UniGe	PoliMi	UniGe
<b>Gender</b>	Female	723	1265	39 %	56 %	33 %	46 %
	Male	1069	965	61 %	44 %	67 %	54 %
	Other	61	17	–	–	–	–
<b>Age group</b>	<26	836	995	45 %	44 %	91 %	87 %
	26 to 35	389	335	21 %	15 %	5 %	8 %
	36 to 45	175	249	9 %	11 %	1 %	1 %
	46 to 55	260	331	14 %	14 %	1 %	2 %
	56 to 65	159	272	9 %	12 %	1 %	1 %
	>65	34	65	2 %	3 %	< 1 %	1 %
<b>Role in university</b>	Bachelor student	556	742	30 %	33 %	49 %	57 %
	Master student	228	405	12 %	18 %	38 %	29 %
	PhD students, research associates and fellows	334	210	18 %	9 %	4 %	3 %
	Professors and researchers	363	497	20 %	22 %	7 %	7 %
	Technical and administrative staff	372	393	20 %	17 %	2 %	3 %

\* Source: MUR – Italian Ministry of University and Research.

Regarding age, both samples from PoliMi and from UniGe mainly comprise respondents under the age of 26 years, at 45 % and 44 % respectively. Individuals aged between 26 and 35 years constitute 21 % and 15 % of PoliMi and UniGe samples, respectively, while those aged between 36 and 45 years represent 9 % and 11 % of their respective samples. Individuals between 46 and 55 years represent 14 % of the samples in both contexts, while 9 % of PoliMi respondents and 12 % of UniGe respondents are between 56 and 65 years. Finally, individuals aged 65 and above represent 2 % and 3 %, respectively. As regards respondents' roles within their respective university communities, students represent the largest group, comprising 42 % of the sample of PoliMi and 51 % of the sample of UniGe. The majority of students are at the Bachelor level in both cases, representing 30 % of respondents from PoliMi and 33 % of respondents from UniGe. Master students represent 18 % of the sample from UniGe, compared to 12 % of that from PoliMi. Additionally, PhD students, research associates and fellows constitute 18 % of respondents from PoliMi and 9 % of respondents from UniGe. Finally, professors and researchers constitute 20 % of the sample from PoliMi and 22 % of the sample from UniGe, while technical and administrative staff represent 20 % of respondents from PoliMi and 17 % of those from UniGe.

From the comparison between the sample distributions and those of the university populations, it emerges that for both PoliMi and UniGe, the respondents are less skewed towards students and the youngest age group (<26 years old). This, however, benefits the study by providing substantial subsamples for other roles and age groups, allowing for the derivation of robust aggregate and disaggregated statistics. Consequently, the dataset offers a strong foundation for reliable statistical analyses, both at a general level and within specific subgroups, thereby enhancing the credibility and relevance of the findings.

#### 3.2. Travel habits and stated intentions

A deeper investigation was conducted into respondents' travel habits, with a particular emphasis on the specific factors that shape current commuting and transportation choices, compared to mobility behaviors observed in the whole university communities, which are derived from the home-work commute plans of PoliMi [54] and UniGe [55], as reported in Table 2.

Starting with commuting patterns, the majority of respondents, 48 % of the PoliMi sample and 61 % of the UniGe sample, reside within the municipal boundaries of Milan and Genoa respectively, and their daily commutes occur within the cities. Additionally, 17 % and 16 % of respondents commute within the respective metropolitan areas of Milan and Genoa. Lastly, 35 % of respondents from PoliMi and 23 % of respondents from UniGe travel daily from other provinces to university.

**Table 2**  
– PoliMi and UniGe respondents' mobility behaviors, compared to universities population data.

	Variable	Number of respondents		University sample (%)		University population* (%)	
		PoliMi	UniGe	PoliMi	UniGe	PoliMi	UniGe
<b>Origin zone</b>	Municipality	890	1373	48 %	61 %	–	–
	Metropolitan city	323	356	17 %	16 %	–	–
	Other provinces	640	518	35 %	23 %	–	–
<b>Destination campus</b>	Bovisa	656		35 %		–	–
	Leonardo	1197		65 %		–	–
	Western cluster		719		32 %	–	–
	Central cluster		225		10 %	–	–
	Eastern cluster		1146		51 %	–	–
	Other		157		7 %	–	–
	<b>Travel frequency</b>	Once or less	61	116	3 %	5 %	–
	Twice	81	127	4 %	6 %	–	–
	Three times	340	464	18 %	21 %	–	–
	Four times	554	584	30 %	26 %	–	–
	Five times or more	817	956	44 %	43 %	–	–
<b>Private vehicle availability</b>	Yes	759	1641	41 %	73 %	–	–
	No	1094	606	59 %	27 %	–	–
<b>Transport mode</b>	Public Transport	1358	1160	73 %	52 %	72 %	69 %
	Car/Moped	207	899	11 %	40 %	13 %	20 %
	Foot	113	157	6 %	7 %	9 %	9 %
	Bike/Scooter	146	27	8 %	1 %	6 %	2 %
	Car Sharing	15	4	< 1 %	< 1 %	< 1 %	< 1 %
	Bike/Scooter Sharing	14	–	< 1 %	< 1 %	< 1 %	< 1 %
	<b>Transport mode seasonality</b>	Yes	306	38	17 %	2 %	–
	No	1547	2209	83 %	98 %	–	–
<b>Transport options satisfaction</b>	Yes	902	637	49 %	28 %	–	–
	No	951	1610	51 %	72 %	–	–
<b>Interest in bundles</b>	Yes	1014	239	55 %	11 %	–	–
	No	839	2008	45 %	89 %	–	–

\* Source: Home-work commute plan (namely, PSCL – Piano Spostamenti Casa-Lavoro) of PoliMi and UniGe.

Regarding the university campus destinations, PoliMi commuter flows are more polarized, in line with the campus structure mentioned above. Specifically, commuters are divided between the two main destinations: 35 % of respondents travel to the Milano Bovisa campus, while the remaining 65 % travel to Milano Leonardo, which is closer to the city center. In contrast, the dispersed nature of UniGe campus structure leads to more diversified travel patterns. Most respondents (51 %) travel to the “Eastern Cluster”, which includes the Faculties of Engineering, Medicine, and Natural Science. Additionally, 32 % of the sample of UniGe commute to the “Western Cluster”, where the Faculties of Social Sciences and Humanities are located. Meanwhile, 10 % of UniGe respondents travel to the “Central Cluster”, which includes the Faculties of Architecture and Design, Education, and Psychology, as well as the main administrative offices. The remaining 7 % of the sample commute to other campuses outside of Genoa. In terms of travel frequency during a typical week, the results show a relatively homogeneous distribution between the two contexts. Approximately 30 % of PoliMi respondents and 26 % of UniGe respondents travel to university 4 days a week, while 20 % and 17 % of respondents do so 3 days a week. Finally, the percentage of people who travel to university once or twice a week ranges between 3 % and 6 %. Regarding vehicle availability, 41 % of PoliMi respondents stated that they have access to a private car/moped, while this share increases to 73 % among UniGe respondents. Regarding the transport mode used for their commuting routine, PT is chosen by 73 % of PoliMi respondents and 52 % of UniGe respondents. Private cars and scooters are used respectively by 11 % and 40 % of PoliMi and UniGe respondents. Only 6 % of the PoliMi sample and 7 % of UniGe sample walk to their destination, while 8 % of PoliMi respondents and 1 % of UniGe respondents travel by bicycle. Finally, sharing services represent a residual option, chosen by only a few respondents.

A distinct distribution of transport modes is observed among UniGe respondents compared to the reference population. This discrepancy is primarily due to the higher percentage of employees in the sample relative to that in the population. Employees tend to rely more heavily

on private motorized vehicles compared to students, which influences the modal share in the sample. In contrast, this issue does not arise within the PoliMi sample, as the modal choices of students and employees are more similar. Additionally, respondents from PoliMi show a higher degree of seasonality in their transport mode use compared to those from UniGe, likely due to a greater reliance on weather-sensitive modes such as walking and bike/scooter. A higher proportion of PoliMi respondents also reported being satisfied with their current transport options (49 %) compared to those from UniGe (29 %). Finally, a notable contrast emerges in the expressed interest in MaaS bundles, i.e. mobility packages combining public transport with services such as bike sharing and car sharing. While 55 % of PoliMi respondents indicated interest in such solutions, only 11 % of UniGe respondents did so, highlighting a significant divergence in perceived appeal between the two university communities.

As regards individuals' Stated Intentions, the results of the analyses are reported in Table 3, which includes the percentage shares of each value on the Likert scale, the average value, the standard deviation, and a statistical test to assess the significance of the difference in means between the two samples. Specifically, Welch's *t*-test was employed to assess the difference in means between the two subsamples. The null hypothesis ( $H_0$ ) and alternative hypothesis ( $H_1$ ) were defined as follows:

$H_0$ : the difference in means between the two subsamples is equal to 0.

$H_1$ : the difference in means between the two subsamples is not equal to 0.

In terms of the use of digital applications for journey planning, respondents from UniGe generally seem to rely more on these tools, both to plan their journey and to check travel status (road traffic, PT delays) during their journey. The *t*-test indicates, in fact, that the difference in means between the two contexts is statistically significant. Regarding transport services to be integrated into a MaaS app, PT constitutes the backbone of MaaS in both contexts, although PoliMi members rate is

**Table 3**

– PoliMi and UniGe respondents’ Stated Intentions to attitudinal and perception questions, expressed using Likert scales ranging from 1 to 5.

Statement	University	1	2	3	4	5	Avg.	Std. Dev.	t-test	p-value
<b>S1 – Before going to the university, do you plan your journey using smartphone applications?</b>	PoliMi	37.5 %	21.7 %	18.3 %	13.3 %	9.2 %	2.35	1.34	−5.96	0.00
	UniGe	37.8 %	15.3 %	13.2 %	14.2 %	19.4 %	2.62	1.56		
<b>S2 – While travelling to the university, do you use smartphone applications to check the road traffic or possible delays of public transport services?</b>	PoliMi	26.6 %	16.2 %	18.1 %	20.8 %	18.3 %	2.88	1.47	−3.00	0.00
	UniGe	26.2 %	13.3 %	16.8 %	19.7 %	24.1 %	3.02	1.53		
<b>S3 – How important do you think it is for a MaaS app to integrate the following transport services?</b>										
S3.1 – Public transport	PoliMi	2.6 %	2.4 %	6.1 %	20.5 %	68.3 %	4.49	0.91	12.52	0.00
	UniGe	6.8 %	5.6 %	15.7 %	17.5 %	54.5 %	4.07	1.24		
S3.2 – Bike sharing	PoliMi	11.0 %	13.1 %	22.7 %	28.0 %	25.3 %	3.44	1.29	11.62	0.00
	UniGe	23.2 %	14.9 %	24.3 %	19.6 %	18.1 %	2.94	1.41		
S3.3 – Car sharing	PoliMi	14.1 %	17.3 %	25.0 %	26.0 %	17.6 %	3.16	1.30	−0.02	0.99
	UniGe	19.0 %	13.0 %	23.1 %	23.0 %	22.0 %	3.16	1.41		
S3.4 – Taxi	PoliMi	37.2 %	19.8 %	20.5 %	14.2 %	8.2 %	2.36	1.32	−7.36	0.00
	UniGe	26.9 %	19.8 %	25.2 %	15.3 %	12.8 %	2.67	1.35		
<b>S4 – How important do you think it is for a MaaS app to include the following functionalities?</b>										
S4.1 – Time- and cost-optimized route search (also including several modes of transport)	PoliMi	1.8 %	2.9 %	6.0 %	26.3 %	63.0 %	4.46	0.87	11.62	0.00
	UniGe	7.1 %	5.8 %	14.1 %	18.5 %	54.5 %	4.07	1.25		
S4.2 – Electronic payment in a single transaction of the services used	PoliMi	3.3 %	3.5 %	12.2 %	27.1 %	53.9 %	4.25	1.02	12.20	0.00
	UniGe	9.3 %	8.0 %	16.2 %	25.7 %	40.8 %	3.81	1.30		
S4.3 – Discounts for the use of more sustainable modes of transport	PoliMi	3.3 %	3.5 %	9.9 %	23.2 %	60.2 %	4.33	1.01	13.66	0.00
	UniGe	9.1 %	8.2 %	16.9 %	21.5 %	44.2 %	3.84	1.32		
S5 – If there is a MaaS app that offer all the above-described functionality, would you use it to ...										
S5.1 – travel to the university	PoliMi	10.1 %	12.1 %	17.1 %	29.0 %	31.7 %	3.60	1.31	2.29	0.02
	UniGe	12.9 %	15.8 %	12.7 %	25.5 %	33.2 %	3.50	1.41		
S5.2 – undertake other travels (leisure, shopping)	PoliMi	5.7 %	4.7 %	16.4 %	33.4 %	39.8 %	3.97	1.13	9.84	0.00
	UniGe	9.3 %	14.7 %	14.0 %	31.3 %	30.7 %	3.59	1.31		

higher than UniGe members, with a statistically significant difference in means. Sharing services are unequally assessed between the two contexts: bike sharing is highly rated by potential users from PoliMi, while car sharing is equally rated in both contexts, as evidenced by the non-significance of the t-test, indicating that the null hypothesis cannot be rejected. The integration of taxi services is not considered important by respondents in either UniGe or PoliMi contexts. With respect to the functionalities that should be included in a MaaS app, multi-modal time- and cost-optimized travel planning is the preferred functionality both within PoliMi and UniGe contexts. Additionally, the possibility of benefiting from discounted fares for sustainable transport alternatives and using electronic and integrated payments are also highly rated. Finally, regarding the willingness to adopt MaaS for different travel purposes, respondents from both PoliMi and UniGe demonstrate a positive inclination toward adopting MaaS for home-university commuting, with average values of 3.60 and 3.50, respectively. Interestingly, this willingness is even higher when considering other travel purposes, with average values of 3.97 for PoliMi and 3.59 for UniGe. This trend suggests that MaaS is perceived as a viable and attractive option not only for

routine commutes but also for a broader range of mobility needs. The higher willingness for other trip purposes could reflect greater flexibility or convenience offered by MaaS in addressing diverse travel demands beyond systematic trips.

The statements of the Stated Intentions section were further analyzed to identify any mutual correlation. For this purpose, a Spearman’s rank correlation analysis was carried out, and the correlation matrix is presented in Fig. 3. Statements regarding the use of journey planning digital applications, namely S1 and S2, show a high degree of mutual correlation, indicating that individuals generally use these tools both before and during the journey. Statement S3.1, which addresses the integration of PT in a MaaS app, is strongly correlated with statement S4.1, which focuses on the time- and cost-optimized route search functionality of a MaaS app, while having a lower but significant correlation with S4.2 and S4.3, concerning the possibility of electronic and integrated payments and of discounts for the use of sustainable transport modes respectively. Moreover, a strong correlation is also evident between statements S3.2 and S3.3, related to bike sharing and car sharing, respectively, among the services to be integrated in a MaaS app. This evidence suggests a

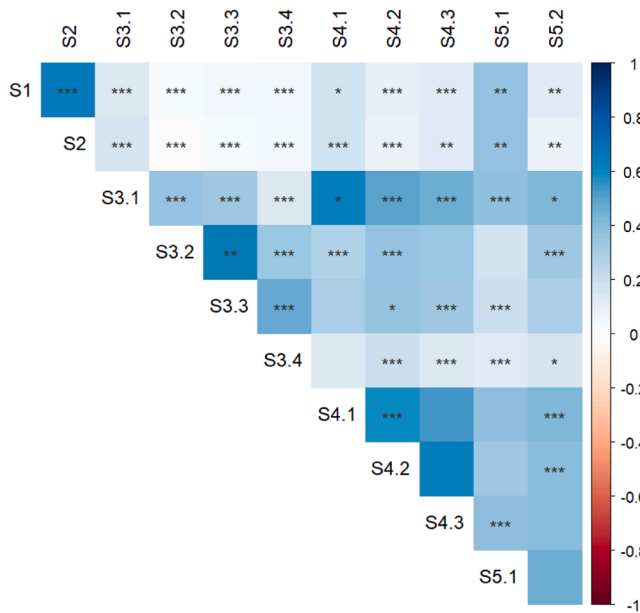


Fig. 3. – Spearman correlation matrix between the statements of the Stated Intentions section of the survey (\*\*\*, \*\*, \* Significance at 1 %, 5 %, 10 % level).

potential intrinsic predisposition towards sharing services among individuals. Finally, correlations between functionalities to be included in a MaaS app are also observed, particularly between statements S4.1 and S4.2.

### 3.3. Estimated models

The estimation of Ordered Logit Models to evaluate the factors affecting the willingness to adopt MaaS for home-university commuting, derived from Statement 5.1 of the Stated Intentions section of the survey, was performed using the *Apollo* [56] choice modelling software package in R [57]. The analysis included four distinct models.

The first two models considered the UniGe subsample (Model 1) and the PoliMi subsample (Model 2) separately to assess the potential existence of deterministic heterogeneity concerning certain explanatory variables. For these specifications, both sociodemographic characteristics (i.e. Age, Gender, Role in university, Origin Zone), travel habits (i.e. Travel Frequency, Transport Mode Seasonality, Private Vehicle Availability, Private Transport Mode, Transport Mode Satisfaction, Usage of Journey Planning Smartphone Apps) and attitudinal and perception indicators were used. In Model 3, since deterministic heterogeneity was shown to be absent for all explanatory variables, the full sample (UniGe and PoliMi) was considered, and interactions were introduced with respect to the university community of affiliation for the variables where relevant differences in the value and/or sign of parameters were observed in Model 1 and Model 2. By doing so, it was possible to directly measure variations in preferences within a single model concerning the university community of affiliation. To assess potential differences in preferences between students and employees, two separate Ordered Logit Models were estimated based on Model 3 (with interaction terms), applied to the respective subsamples. However, the results did not indicate any statistically significant divergence between the two groups. Therefore, the analysis proceeded using the full sample, incorporating interaction terms to account for potential deterministic heterogeneity with respect to the “Role” while maintaining a sufficient sample size for robust parameter estimation. Finally, in Model 4 random parameters were introduced to verify the existence of random heterogeneity among individuals. The final estimates of the specified models are reported in Table 4.

First of all, the performance indicators for Model 1 (UniGe sample)

and Model 2 (PoliMi sample) show Final Log-Likelihood values of  $-2894$  and  $-2393$ , respectively, starting from Null Log-Likelihood values of  $-3616$  for Model 1 and  $-2982$  for Model 2, thus resulting in Rho-squared values equal to  $0.1997$  and  $0.1977$ , respectively.

The model estimates indicate that the intercept *ais* is significant and negative in both models, with similar values, suggesting the presence of unobserved disutility that was not captured by the included explanatory variables. Regarding the parameters associated with sociodemographic characteristics, the age parameter is found to be significant and positive in Model 1 but not significant in Model 2. This evidence suggests that age only affects the WTA of UniGe respondents, with older individuals showing a greater WTA. The influence of gender on WTA does not appear to be significant in either the UniGe or PoliMi samples. However, in Model 1, a parameter that is close to significance and positive suggests that females may be more inclined towards MaaS adoption compared to males, although further investigation is required. Regarding the role in university, the parameter associated with the role of professor is significant and negative in both Model 1 and Model 2, thereby indicating a disutility towards MaaS adoption among teaching staff. Moreover, the parameter associated with being a PhD student is statistically significant only in Model 2, with a negative sign indicating that PoliMi’s PhD students do not consider MaaS as a viable option for their home-commuting routines. Conversely, the status of Bachelor or Master student has no influence on MaaS WTA. With respect to the residential zone, from which respondents commute to university, the significant and negative estimated parameters indicate that individuals from the Municipality are unlikely to adopt MaaS, whereas those residing in provinces outside that of the Municipality have no impact on MaaS WTA.

As regards the travel habits variables, the availability of a private vehicle within the household is found to exert a disutility on MaaS adoption among respondents from PoliMi, as evidenced by the negative sign of the parameter associated with this characteristic in Model 2, while it has no influence among UniGe respondents. On the other hand, the parameter associated with commuting to university by private vehicle is not statistically significant in either model, although it is very close to significance for the UniGe subsample. The parameter associated with satisfaction with current transport mode is significant and negative in both Model 1 and Model 2. Additionally, it assumes the highest absolute value among transport routine-related parameters, indicating that satisfaction is a key influencing factor for MaaS WTA and that individuals who are already satisfied with the transport modes used in their commuting routine are unlikely to change them in favor of MaaS solutions. Finally, travel frequency and transport mode seasonality have no impact on the utility for MaaS adoption, as evidenced by the associated parameters.

The current usage of journey planning smartphone apps influences the WTA MaaS in both university contexts. Individuals who currently plan their journeys both before (S1) and during the trip (S2) are more prone to adopt MaaS for home-university trips, given the positivity of the parameters. Regarding the functionalities and the mobility services deemed important in a MaaS app, individuals who indicated trip planning (S4.1) and discounts for the use of sustainable transport modes (S4.3) as desired functionalities are more likely to adopt MaaS, as evidenced by the positive sign of the associated parameter in both models. Similarly, individuals who prioritized PT (S3.1) and taxi (S3.4) integration as services to be included in a MaaS app have a higher WTA. In contrast, functionalities such as the Single Transaction Payment (S4.2), or services like Bike (S3.2) and Car sharing (S3.3), do not generate any utility for MaaS WTA, as evidenced by the parameters being statistically not significant. Finally, individuals who do not express interest in any MaaS bundle are less likely to adopt MaaS, as evidenced by the negative signs of parameters in both Model 1 and Model 2.

As regards the specification for the whole sample, comprising both UniGe and PoliMi respondents and introducing interactions according to the university community of affiliation for variables exhibiting notable differences in the value or sign of parameters in Model 1 and Model 2,

**Table 4**

– Estimated parameters for the Ordered Logit Models for UniGe subsample (Model 1), PoliMi subsample (Model 2), full sample with interactions (Model 3), and full sample with interactions and random parameters (Model 4).

	Model 1: Ordered Logit Model, UniGe subsample			Model 2: Ordered Logit Model, PoliMi subsample			Model 3: Ordered Logit Model with interactions, full sample			Model 4: Ordered Logit Model with interactions and random parameters, full sample		
<b>Number of observations</b>	2247			1853			4100			4100		
<b>Null-Log Likelihood</b>	−3616			−2982			−6599			−6599		
<b>Final-Log Likelihood</b>	−2894			−2393			−5304			−5257		
<b>Rho-squared</b>	0.1997			0.1977			0.1962			0.2033		
<b>Akaike Information Criterion</b>	5843			4839			10,672			10,583		
<b>Number of MLHS draws (Normal distribution)</b>										1000		
<b>Parameter</b>	<b>Value</b>	<b>t-Test</b>		<b>Value</b>	<b>t-Test</b>		<b>Value</b>	<b>t-Test</b>		<b>Value</b>	<b>t-Test</b>	
$\alpha$ (intercept)	−1.38	−3.68	***	−1.34	−3.16	***	−1.35	−5.61	***	−2.43	−4.81	***
<b>Sociodemographic characteristics</b>												
Age $\mu$ ( $> 35$ y.o. = 1, $\leq 35$ y.o. = 0)	0.10	2.17	**	−0.06	−0.98					0.19	2.70	***
Age * UniGe $\mu$ (Interaction)							0.09	2.49	**			
Gender $\mu$ (Female = 1, Male = 0)	0.13	1.61		0.09	1.04		0.11	1.98	**	0.24	2.04	**
Role: Bachelor Student $\mu$ (Yes = 1, No = 0)	0.18	0.98		−0.15	−0.75		0.07	0.70		0.31	1.81	*
Role: Bachelor Student $\sigma$										1.59	3.64	***
Role: Master Student $\mu$ (Yes = 1, No = 0)	0.09	0.46		−0.30	−1.34		−0.04	−0.36				
Role: PhD Student $\mu$ (Yes = 1, No = 0)	0.11	0.60		−0.45	−2.46	**						
Role: PhD Student * PoliMi $\mu$ (Interaction)							−0.27	−2.02	**	−0.44	−1.80	*
Role: Professor $\mu$ (Yes = 1, No = 0)	−0.23	−1.81	*	−0.49	−3.51	***						
Role: Professor * UniGe $\mu$ (Interaction)							−0.29	−2.45	**	−0.51	−2.10	**
Role: Professor * PoliMi $\mu$ (Interaction)							−0.43	−3.41	***	−0.78	−3.18	***
<b>Travel habits</b>												
Origin: Municipality $\mu$ (Yes = 1, No = 0)	−0.20	−1.73	*	−0.25	−1.89	*	−0.24	−2.76	***	−0.51	−2.10	**
Origin: Municipality $\sigma$										−0.78	−3.18	***
Origin: Other Provinces $\mu$ (Yes = 1, No = 0)	0.07	0.52		−0.01	−0.11		0.03	0.27				
Travel Frequency $\mu$ ( $> 2$ days = 1, $\leq 2$ days = 0)	0.11	1.22		0.05	0.47		0.08	1.26				
Transport Mode Seasonality $\mu$ (Yes = 1, No = 0)	0.35	1.15		0.11	0.89		0.15	1.35				
Private Vehicle Availability $\mu$ (Yes = 1, No = 0)	0.08	0.79		−0.31	−2.94	***						
Private Vehicle Availability * PoliMi $\mu$ (Interaction)							−0.33	−3.46	***	−0.58	−2.94	***
Private Transport Mode Use $\mu$ (Yes = 1, No = 0)	0.12	1.29		0.04	0.27		0.13	1.77	*	0.26	1.67	*
Transport Options Satisfaction $\mu$ (Yes = 1, No = 0)	−0.36	−3.66	***	−0.46	−4.77	***						
Transport Options Satisfaction * UniGe $\mu$ (Interact.)							−0.37	−3.86	***	−0.87	−3.59	***
Transport Options Satisfaction * UniGe $\sigma$										1.77	3.40	***
Transport Options Satisfaction * PoliMi $\mu$ (Interact.)							−0.44	−4.79	***	−0.95	−4.22	***
<b>Attitudinal and perception indicators</b>												
Pre-trip Travel Information (S1) $\mu$ (Likert scale 1–5)	0.15	4.23	***	0.31	7.38	***						
Pre-trip Travel Information (S1) * UniGe $\mu$ (Interact.)							0.16	4.87	***	0.28	3.83	***
Pre-trip Travel Information (S1) * PoliMi $\mu$ (Interact.)							0.30	7.78	***	0.59	5.03	***
Pre-trip Travel Information (S1) * PoliMi $\sigma$										−0.32	−2.39	**
En-route Travel Information (S2) $\mu$ (Likert scale 1–5)	0.19	5.19	***	0.23	5.69	***	0.21	7.71	***	0.40	5.40	***
Travel Planning (S4.1) $\mu$ (Likert scale 1–5)	0.37	6.84	***	0.14	2.02	**						
Travel Planning (S4.1) * UniGe $\mu$ (Interaction)							0.35	7.92	***	0.75	5.72	***
Travel Planning (S4.1) * UniGe $\sigma$										0.56	5.78	***
Travel Planning (S4.1) * PoliMi $\mu$ (Interaction)							0.15	3.04	***	0.26	2.68	***
Travel Planning (S4.1) * PoliMi $\sigma$										−0.33	−3.87	***
Single Transaction Payment (S4.2) $\mu$ (Likert scale 1–5)	−0.04	−0.81		0.07	1.27		0.01	0.22				
Discounts Rewarding (S4.3) $\mu$ (Likert scale 1–5)	0.32	6.42	***	0.38	7.11	***	0.35	9.49	***	0.70	6.16	***
Discounts Rewarding (S4.3) $\sigma$										−0.36	−3.96	***
Public Transport (S3.1) $\mu$ (Likert scale 1–5)	0.30	6.32	***	0.28	4.38	***	0.30	7.87	***	0.62	5.61	***
Public Transport (S3.1) $\sigma$										−0.23	−2.11	**
Bike Sharing (S3.2) $\mu$ (Likert scale 1–5)	−0.04	−0.90		0.02	0.44		−0.01	−0.36				
Car Sharing (S3.3) $\mu$ (Likert scale 1–5)	0.03	0.67		−0.04	−0.83		0.00	0.00				
Taxi (S3.4) $\mu$ (Likert scale 1–5)	0.07	1.78	*	0.10	2.46	**	0.07	2.72	***	0.12	2.42	**
Interest in Bundles $\mu$ (No = 1, Yes = 0)	−1.42	−8.66	***	−0.95	−9.97	***						
Interest in Bundles * UniGe $\mu$ (Interaction)							−1.40	−9.60	***	−3.08	−5.89	***
Interest in Bundles * PoliMi $\mu$ (Interaction)							−0.92	−10.38	***	−1.87	−5.97	***
Interest in Bundles * PoliMi $\sigma$										0.91	1.88	*
<b>Threshold parameters</b>												
$\tau_1$	0.00			0.00			0.00			0.00		
$\tau_2$	1.33	19.94	***	1.22	15.86	***	1.28	25.49	***	2.36	8.08	***
$\tau_3$	2.11	27.50	***	2.34	25.25	***	2.21	37.38	***	4.17	8.17	***
$\tau_4$	3.63	38.78	***	3.96	36.16	***	3.77	53.10	***	7.31	8.07	***

\*\*\*, \*\*, \* Significance at 1 %, 5 %, 10 % level.

the performance indicators show a Final Log-Likelihood of −5304 starting from a Null Log-Likelihood of −6599, and a Rho-squared equal to 0.1962. In this third model, the variables whose parameters did not exhibit statistically significant differences between Model 1 and Model 2 were included without interactions. In particular, the parameters associated with the variables Bachelor Student, Master Student, Other

Provinces as Residential Zone, Travel Frequency, Travel Seasonality, Single Transaction Payment (S4.2) as a functionality that a MaaS app should offer, and Car Sharing (S3.2) and Bike Sharing (S3.3) as services to be included in a MaaS app were not statistically significant in both Model 1 and Model 2 and were also found to be not-significant in Model 3. Conversely, the parameters associated with Municipality as

Residential Zone, En-route (S2) usage of journey planning smartphone apps, Discounts Rewarding (S4.3) as functionality that a MaaS app should offer, and PT (S3.1) and Taxi (S3.4) as services to be included in a MaaS app, which were statistically significant in Model 1 and Model 2, maintained their significance also in Model 3 for the full sample. Finally, the parameters associated with Gender and Private Transport Mode, which were only near significance in Model 1 for the UniGe subsample, proved to be significant for the full sample in Model 3. In detail, some parameters were found to be significant for only one university. This is the case of Age, that is significant and positive only for respondents from UniGe, confirming the trend observed in Model 1 regarding older individuals having a higher WTA. On the other hand, the parameters associated with being a PhD Student and Private Vehicle Availability are significant only for respondents from PoliMi, indicating a negative inclination of PhD students and individuals with private vehicle access towards MaaS. By contrast, some other parameters, through interactions on the home university of respondents, proved to be significant for the two subsamples with distinct differences. For example, the parameters of being a professor and being satisfied with their current transport mode, although significant and negative for both universities, have higher absolute values for PoliMi respondents. This indicates that these characteristics generate a lower WTA MaaS among this subsample compared to UniGe respondents. Furthermore, the parameter associated with the usage of journey planning apps for Pre-trip Travel Information (S1) yields higher utility for PoliMi respondents, while those associated with the Travel Planning (S4.1) functionality of a MaaS app and with having no interest in MaaS bundles yield, respectively, higher utility and higher disutility for UniGe respondents.

In the last specification (Model 4), which introduces random parameters to verify the existence of random heterogeneity among individuals and excludes all the explanatory variables that were not statistically significant in Model 3, the goodness-of-fit statistics show improvements in terms of Final Log-Likelihood ( $-5257$ ), Rho-squared ( $0.2033$ ) and Akaike Information Criterion ( $10,583$ ) compared to Model 3. The estimated parameters confirm the existence of random heterogeneity among individuals, regardless of their university community of affiliation, with respect to being a Bachelor student, living within the Municipality limits, Discounts Rewarding (S4.3) as functionality that a MaaS app should offer, and PT (S3.1) as a service to be included in the MaaS app. Furthermore, random heterogeneity in respondents' preferences is also observed among UniGe respondents, regarding satisfaction with the current transport mode used and Travel Planning (S4.1) functionality of a MaaS app, and PoliMi respondents, regarding the usage of journey planning apps for Pre-trip Travel Information (S1), the Travel Planning (S4.1) functionality of a MaaS app, and lack of interest in MaaS bundles.

#### 4. Discussion

The present research provides a deeper understanding of university communities' willingness to adopt MaaS solutions by employing a comparative approach across two distinct contexts. Emphasis was placed on the main variables affecting individuals' stated intentions about MaaS adoption. From the aggregate statistics it was observed that PoliMi respondents show a higher predisposition towards it than the UniGe respondents. This evidence may be attributed to the limited range of mobility services that are available in Genoa, as well as lower levels of knowledge and awareness about this technology. For example, PoliMi's campuses are located in areas well-served by both PT and sharing services, and aggregate statistics show a higher satisfaction rate with mobility solutions among their users compared to those of UniGe. This finding may justify the higher willingness of individuals from UniGe to change travel behavior and test new mobility solutions.

The estimated models highlight two key findings regarding the adoption of MaaS solutions among university members.

On the one hand, certain explanatory variables appear to be equally

important across the communities of UniGe and PoliMi. Therefore, it can be inferred that these factors do not contribute to explaining the differing predisposition of PoliMi members towards MaaS compared to UniGe respondents. This suggests that while these variables may influence interest in MaaS overall, their uniform effect across the two university contexts implies that they are not drivers of the observed heterogeneity between the two groups. For instance, gender and being a Bachelor's student are factors that significantly influence individuals' WTA MaaS solutions, but their impact is the same across members of the different university campuses. Similar to what was observed by [23] regarding gender, females show a higher predisposition to MaaS adoption compared to males, potentially reflecting differences in mobility preferences (e.g. females may be more inclined to use PT services than males [23]). Conversely, other variables do not show statistical significance for either UniGe or PoliMi members. For example, neither travel frequency nor seasonality appear to influence MaaS adoption. This suggests that the flexibility inherent in MaaS offering makes it equally attractive to individuals regardless of some of their travel habits (e.g. frequent travelers may value MaaS for its convenience in providing mobility bundling schemes, while infrequent travelers might appreciate its occasional utility through a pay-as-you-go approach).

On the other hand, other factors are likely responsible for the variation in preferences based on institutional affiliation. The discrete choice analysis provides modeling evidence of the existence of deterministic heterogeneity among individuals. Specifically, members of UniGe and PoliMi communities exhibit distinct attitudes that may stem from contextual differences, such as the availability, quality, and efficiency of existing transport options in Genoa and Milan, respectively. These contextual factors likely influence the perceived utility and attractiveness of MaaS, emphasizing the importance of tailoring such solutions to the specific needs and conditions of each urban area. For example, the availability of a private vehicle emerges as a barrier to MaaS adoption only for PoliMi university members, reflecting the findings of existing studies in the literature [25], which highlights that car users value the convenience of car and do not easily consider the possibility of shifting to other transport modes. Another example is satisfaction with the current transport mode, for which a statistically significant difference is observed in the weight of this variable on the willingness of individuals to adopt MaaS: the parameter associated with PoliMi members is, in absolute terms, greater than that associated with UniGe members. Nevertheless, the negative relationship between satisfaction with the current transport mode used and WTA MaaS suggests that individuals who are not satisfied with their current transport routine may represent a potential target group for MaaS. On the contrary, people who are already satisfied with their current transport routine do not see any benefit in changing it, which implies that MaaS must offer clear cost-saving and sustainable solutions to attract new users from this class as well. Contrary to the findings of existing research [23], age does not play a relevant role in MaaS adoption, being a slightly significant factor only in UniGe contexts. However, other characteristics strongly correlated to age, such as the role in university (e.g. student, professor), do influence MaaS adoption.

Moreover, with respect to the statistically significant attitudinal and perception indicators, the results of this research align with those of existing studies in literature [30,32]: individuals who already plan trips using smartphone apps are more willing to adopt MaaS. In fact, people who use mobile applications on a daily basis, and are therefore more familiar with digital platforms –of which MaaS is an extension with additional and improved functionalities– tend to exhibit a higher predisposition towards MaaS. On the other hand, people who do not use travel planning applications may be wary of MaaS potential, fearing limited ease of use and perceived usefulness.

Finally, the statistical significance of certain random parameters demonstrates the existence of a distribution of preferences among the sampled respondents around the mean marginal utility of the corresponding factors. This variability indicates that while the average effect

of these factors is meaningful, individual preferences vary significantly, reflecting a heterogeneous perception of the utility associated with these explanatory variables for individuals' WTA MaaS solutions.

#### 4.1. Policy implications

Deriving policy implications to promote MaaS adoption within communities is crucial for providing a sustainable and efficient alternative to traditional mobility options.

A key consideration is the importance of tailoring MaaS solutions to specific contexts. The variability in willingness to adopt MaaS, as observed in this study, underscores this necessity. For instance, individuals from UniGe and PoliMi showed differing levels of acceptance, influenced by their satisfaction with existing transport modes and the availability of distinct mobility options in Genoa and Milan. These findings suggest that a one-size-fits-all approach is unlikely to be effective. Instead, MaaS solutions should be flexible and customizable, designed to meet the unique mobility needs of different groups and align with their specific preferences. The context in Milan, for instance, with its extensive range of transport services (trains, buses, subways, and shared mobility), could benefit from subscription-based MaaS bundles that integrate these mobility options, as proposed by Pastorelli et al. (2025) [58]. In contrast, in Genoa, where the public transport network is less developed and alternative modes are limited, focusing on monomodal, point-to-point, pay-as-you-go MaaS solutions may be more appropriate.

To account for these contextual diversities and enable tailored travel solutions, policy measures may address various aspects of MaaS, which can be broadly categorized into soft-, hard-, and orgware interventions.

The first category – software interventions – regards the technological components of a MaaS digital platform, which should incorporate rewarding mechanisms to encourage sustainable choices and enable greater user engagement. One effective approach is the use of gamified feedback tools that nudge and reward sustainable mobility choices (e.g., earning points for using public transport instead of a private vehicle), as discussed by Costa and Delponte (2025) [59]. This strategy, already adopted in university initiatives like the MUV game app [60,61], allows users to track their progress alongside their peers and receive rewards, thus reinforcing positive (i.e. sustainable) behaviors. On a different perspective, the design of the technology itself must ensure accessibility. While many individuals are familiar with using smartphone apps to retrieve travel information (both pre-trip and en-route), others may lack digital readiness. To ensure that MaaS is accessible to the widest possible audience, developers must prioritize user-friendly app design. Intuitive and easy-to-navigate platforms can help newcomers feel comfortable adopting MaaS, reducing barriers to entry and broadening the user base. Furthermore, developers should adopt standardized data formats (e.g. GTFS, GBFS) to enable interoperability and ensure that users benefit from real-time, multimodal trip planning across all available transport services.

The second category – hardware interventions – concerns the physical transformation of spaces to enable convenient access to MaaS solutions. This includes the development of mobility hubs near campus buildings, as proposed by Delponte et al. (2024) [62], along with signage and clear maps indicating MaaS options and walking distances to mobility points. These tangible elements complement the digital app and can facilitate awareness and adoption. In addition, improving pedestrian and cycling infrastructure around campuses can further support MaaS uptake through the promotion of active mobility and its physical integration with other sustainable modes (e.g. improving the attractiveness of intermodal public transport services). Micromobility services (e.g. e-scooters) could also be strategically deployed in campus-adjacent areas, supported by adaptive pricing schemes that encourage use in underserved locations or during off-peak hours.

The final category – orgware interventions – relates to organizational measures to promote MaaS. These include offering discounted access to

services through partnerships with local transport providers, which can make bundled offerings more affordable and attractive. Awareness-raising initiatives such as on-campus information sessions and pilot programs can further encourage behavioral changes in mobility habits (e.g. modal shifts). Some efforts have already been implemented in Genoa through the PRINCE project [63], which aims to foster collaboration between the university, local authorities, and transport providers. Such measures can help overcome resistance to MaaS adoption from private vehicle owners and those satisfied with their current transport routines. For instance, on one hand, private vehicle owners could be encouraged to shift part of their journeys to public transport by improving first-/last-mile connectivity to/from railway and metro station through shared mobility services and park&ride systems. In fact, university staff could forego personal parking permits in change of subscription-based MaaS bundles offered at discounted prices. On the other hand, satisfied commuters should be attracted through the added value tools offered by a MaaS platform, such as real-time travel assistance and personalized door-to-door information. Finally, to ensure broad participation, universities should also consider offering subsidized subscriptions, for example to low-income students and staff, and conducting periodic audits to assess accessibility and equity. A co-design approach, through the engagement of students, staff and mobility providers in the development and testing of MaaS solutions, could improve service quality, relevance, and acceptance.

#### 4.2. Limitations

The present research has limitations that must be acknowledged to contextualize the findings and guide future studies in addressing these gaps.

Firstly, the study focused exclusively on two communities, namely the university members of the University of Genoa and Politecnico di Milano, which limits the generalizability of the results to other community contexts. While MaaS is expected to benefit users at other large organizations, extending the study to additional communities is essential for gaining a more comprehensive understanding of MaaS's broader impact.

Secondly, the demographic composition of the sample, although representative in many respects, showed an overrepresentation of employees compared to the overall university populations. Conversely, younger students, particularly undergraduates, were underrepresented despite comprising a significant portion of university communities. This demographic imbalance may have skewed the aggregated results, particularly in terms of attitudes towards the adoption of technology and sustainable mobility, as these are known to vary by age and role. However, the main goal was to obtain enough observations across age groups and employment statuses to support a reliable estimation of behavioral models for each subgroup, which are not affected by the size of the subgroups.

Thirdly, this study did not consider contextual variables related to the built environment, such as public transport availability, the density of shared mobility services, and proximity to urban centers. These factors are known to influence mobility behavior and could offer additional explanatory power in modeling MaaS adoption. However, the dataset collected through the current survey does not include spatially explicit indicators that would allow for a systematic analysis of the built environment or transport supply characteristics across the two university contexts. Nonetheless, the proposed estimated models incorporate several user-specific variables that indirectly reflect elements of the transport context. These include the personal availability of a private vehicle, satisfaction with current travel options, and perceptions of the importance of including services such as public transport, bike-sharing, car-sharing, and taxis within a MaaS platform, which were found to be statistically significant in explaining users' willingness to adopt MaaS.

Finally, although the research identified random heterogeneity in preferences, the analysis did not extensively explore the underlying

causes of this variability. Understanding the drivers of random heterogeneity, such as psychological factors, personal values, or lifestyle differences, could provide deeper insights into the nuanced attitudes toward MaaS adoption. The use of integrated choice and latent variables modeling techniques would allow researchers to delve into these aspects and uncover individuals' unobservable traits that influence heterogeneity.

#### 4.3. Research perspective

Future perspectives for this research include distributing the survey to a broader range of Italian universities within the RUS network. By using a standardized survey, future studies could better identify commonalities and differences in MaaS perceptions and adoption potential, providing a clearer picture of its feasibility and acceptance across diverse academic contexts. Future research will seek to integrate spatially explicit data to better account for the influence of local transport infrastructure and to improve the generalizability of the findings.

Another important area for future research is the investigation of individuals' willingness to adopt MaaS for non-systematic trips. While much of the existing research, including the present study, focuses on systematic mobility, such as commuting to work or university, non-systematic trips, such as leisure travel, shopping, or social visits, represent a significant share of overall travel behavior. Moreover, non-systematic trips differ from systematic ones in several aspects. They are typically less predictable, both in terms of frequency and destination, and are often influenced by situational factors such as time availability, spontaneity, or specific travel goals. This variability presents unique challenges for MaaS platforms, as they must be flexible enough to accommodate the diverse and often ad hoc nature of these trips. Investigating the willingness to adopt MaaS for such trips would provide valuable insights into how well MaaS systems can adapt to these requirements. Finally, examining the willingness to adopt MaaS for non-systematic trips could highlight opportunities for innovation in the design and delivery of MaaS solutions. For instance, the integration of additional features could be explored, such as gamification to reward sustainable choices, or partnerships with tourism and retail sectors to create value-added services.

## 5. Conclusion

Investigating the factors that affect individuals' willingness to adopt Mobility as a Service platforms emerges as a key priority for assessing the conditions that favor the scaling up and widespread adoption of MaaS solutions. Understanding these factors can provide valuable insights for designing effective strategies to enhance MaaS adoption and its integration into existing mobility systems.

Universities represent particularly compelling contexts for exploring these dynamics due to their socio-demographic diversity, which includes students, faculty, and staff from various backgrounds. This diversity allows for the examination of MaaS preferences across different user profiles. Furthermore, university communities are often characterized by heightened environmental awareness and a strong inclination to experiment with innovative technologies, making them ideal testing grounds for new mobility solutions.

The opportunity to examine two distinct Italian academic settings has further enriched this research by highlighting the importance of exogenous factors, such as campus structure and proximity to the urban area, as well as the variety, coverage, and perceived quality of local mobility options. These external elements significantly shape users' perceptions of and willingness to adopt MaaS, underscoring the need for context-sensitive approaches that allow for the customization of MaaS supply to meet user needs. Most of the policies derived from the two university case studies can be extended to similar environments, in particular software and hardware measures that aim at creating the necessary digital and physical conditions for effective MaaS

implementation. In contrast, orgware policies may be more challenging to replicate in their full effectiveness, as they rely on strong and sustained coordination between academic institutions and external stakeholders, and there must be strong political will to implement them, given that these policy interventions also align with broader institutional sustainability goals, such as reducing campus-related emissions and promoting low-carbon commuting.

At the individual level, features such as gender and professional status, as well as mobility-related behaviors and personal attitudes, have been shown to influence WTA MaaS. These findings align with existing literature but also highlight the need for further, more standardized investigation across a wider range of communities. Leveraging the RUS network for such an initiative could enable the collection of more comprehensive data, allowing for robust comparisons and the identification of shared trends across diverse academic contexts.

Ultimately, by focusing on user-centered design, fostering flexibility and customization, and implementing targeted incentive mechanisms, MaaS initiatives can overcome existing barriers and pave the way for more sustainable, efficient, and inclusive urban mobility solutions. These efforts are not only critical for addressing the mobility needs of university communities but also serve as a blueprint for broader applications in urban mobility systems.

#### CRediT authorship contribution statement

**Fulvio Silvestri:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Valentina Costa:** Writing – original draft, Visualization, Investigation, Formal analysis, Data curation. **Luca Pastorelli:** Writing – original draft, Visualization, Software, Investigation, Formal analysis.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

#### Data availability

The authors do not have permission to share data.

#### References

- [1] L. Barreto, A. Amaral, S. Baltazar, Mobility in the Era of Digitalization: Thinking Mobility as a Service (MaaS), in: V. Sgurev, V. Jotsov, J. Kacprzyk (Eds.), *Intelligent Systems: Theory, Research and Innovation in Applications*, R. Jardim-Goncalves, Springer International Publishing, Cham, 2020, pp. 275–293, [https://doi.org/10.1007/978-3-030-38704-4\\_12](https://doi.org/10.1007/978-3-030-38704-4_12). Eds.
- [2] E. Alyavina, A. Nikitas, E. Tchouamou Njoya, Mobility as a service and sustainable travel behaviour: a thematic analysis study, *Transportation Research Part F: Traffic Psychology and Behaviour* 73 (Aug. 2020) 362–381, <https://doi.org/10.1016/j.trf.2020.07.004>.
- [3] P. Coppola, F. Silvestri, 1 - Autonomous vehicles and future mobility solutions, in: P. Coppola, D. Esztergár-Kiss (Eds.), *Autonomous Vehicles and Future Mobility*, Elsevier, 2019, pp. 1–15, <https://doi.org/10.1016/B978-0-12-817696-2.00001-9>.
- [4] R. de Viet, E. Molin, Mobility-as-a-Service: does it contribute to sustainability?. 2020 Forum On Integrated and Sustainable Transportation Systems (FISTS), Nov. 2020, pp. 192–197, <https://doi.org/10.1109/FISTS46898.2020.9264902>.
- [5] Z. Zhang, N. Zhang, A Novel Development Scheme of Mobility as a Service: Can It Provide a Sustainable Environment for China? *Sustainability*. 13 (8) (Jan. 2021) <https://doi.org/10.3390/su13084233>. Art. no. 8.
- [6] J. Pritchard, MaaS to pull us out of a car-centric orbit: Principles for sustainable Mobility-as-a-Service in the context of unsustainable car dependency, *Case Stud. Transp. Policy*. 10 (3) (Sep. 2022) 1483–1493, <https://doi.org/10.1016/j.cstp.2022.08.004>.

- [7] D.A. Hensher, C. Mulley, J.D. Nelson, Mobility as a service (MaaS) – Going somewhere or nowhere? *Transp. Policy*. (Oxf) 111 (Sep. 2021) 153–156, <https://doi.org/10.1016/j.tranpol.2021.07.021>.
- [8] “MaaS Global (Whim) files for bankruptcy, a turning point for the sector?,” M2050. Accessed: Dec. 14, 2024. [Online]. Available: <https://m2050.media/en/maas-global-whim-files-for-bankruptcy-a-turning-point-for-the-sector/>.
- [9] D.A. Hensher, What might Covid-19 mean for mobility as a service (MaaS)? *Transp. Rev.* 40 (5) (Sep. 2020) 551–556, <https://doi.org/10.1080/01441647.2020.1770487>.
- [10] L. Mitropoulos, A. Kortsari, V. Mizaras, G. Ayfantopoulou, Mobility as a Service (MaaS) Planning and Implementation: Challenges and Lessons Learned, *Future Transportation* 3 (2) (Jun. 2023), <https://doi.org/10.3390/futuretransp3020029>. Art. no. 2.
- [11] I.C.M. Karlsson, et al., Development and implementation of Mobility-as-a-Service – A qualitative study of barriers and enabling factors, *Transportation Research Part A: Policy and Practice* 131 (Jan. 2020) 283–295, <https://doi.org/10.1016/j.tra.2019.09.028>.
- [12] J. Milne, M. Beecroft, J.D. Nelson, P. Greening, C. Cottrill, S. Wright, Urban (UMaaS) and rural (RMaaS) mobility as a service (MaaS): practical insights from international practitioners and experts, *Eur. Transp. Res. Rev.* 16 (1) (Jan. 2024) 5, <https://doi.org/10.1186/s12544-023-00620-2>.
- [13] “The National Recovery and Resilience Plan (NRRP),” MEF. Accessed: Dec. 16, 2024. [Online]. Available: <https://www.mef.gov.it/en/focus/The-National-Recovery-and-Resilience-Plan-NRRP/>.
- [14] “Mobility as a Service for Italy,” Dipartimento per la trasformazione digitale. Accessed: Sep. 04, 2024. [Online]. Available: <https://innovazione.gov.it/notizie/avvisi-pubblici/mobility-as-a-service-for-italy/>.
- [15] Dipartimento per la Trasformazione Digitale, “Discussion paper ‘Data Sharing and Service Repository Facilities’ (DS&SRF).” 2022. [Online]. Available: [https://assets.innovazione.gov.it/1654592242-allegato-2\\_requisiti\\_dssrf\\_dopoprogettazione\\_publicato-07-06-2022.pdf](https://assets.innovazione.gov.it/1654592242-allegato-2_requisiti_dssrf_dopoprogettazione_publicato-07-06-2022.pdf).
- [16] Regolamento delegato (UE) 2017/1926 della Commissione, del 31 maggio 2017, che integra la direttiva 2010/40/UE del Parlamento europeo e del Consiglio per quanto riguarda la predisposizione in tutto il territorio dell’Unione europea di servizi di informazione sulla mobilità multimodale (Testo rilevante ai fini del SEE.), vol. 272. 2017. Accessed: Sep. 04, 2024. [Online]. Available: [http://data.europa.eu/eli/reg\\_del/2017/1926/oj/ita](http://data.europa.eu/eli/reg_del/2017/1926/oj/ita).
- [17] “Italian implementation | NeTEx.” Accessed: Sep. 04, 2024. [Online]. Available: <https://netex-cen.eu/implementation/italian-implementation/>.
- [18] MITD, DTD, and MIMS, Indirizzi per l’attuazione del progetto ‘MaaS for Italy, in: Ministero per l’Innovazione Tecnologica e la Transizione Digitale (MITD), Dipartimento per la Trasformazione Digitale (DTD), Ministero delle Infrastrutture e della Mobilità Sostenibili (MIMS), 2022. Accessed: Dec. 16, 2024. [Online]. Available: [https://assets.innovazione.gov.it/1661781483-indirizzi-per-l-attuazi-one-del-progetto-maas-for-italy\\_29-08-22.pdf](https://assets.innovazione.gov.it/1661781483-indirizzi-per-l-attuazi-one-del-progetto-maas-for-italy_29-08-22.pdf).
- [19] J. Schikofsky, T. Dannewald, M. Kowald, Exploring motivational mechanisms behind the intention to adopt mobility as a service (MaaS): Insights from Germany, *Transportation Research Part A: Policy and Practice* 131 (Jan. 2020) 296–312, <https://doi.org/10.1016/j.tra.2019.09.022>.
- [20] M. van I. en Waterstaat, “Mobility-as-a-Service and changes in travel preferences and travel behaviour: a literature review (English) - Document (research publication) - Netherlands Institute for Transport Policy Analysis.” Accessed: Sep. 14, 2024. [Online]. Available: <https://english.kimnet.nl/publications/document-s-research-publications/2018/09/17/mobility-as-a-service-and-changes-in-travel-preferences-and-travel-behaviour-a-literature-review>.
- [21] A. Polydoropoulou, I. Pagoni, A. Tsimpra, Ready for Mobility as a Service? Insights from stakeholder and end-users, *Travel Behaviour and Society* 21 (Oct. 2020) 295–306, <https://doi.org/10.1016/j.tbs.2018.11.003>.
- [22] H.E. Mustapha, B. Ozkan, O. Turetkin, Acceptance of Mobility-as-a-Service: Insights from empirical studies on influential factors, *Communications in Transportation Research* 4 (Dec. 2024) 100119, <https://doi.org/10.1016/j.comtr.2024.100119>.
- [23] I. Lopez-Carreiro, A. Monzon, E. Lopez, M.E. Lopez-Lambas, Urban mobility in the digital era: An exploration of travellers’ expectations of MaaS mobile-technologies, *Technology in Society* 63 (Nov. 2020) 101392, <https://doi.org/10.1016/j.techsoc.2020.101392>.
- [24] V. Caiati, S. Rasouli, H. Timmermans, Bundling, pricing schemes and extra features preferences for mobility as a service: Sequential portfolio choice experiment, *Transportation Research Part A: Policy and Practice* 131 (Jan. 2020) 123–148, <https://doi.org/10.1016/j.tra.2019.09.029>.
- [25] H. Raphael, S. Anna, A. Patt, D.D. Andrea, What are the factors and needs promoting mobility-as-a-service? Findings from the Swiss Household Energy Demand Survey (SHEDS), *European Transport Research Review* 12 (1) (Dec. 2020), <https://doi.org/10.1186/s12544-020-00412-y>.
- [26] C.Q. Ho, C. Mulley, D.A. Hensher, Public preferences for mobility as a service: Insights from stated preference surveys, *Transportation Research Part A: Policy and Practice* 131 (Jan. 2020) 70–90, <https://doi.org/10.1016/j.tra.2019.09.031>.
- [27] “MaaS - Mobility as a Service - Municipality of Milan,” Comune di Milano. Accessed: May 05, 2025. [Online]. Available: <https://www.comune.milano.it/en/aree-tematiche/mobilita/maas-mobility-as-a-service>.
- [28] “MaaS4ER: mobility as a Service for Italy.” Accessed: May 05, 2025. [Online]. Available: <https://www.regione.emilia-romagna.it/comunicazione/campagne-per-anno/2024/maas>.
- [29] “MaaS - Mobility as a Service - Comune di Bari.” Accessed: May 05, 2025. [Online]. Available: <https://www.comune.bari.it/web/trasporti-e-viabilita/maas-mobility-as-a-service>.
- [30] I. Lopez-Carreiro, A. Monzon, D. Lois, M.E. Lopez-Lambas, Are travellers willing to adopt MaaS? Exploring attitudinal and personality factors in the case of Madrid, Spain, *Travel Behaviour and Society* 25 (Oct. 2021) 246–261, <https://doi.org/10.1016/j.tbs.2021.07.011>.
- [31] P. Coppola, F. Silvestri, L. Pastorelli, Mobility as a Service (MaaS) for university communities: Modeling preferences for integrated public transport bundles, *Travel Behaviour and Society* 38 (Jan. 2025) 100890, <https://doi.org/10.1016/j.tbs.2024.100890>.
- [32] T. Zijlstra, A. Durand, S. Hoogendoorn-Lanser, L. Harms, Early adopters of Mobility-as-a-Service in the Netherlands, *Transp. Policy*. (Oxf) 97 (Oct. 2020) 197–209, <https://doi.org/10.1016/j.tranpol.2020.07.019>.
- [33] W. Kriswardhana, D. Esztergár-Kiss, Exploring the aspects of MaaS adoption based on college students’ preferences, *Transp. Policy*. (Oxf) 136 (Jun. 2023) 113–125, <https://doi.org/10.1016/j.tranpol.2023.03.018>.
- [34] M. Le Pira, UaaS App – University as a Service App: exploring the acceptability of a MaaS-like concept for a University community, *European Transport/Trasporti Europei* (90) (Feb. 2023) 1–10, <https://doi.org/10.48295/ET.2023.90.2>.
- [35] F. Silvestri, F. Silvestri, P. Coppola, Mobility as a Service (MaaS) bundle uptake: a case study in Milan, Italy, *European Transport Research Review* (2025), <https://doi.org/10.1186/s12544-024-00698-2>.
- [36] W. Kriswardhana, D. Esztergár-Kiss, Generational differences in the preferences for MaaS bundles, *J. Transp. Geogr.* 126 (Jun. 2025) 104256, <https://doi.org/10.1016/j.jtrangeo.2025.104256>.
- [37] Y. Lee, G. Circeola, P.L. Mokhtarian, S. Guhathakurta, Are millennials more multimodal? A latent-class cluster analysis with attitudes and preferences among millennial and Generation X commuters in California, *Transportation*. (Amst) 47 (5) (Oct. 2020) 2505–2528, <https://doi.org/10.1007/s11116-019-10026-6>.
- [38] M. Cattaneo, P. Malighetti, C. Morlotti, S. Paleari, Students’ mobility attitudes and sustainable transport mode choice, *International Journal of Sustainability in Higher Education* 19 (5) (Jul. 2018) 942–962, <https://doi.org/10.1108/IJSHE-08-2017-0134>.
- [39] X. Wang, X. Yan, X. Zhao, Z. Cao, Identifying latent shared mobility preference segments in low-income communities: Ride-hailing, fixed-route bus, and mobility-on-demand transit, *Travel Behaviour and Society* 26 (Jan. 2022) 134–142, <https://doi.org/10.1016/j.tbs.2021.09.011>.
- [40] “RUS - Rete delle Università per lo Sviluppo sostenibile.” Accessed: Sep. 14, 2024. [Online]. Available: <https://reterus.it/mobilita/>.
- [41] “Mobility management e Linee guida per la predisposizione dei PSCL – Piani degli Spostamenti Casa-Lavoro | Ministero dell’Ambiente e della Sicurezza Energetica.” Accessed: Sep. 07, 2024. [Online]. Available: <https://www.mase.gov.it/pagina/mobility-management-e-linee-guida-la-predisposizione-dei-pscl-piani-degli-spostamenti-casa>.
- [42] I. Lopez-Carreiro, A. Monzon, M.E. Lopez-Lambas, Comparison of the willingness to adopt MaaS in Madrid (Spain) and Randstad (The Netherlands) metropolitan areas, *Transportation Research Part A: Policy and Practice* 152 (Oct. 2021) 275–294, <https://doi.org/10.1016/j.tra.2021.08.015>.
- [43] C. Caballini, M.V. Corazza, V. Costa, I. Delpono, E. Olivari, Assessing the Feasibility of MaaS: a Contribution from Three Italian Case Studies, *Sustainability*. 14 (24) (Jan. 2022), <https://doi.org/10.3390/su142416743>. Art. no. 24.
- [44] W. Kriswardhana, D. Esztergár-Kiss, Examining university students’ preferences toward MaaS aspects, *Transp. Res. Interdiscip. Perspect.* 30 (Mar. 2025) 101348, <https://doi.org/10.1016/j.trip.2025.101348>.
- [45] S. Kim, S. Rasouli, The influence of latent lifestyle on acceptance of Mobility-as-a-Service (MaaS): a hierarchical latent variable and latent class approach, *Transportation Research Part A: Policy and Practice* 159 (May 2022) 304–319, <https://doi.org/10.1016/j.tra.2022.03.020>.
- [46] W. Kriswardhana, D. Esztergár-Kiss, Identifying latent mobility as a service preference segments among college students, *European Transport Research Review* 17 (1) (Apr. 2025) 24, <https://doi.org/10.1186/s12544-025-00719-8>.
- [47] C.F. Chen, M.L. He, Exploring heterogeneous preferences for mobility-as-a-service bundles: a latent-class choice model approach, *Research in Transportation Business & Management* 49 (Aug. 2023) 101014, <https://doi.org/10.1016/j.rtbm.2023.101014>.
- [48] L. dell’Olio, A. Ibeas, P. Cecín, Modelling user perception of bus transit quality, *Transp. Policy*. (Oxf) 17 (6) (Nov. 2010) 388–397, <https://doi.org/10.1016/j.tranpol.2010.04.006>.
- [49] P. Coppola, F. Silvestri, Assessing travelers’ safety and security perception in railway stations, *Case Stud. Transp. Policy*. 8 (4) (Dec. 2020) 1127–1136, <https://doi.org/10.1016/j.cstp.2020.05.006>.
- [50] L. Eboli, A Stated Preference Experiment for Measuring Service Quality in Public Transport, *Transportation Planning and Technology* 31 (5) (Oct. 2008) 509–523, <https://doi.org/10.1080/03081060802364471>.
- [51] S. Hess, K.E. Train, J.W. Polak, On the use of a Modified Latin Hypercube Sampling (MLHS) method in the estimation of a Mixed Logit Model for vehicle choice, *Transportation Research Part B: Methodological* 40 (2) (Feb. 2006) 147–163, <https://doi.org/10.1016/j.trb.2004.10.005>.
- [52] D.A. Hensher, J.M. Rose, W.H. Greene, *Applied Choice Analysis*, 2nd ed., Cambridge University Press, 2015 <https://doi.org/10.1017/CBO9781316136232>.
- [53] USTAT, “Home,” USTAT. Accessed: Nov. 13, 2024. [Online]. Available: <http://ustat.mur.gov.it/>.
- [54] “Il Piano Spostamenti Casa Lavoro/Università (PSCL/PSCU) del Politecnico di Milano - 2024,” Campus Sostenibile. Accessed: Nov. 14, 2024. [Online]. Available: <https://www.campus-sostenibile.polimi.it/mobilita-sostenibile/piano-spostamento-casa-lavoro-pscl/il-piano-spostamenti-casa-lavoro-universita-pscl-pscu-del-polo-litecnico-di-milano-2024/>.

- [55] "UniGe approva il nuovo Piano Spostamento Casa Università | UniGe Sostenibile." Accessed: Nov. 14, 2024. [Online]. Available: [https://unigesostenibile.unige.it/PSCU\\_2024](https://unigesostenibile.unige.it/PSCU_2024).
- [56] S. Hess, D. Palma, Apollo: a flexible, powerful and customisable freeware package for choice model estimation and application, *J. Choice Model.* 32 (Sep. 2019) 100170, <https://doi.org/10.1016/j.jocm.2019.100170>.
- [57] "R: The R Project for Statistical Computing." Accessed: Dec. 16, 2024. [Online]. Available: <https://www.r-project.org/>.
- [58] L. Pastorelli, F. Silvestri, P. Coppola, Assessing Mobility as a Service bundles potential for university students and employees, *Transportation Research Procedia* 86 (Jan. 2025) 556–563, <https://doi.org/10.1016/j.trpro.2025.04.070>.
- [59] V. Costa, From words to deeds: when digital app acceptance turns into sustainable mobility behaviours. Methodologies and insights from MaaS experiences, *Urban. Plan. Transp. Res.* 13 (1) (Dec. 2025) 2429384, <https://doi.org/10.1080/21650020.2024.2429384>.
- [60] "Safe and Sustainable Mobility as a Sport," MUV. Accessed: Jun. 20, 2025. [Online]. Available: <https://www.muvgame.com/en/>.
- [61] S. Di Dio, E. Lissandrello, D. Schillaci, B. Caroleo, A. Vesco, I. D'Hespeel, MUV: a Game to Encourage Sustainable Mobility Habits, in: M. Gentile, M. Allegra, H. Söbke (Eds.), *Games and Learning Alliance*, Springer International Publishing, Cham, 2019, pp. 60–70, [https://doi.org/10.1007/978-3-030-11548-7\\_6](https://doi.org/10.1007/978-3-030-11548-7_6). Eds.
- [62] "Il Piano Spostamento Casa Università: cultura urbana e spazi pubblici di mobilità | Territorio della Ricerca su Insempiamenti e Ambiente. Rivista internazionale di cultura urbanistica", Accessed: Jun. 20, 2025. [Online]. Available: <http://www.se.rena.unina.it/index.php/tria/article/view/11105>.
- [63] "PRINCE Project 'Prizes and incentives for changes of methods' | UniGe Sostenibile." Accessed: Jun. 20, 2025. [Online]. Available: <https://unigesostenibile.unige.it/en/PRINCE>.