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Global contexts, local intentions: modeling MaaS acceptance across 10 cities

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ABSTRACT

Transport innovations are often described as 'disruptive' in public discourse, yet their acceptance varies due to underlying social-psychological factors that influence user decisions, with responses differing across user groups and contexts. Mobility as a Service (MaaS) is one such innovation that has experienced slow adoption, despite its potential benefits, with many initiatives failing to deliver on their promise. This study examines user perceptions and attitudes influencing MaaS adoption, demonstrating that a one-size-fits-all approach is inadequate given the diverse needs and contextual factors shaping user acceptance. We surveyed users in 10 cities across Europe, Latin America, Africa, and Asia, assessing preferences and attitudes toward MaaS and new mobility services. A structural equation model was estimated, followed by a multi-group analysis stratified by the development level of local transport networks. The results indicate that latent constructs such as Performance Expectancy and Social Influence significantly increase the intention to use MaaS, while Commute Satisfaction reduces it. Moreover, the strength and significance of these latent constructs vary with the degree of transport system development. We conclude that MaaS has the greatest potential in cities with lower levels of transport digitalization and integration, where user dissatisfaction creates more space for its acceptance. In contrast, in more developed systems, where transport services are already highly integrated and user satisfaction is higher, the value proposition of MaaS must be more carefully tailored to address specific

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unmet needs. These findings underscore the importance of flexible, context-sensitive implementation strategies for MaaS, informed by social- psychological drivers, to effectively promote sustainable transport choices.

1. Introduction

The digitalization and electrification of transport services, along with the rise of shared and micro-mobility and automation, have significantly influenced and reshaped urban mobility dynamics over the past few decades (Sperling, 2018). Many of these new mobility services were initially expected to revolutionize the sector. However, their impact has often fallen short of expectations, with slow user adoption emerging as one of the primary challenges (Abouee-Mehrizi et al., 2021; Bezai et al., 2021; Curtale et al., 2021; Samadzad et al., 2023). For instance, the Segway, once predicted to transform mobility in the same way the iPhone revolutionized telecommunications and even hailed as the "invention of the century," ultimately failed. Its downfall was driven by low social acceptance and insufficient market readiness, underscoring the importance of aligning technological innovation with user needs and societal context (Clark et al., 2019; Kelly et al., 2023). Conversely, shared e-scooters were rapidly embraced by the public, but cities were unprepared for their success (Orozco-Fontalvo et al., 2022). This lack of readiness resulted in regulatory voids, operational challenges, and safety concerns (Félix et al., 2023), ultimately leading to bans in some cities. Moreover, this gap highlights the need for alignment between public acceptance and governance.

Another approach to transport innovation focuses on how services are provided rather than on the vehicles themselves. This is where the concept of Mobility as a Service (MaaS) emerged (Hietanen, 2014). Over the last decade, MaaS has captured the attention of transportation stakeholders and, in some cases, become the central objective of both private companies and public authorities. However, its widespread adoption has been slower than anticipated due to feasibility, governance, and implementation challenges, dampening the initial enthusiasm. While a few initiatives, such as Jelbi (Berlin) and Umaji (Taiwan), have consolidated, the recent bankruptcy of the pioneer MaaS provider "Whim" in early 2024 illustrates the difficulty of delivering a seamless, integrated transportation service through a single app.

Since then, different approaches to reviving MaaS have emerged, such as Mobility-as-a-Feature (Hensher and Hietanen, 2022), in which mobility and non-mobility services are bundled (e.g., insurance); MaaS 2.0 (Larco et al., 2024), in which the authors go beyond the technology to also consider infrastructure and regulations, and approaches by Orozco-Fontalvo and Moura (2023) and Lajas and Macario (2020), who position MaaS as a tool for public authorities rather than solely as a business. Ultimately, Maas will succeed only if it can attract sufficient users to remain viable. As some authors argue (Al Haddad et al., 2020; Fioreze et al., 2019; Lopez-Carreiro et al., 2020), attitudes and perceptions may be even more important than socio-demographics or cost-related attributes in shaping adoption. Moreover, it is still regarded in some cities as one of the leading emerging mobility services due to its sustainability potential (He et al., 2025).

However, none of these approaches consider users' perspectives on MaaS or how it should be tailored to meet their needs. This is concerning, as psychosocial factors play a crucial role in adoption (Abouelela et al., 2024; Useche et al., 2022). Only a limited number of studies have assessed how attitudes influence acceptance, and these are geographically restricted. For instance, Kim and Rasouli (2022) Lopez-Carreiro et al. (2024) Matowicki et al. (2022); and Schikofsky et al. (2020) conducted their analyses in the Netherlands and northeastern Europe. Kriswardhana and Esztergár-Kiss (2024) analyzed the potential of MaaS in Hungary. Beyond Europe, studies on Maas acceptance are scarce and are concentrated in Asia (Gan and Li, 2025; Hasselwander et al., 2022; Toyama, 2022; Zhao et al., 2023), where it is considered one of the main emerging mobility services in Hong Kong (He et al., 2025), with none conducted in Latin America or Africa. This gap hinders a broader understanding of MaaS adoption and interest worldwide.

We argue that broader and deeper insights into user behavior and acceptance are needed to shape the next phase of MaaS evolution. Results from European studies cannot be generalized to other contexts, as acceptance depends on local characteristics. In this study, we apply the Extended Unified Theory of Acceptance and Use of Technology to test whether latent constructs directly influence the intention to use MaaS and how different city contexts, in terms of the transport system, shape adoption. To do so, we surveyed 10 cities across Latin America, Europe, Asia, and Africa. These were grouped by MaaS development stage (low, medium, or high) using the IMPReSS score, developed by Orozco-Fontalvo et al. (2024b). We then estimated a Multigroup Structural Equation Model (SEM) to examine the association between the score and cities and respondents' attributes.

The contributions of our study are threefold. First, we fill a critical research gap by examining user behavior through latent constructs in MaaS acceptance, a foundational step toward wider adoption. Second, our cross-sectional approach spans multiple cities, with a significant emphasis on the Global South (Dados and Connell, 2012), providing much-needed insights into regions often underrepresented in MaaS research. Third, we deliver actionable guidance for policymakers to design MaaS strategies that align with the specific strengths and developmental trajectories of urban transport systems, enabling more context-sensitive and effective mobility solutions.

This work is structured as follows. Section 2 presents a literature review of prior MaaS studies, technology acceptance theory, and our research hypothesis. Section 3 describes the analytical methods used, including the survey design, the cities studied, and the modelling framework. Section 4 reports the model results. Section 5 situates these findings within existing research, offers avenues for policymakers, and details future research considerations. Section 6 concludes by summarizing the impact of this research and its contribution to the field.

2. Literature review

To understand MaaS adoption, it is essential to explore its background, development, benefits, and challenges. This section synthesizes key findings from prior studies to frame the discussion of this research, identify the research gap and its contribution, and present the theoretical background and hypothesis development.

2.1. Previous studies on MaaS adoption

Since its official introduction in 2014, MaaS has promised to enable access without the need to own a means of transport (Hietanen, 2014). Its objective was to integrate existing and new mobility services into a single digital platform, providing customized door-to-door transport, personalized trip planning, and payment options (Durand et al., 2018). MaaS relies on the integration and cooperation of several stakeholders, namely Users, Operators (public and private), Mobility Brokers, Technology providers, and Policymakers. Users may benefit from lower transport costs, increased accessibility, and more reliable information. Operators could benefit from accessing a profitable market, Mobility brokers and Technology Providers could expand their businesses, and Policymakers could improve the transport system and resource allocation (Lopes et al., 2023).

However, in practice, MaaS implementation and feasibility have faced numerous challenges. Interactions between stakeholders are often hindered by legal, contracting, interoperability, and data-sharing issues. These issues ultimately impact users' costs, available alternatives, and trust in the system, failing to meet demand. Moreover, MaaS implementation and pilots have predominantly taken place in higher-income cities with well-developed transport networks (Lopes et al., 2023; Orozco-Fontalvo and Moura, 2023), raising questions about its relevance and potential in other realities, such as those in the Global South. The discussion surrounding MaaS has mainly focused on its business model (Chinaei et al., 2022; Ho et al., 2021; Polydoropoulou et al., 2020), theoretical conceptualizations (Arias-Molinares et al., 2022; Esztergár-Kiss et al., 2020; Jittrapirom et al., 2017; Orozco-Fontalvo et al., 2024b; Sochor et al., 2018), travel behavior impacts (Durand et al., 2018; Hensher et al., 2021a; Kamargianni et al., 2016), implications of local policy and governance (Audouin and Finger, 2018; Docherty et al., 2018; Meurs et al., 2020; Orozco-Fontalvo and Moura, 2023, 2023; Smith et al., 2018; Vij and Dühr, 2022), and end-users perceptions or preferences (Gan and Li, 2025; Ho et al., 2020, 2018; Kanuri et al., 2019; Krauss et al., 2023; Tsouros et al., 2021).

Other MaaS-focused papers, including several systematic reviews synthesizing multiple data sources, have evaluated its environmental sustainability impacts (Butler et al., 2020; Storme et al., 2021) and its effects on social conditions (Butler et al., 2021; Lopes et al., 2023). However, only a few studies have explored acceptance and attitudes towards MaaS (Gan and Li, 2025; Kim and Rasouli, 2022; Kriswardhana and Esztergár-Kiss, 2024; Lopez-Carreiro et al., 2024; Matowicki et al., 2022; Schikofsky et al., 2020), and none have compared how it varies across transportation systems or specifically addressed how network maturity influences MaaS uptake.

Moreover, the specific constraints, challenges, and opportunities of cities in the Global South remain largely unassessed in applied research, making it valuable to address their cases in further studies. This is the focus of our research, which analyzes a sample of ten cities to identify gaps in current designs and tailor MaaS solutions to diverse needs.

One topic that remains underexplored is the role of attitudinal factors (e.g., intrinsic motivations, values, and identity-related issues) that may differently drive individuals in the Global South and Global North to adopt (or not adopt) MaaS. Beyond warranting further exploration, these differences may help to explain how attitudes toward urban dynamics (including MaaS) are not formed in isolation but are shaped by collective experiences and socio-cultural influences (Schikofsky et al., 2020; Zhang et al., 2021).

Another subsequent contribution of this study is its potential to provide pioneering insights into how MaaS can be scaled "for the masses." By examining these underexplored differences, we position MaaS as a strategic tool to steer urban mobility, particularly in contexts where its adoption could drive meaningful change (Hasselwander et al., 2023).

2.2. Theoretical background and hypothesis development

Acceptance of new technologies has been a major research topic over the last few decades (Kelly et al., 2023), with the Unified Theory of Acceptance and Use of Technology (UTAUT) frequently cited in explaining technology acceptance and use. Venkatesh et al. (2003) originally designed the UTAUT for organizational and workplace contexts but later expanded it to include the consumer context. The UTAUT2 (Venkatesh et al., 2012) has since been applied in different fields, including transport (Kopplin et al., 2021; Korkmaz et al., 2021; Nguyen-Phuoc et al., 2024; Nordhoff et al., 2020). In this theory, the authors propose several latent constructs that define the behavioral intention to accept and use new technologies. These constructs include: Performance Expectancy (the degree to which using a technology will provide benefits to consumers in performing certain activities); Effort Expectancy (the degree of ease associated with use); Social Influence (the extent to which consumers perceive that important others believe they should use a particular technology); Facilitating Conditions (consumers' perceptions of the resources and support available to perform the behavior); Hedonic Motivation (fun or pleasure derived from using a technology); Price Value (perceived benefits compared to monetary cost); and Habit (the extent to which people perform behaviors automatically through learning).

MaaS is also a technological innovation (integrating services within a single app), making it suitable for assessment using this theory. However, some theoretical constructs, such as Price Value and Habit, are not directly applicable to MaaS, given that it is still a new offering and that even in MaaS-like systems, users often do not recognize they are using MaaS. Moreover, Schikofsky et al. (2020) argue that potential users of disruptive innovations are not necessarily aware of the costs and net benefits across different (and sometimes complex) mobility alternatives. Another construct that can be waived in MaaS acceptance is Facilitating Conditions, because its effect is already captured by Effort Expectancy (Venkatesh et al., 2003). In previous studies, other latent constructs have

been assessed and found significant in explaining the intention to use MaaS, such as sustainability concerns (Kriswardhana and Esztergár-Kiss, 2024; Matowicki et al., 2022), and trust (Chen and Yan, 2019; Curtale et al., 2021; Garroussi et al., 2025). Regarding the observed variables that may influence MaaS acceptance, research indicates that car owners are less likely to use the service, as the initial goal of reducing car ownership was not achieved in most pilot studies (Hensher et al., 2021b). On the other hand, people experienced with mobility apps (e.g., trip planners) and shared mobility services show greater acceptance. The notion of a one-size-fits-all MaaS solution has already been challenged (Lopes et al., 2023; Orozco-Fontalvo and Moura, 2023; Pickford and Chung, 2019).

Although UTAUT2 has been increasingly applied in the context of MaaS, prior research has been constrained in both scope and explanatory depth. Existing applications are generally single-country or single-city case studies, including Japan (Toyama, 2022), India (Hasnah and Pandit, 2025), and the Randstad region (Lopez-Carreiro et al., 2024). These works provide useful insights into localized adoption dynamics, but they often rely on relatively homogeneous samples and do not test the framework's robustness across contrasting transport environments. Moreover, the absence of systematic cross-contextual validation limits the comparability of findings and leaves open the question of how well UTAUT2 captures behavioral intentions across diverse socio-technical settings. This gap underscores the need for studies that examine MaaS adoption more broadly, integrating cases from multiple continents and levels of system maturity to test both the reach and the boundaries of the UTAUT2 framework.

However, to the best of our knowledge, no previous studies have quantitatively compared different city contexts and transportation systems in this regard. Thus, to enable such a comparison, it is first necessary to classify and group these contexts. As an alternative, Orozco-Fontalvo et al. (2024b) proposed a comprehensive method to classify MaaS and MaaS-like systems, building on the proposal by Sochor (2018) and addressing its caveats. This method provides direct insights and facilitates the comparison of the "completeness" of MaaS systems—whether managed by a company or a city—towards achieving full integration. It uses the IMPReSS scoring system, which evaluates six features: the availability and reliability of a multimodal trip planner (Information); the inclusion of public transport and other modes (Multimodality); the ability to make seamless in-app payments (Payment); the capability to make reservations within the app (Reservation); the provision of more than one subscription option (Subscription); and the integration of local or regional policies and goals into the service (Societal goals). These features are assessed in ascending order of implementation complexity and systemic relevance, with each feature scored as 0 (absent) or 1 (present). The binary score is then converted to a decimal value for classification purposes. Based on the final score, systems are categorized as High (>40), Medium (20–40), or Low (<20), with the maximum possible score being 63 (Orozco-Fontalvo et al., 2024b). We hypothesize that the higher the IMPReSS score, the higher the MaaS acceptance. Fig. 1 presents the hypothesized model. Age and gender serve as control variables.

Based on the aforementioned framework, the hypotheses we aim to test are as follows:

H1: The defined constructs in the UTAT2 are applicable, and positively and significantly affect the intention to use MaaS.

H1a: Performance Expectancy positively and significantly affects the intention to use MaaS. H1b: Effort Expectancy positively and significantly affects the intention to use MaaS.

H1c: Social Influence positively and significantly affects the intention to use MaaS. H1d: Hedonic Motivation positively and significantly affects the intention to use MaaS.

H1e: Previous Experience with mobility apps and new mobility services increases the intention to use MaaS.

H2: Sustainability Awareness directly, positively, and significantly affects the intention to use MaaS.

H3: Trust in digital mobility services directly, positively, and significantly affects the intention to use MaaS.

H4: Car owners are less likely to use MaaS

H5: Users who are more satisfied with their commute are less likely to use MaaS.

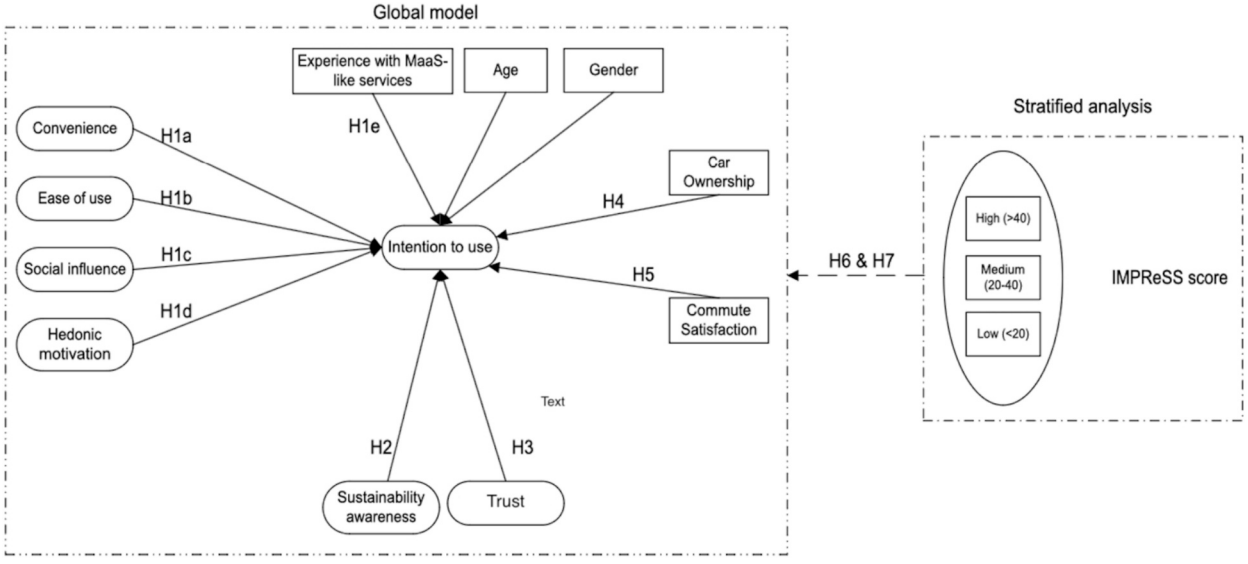

Fig. 1. Literature-based hypothetical study model.

H6: The more developed a city's transport system is (the closer it is to a full MaaS (IMPReSS)), the higher the intention to use MaaS.
H7: The intention to use MaaS varies based on the city's transport system.

3. Methods

We conducted a cross-sectional study of commuters' perceptions and preferences regarding MaaS. A survey was designed using the LimeSurvey platform (suitable for different devices, including smartphones and tablets) and administered in 10 cities (see Fig. 2) with different transport networks, cultural contexts, and socio-demographic conditions. The data were collected between September 2023 and June 2024, and the distribution was carried out first through social media and later through face-to-face interviews in public spaces, focusing on the underrepresented segments.

3.1. Survey design and data collection

The complete survey is part of a broader project. This study focuses on the five sections related to MaaS acceptance. In the first section, respondents were asked about their familiarity with the MaaS concept and then given a brief explanation with an (optional) video for clarification. The second section inquired about travel patterns, including modes and frequency of use, commute time, use of trip planners, and riding skills. The third section covered vehicle ownership, followed by the main section, which used 5-point Likert-scale items adapted from the UTAUT2 to measure the intention to use MaaS. Lastly, respondents reported their sociodemographic characteristics, including household characteristics and ownership of MaaS-related items. Completion time ranged from 15 to 25 min, and we obtained 3,828 valid responses.

These indicators were theoretically explained by latent variables as follows: Performance Expectancy (Perf), Effort Expectancy (Effort), Social Influence (SocInf), Hedonic Motivation (Hed), and the behavioral intention to use MaaS, following the UTUAT2 (Venkatesh et al., 2012). We extended this framework with two proposed constructs from the literature: Sustainability Awareness (SusAwr) (Kriswardhana and Esztergár-Kiss, 2024; Matowicki et al., 2022; Orozco-Fontalvo et al., 2024a) and Trust in digital mobility services (Trust), which encompasses the reliability and trust of new technologies (Chen and Yan, 2019; Curtale et al., 2021; Garroussi et al., 2025). Respondents ranked all items on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". The experience with MaaS-like systems was an observed variable, measured using the frequency of shared modes usage and the use of digital mobility platforms and trip planners as a proxy. Commute satisfaction was also measured on a 5-point Likert scale, where 1 was "very unsatisfied," and 5 was "very satisfied".

To ensure clarity and cultural relevance, the survey was translated into the native language of each city and adapted to local jargon and expressions. In total, the survey was translated from English into five other languages (Portuguese, Spanish, Chinese, Arabic, and Dutch), resulting in ten distinct versions (one per city). Each version was specifically customized to the local culture, terminology, and transportation conditions, with variations even within the same country. For example, in Colombia, regional differences in language and context required additional adjustments. To validate its relevance, the versions were developed in collaboration with a local representative from each city. The questionnaire items were equal for each city except for income level, currency, and prices, which were adjusted for each context. The names of shared mobility services (e.g. Uber, Blabla car, Grab, etc.) were adapted to match local operations and service availability.

Fig. 2. Cities covered by the study.

The data collection process varied across cities, requiring tailored incentives and methodologies based on local contexts. In Barranquilla, Manila, Santiago, Ghent, Cairo, and Porto Alegre, a convenience sampling approach employing snowball sampling was employed. In contrast, trained pollsters conducted surveys in Valencia and Bogota, while specialized data collection companies were hired in Hong Kong and Lisbon. As anticipated, the latter approaches yielded better results overall. However, a notable exception was Manila, where the snowballing method proved unexpectedly effective. To further motivate participation, a raffle offering ten gift cards from an online retailer served as an incentive. The final sample characteristics are presented in Tables 1a and 1b.

3.2. Cities' characteristics and classification

To conduct our stratified analysis, each city's transportation system was classified using the IMPReSS method (Orozco-Fontalvo et al., 2024b). This method captures the context of the transportation system, as it accounts for mode availability, digitalization, integration, and societal goals. The selected cities provide a representative sample of the transportation conditions worldwide, highlight the understudied Global South, and offer a diverse range of IMPReSS scores. Specifically, three cities were classified as low, three as medium, and four as high. This distribution allowed us to test our hypotheses across these groups and compare cities with similar characteristics or scores. The cities' main characteristics are presented in Table 2, and the transportation systems and modal splits are presented in Table 3.

3.3. Modeling framework

To model the relationships between the hypothesized variables and the intention to use MaaS, a Structural Equation Model (SEM) was estimated using the Lavaan package in R (Rosseel, 2012). Prior to estimating the SEM, we conducted an Exploratory Factor Analysis (EFA) followed by a Confirmatory Factor Analysis (CFA). The EFA assessed the dimensionality of the measurement items and ensured that observed indicators loaded as expected. The CFA evaluated the validity and reliability of the latent constructs. The full dataset was randomly divided into two independent subsamples: 70% of the observations were used for EFA, while the remaining 30% were reserved for CFA (Wang et al., 2015).

The number of factors retained in the EFA was determined using parallel analysis. Seven factors were selected, as their empirical eigenvalues exceeded those obtained from randomly generated data. In the EFA, factors were extracted using the minimum residual (minres) method and rotated using an oblique (oblimin) rotation, given the theoretical expectation of correlated latent constructs. Although orthogonal rotations such as Varimax are commonly applied in exploratory factor analysis (Wang et al., 2015), an oblique rotation was adopted in this study. This choice was motivated by the theoretical expectation that the latent constructs are correlated, as implied by the UTAUT2 framework and supported by prior empirical evidence in technology acceptance and mobility behavior research. As for the CFA, we included tests of factor loadings and discriminant validity (all the ratios were below 0.85). Only items with satisfactory psychometric properties were retained (i.e., loadings > 0.4 and no cross-loadings).

Detailed EFA and CFA results are reported in Appendix A. Table 4 presents the statements (indicators) that respondents assessed using a Likert scale.

The CFA results showed excellent global model fit (CFI $= 0.960$, TLI $= 0.953$, RMSEA $= 0.042$, SRMR $= 0.038$), and standardized factor loadings were all satisfactory (mostly > 0.60), confirming the reliability and validity of the latent constructs.

We then estimated a structural equation base model using the complete dataset to test the hypothesis. Next, we conducted a multi-group SEM to assess whether the structure of the model was equivalent across the different IMPReSS levels, meaning both the variables and the loadings remained consistent across groups, in what is called an invariance test (Marôco, 2010). This adds explanatory strength by supporting that the differences between groups are not due to measurement discrepancies but to genuine variations in relationships, thereby allowing valid comparison of the influence of variables on the intention to use MaaS. The groups for the stratified analysis corresponded to the IMPReSS classification of the cities' transportation systems.

The model was estimated using the maximum likelihood method with bootstrapping and 2000 replications. Bootstrapping was employed to account for the lack of multivariate normality in the data, which was expected. It provides a more robust estimation of standard errors by generating numerous random resamples from the original dataset, allowing a distribution of parameter estimates and supporting hypothesis testing even with non-normally distributed data. This technique was suitable for our dataset, given its size and representativeness of the target population. However, it produces wider confidence intervals that may affect the precision of the estimates.

To conduct the invariance test, we estimated a set of models following Van de Schoot (2012):

1. Configural invariance: a model where all parameters are allowed to vary across groups.
2. Metric invariance: a model where the factor loadings are constrained to be equal across groups, but the intercepts are allowed to vary. This tests whether respondents across groups attributed the same meaning to the latent construct.
3. Scalar invariance: a model where both factor loadings and intercepts are constrained to be equal. This tests whether groups can be compared on their scores on the latent variable.
4. Uniqueness invariance: a model where residual invariances are also fixed. This tests whether the latent construct is measured identically across groups.

Table 1a
Sample (population) characteristics by city.

		Gender					Occupation					Income		Sample (Frequency)
City	**Man**	**Woman**	**Other**	**Selfemp**	**Emp**	**FL**	**GradS**	**Retired**	**UndS**	**Unemp**	**High**	**Medium**	**Low**	
Barranquilla	48% (48%)	51% (52%)	1%	1%	54%	11%	3%	2%	27%	3% (10%)	4%	37%	59%	317
Bogota	51% (47%)	49% (53%)	1%	2%	50%	10%	1%	4%	29%	4% (9%)	24%	45%	31%	497
Cairo	83% (51%)	15% (49%)	1%	1%	19%	1%	6%	1%	69%	8% (10%)	8%	28%	63%	166
Ghent	45% (50%)	46% (50%)	9%	2%	72%	6%	10%	1%	7%	2% (4%)	15%	49%	36%	195
Hong Kong	43% (45%)	49% (55%)	8%	1%	74%	7%	5%	1%	10%	2% (4%)	23%	60%	17%	400
Lisbon	42% (47%)	57% (53%)	2%	4%	61%	5%	2%	2%	24%	1% (7%)	13%	61%	27%	865
Manila	52% (50%)	32% (50%)	16%	3%	60%	9%	6%	0%	18%	4% (5%)	21%	59%	20%	490
Porto Alegre	51% (47%)	47% (53%)	3%	5%	40%	8%	18%	3%	25%	1% (8%)	35%	38%	26%	317
Santiago	54% (51%)	42% (49%)	4%	3%	58%	10%	4%	1%	21%	3% (9%)	29%	35%	36%	281
Valencia	30% (48%)	66% (53%)	4%	2%	30%	3%	6%	2%	54%	4% (11%)	17%	54%	29%	300
Global	**47%**	**48%**	**5%**	**3%**	**55%**	**7%**	**5%**	**2%**	**25%**	**3%**	**19%**	**50%**	**31%**	**3,828**

Notes: Selfemp: Self-Employed; Emp: Employee; FL: Freelancer; GradS: Graduate student; UndS: Undergraduate student; Unemp: Unemployed.

Table 1b
Sample (population) characteristics by city (adults only).[a]

		Age				Education					Sample (Frequency)
City	**<24**	**24–34**	**44–64**	**>65**	**Elementary**	**High-School**	**Technician**	**Associate**	**Bachelors**	**Masters**	**PhD**	**None**	
Barranquilla	23% (16%)	38% (22%)	37% (48%)	2% (14%)	2% (12%)	25% (50%)	26% (37%)	–	37%	9% (<1%)	1%	3% (1%)	317
Bogota	39% (15%)	32% (26%)	28% (51%)	1% (14%)	0% (32%)	30% (42%)	16% (19%)	–	43%	9% (3%)	19%	4% (5%)	497
Cairo	63% (26%)	19% (23%)	17% (39%)	1% (11%)	0% (28%)	26% (28%)	3% (18%)	–	51%	10% (n.a.)	4%	8% (15%)	166
Ghent	15% (10%)	47% (24%)	37% (47%)	1% (20%)	1% (9%)	12% (50%)	6% (28%)	–	38%	36% (14%)	6%	2% (1%)	195
Hong Kong	15% (7%)	40% (14%)	45% (56%)	1% (27%)	22% (24%)	38% (54%)	0% (19%)	13%	15%	10% (3%)	1%	2% (1%)	400
Lisbon	29% (8%)	23% (16%)	45% (48%)	2% (29%)	2% (15%)	34% (30%)	9% (37%)	–	34%	18% (n.a.)	3%	1% (n.a.)	865
Manila	15%	58%	2%	0% (5%)	0% (19%)	14% (40%)	12% (35%)	–	53%	17% (<1%)	3%	4% (1%)	490
Porto Alegre	25% (12%)	48% (20%)	25% (57%)	1% (11%)	0% (10%)	21% (n.a.)	4% (35%)	–	40%	23% (n.a.)	12%	1% (2%)	317
Santiago	16%	40%	42%	1% (14%)	1% (18%)	17% (41%)	15% (36%)	–	48%	15% (5%)	5%	3% (1%)	281
Valencia	64% (9%)	9% (15%)	25% (50%)	2% (25%)	1% (17%)	19% (51%)	27% (29%)	–	45%	5% (8%)	3%	4% (1%)	300
Global	**47%**	**48%**	**5%**		**4%**	**26%**	**12%**	**–**	**39%**	**15%**	**3%**	**1%**	**3,828**

[a]Population data obtained from national and city official statistics.

Table 2
Main characteristics of the cities involved.

City	Pop.[1] (mill)	Area[1] (Km2)	Pop. density[1](Km2)	GDP per capita[2]	GINI[2]	IMPReSS
Barranquilla	1.30	154	8,618	€6,600	0.460	Low
Bogota	8.00	1587	20,691	€10,526	0.530	Medium
Cairo	22.00	3085	19,376	€3,951	0.315	Low
Ghent	0.26	156	1,709	€47,300	0.249	High
Hong Kong	7.50	1106	7,062	€45,064	0.540	High
Lisbon	0.55	100	6,425	€30,500	0.340	High
Manila	1.80	42	43,079	€10,100	0.420	Low
Porto Alegre	1.50	496	2,837	€17,628	0.490	Medium
Santiago	7.00	641	8,464	€17,800	0.440	Medium
Valencia	0.80	135	5,998	€24,473	0.350	Medium

Note: 1: Source: Thomas Brinkhoff: City Population, http://www.citypopulation.de; 2: Source: https://www.statista.com/markets/2535/topic/970/economT/overview.

Table 3
Available mobility statistics of the cities.[a]

City	PT options	Modal split
Barranquilla	BRT, Bus, Taxi	Car = 6%, PT = 57% Walk = 30%, bike = 1%, Mot = 4%, Other = 2%
Bogota	BRT, Bus, Taxi	Car = 14%, PT = 48%, Walk = 25%, bike = 7%, Mot = 6%
Cairo	Bus, Taxi, Metro, Tram, Train	Car = 24%, PT = 61% Walk = 12%, bike = 1%, Mot = 2%
Ghent	Tram, Bus, Taxi, Train	Car = 38%, PT = 15% Walk = 13%, bike = 33%, Mot = 2%
Hong Kong	Metro, Tram, Bus, Taxi, Ferry	Car = 14%, PT = 71% Walk = 12%, bike = 1%, Mot = 1%, Other = 1%
Lisbon	Bus, Train, Metro, Tram, Ferry, Taxi	Car = 58%, PT = 16% Walk = 23%, bike = 1%, Mot = 2%
Manila	Train, Bus	Car = 8%, PT = 32% Walk = 31%, bike = 2%, Mot = 8%, Para = 18%, Other = 1%
Porto Alegre	Bus, Taxi	Car = 29%, PT = 45% Walk = 9%, bike = 6%, Mot = 2%, RH = 7%, Other = 2%
Santiago	BRT, Metro, Bus, Taxi	Car = 34%, PT = 36% Walk = 46%, bike = 4%, Mot = 2%
Valencia	Bus, Metro, Tram, Taxi	Car = 41%, PT = 14% Walk = 41%, bike = 3%, Other = 1%

[a]PT= Public transport, BS = BikeSharing, CS= Car-Sharing, ES = E-scooter, MS = MotorcycleSharing, RH = Ridehailing, Mot = Motorcycle, Para=Paratransit.

Table 4
List of indicators.

No.	Code	Statement
1	Perf_1	MaaS would reduce my commuting time
2	Perf_2	MaaS would improve my commute experience
3	Perf_3	MaaS would be useful for my commute
4	Perf_4	MaaS would help me choose the best alternative for my daily trips
6	Eff_1	I'm capable of using mobility apps
7	Eff_2	New mobility services have clear and understandable instructions
8	Eff_3	New mobility services are easy to learn to use
9	Eff_4	New mobility services are easy to use
10	Hed_1	New mobility services are fun
11	Hed_2	New mobility services are exciting
12	Hed_3	New mobility services are enjoyable
13	SusAwr_2	I believe that integrated mobility services help to fight climate change
14	SusAwr_3	I try to avoid using motorized modes for environmental reasons
15	SusAwr_4	I usually use sustainable modes even if they are more expensive
16	SusAwr_5	I usually use sustainable modes even if they require more effort
17	Socinf_2	New mobility services presented as positive or impactful in social media
18	SocInf_3	New mobility services are recommended to me by people whose opinion I value
19	SocInf_4	New mobility services are being used by people who are important to me
20	SocInf_5	My peers are increasingly using new mobility services
21	Trust_2	New mobility services are reasonably priced
22	Trust_3	Services like Airbnb, Blabla Car and Uber are better than the traditional alternatives
23	Trust_5	My personal information is handled appropriately when using mobility apps
24	Trust_6	The new service providers will deliver reliable and safe transportation options
25	Trust_7	My payment information will be secure when using Mobility apps
26	IntUse_intend	I intend to use MaaS in the future
27	IntUse_plan	I plan to use MaaS regularly
28	IntUse_use	I will use MaaS daily

4. Results

The results are presented considering the hypothesis formulated in Section 2.2 and are divided into two parts: the base model and the multi-group SEM. The base model presents the results for the complete dataset (as previously explained in correspondence with Fig. 1), and the multi-group SEM presents the results for the stratified analysis of IMPReSS classification groups. The comparison between Commute Satisfaction and IMPReSS scores highlights this contrast: in cities with higher IMPReSS scores, more than half of respondents expressed high satisfaction with their commutes, whereas in cities with lower scores, less than a third of respondents reported the same. This is shown in Fig. 3.

Regarding the validity of the constructs, Table 5 shows the reliability coefficients (Cronbach's alpha and Omega) and the Average Variance Extracted (AVE) for each construct. We present both the Cronbach's alpha, as it is commonly used, and the McDonald's omega, as it is considered more reliable, especially for congeneric items (when essential tau-equivalence is violated), because it accounts for the dimensional structure of the data (Hayes and Coutts, 2020). Congeneric items refer to indicators that are assumed to measure the same underlying construct but may vary in their loadings or variances, as is the case here.

In our results, the reliability coefficients were above or near the threshold of 0.8, except for Hedonic Motivation, which was close to 0.7 and can be considered acceptable. The values for Omega and Omega2 were identical, which indicates that there are no "dual-loadings" of the indicators, as Omega2 is also known as unconditional reliability (Flora, 2020). Finally, AVE further supports construct validity by assessing the proportion of variance captured by the construct relative to the total variance, with all constructs showing adequate convergent validity except for Hedonic Motivation, which was retained for theoretical completeness.

4.1. Base model

Our base model diagram is presented in Table 6. The latent variables had factor loadings above 0.4, and a cumulative variance of 0.62, which is considered acceptable and valid for this type of model (Marôco, 2010). We obtained a good fit with a CFI of 0.95, TLI of 0.95, and RMSEA of 0.040. Regarding the regressions, as expected, Performance Expectancy proved to be one of the stronger predictors of the behavioral intention to use MaaS (Estimate = 0.321, $p < 0.001$), supporting H1a.

Early Working Age adults (24–34) derived higher enjoyment from using the service, as shown by Hedonic Motivation (Estimate = 0.067, $p = 0.008$), while Middle Aged respondents found it more difficult to use new mobility services (Estimate = −0.217, $p = 0.00$). This suggests that age plays a role in the perception of MaaS: younger users may find the service more intuitive and enjoyable, while older users encounter barriers to adoption. Previous studies have shown that ride-hailing services are mostly used by young, educated people (Nguyen et al., 2021). Interestingly, gender does not have a significant impact on the intention to use MaaS, as seen from the non-significant coefficient (Estimate = −0.024, $p = 0.29$). This implies that gender differences are not a key factor in shaping user perceptions or intentions regarding MaaS adoption, which can be an opportunity to reduce the gender gap in transport as women follow different travel patterns and often make trip chains, which could be better served by MaaS (Balarezo et al., 2024; McIlroy,

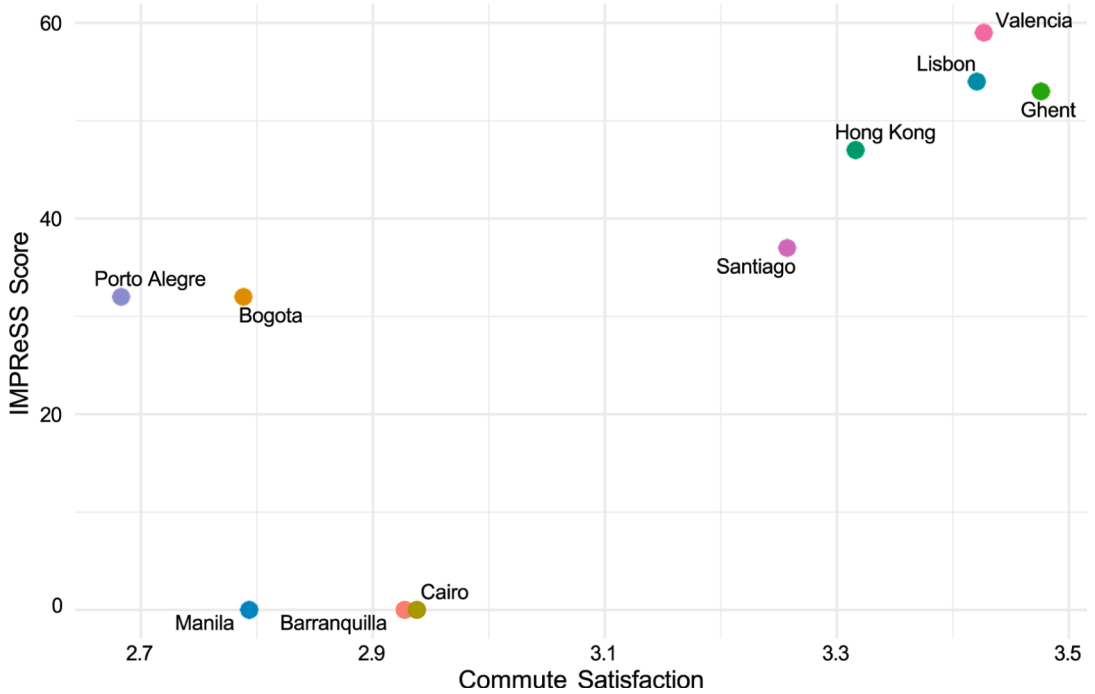

Fig. 3. Commute satisfaction avg vs IMPReSS score.

Table 5
Reliability and validity measures for constructs.

	Perf	SusAwr	Effort	Hedonic	Socinf	Trust	IntUse
Alpha	0.889	0.853	0.867	0.670	0.808	0.791	0.845
Omega	0.889	0.856	0.869	0.680	0.810	0.792	0.848
Omega2	0.889	0.856	0.869	0.680	0.810	0.792	0.848
Omega3	0.890	0.857	0.871	0.687	0.812	0.793	0.850
AVE	0.668	0.666	0.689	0.416	0.588	0.560	0.652

Table 6
SEM results.

Predictor		Outcome	Estimate	Std.Err	Z value	P value
Earlyworksage	→	IntUse	0.107	0.022	4.922	0.000
CommuteStsfctn	→	IntUse	−0.035	0.011	−3.128	0.002
Gendhom	→	IntUse	−0.024	0.022	−1.059	0.290
ExperienceMaaS	→	IntUse	0.210	0.033	6.303	0.000
Carown	→	IntUse	−0.041	0.022	−1.868	0.062
Perf	→	IntUse	0.321	0.017	18.888	0.000
SusAwr	→	IntUse	0.066	0.015	4.414	0.000
Hedonic	→	IntUse	0.039	0.023	1.728	0.084
Socinf	→	IntUse	0.146	0.023	6.393	0.000
Eff	→	IntUse	−0.006	0.021	−0.262	0.793
Trust	→	IntUse	0.142	0.028	5.090	0.000
Trust	→	Perf	0.816	0.046	17.892	0.000
Middleage	→	Eff	−0.217	0.042	−5.187	0.000
ExperienceMaaS	→	Eff	0.247	0.045	5.440	0.000
Earlyworksage	→	Hedonic	0.067	0.025	2.658	0.008
ExperienceMaaS	→	Hedonic	0.162	0.037	4.346	0.000
Eff	→	Hedonic	0.336	0.019	17.333	0.000
ExperienceMaaS	→	Trust	0.177	0.040	4.449	0.000
Eff	→	Trust	0.546	0.024	23.191	0.000
Trust	→	Socinf	0.618	0.030	20.597	0.000
Trust	→	SusAwr	0.266	0.037	7.225	0.000
Socinf	→	Trust	0.290	0.035	8.352	0.000

2023). On the other hand, car owners are less likely to use MaaS (Estimate = −0.041, p = 0.06), which is in line with the literature, as several studies show the difficulty of shifting from private cars to MaaS (Alonso-González et al., 2020; Fioreze et al., 2019; Hensher et al., 2021a; Storme et al., 2020), thus supporting H4.

Other demographic and attitudinal factors also play critical roles in MaaS adoption. Trust in digital mobility services was a strong predictor of both the Performance Expectancy (Estimate = 0.87, p = 0.00) and Social Influence (Estimate = 0.618, p = 0.00), indicating that those more comfortable with technology are more likely to find MaaS convenient and be influenced by others to adopt it. Previous experience with MaaS significantly enhanced Effort Expectancy (Estimate = 0.247, p = 0.00) and also increases the likelihood of adoption (Estimate = 0.210, p = 0.00), suggesting that familiarity with the service is a major driver of intention. Additionally, Sustainability Awareness (Estimate = 0.066, p = 0.00) and Social Influence (Estimate = 0.146, p = 0.00) positively impact the intention to use MaaS, highlighting the importance of environmental consciousness and social networks in shaping user behavior. Together, these findings highlight the need for MaaS strategies that consider both technological familiarity and attitudinal factors, such as Social Influence and environmental benefits, to encourage broader adoption across diverse demographic groups. These support H1c, H1e, H2, and H3.

On the other hand, and in line with H5, Commute Satisfaction had a negative effect, indicating that respondents who are more satisfied with their current commute are less likely to use MaaS. This is an interesting result, which can be explained by the fact that people who are satisfied with their situation are less likely to modify it by trying new services.

Surprisingly, Effort Expectancy was not significant, which could be explained by the fact that respondents are already familiar with similar technologies and do not see it as a barrier to using MaaS, leading to the rejection of H1b. Hedonic Motivation was also not significant (rejecting H1d), though this latent variable was found to be significant in previous studies regarding e-scooters (Kopplin et al., 2021; Orozco-Fontalvo et al., 2024a). This indicates that respondents view MaaS primarily as a utilitarian service rather than something fun or exciting, as was the case in those studies. However, Schikofsky et al. (2020) concluded that Hedonic Motivation had a similar impact as perceived usefulness on behavioral intention. Such results could be related to the year of data collection (Schikofsky et al., 2020). For example, in 2017, shared mobility and mobility apps were still quite a novelty, potentially increasing the Hedonic Motivation construct. Our data collection was conducted in 2024, when these mobility services and corresponding apps were widespread with high citizen awareness, as our Effort Expectancy result supports. These results indicate that not all constructs defined in the UTAUT2 apply to the intention to use MaaS. This contrasts with the findings of Kriswardhana and Esztergár-Kiss (2024), where Effort Expectancy was significant for two of the three clusters tested.

4.2. Multi-group SEM

As we argue that a single base model cannot adequately capture the differences in MaaS acceptance among city groups at different stages of development (H7), the detailed multi-group results are reported in Appendix 1. The configural model (Table 7) demonstrated a satisfactory fit to the data ($\chi^2 = 2978.6$, $p < 0.001$), suggesting the basic structure of the model was consistent across groups.

However, when we tested for metric invariance (constraining the factor loadings to be equal across groups), the chi-square difference was highly significant ($\Delta\chi^2 = 104.70$, $df = 30$, $p < 3.3e\text{-}10$). This result indicates that the relationships between the observed variables and their underlying latent constructs varied significantly across the levels of MaaS development. In other words, respondents in different groups did not interpret constructs such as Performance Expectancy, Sustainability Awareness, and Effort Expectancy in the same way.

Testing for scalar invariance (constraining both factor loadings and intercepts to be equal across groups) also resulted in a significant chi-square difference ($\Delta\chi^2 = 372.54$, $df = 30$, $p < 2.2e\text{-}16$). This finding implies that not only the relationships but also the baseline levels of the indicators varied across groups. Therefore, the assumption of equal measurement across different levels of MaaS development is not supported.

Overall, these results support the hypothesis that a one-size-fits-all model is not suitable for assessing MaaS acceptance across different cities (H7). The lack of metric and scalar invariance indicates that the relative importance and meaning of MaaS-related constructs differ across urban contexts. This suggests that respondents in cities at different stages of MaaS maturity interpret and prioritize latent constructs in distinct ways. Consequently, MaaS design and policy strategies should be adapted to local sociocultural and infrastructural conditions rather than assuming universal behavioral patterns.

Moreover, the results also show how latent constructs and other predictors vary across groups. For instance, Commute Satisfaction was not significant in the High and Medium IMPReSS groups, confirming our argument in the base model that this variable does not strongly influence MaaS adoption where transport systems are already more developed. Hedonic Motivation was significant in the High IMPReSS group but not in the Medium or Low groups. Sustainability Awareness is significant in both the High and Medium IMPReSS groups but not in the Low group. These results align with expectations: in settings with poor transportation, users tend to prioritize basic functionality over sustainability or enjoyment.

Other notable differences include Performance Expectancy, which was a strong predictor across all groups but shows a higher estimated effect in the Medium IMPReSS group. Social Influence appears more relevant in the Low group, suggesting that social factors are particularly influential where MaaS is less established. Trust positively affected all groups, particularly by strengthening Performance Expectancy. In short, the High IMPReSS group prioritized Performance Expectancy and Trust as critical drivers for adopting MaaS, reflecting a more pragmatic and reliability-focused outlook, but still showed the least overall interest in MaaS. The Low IMPReSS group also valued Performance Expectancy but was more strongly impacted by Social Influence, perhaps due to less familiarity with the technology. The Medium IMPReSS group balanced these trends, with moderate scores across most latent variables.

5. Discussion and policy implications

This discussion focuses on the key findings from the multi-group analysis of MaaS acceptance across cities with varying levels of transportation system development. To guide this analysis, we explore the factors that influence the intention to use MaaS, with particular attention to the diverse impacts of socio-demographic characteristics, user satisfaction, and transport system conditions. By examining how factor loadings such as Performance Expectancy, Sustainability Awareness, and Social Influence differ between cities with High, Medium, and Low IMPReSS scores, we aim to understand how these differences influence MaaS adoption and identify the contextual conditions that facilitate or hinder its success. The discussion is structured to provide insights into how these findings relate to broader policy implications for promoting MaaS in different urban environments.

Overall, our findings suggest a strong but negative relationship between the maturity of urban transport systems and the likelihood of MaaS adoption, leading to the rejection of H6. In cities with highly developed and efficient transport networks, where 52% of respondents reported being highly satisfied with their daily travel experiences, there are fewer incentives to adopt MaaS. The convenience and reliability of the existing infrastructure appear to reduce the perceived benefits of switching to new, integrated mobility solutions.

5.1. Is it 'that different' between the Global South and the Global North?

While a categorical answer to this question would require further studies, additional variables, and broader coverage, the findings from the cities analyzed suggest that key differences may indeed exist. This is reflected in the multi-group analysis, where Commute Satisfaction was not a significant factor for the intention to adopt MaaS in High and Medium IMPReSS groups. This insignificance suggests that in such contexts, users do not rely on their commute satisfaction to guide decision-making about MaaS adoption. Consequently, MaaS faces a bigger challenge in these cities: it cannot rely on simply improving the perceived quality of commuting but must offer additional incentives or unique value propositions to attract users.

In contrast, in cities with lower transport system maturity, where only 28% of commuters report high satisfaction, MaaS becomes a more attractive option. These cities, often in the Global South (e.g., Bogota, Cairo, and Manila), face significant mobility challenges, including long travel times, unreliable services, and fragmented transport modes (Jahangir et al., 2024). In such contexts, MaaS has the potential to integrate even existing informal transport services, offering a more cohesive and reliable transport solution that addresses unmet user needs.

Table 7
Multigroup SEM (MGSEM) results.

Predictor		Outcome	Estimate			Standard Error			Z value			P value		
			High	Medium	Low	High	Medium	Low	High	Medium	Low	High	Medium	Low
Earlyworksage	→	IntUse	0.134	0.002	0.095	0.042	0.030	0.032	3.208	0.052	3.122	0.001	0.958	0.002
CommuteStsfctn	→	IntUse	−0.005	−0.022	−0.03	0.021	0.017	0.017	−0.250	−1.030	−1.737	0.803	0.303	0.082
Gendhom	→	IntUse	−0.043	−0.094	−0.01	0.038	0.032	0.033	−1.106	−2.289	−0.142	0.269	0.022	0.887
ExperienceMaaS	→	IntUse	0.193	0.106	0.159	0.045	0.071	0.069	4.289	1.642	2.250	0.000	0.101	0.024
Carown	→	IntUse	−0.018	−0.023	−0.02	0.045	0.035	0.035	−0.409	−0.579	−0.592	0.683	0.562	0.554
Perf	→	IntUse	0.304	0.403	0.201	0.026	0.031	0.034	11.513	11.030	6.448	0.000	0.000	0.000
SusAwr	→	IntUse	0.061	0.070	0.001	0.021	0.040	0.041	2.954	3.061	0.036	0.003	0.002	0.972
Hedonic	→	IntUse	0.117	−0.044	−0.01	0.037	0.051	0.082	3.177	−1.198	−0.074	0.001	0.231	0.941
Socinf	→	IntUse	0.080	0.128	0.287	0.036	0.062	0.065	2.212	4.201	4.669	0.027	0.000	0.000
Eff	→	IntUse	0.010	−0.024	0.001	0.030	0.049	0.052	0.320	−0.767	0.027	0.749	0.443	0.978
Trust	→	IntUse	0.083	0.171	0.197	0.041	0.082	0.094	2.021	4.571	2.401	0.043	0.000	0.016
Trust	→	Perf	0.812	0.593	0.918	0.099	0.057	0.067	8.34	6.751	16.182	0.000	0.000	0.000
Middleage	→	Eff	−0.307	−0.270	0.040	0.060	0.089	0.105	−5.149	−3.104	0.449	0.000	0.002	0.653
ExperienceMaaS	→	Eff	0.205	0.277	0.258	0.063	0.105	0.101	3.241	2.467	2.444	0.001	0.014	0.015
Earlyworksage	→	Hedonic	0.028	0.060	0.044	0.046	0.034	0.031	0.617	1.186	1.289	0.537	0.236	0.198
ExperienceMaaS	→	Hedonic	0.114	0.087	0.150	0.048	0.073	0.063	2.361	1.001	2.057	0.018	0.317	0.040
Eff	→	Hedonic	0.202	0.297	0.490	0.032	0.032	0.029	6.346	8.284	15.340	0.000	0.000	0.000
ExperienceMaaS	→	Trust	0.103	0.143	0.133	0.058	0.077	0.066	1.787	1.700	1.736	0.074	0.089	0.083
Eff	→	Trust	0.435	0.454	0.728	0.038	0.045	0.043	11.416	10.604	16.288	0.000	0.000	0.000
Trust	→	Socinf	0.538	0.484	0.745	0.045	0.054	0.051	11.956	8.254	13.839	0.000	0.000	0.000
Trust	→	SusAwr	0.124	0.146	0.453	0.060	0.073	0.081	2.076	2.504	6.195	0.038	0.012	0.000
Socinf	→	SusAwr	0.239	0.310	0.221	0.056	0.073	0.079	4.248	6.272	3.033	0.000	0.000	0.002

From a transport justice perspective, this suggests that MaaS can play a relevant role in improving the overall quality of urban transport in cities with mobility poverty, which is exacerbated by issues such as insecurity, inaccessibility, and limited transport choices (Alfaro et al., 2024; Durand et al., 2022). Based on our study, the IMPReSS results linked to our analysis show that the fundamental idea behind MaaS –a seamless digital integration of various transportation modes- leads to higher overall commuter satisfaction. This indicates that cities prioritizing innovation, integration, multimodality, and digitalization of their transport services tend to have more satisfied users.

The multi-group Structural Equation Model (SEM) analysis indicates that latent constructs such as Performance Expectancy, Trust, and Social Influence are key factors influencing the intention to adopt MaaS, particularly in cities with less developed transport systems. These attitudinal factors, in many cases, outweigh traditional considerations like cost and time savings. In other words, this underscores the importance of psychosocial factors in user decision-making processes. Therefore, a successful MaaS strategy must be flexible and tailored to specific urban contexts, recognizing the diversity in user expectations and infrastructure maturity. Ultimately, MaaS adoption will depend on adaptive, user-centered solutions that address both the practical and attitudinal needs of commuters across different cities.

5.2. *Different social influences… different choices and policy needs?*

Building on these points, our results highlight the significant impact of Social Influence on the intention to use MaaS –a factor often overlooked in policy discussions– suggesting that community dynamics and peer endorsements are crucial in driving adoption. In contrast, Effort Expectancy, traditionally emphasized in technology acceptance models, was not significant, suggesting that users' familiarity with similar digital platforms makes usability less critical. Additionally, the non-significance of Hedonic Motivation implies that MaaS is perceived more as a functional solution than an enjoyable experience, perhaps reflecting its established status in the mobility ecosystem.

In other words, these findings reveal that in the context of MaaS, practical and social benefits are more impactful than usability or enjoyment. This suggests a more complex adoption landscape where attitudes toward Performance Expectancy, Sustainability Awareness, and Social Influence surpass the influence of technology-related factors. Coherently, some of the few existing studies emphasize that, to guarantee access to the service, MaaS systems operators must work closely with communities to ensure inclusivity. For instance, aging adults who may have low digital literacy may experience significant challenges interacting with these platforms (Durand et al., 2022; Zhang and Yang, 2024) – an issue not reflected in our results, possibly due to the low sample of aging respondents, which we acknowledge as a limitation. Table 8 presents a summary of the hypothesis evaluation.

Based on these insights, a feasible practical implication could be that policymakers should prioritize MaaS implementation in cities with lower transport maturity (in terms of IMPReSS), such as Bogota or Manila, where commuter dissatisfaction and fragmented transport networks offer a strategic opportunity to improve mobility integration and service reliability. In these settings, MaaS can serve as a coordinating platform to unify informal and formal transport services, ultimately enhancing accessibility and commuter satisfaction. For cities with advanced, integrated systems like Hong Kong or Ghent, where commuter satisfaction is already high, MaaS adoption may require a more tailored, value-added approach, such as offering premium features or customizable service options that meet specific user needs.

In this context, our results also suggest that Social Influence plays a particularly important role, reinforcing the need for policy strategies that leverage social networks and community influence to foster awareness and interest in MaaS. For example, collaborating with local influencers or community groups could strengthen a community-driven push toward MaaS adoption, particularly in regions where technological familiarity varies. Furthermore, as previous studies indicate, income is not a significant determinant of MaaS adoption (Hasselwander et al., 2022). Therefore, marketing and educational campaigns should focus broadly on increasing awareness of MaaS benefits rather than targeting specific income groups. By aligning MaaS strategies with the attitudinal drivers of Performance Expectancy, Social Influence, and Sustainability Awareness, and by considering the unique transport needs of each city, policymakers can effectively optimize MaaS adoption potential and contribute to its long-term success.

MaaS, at its core, represents the ongoing evolution of transport systems and integration efforts implemented in cities worldwide,

Table 8
Hypothesis summary.

No.	Hypothesis	Result	Conclusion
1	H1	Not all the constructs in the UTAUT2 influence the intention to use MaaS.	Partially endorsed
2	H1a	Performance Expectancy positively and significantly affect the intention to use MaaS.	Endorsed
3	H1b	Effort Expectancy does not affect the intention to use MaaS.	Rejected
4	H1c	Social influence positively and significantly affects the intention to use MaaS.	Endorsed
5	H1d	Hedonic Motivation does not affect the intention to use MaaS.	Rejected
6	H1e	Previous experience with mobility apps and new mobility services increases the intention to use MaaS.	Endorsed
7	H2	Sustainability Awareness directly, positively and significantly affect the intention to use MaaS.	Endorsed
8	H3	Trust directly, positively and significantly affects the intention to use MaaS.	Endorsed
9	H4	Car owners are less likely to use MaaS	Endorsed
10	H5	Users who are more satisfied with their commute are less likely to use MaaS.	Endorsed
11	H6	The more developed a city's transport system is, the higher the intention to use MaaS.	Rejected
12	H7	The intention to use MaaS varies based on the city's transport system.	Endorsed

often without the formal "MaaS" label. As our results show, in cities with high IMPReSS, many individuals have already been using systems that embody the principles of MaaS without being aware of it. This suggests that the focus need not be on defining MaaS, but on enhancing the elements that contribute to greater mobility-related satisfaction. Nevertheless, the MaaS label remains valuable for quickly referencing the ideal model for integrating mobility services that cities should aim to offer. It also serves as a standardized term in regulatory and policy documents to avoid legal ambiguities due to interpretation.

6. Conclusion

By applying a validated, multilingual survey instrument across ten cities worldwide, this study advances the literature by enabling direct cross-country comparison of MaaS acceptance patterns. In addition, the model was extended to include Sustainability Awareness and Trust, reflecting contemporary shifts in user expectations around environmental performance, digital trust, and technological readiness. These additions not only strengthen the theoretical explanatory power of UTAUT2 but also provide more practically relevant insights. For policymakers and practitioners, the results highlight the differentiated role of MaaS: in low-IMPReSS settings where mobility is fragmented and informal services dominate, MaaS offers the potential to integrate and rationalize provision; in high-IMPReSS cities, where services are already advanced, MaaS must be designed to deliver customized and added value. These findings position our study as both a conceptual update of UTAUT2 and a policy-relevant contribution to the global MaaS debate.

The results show that the intention to use MaaS is influenced by the city's transport system development (according to the IMPReSS method). Still, contrary to our H1, higher IMPReSS score cities are associated with a lower intention to use MaaS. On the other hand, we support H2, as the model indicates that the influence of the latent constructs on the intention to use MaaS varies based on the city's transportation system. This suggests that a one-size-fits-all model is unsuitable for assessing MaaS acceptance across different cities (in line with Gan & Li (2025)), and that local context and development level should be considered when designing MaaS policies and strategies. Moreover, H3 was partially supported: the defined constructs positively and significantly influenced the intention to use MaaS, except for Effort Expectancy, which appeared irrelevant given respondents' prior familiarity with such apps.

Our main finding is that MaaS acceptance is higher in cities with a low IMPReSS score due to lower levels of commute satisfaction. Therefore, MaaS stakeholders and advocates should focus on cities with similar characteristics instead of (as has been done in the last decade) trying to implement MaaS in cities with already reliable and robust transport systems. This also represents an opportunity to improve transport equity on a global scale for those in low-IMPReSS cities.

The main value of this study is its thorough multi-city comparison, which incorporates a sizable number of cities from the Global South, a region that is frequently under-represented in transportation studies. By examining MaaS adoption across diverse contexts, our findings highlight the need to move beyond the notion that solutions implemented in the Global North will universally apply to the rest of the world. The findings emphasize how crucial it is to acknowledge and consider the various cultural, social, and infrastructural realities that influence mobility requirements and practices in different regions. A more nuanced and holistic approach is essential to design urban transport systems that deliver tailored benefits to specific contexts, ensuring equitable and effective mobility solutions for all cities, regardless of their development stage.

Given that MaaS involves integrating diverse transport services, future research should focus on tailoring MaaS packages to align with the unique preferences and needs of potential users, considering the specific characteristics of each city's transportation system. Moreover, expanding the scope of MaaS beyond mobility services and including "non-mobility" services such as home delivery could provide better insights into what people truly want from a mobility solution, as this may encompass more than commuting-related services. This was also a limitation of this study, as we accounted only for commute satisfaction, while it would be worthwhile to consider well-being for a more holistic view.

7. Limitations of the study and further research

While the findings offered by this study provide valuable insights into the intentional factors and antecedents of MaaS adoption across different geographical and socioeconomic contexts, several limitations must be acknowledged when interpreting and applying the results.

First, the sample sizes and data collection methods varied, which may impact the generalizability of the study. For instance, despite efforts to represent the population in all cities, the use of convenience sampling may have introduced selection bias; population reference values have been provided to aid interpretation. Future studies should aim for probabilistic sampling designs to enhance generalizability. Second, because the survey was predominantly distributed online, we were limited in collecting representative data from aging adults, restricting insights into this demographic segment. Not having representation of this population may lead to an underestimation of adoption barriers, especially around digital literacy and usability, with associated equity implications.

Third, the study provides a snapshot of current attitudes and behaviors toward MaaS but does not examine how these may change over time. This presents an opportunity for future research as transport systems and MaaS offerings continue to evolve. This limitation is common in cross-sectional designs, which, while not diminishing their contributions, require that outcomes be interpreted with caution (Savitz and Wellenius, 2023; Wang and Cheng, 2020). Moreover, although IMPReSS scores capture system-level differences in mobility integration, they may also correlate with broader socio-economic conditions such as GDP, inequality, or digital literacy. Future studies could extend our approach by integrating such macro-level indicators or applying multilevel modeling to further disentangle system-specific from socio-economic influences.

Lastly, while the diversity of cities included is a major strength of this study, it neither fully captures the range of urban environments globally nor encompasses the complete set of psychosocial and cultural variables that may explain intention-related

differences. In this regard, we encourage other researchers to explore, perhaps through complementary research designs (e.g., qualitative and mixed-method studies), the role of socio-cultural traits, values, and transport justice dynamics in shaping MaaS acceptance, usage patterns, and its potential contributions to transport justice and sustainability in different regions. Assessing whether certain IMPReSS components are more influential than others in shaping user acceptance could also further guide policy making.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT as a grammar checker and to enhance readability in some sections. However, the study's insights, hypotheses, and interpretations were developed exclusively by the qualified researchers.

CRediT authorship contribution statement

Mauricio Orozco-Fontalvo: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Oscar Oviedo-Trespalacios:** Writing – review & editing, Supervision, Methodology. **Sergio Useche:** Writing – review & editing, Methodology, Conceptualization. **Sylvia Y. He:** Resources, Data curation, Funding acquisition, Methodology, Writing – review & editing. **Sonia Mangones:** Writing – review & editing, Resources, Funding acquisition. **Margareth Gutierrez:** Resources, Formal analysis. **Ana Karina Christ:** Resources, Funding acquisition. **Hannah Hook:** Writing – review & editing, Investigation. **Mohamed Abouelela:** Writing – review & editing, Formal analysis, Data curation. **Jorge Bolivar-Redondo:** Resources, Data curation. **Lenin Bulla-Cruz:** Writing – review & editing, Visualization, Resources. **Marc Hasselwander:** Writing – review & editing, Resources, Investigation. **Filipe Moura:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Conceptualization.

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Appendix A

Table A1
Exploratory Factor Analysis (EFA) 70% sampling– Rotated factor loadings: Oblimin.

Item	Performance expectancy	Sustainability Awareness	Effort expectancy	Hedonic	Social Influence	Trust	Intended Use
Perf_1	**0.715**	–	–	–	–	–	–
Perf_2	**0.820**	–	–	–	–	–	–
Perf_3	**0.853**	–	–	–	–	–	–
Perf_4	**0.800**	–	–	–	–	–	–
SusAwr_2	0.103	0.297	–	–	–	0.150	0.107
SusAwr_3	–	**0.761**	–	–	–	–	–
SusAwr_4	–	**0.745**	–	–	–	–	–
SusAwr_5	–	**0.863**	–	–	–	–	–
Eff_1	0.126	–	0.423	−0.146	–	–	0.134
Eff_2	–	–	**0.695**	–	–	–	–
Eff_3	–	–	**0.880**	–	–	–	–
Eff_4	–	–	**0.837**	–	–	–	–
Hed_1	–	–	–	**0.872**	–	–	–
Hed_2	–	–	–	**0.844**	–	–	–
Hed_3	0.104	0.143	–	**0.509**	–	–	–
SocInf_2	–	–	0.144	–	0.307	0.158	–
SocInf_3	–	–	–	–	**0.700**	–	–
SocInf_4	–	–	–	–	**0.865**	–	–
SocInf_5	–	–	–	–	**0.698**	–	–
Trust_2	–	0.111	–	–	–	0.359	–
Trust_3	–	–	–	–	0.127	0.401	–
Trust_5	–	–	–	–	–	**0.726**	–
Trust_6	–	–	–	–	–	**0.697**	–
Trust_7	–	–	–	–	–	**0.751**	–
IntUse_intend	–	–	–	–	–	–	**0.679**
IntUse_plan	–	–	–	–	–	–	**0.903**
IntUse_use	–	–	–	–	–	–	**0.733**

Note: Factors with weak loadings < 0.4 or with cross-loadings were dropped for the modeling steps.

Table A2
Confirmatory Factor Analysis (CFA) 30% sampling – Standardized Loadings.

Construct	Item	Std. Loading
Performance expectancy	Perf_1	0.764
	Perf_2	0.835
	Perf_3	0.863
	Perf_4	0.810
Sustainability Awareness	SusAwr_3	0.774
	SusAwr_4	0.789
	SusAwr_5	0.880
Effort expectancy	Eff_2	0.755
	Eff_3	0.882
	Eff_4	0.860
Hedonic Motivation	Hed_1	0.698
	Hed_2	0.724
	Hed_3	0.528
Social Influence	SocInf_3	0.781
	SocInf_4	0.811
	SocInf_5	0.712
Trust	Trust_5	0.744
	Trust_6	0.725
	Trust_7	0.776
Intended Use	IntUse_intend	0.860
	IntUse_plan	0.770
	IntUse_use	0.790

Model Fit: $\chi^2(188) = 475.996$, CFI = 0.977, TLI = 0.971, RMSEA = 0.037 (90% CI: 0.033–0.041), SRMR = 0.032.

Table A3
HTMT ratios (discriminant validity).

	Perf	SusAwr	Eff	Hedonic	Socinf	Trust	IntUse
Perf	1	0.281	0.389	0.480	0.428	0.384	0.668
SusAwr		1	0.209	0.535	0.402	0.321	0.364
Eff			1	0.516	0.447	0.560	0.371
Hedonic				1	0.572	0.606	0.508
Socinf					1	0.552	0.524
Trust						1	0.479
IntUse							1

Data availability

Data will be made available on request.

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