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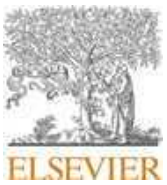

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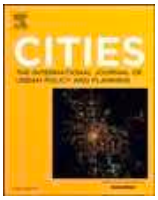

Why smart mobility alone does not ensure accessibility? Social, spatial, and digital dimensions of mobility as a service in island contexts

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ABSTRACT

Mobility as a Service (MaaS) is increasingly promoted as a key component of smart and sustainable urban mobility; however, empirical evidence on its capacity to deliver socially accessible and satisfactory travel experiences remains limited, particularly in constrained and insular contexts. Addressing this gap, this study investigates the role of social accessibility in MaaS and its impact on user experience, focusing on airport-to-city mobility in the island context of Sardinia, Italy. The research adopts a quantitative multi-method approach, combining a questionnaire survey ($N = 391$) with Space Syntax analysis. The survey examines the association between perceived social accessibility, user experience and satisfaction, and perceived spatial accessibility through Pearson correlation and linear regression analyses. In parallel, syntactic segment analysis evaluates the topological accessibility of airport-to-city corridors in selected island urban systems. The results reveal that accessibility is not merely determined by the availability of services, but by the interaction between social inclusion, spatial configuration, economic affordability, digital integration, and temporal reliability. While public transport affordability and safety were generally perceived positively, fragmented digital platforms, inadequate pedestrian connections, and service unreliability during peak periods undermined overall user experience. These insights underscore that MaaS effectiveness depends as much on physical and institutional coherence as on technological innovation. By foregrounding accessibility as a multidimensional and lived experience, this study provides a grounded and actionable contribution to the development of more inclusive, resilient, and user-centred MaaS systems in island and peripheral contexts.

1. Introduction

In the transition toward smarter and more sustainable cities, mobility has emerged as a central challenge and opportunity for urban development. Traditional transport systems are being reshaped by digitalisation, integration, and user-centric approaches, with Mobility as a Service (MaaS) often presented as one of several emerging approaches to integrate transport services within digitally enabled and user-oriented mobility systems (Paiva et al., 2021; Pencarelli, 2020; Wong et al., 2020). MaaS integrates multiple modes of transport, including public and private, collective and individual, into a single digital platform that enables seamless planning, booking, and payment of journeys (Enoch & Potter, 2023; Pickford & Chung, 2019; Sochor et al., 2018). However, despite strong academic and policy interest, the real-world impact of MaaS remains limited, with many large-scale implementations struggling to achieve long-term adoption or scalability. Emerging evidence suggests that alternative models, such as transport "super apps" integrating mobility with broader digital services, as well as simplified fare systems, may offer more practical and widely adopted pathways toward integrated mobility (Hasselwander, 2025; Weiss & Hasselwander, 2025). These developments indicate that the transition toward smart and sustainable mobility may not depend on MaaS alone, but rather on a broader ecosystem of digitally connected and user-centred mobility solutions.

Within this evolving ecosystem, MaaS is often associated with the potential to improve convenience, integration, and accessibility;

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however, its actual contribution to broader societal goals—such as inclusivity and equity—remains empirically underexplored (Catulli et al., 2025; Chinbat et al., 2023; Dadashzadeh et al., 2024). This is where the concept of social accessibility becomes critical: ensuring that diverse groups of users, regardless of their socio-economic status, physical ability, or demographic profile, can equally benefit from integrated mobility services (Bocarejo S & Oviedo H, 2012; Garau et al., 2025; Orozco-Fontalvo et al., 2025). At the same time, the user experience has become a decisive factor in determining the success and adoption of MaaS-related mobility systems, as satisfaction, trust, and perceived value directly influence their long-term viability (Aman & Smith-Colin, 2022; Lyons et al., 2019; Smith et al., 2022). Understanding the intersection of these variables, social accessibility, MaaS, and user experience, has therefore become an important research priority in both academic and policy debates on the future of urban mobility.

Despite ongoing debates regarding the practical relevance and scalability of MaaS, the broader challenge of delivering integrated, accessible, and user-centred mobility systems remains unresolved (Li et al., 2024). Although MaaS has gained increasing attention in both academic and professional discourses, most existing studies have focused on its technological design (Kriswardhana & Esztergar-Kiss, 2023; Musolino et al., 2022), business models (Krauss et al., 2022; Polydoropoulou et al., 2020; Wong & Hensher, 2021), and environmental benefits (Becker et al., 2020; Ho & Tirachini, 2024; Martinčević et al., 2022), often overlooking its social dimension. Importantly, existing research has rarely examined these issues in relation to real-world constraints of sustainable mobility (An & Shen, 2025), where digital fragmentation, infrastructural limitations, and service inconsistencies may undermine the theoretical benefits associated with MaaS and similar integrated mobility concepts. In particular, limited research has addressed how MaaS-related mobility systems perform in terms of social accessibility, especially in contexts where mobility challenges are intensified by geographic and infrastructural constraints. Equally, while user experience is widely acknowledged as a decisive factor for the adoption and success of MaaS (Bu et al., 2025; Chen & Chen, 2023; Hesselgren et al., 2020; Tsouros et al., 2021), empirical evidence on how social accessibility influences satisfaction remains scarce. This gap is especially evident in island contexts, where reliance on air travel and seasonal fluctuations in demand create unique mobility patterns and needs. Islands also depend heavily on efficient airport-to-city connections, making airports critical nodes in the regional mobility system. Investigating how integrated mobility services address these connections provides an opportunity to better understand not only the inclusivity of mobility services but also their ability to meet diverse user expectations. Against this background, this study responds to the need for more context-sensitive analyses that link social accessibility with user satisfaction in MaaS-related mobility contexts, with a particular focus on airports as gateways to wider mobility networks.

In Sardinia Island, mobility challenges are particularly pronounced due to its insular geography, limited transport infrastructure, and high reliance on air connections. The three main airports including Cagliari Elmas, Olbia Costa Smeralda, and Alghero-Fertilia function as critical gateways for residents, tourists, and businesses alike, yet their connections to nearby urban centres often suffer from fragmentation, frequent public transport delays, inconsistent service quality, and insufficient integration across modes. These gaps risk excluding certain groups of users, undermining both the inclusivity and efficiency of the public transport system. In this context, MaaS-related mobility systems can be considered as one potential approach among several strategies aimed at improving integration and user experience in airport-to-city mobility systems. However, given the limited maturity of MaaS implementations, it is essential to critically assess whether existing mobility systems—regardless of their formal classification as fully integrated MaaS systems—effectively deliver socially accessible and satisfactory travel experiences. Consequently, little is known about whether current systems in Sardinia deliver on these promises, particularly from the perspective of social accessibility and user satisfaction. To address this, the study employs a quantitative multi-method approach, combining a questionnaire survey to capture user perceptions and satisfaction with MaaS-related services, alongside Space Syntax analysis to evaluate the spatial accessibility of airports in relation to their associated cities.

In the context of this study, MaaS is operationalised in a pragmatic and context-sensitive manner, reflecting its current stage of development in Sardinia. While fully integrated MaaS platforms—enabling unified planning, booking, and payment across all transport modes—are not yet fully implemented, the region has begun to adopt several digital mobility solutions that exhibit partial MaaS characteristics. These include multimodal journey planning applications, regionally coordinated public transport systems, and emerging digital ticketing platforms that facilitate integration across buses, trains, and other services. Accordingly, this study refers to "MaaS-related mobility systems" as transport environments that demonstrate partial functional integration (e.g., shared information systems, multimodal coordination, and digital interfaces), even if they do not yet constitute fully mature MaaS ecosystems. This operationalisation acknowledges that MaaS implementation in many European peripheral and regional contexts remains evolutionary rather than fully consolidated, making partially integrated systems an important empirical domain for contemporary MaaS research. The survey was designed to capture users' perceptions of these integrated mobility experiences—particularly in airport-to-city travel contexts—rather than a single unified MaaS platform. This approach reflects the transitional nature of MaaS implementation in many real-world settings, where integration remains incremental and uneven. In this context, integrating spatial configuration analysis with user perception data enables a more comprehensive understanding of accessibility. While questionnaire data capture subjective evaluations of mobility systems, Space Syntax analysis provides an objective assessment of spatial accessibility and network structure. Comparing these dimensions allows the study to identify potential mismatches between perceived and actual accessibility conditions.

The aim of this study is to investigate the role of social accessibility in MaaS and its impact on user experience, focusing on airport-to-city mobility in the island context of Sardinia. Accordingly, the following questions are proposed: 1. To what extent do current MaaS-related services in Sardinia's airports ensure socially accessible connections to nearby cities? 2. How does social accessibility influence users' satisfaction and overall experience with integrated mobility services? 3. What spatial accessibility patterns, revealed through Space Syntax analysis, align with or contradict users' perceptions of accessibility and satisfaction? It is assumed that higher levels of perceived social accessibility in MaaS-related mobility systems are positively correlated with greater user satisfaction. It is hypothesised that proper spatial accessibility to the public transport significantly influences users' perceptions of accessibility and their reported experience. Also, it is premised that Airport-to-city integrated mobility services in Sardinia reveal gaps between their topological accessibility and perceived accessibility experienced by users. This research is structured as follows: following the Introduction, a Literature Review section establishes the research gaps and theoretical basis of the study; this is followed by the Materials and Methods section outlining the instruments and techniques employed. Subsequently, the Results and Findings are presented, followed by a Discussion with interpretation and implications, and finally the Concluding Remarks.

2. Literature review

2.1. Rethinking accessibility in the era of smart and integrated mobility

Accessibility has long been recognised as a fundamental dimension of transport equity and urban sustainability, yet its interpretation is evolving in the context of smart mobility systems. Traditionally defined in terms of physical proximity and network efficiency, accessibility is

increasingly understood as a multidimensional construct shaped by social, economic, and technological factors. Karolemeas et al. (2026) argue that despite advances in smart transport technologies, significant barriers persist for vulnerable groups, particularly older adults and people with disabilities, due to infrastructural deficiencies and digital usability challenges. This highlights that technological innovation alone does not guarantee equitable access.

This shift toward a more inclusive understanding of accessibility is further reinforced by Costa and Delponte (2024), who emphasise the importance of user-centred mobility management in ensuring that transport systems respond to diverse needs. Similarly, Kennedy et al. (2024) demonstrate that improving door-to-door journeys requires attention not only to infrastructure but also to user perceptions, autonomy, and service experience. These perspectives collectively suggest that accessibility must be evaluated beyond spatial metrics, incorporating user capabilities and system usability.

However, emerging research also reveals tensions in how accessibility improvements are distributed. For instance, Lopes et al. (2025) find that integrating transport modes, such as bike-sharing and transit, can enhance overall accessibility but may simultaneously increase inequalities in certain contexts. Likewise, Qin and Liao (2024) show that ignoring financial constraints can lead to overestimations of accessibility, underscoring the importance of affordability as a critical dimension. These findings suggest that accessibility is not inherently equitable and must be critically examined across multiple dimensions, particularly in the context of emerging mobility systems.

2.2. MaaS: Promises, potentials, and limitations

MaaS has emerged as a prominent framework for integrating transport modes into unified, user-centric platforms. A substantial body of literature highlights its potential to enhance accessibility, reduce car dependency, and support sustainable mobility transitions. For example, Witlox (2024) demonstrates through meta-analysis that MaaS can improve accessibility, safety, and energy efficiency, while Liu et al. (2025) provide empirical evidence of its contribution to reducing air pollution through decreased private vehicle use.

At the operational level, MaaS facilitates multimodal integration, enabling more efficient travel patterns. Li et al. (2026) show that metro-integrated multimodal systems can substitute a significant proportion of ride-hailing trips, generating both environmental and economic benefits. Similarly, Han et al. (2026) highlight the importance of intermodal transfer efficiency, demonstrating that the success of MaaS depends on seamless connections between transport modes. Supporting this, Golightly et al. (2024) illustrate how integrating ridesharing into rail systems can enhance accessibility and user satisfaction.

Despite these promising findings, a growing body of research questions the extent to which MaaS delivers its anticipated benefits in practice. Lyko and Kębłowski (2025) critically argue that MaaS is often framed as a technological solution without sufficient attention to its broader societal implications, particularly regarding publicness and governance. Similarly, Mårtensson et al. (2023) highlight the complex and sometimes contradictory effects of mobility services, noting that their impacts depend on systemic interactions rather than isolated interventions. These critiques suggest that MaaS should be understood not as a universal solution, but as one component within a broader ecosystem of mobility innovations. Importantly, a growing gap in the literature concerns the empirical investigation of MaaS within partially implemented or transitional contexts, where integration remains incomplete and fragmented, yet continues to shape user experience and accessibility outcomes beyond idealised MaaS models (Lyons et al., 2019).

2.3. Social accessibility and inclusion in MaaS systems

A critical strand of the literature focuses on the inclusivity of MaaS and its ability to address social inequalities in transport access. While MaaS is often promoted as an inclusive solution, empirical evidence indicates that access to such systems is unevenly distributed. Orozco-Fontalvo et al. (2025) identify key barriers, including digital literacy, access to mobile data, and affordability, which exclude up to 30% of potential users. This highlights that digital integration, while enabling, can also reinforce existing inequalities.

Similarly, Dadashzadeh et al. (2024) propose a multi-criteria framework for evaluating inclusivity in MaaS, emphasising the importance of accessible services, platforms, and data systems. Earlier work by Dadashzadeh et al. (2022) further introduces the MaaS Inclusion Index, demonstrating that current systems often fail to adequately address the needs of vulnerable populations. Complementing this, Congiu et al. (2025), highlight that MaaS can enhance mobility capital for vulnerable groups, but only when individual capabilities and environmental conditions are explicitly considered.

The literature also explores specific dimensions of social inclusion, such as gender and age. Giuffrida et al. (2025) show that MaaS has the potential to address women's mobility needs, particularly in terms of safety and flexibility, while Chinbat et al. (2023) demonstrate its capacity to reduce accessibility inequalities for elderly populations in rural contexts. However, Karolemeas et al. (2026) caution that technological complexity may simultaneously create new barriers for these groups. Together, these studies reveal a fundamental paradox: while MaaS has the potential to enhance inclusivity, it may also reproduce or even exacerbate inequalities if not carefully designed and implemented.

In the context of this study, social accessibility is conceptualised as the extent to which mobility systems are socially inclusive, understandable, affordable, and usable for diverse groups of users regardless of socio-economic status, physical ability, linguistic background, or travel familiarity. While closely related to concepts such as transport equity (Litman, 2017), universal accessibility (Audirac, 2008), and capability-based approaches to mobility (Nussbaum, 2007), social accessibility is operationalised here as an applied and user-oriented construct that focuses specifically on the lived accessibility conditions experienced within integrated mobility environments. In contrast to transport equity frameworks, which primarily address the fair distribution of transport resources and opportunities, and capability approaches, which emphasise individuals' substantive freedoms to access opportunities, the present study focuses more directly on how users perceive the practical usability, inclusiveness, and navigational accessibility of mobility systems in everyday travel contexts. Accordingly, dimensions such as affordability, informational legibility, multilingual support, and accessibility for vulnerable users are treated as interconnected components influencing the social usability of airport-to-city mobility systems.

2.4. Adoption, user behaviour, and the role of service design

Understanding user adoption and behavioural responses is critical to evaluating the real-world impact of MaaS. Recent studies emphasise that adoption is highly heterogeneous and influenced by a range of socio-demographic, behavioural, and service-related factors. Sogbe et al. (2026a) demonstrate that MaaS users cannot be treated as a homogeneous group, identifying distinct segments with varying preferences and expectations. Similarly, Sogbe et al. (2026b) show that features such as real-time information and accessibility are key drivers of adoption, while pricing mechanisms and multimodal planning may generate scepticism among certain user groups.

These findings are supported by Zhou et al. (2025), who highlight the complexity of modelling multimodal travel behaviour in MaaS environments, and Monteiro et al. (2023), who show that user preferences for shared mobility services are highly context-dependent. Additionally, Ye and Zheng (2024) emphasise the role of stakeholders and institutional frameworks in shaping MaaS adoption, pointing to the importance of governance and policy support.

At the same time, empirical studies of MaaS implementation reveal mixed outcomes. Lu et al. (2025) find that MaaS trials can increase public transport ridership in certain areas, while Bruzzone et al. (2025) demonstrate its potential to improve accessibility in long-distance travel contexts. However, Papaioannou et al. (2023) highlight significant challenges in island and rural areas, including market fragmentation and limited infrastructure, which constrain MaaS development. These findings suggest that user adoption and system performance are highly context-sensitive, requiring tailored approaches rather than one-size-fits-all solutions.

2.5. Spatial and contextual dimensions of accessibility in complex environments

Beyond service design and user behaviour, accessibility is also shaped by spatial configuration and environmental constraints. Studies employing spatial and morphological analysis provide important insights into how built environments influence mobility outcomes. For instance, Boonprong et al. (2025) demonstrate the importance of polycentric hub development in improving first- and last-mile accessibility, while Dastoum et al. (2026) show how spatial configuration can either mitigate or exacerbate socio-spatial inequalities.

In more complex and sensitive environments, such as tourism landscapes and island regions, these challenges become even more pronounced. Alam et al. (2026) highlight how terrain constraints significantly limit transport network development, reducing accessibility potential in coastal areas. Similarly, Papaioannou et al. (2023) emphasise the unique characteristics of island contexts, including fragmentation, seasonality, and reliance on external connections, which complicate the implementation of integrated mobility systems.

Technological innovations, such as autonomous shuttles, also interact with spatial factors. Shi et al. (2025) demonstrate that deployment risks and operational efficiency depend heavily on route characteristics and local conditions. These studies underscore that accessibility is not only a function of service integration but also of spatial structure and geographic context, reinforcing the need for context-sensitive analyses.

2.6. Research gap and contribution

The reviewed literature highlights significant advancements in understanding MaaS and accessibility, yet several critical gaps remain. First, while many studies examine technological integration and environmental impacts, the intersection between social accessibility, spatial configuration, and user experience remains underexplored. Second, existing research often treats accessibility dimensions in isolation, without considering their interaction within real-world mobility systems. Third, island contexts—characterised by unique spatial, infrastructural, and socio-economic constraints—remain insufficiently investigated, particularly in relation to airport-to-city mobility.

Moreover, while MaaS is frequently positioned as a transformative solution, the literature increasingly recognises its limitations and context-dependent performance. This calls for a more nuanced, empirically grounded assessment of how integrated mobility systems function in practice, beyond their conceptual promises.

In response to these gaps, this study adopts a multi-dimensional approach to accessibility, examining the interplay between social, spatial, and digital factors in shaping user experience within MaaS-related systems. By focusing on airport-to-city mobility in an island context, it contributes to advancing a more context-sensitive and critical understanding of accessibility in the era of smart mobility.

3. Material and methods

3.1. Research design

This study adopts a quantitative multi-method research design that integrates perceptual and spatial analyses to investigate the relationship between social accessibility, MaaS, and user experience. The combination of survey-based data and spatial modelling of Space Syntax allows for a comprehensive understanding of both subjective and objective aspects of accessibility within Sardinia's airport-to-city mobility systems. The quantitative approach provides an evidence-based framework for identifying patterns, relationships, and potential disparities between user perceptions and spatial realities. This dual-method design ensures that both the social and spatial dimensions of accessibility are examined, bridging the gap between user-centred experiences and the physical structure of mobility networks.

The methodological framework is structured around the three main research questions outlined in the Introduction. The first research question investigates the degree of social accessibility offered by existing MaaS-related services through users' perspectives. The second explores how such accessibility influences satisfaction and overall experience, while the third compares users' perceived accessibility with the objectively measured spatial accessibility using Space Syntax analysis. By addressing these questions through complementary datasets, the study aims to establish a correlative link between spatial configuration metrics and social perceptions of accessibility. This approach reflects a growing trend in urban mobility studies to combine spatial analytics with behavioural and perceptual data to achieve a holistic understanding of user-centred mobility systems. The overall methodological flow is visually delineated in Fig. 1. In the following subsections, the detailed explanations of each adopted methodological approach are described.

3.2. Questionnaire survey

The first methodological component consists of a questionnaire survey designed to capture users' perceptions of social accessibility, satisfaction, and overall experience with airport-to-city mobility services. The questionnaire was structured into five sections, covering demographic information, perceived social accessibility, user experience, spatial accessibility, and open-ended feedback. The final section of the questionnaire included an open-ended question inviting respondents to provide additional comments and suggestions. These qualitative responses were reviewed and thematically examined to identify recurring issues related to digital integration, fare affordability, multilingual information, pedestrian conditions, and service reliability. Although these responses were not subjected to formal qualitative coding, they were used to contextualise and incorporate the quantitative findings and to inform the interpretation of recurring concerns raised by participants. Each question was formulated to directly correspond to the research objectives, ensuring conceptual alignment between the theoretical framework and the empirical data collected. The construct of perceived social accessibility was operationalised through indicators reflecting users' perceived affordability, inclusiveness, informational clarity, usability, and accessibility for diverse user groups. These dimensions were identified through the literature to capture the socially mediated conditions influencing users' ability to effectively access and navigate airport-to-city mobility systems in practice. A five-point Likert scale (ranging from 1 = strongly disagree to 5 = strongly agree) was employed to quantify respondents' attitudes, perceptions, and satisfaction levels. This format allows for the statistical analysis of associations among the study variables, using techniques such as Pearson correlation, and ANOVA, depending on data characteristics and research hypotheses.

The questionnaire was distributed both in person and online to reach a diverse sample of users across the three airports. On-site surveys were administered at key transport nodes including airport terminals, bus stops, and train stations, while the online version was disseminated

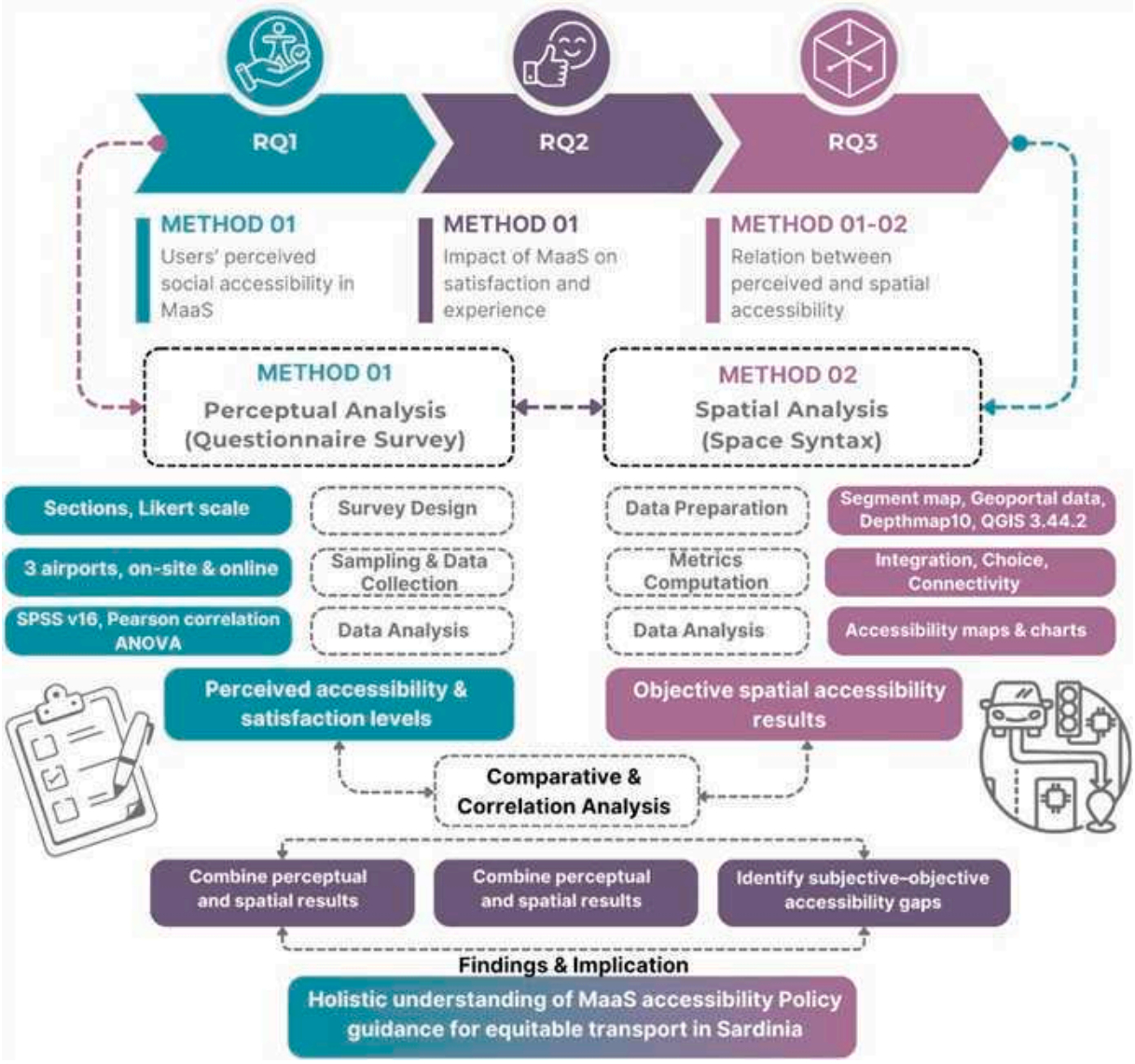

Fig. 1. Methodological framework of the study, displaying the integrated quantitative multi-method approach combining questionnaire survey data and Space Syntax analysis to examine social accessibility, user experience, and spatial accessibility within airport-to-city mobility systems.

through local transport users mailing lists and social media groups dedicated to mobility in Sardinia. Participants were selected using a convenience sampling strategy aimed at capturing a diverse range of residents, tourists, and frequent travellers using airport-to-city mobility services across Sardinia. The target sample size was estimated using the Cochran formula as a general reference point for achieving adequate statistical robustness in large populations. Considering the population of Sardinia and a confidence level of 95% with a margin of error of 5%, the optimal sample size was calculated as 384 respondents. In total, 391 valid questionnaires were collected, exceeding the minimum required threshold and thereby strengthening the statistical reliability of the survey findings. Respondents were informed of the study's purpose, the voluntary nature of participation, and the anonymity of their responses in accordance with the Declaration of Helsinki. To ensure data reliability, incomplete or inconsistent responses were excluded from the analysis. All survey instruments and procedures received prior approval from the university's Institutional Review Board, confirming compliance with ethical research standards.

To minimise potential biases associated with self-administered questionnaires, several procedural measures were implemented during the survey design and data collection stages. Respondents were informed that participation was anonymous and voluntary, thereby reducing the likelihood of social desirability bias and evaluation apprehension. Questionnaire items were carefully formulated using clear and neutral language to avoid leading or suggestive phrasing. In addition, the questionnaire structure separated the main constructs into distinct thematic sections to reduce respondents' tendency to provide mechanically consistent answers across variables. Both online and in-person distribution methods were employed to diversify the respondent pool and minimise sampling bias. Furthermore, incomplete, repetitive, or inconsistent responses were excluded during the data screening process to improve data quality and reduce potential response bias. Additionally, while all variables were collected through self-reported measures, the study incorporates both subjective perceptual data and objective spatial analysis, providing methodological integration. This mixed-method approach reduces the likelihood that the observed relationships are solely attributable to common method variance.

Nevertheless, because the principal constructs were measured through self-reported responses collected at a single point in time, the possibility of common method bias cannot be entirely excluded. Following recommendations in survey-based behavioural research,

several procedural remedies were adopted to minimise this risk, including respondent anonymity, neutral item wording, thematic separation of constructs, and the integration of subjective perceptual measures with objective spatial analysis. While these measures reduce the likelihood of systematic response inflation, the observed relationships should be interpreted as associative rather than strictly causal. Moreover, because the study employed a non-probability convenience sampling strategy, the findings should be interpreted cautiously in terms of broader population generalisability, particularly given the potential for self-selection effects among respondents more engaged with airport mobility services or digital transport tools.

The collected data were processed using IBM SPSS Statistics 16 and Canva. Descriptive statistics were first computed to summarise demographic characteristics and response distributions. Inferential statistical analyses were then applied to examine correlations between perceived social accessibility and user satisfaction, testing the hypotheses formulated in the Introduction. Prior to the full data collection phase, a pilot pre-test was conducted with 30 participants to assess the internal reliability of the questionnaire items. A Cronbach's alpha test was performed on the pre-test responses ($n = 30$) to assess the internal reliability of the questionnaire items. The results indicated high internal consistency across all constructs, with alpha values of 0.903 for perceived social accessibility, 0.883 for user experience, and 0.790 for perceived spatial accessibility, confirming the robustness of the measurement instrument prior to large-scale data collection. In the full sample ($N = 391$), Cronbach's alpha values were 0.762, 0.882, and 0.695 for the respective constructs. While the value for perceived spatial accessibility ($\alpha = 0.695$) is negligibly below the conventional threshold of 0.70, it remains within the acceptable range for exploratory research and multidimensional constructs. Methodological studies suggest that Cronbach's alpha values between 0.60 and 0.70 can be considered acceptable in early-stage or context-specific research, particularly when measuring complex phenomena (DeVellis, 1991; Hair et al., 2019; Nunnally & Bernstein, 1994). Moreover, given that perceived spatial accessibility reflects a combination of objective spatial characteristics and subjective user perceptions, a slightly lower level of internal consistency is consistent with its inherently multidimensional nature.

To further examine the predictive relationships among the study variables, hierarchical linear regression analyses were conducted. In these models, user experience and satisfaction was treated as the dependent variable, while perceived social accessibility and perceived spatial accessibility and experience were separately entered as explanatory variables. To improve model robustness and account for potential heterogeneity among respondents, selected socio-demographic and mobility-related characteristics, including gender, age, travel frequency, and purpose of travel, were introduced as control variables in the first regression block prior to entering the principal explanatory variables in the second block. This analytical approach enabled assessment of the extent to which perceived accessibility dimensions explain user satisfaction beyond individual user characteristics.

To further examine the construct validity of the measurement framework, an Exploratory Factor Analysis (EFA) using Principal Component Analysis with Varimax rotation was conducted on the questionnaire items associated with perceived social accessibility, user experience and satisfaction, and perceived spatial accessibility and experience. The suitability of the dataset for factor analysis was confirmed through adequate communalities and strong component loadings across the majority of items. The analysis extracted two principal components with eigenvalues greater than 1, jointly explaining approximately 62.67% of the total variance. Most questionnaire items demonstrated substantial factor loadings above the recommended threshold of 0.50, indicating acceptable convergent validity and internal coherence among the measured dimensions. The factor structure revealed meaningful clustering between accessibility-related perceptions and service-experience dimensions, supporting the suitability of the measurement framework for exploratory analysis within the context of MaaS-related mobility systems.

To ensure consistency in interpretation, the questionnaire did not refer to a specific MaaS platform. Instead, respondents were asked to evaluate their experience with airport-to-city mobility services, including public transport, multimodal connections, and digital journey planning tools. This approach was adopted to capture users' actual mobility experiences within a partially integrated system, rather than relying on familiarity with a specific MaaS application. As such, the responses reflect perceptions of integrated mobility performance in practice, rather than a single branded MaaS service. This structured analysis enables a comprehensive interpretation of user experiences, revealing whether and how social accessibility in MaaS-related mobility systems influences satisfaction and perceived inclusivity. Data collection was carried out between September and December 2025, ensuring the inclusion of both regular and occasional users of the airport-to-city transport systems. The results from this phase also serve as a reference for comparison with the objective spatial analysis conducted through the Space Syntax method. It should be acknowledged that the comparison between syntactic integration values and user perceptions was not intended as a direct metric equivalence between numerical scales, but rather as an interpretative comparison between objective configurational accessibility patterns and subjective experiential evaluations.

3.2.1. Participants and sample characteristics

This subsection presents the demographic composition and travel characteristics of the respondent group included in the questionnaire survey. A total of 391 valid responses were collected from users of airport-to-city mobility services across Sardinia. In terms of gender distribution, the sample was relatively balanced, with females accounting for 45.3% of respondents and males for 43.2%. A further 9.5% of participants preferred not to disclose their gender, while 2.0% identified as non-binary. The age profile of respondents showed a broad distribution across adult age groups, with the largest proportions belonging to the 35–44 age group (22.0%), followed by 45–54 (21.2%), 25–34 (21.0%), and 18–24 (19.7%). Participants aged 55 and over-represented 16.1% of the sample, indicating the inclusion of both younger and older travellers in the survey.

Regarding place of residence, nearly half of the respondents (46.0%) were residents of Sardinia, while 24.0% lived in other regions of Italy and 29.2% resided outside Italy. This distribution reflects the dual role of Sardinian airports as both regional mobility hubs and international gateways. Travel frequency varied across the sample, with the largest group reporting occasional air travel (3–6 times per year, 37.6%), followed by those travelling rarely (1–2 times per year, 32.0%) and frequent travellers (7 or more trips per year, 30.4%). The primary purpose of travel was predominantly tourism (33.2%), followed by work-related travel (25.3%), study (15.6%), other personal reasons (15.3%), and health-related travel (10.5%), highlighting the multifunctional role of airport mobility in supporting different user needs.

In terms of socio-economic characteristics, more than half of the respondents (52.6%) reported holding a bachelor's degree or higher, while 28.7% had completed secondary education. Smaller proportions reported a high school diploma (9.5%) or elementary education (9.0%). The occupational profile was diverse, with students forming the largest group (19.8%), followed by professionals in education and research (11.3%), retired individuals (10.8%), clerical and skilled occupations (10.3%), and technical professions (8.2%). With respect to airport usage, Cagliari Elmas Airport was the most frequently used (51.7%), followed by Olbia Costa Smeralda (24.8%) and Alghero-Fertilia (23.5%). Respondents reported using a range of transport modes to access airports, with trains (36.3%) and buses (29.7%) being the most common, alongside private cars (27.1%), taxis (19.4%), and other shared or demand-responsive services.

Although the use of convenience sampling limits the statistical generalisability of the findings, the adopted mixed distribution strategy enabled the collection of responses from a heterogeneous group of users

with varied socio-demographic and travel characteristics. This multimodal pattern underlines the relevance of MaaS solutions for integrating diverse transport options within airport-to-city mobility systems. A summary of the demographic data is presented in the infographic in Fig. 2.

3.3. Space syntax analysis

The second methodological component of this research involves Space Syntax analysis, a quantitative spatial analytical technique used to evaluate the configurational accessibility of transport networks. The Space Syntax analysis is employed as an objective analytical framework to evaluate the configurational accessibility of airport-to-city networks. This enables comparison between spatial accessibility patterns and users' perceived accessibility derived from the survey. The analysis was conducted using UCL Depthmap10 and the Space Syntax Toolkit integrated into QGIS 3.44.2. A segment map of Sardinia was generated from the OpenStreetMap database, representing all primary and secondary road networks across the island. The analysis focused particularly on the airport-to-city routes connecting Cagliari Elmas, Olbia Costa Smeralda, and Alghero-Fertilia airports to their respective city centres. Prior to analysis, the spatial network was cleaned and topologically validated to ensure accurate representation of connectivity and intersection points.

The Space Syntax analysis focused on the Integration (HH) as the key metric to evaluate the regional accessibility throughout the road network. Global Integration measures the degree to which each segment is accessible from all others, providing insight into the overall accessibility of the network. The segment map was fabricated by leveraging road centreline data, which served as the crucial foundation for establishing a network of interconnected street segments within the urban configuration. This primary data was derived from a publicly accessible repository, specifically the Geoportal Sector of Cagliari Municipality. The results were visualised as comparative charts, highlighting the most and least accessible areas across the airport-to-city corridors.

Following the computation of syntactical indicators, the outputs were compared with the survey results to explore potential relationships between perceived accessibility (from user experiences) and measured spatial accessibility (from Space Syntax analysis). Given the different nature of quantitative analysis between syntactical values and perceptual survey data, a comparative assessment was conducted to identify whether patterns of high or low spatial accessibility aligned with users' reported experiences, perceived ease of movement, and levels of satisfaction. This involved examining correspondences and mismatches between the most integrated routes in the Space Syntax model and the areas users identified as more or less accessible in the questionnaire. The integration of these analytical layers enables the identification of both objective infrastructural constraints and subjective experiential barriers affecting airport-to-city mobility. This comprehensive analytical approach not only enhances the robustness of the findings but also provides actionable insights for policymakers and transport planners aiming to optimise MaaS-based accessibility in island contexts.

In this study, Space Syntax was therefore employed specifically to examine the configurational dimension of spatial accessibility rather than operational transport performance. The use of global Integration (HH) enabled the analysis of spatial connectedness, route continuity, and topological accessibility within airport-to-city transport environments. Unlike travel-time-based accessibility measures or generalised cost models, which primarily evaluate transport efficiency and service performance, Space Syntax provides insight into how urban spatial structure may facilitate or constrain movement perception, navigability, and spatial orientation. This approach was selected because the study aims to compare objectively measurable configurational accessibility patterns with users' subjective perceptions of accessibility and mobility experience. Accordingly, the syntactic analysis is not intended to replace operational accessibility indicators such as service frequency, waiting time, or travel cost, but rather to complement them by addressing the spatial and morphological dimensions of accessibility that are often overlooked in MaaS-related mobility studies.

3.4. Study area

Sardinia, the second-largest island in the Mediterranean Sea, is located off the western coast of Italy and represents one of the country's most distinctive territorial and socio-economic contexts. The island covers an area of approximately 24,000 km^2 and has a population of about 1.6 million inhabitants, distributed across a polycentric network of small and medium-sized urban centres. Due to its insular geography, Sardinia's mobility system relies heavily on air and maritime transport connections, which serve as vital links between the island and mainland Italy as well as other European destinations. The island's road network forms the principal framework for internal connectivity, yet the mountainous terrain and dispersed settlement pattern present challenges for efficient mobility. These geographical and infrastructural characteristics make Sardinia a particularly relevant context for exploring integrated transport solutions and assessing the performance of MaaS systems.

Sardinia's three main airports—Cagliari Elmas, Olbia Costa Smeralda, and Alghero-Fertilia—function as the island's primary gateways for both domestic and international travel. Collectively, they handle the vast majority of passenger movement, especially during the summer tourist season, when demand for mobility sharply increases. Cagliari Elmas Airport (CAG), located in the southern part of the island, serves as the largest and busiest of the three, accommodating flights to major Italian and European cities. It lies approximately 7 km from the city centre of Cagliari, the island's capital and main economic hub, and is connected via road, rail, and bus networks. Olbia Costa Smeralda Airport (OLB), situated in the northeast, acts as the principal gateway to the Costa Smeralda tourist region. Its connectivity to Olbia's urban area and nearby coastal destinations is of strategic importance, especially for seasonal mobility and tourism-driven travel flows. Alghero-Fertilia Airport (AHO), located in the northwest, serves the city of Alghero and the wider province of Sassari, playing a crucial role in linking northern Sardinia to the mainland through both regular and low-cost carriers.

Despite their importance in ensuring external and internal connectivity, these airports face persistent challenges related to social and spatial accessibility. Public transport connections between the airports and their respective city centres are often characterised by irregular schedules, limited service integration, and insufficient multimodal coordination. For example, while Cagliari Elmas benefits from a direct rail link to the city centre, frequency and coordination with flight arrivals remain suboptimal. In contrast, Olbia and Alghero rely primarily on bus connections, which can be inconsistent during off-peak periods or outside the tourist season. These variations create disparities in user experiences and raise questions about the inclusiveness and efficiency of airport-to-city mobility systems. Such contextual conditions make Sardinia an ideal setting for examining how MaaS can enhance accessibility, improve user satisfaction, and promote more integrated, user-oriented transport systems in geographically constrained environments. The geographical context and specific study areas (Cagliari Elmas, Olbia Costa Smeralda, and Alghero-Fertilia Airports) are visually represented in Fig. 3.

4. Results

4.1. Descriptive data analysis

4.1.1. Perceived social accessibility in airport-to-city mobility (PSA)

The descriptive findings related to perceived social accessibility indicate generally moderate-to-positive evaluations of airport-to-city mobility services, although notable variations and uncertainties remain across different dimensions. Most respondents considered public transport options relatively easy to locate and understand, suggesting

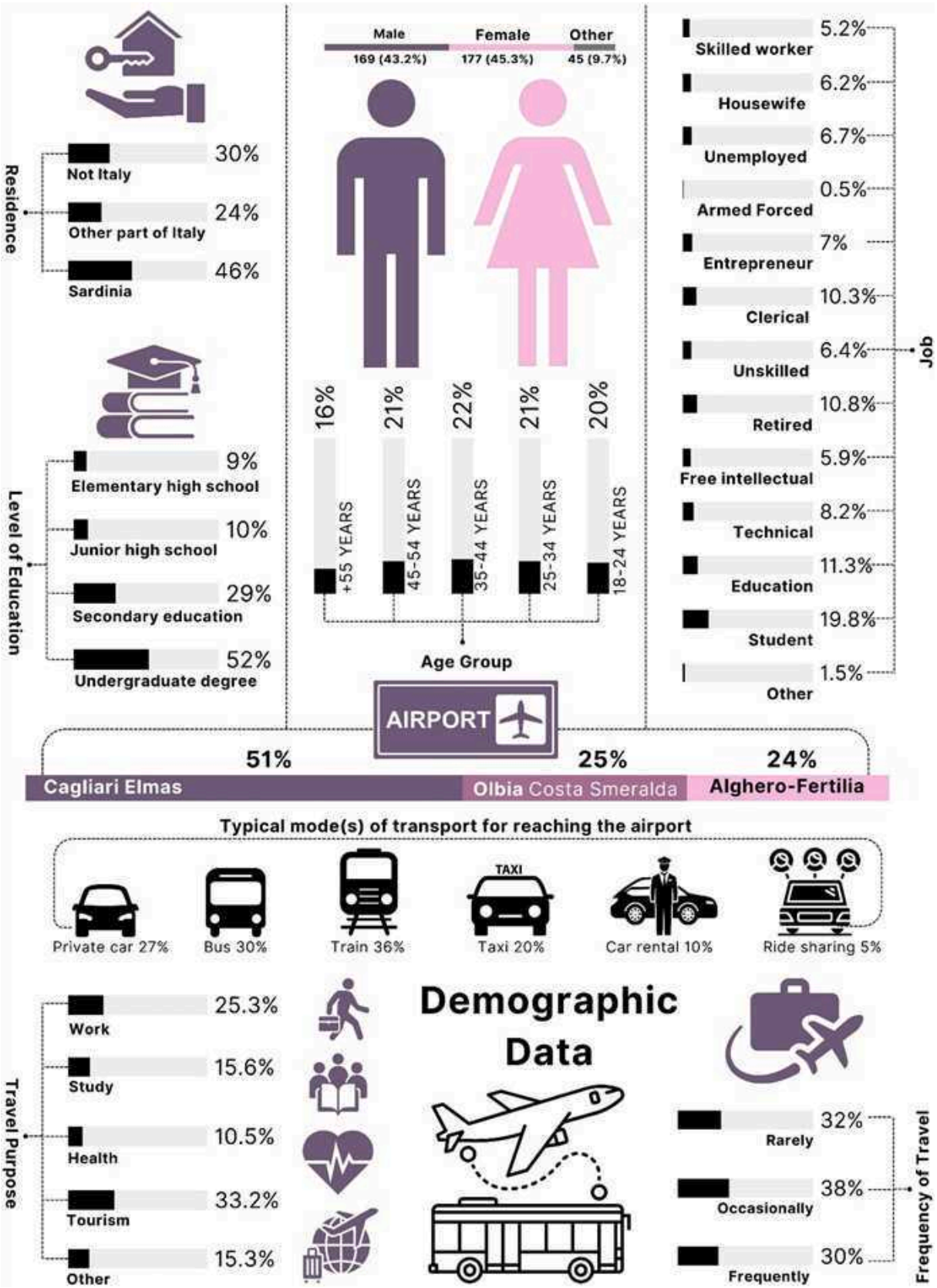

Fig. 2. Infographic representation of key demographic data and characteristics of the respondent group. The infographic was manually created by the authors using Canva based on the collected survey data.

Fig. 3. Geographical context of the study area, showing the location of Sardinia Island and the three principal airports: Cagliari Elmas (CAG), Olbia Costa Smeralda (OLB), and Alghero-Fertilia (AHO).

satisfactory system legibility for many users (62.7% positive responses). Nevertheless, a considerable minority reported uncertainty or dissatisfaction (37.4% combined neutral and negative responses), implying that navigation and information clarity are not consistently experienced across all traveller groups.

Affordability emerged as one of the most polarised dimensions of social accessibility. While a substantial proportion of respondents perceived airport transport services as reasonably affordable (57.9% positive responses), a notable share expressed dissatisfaction with transport costs (28.1% negative responses). This divergence suggests that perceptions of affordability are likely shaped by differences in socio-economic background, travel frequency, and user expectations. Similarly, evaluations of timetable accessibility were generally positive (44.2% agreement), yet the relatively high proportion of neutral responses (26.6%) indicates that information availability may not be equally effective or visible for all users.

Perceptions of inclusivity and universal usability revealed comparatively higher levels of neutrality than other indicators. Although many respondents agreed that airport mobility services were accessible to diverse user groups, including tourists, older adults, and individuals with mobility limitations (48.8% positive responses), a significant share remained uncertain (34.3% neutral responses). The most ambivalent responses were associated with multilingual and accessible information provision, where neutral and negative perceptions collectively accounted for the majority of responses (58.1%). This pattern suggests that informational accessibility remains uneven and may represent a critical barrier to socially inclusive mobility experiences (Fig. 4).

Overall, these findings indicate that perceived social accessibility extends beyond the physical availability of transport services to include affordability, informational clarity, and perceived inclusiveness. The recurring presence of neutral responses across several indicators may reflect inconsistent user experiences and varying levels of familiarity with the MaaS ecosystem, thereby justifying further inferential analysis of the relationship between social accessibility and user satisfaction.

4.1.2. User experience and satisfaction with MaaS (UXS)

The findings related to user experience and satisfaction suggest a generally positive evaluation of airport-to-city mobility services, although important inconsistencies remain regarding intermodality and digital integration. Most respondents perceived the transport system as reasonably convenient and accessible (57.6% positive responses), particularly in relation to travel reliability and operational safety. Positive evaluations of travel time reliability were especially prominent, with 66.0% of respondents reporting agreement or strong agreement, indicating that current airport-to-city connections generally meet users' functional expectations.

However, perceptions became more mixed when respondents evaluated the integration between transport modes and the effectiveness of digital mobility tools. While over half of respondents acknowledged the benefits of digital tools such as journey planners and ticketing applications (53.7% positive responses), a substantial proportion reported neutral or negative perceptions (46.3% combined). Similarly, evaluations of intermodal continuity revealed considerable uncertainty, with neutral responses representing the largest individual category (36.1%). These findings suggest that the digital and integrative dimensions of MaaS are not yet uniformly experienced as seamless or intuitive.

A particularly important finding is the contrast between the relatively high satisfaction with safety and reliability and the more hesitant perceptions regarding digital and intermodal integration. Perceived reliability and safety received the strongest positive evaluations overall

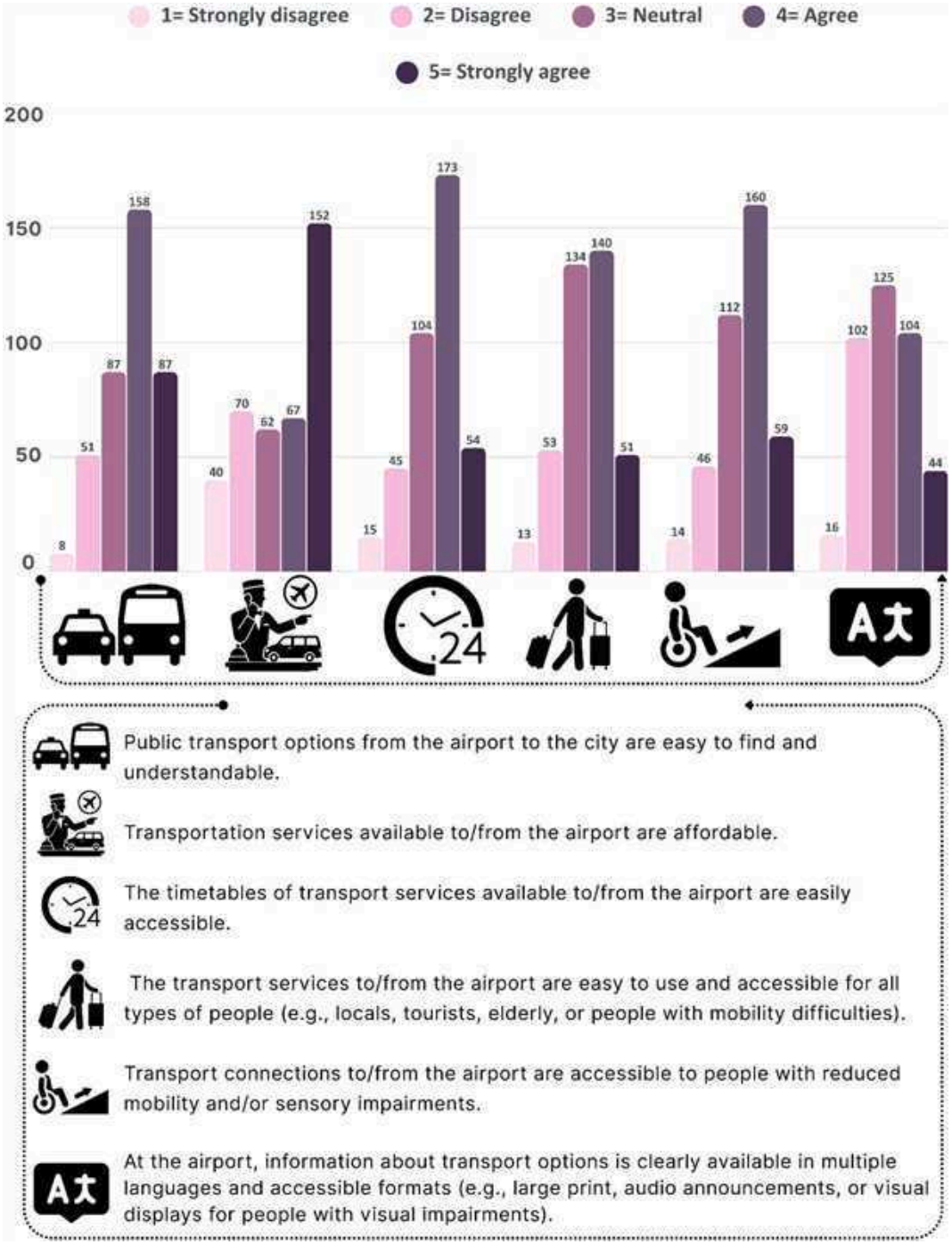

Fig. 4. Infographic representation of perceived social accessibility in airport-to-city mobility of the respondent group (Cronbach's α = 0.762). The infographic was manually created by the authors using Canva based on the collected survey data.

(70.6% positive responses), whereas intermodal connectivity generated comparatively lower levels of agreement (42.1%). This contrast indicates that users may value operational efficiency more consistently than technological innovation or multimodal coordination, pointing to a partially integrated rather than fully seamless MaaS experience.

Overall, the descriptive analysis demonstrates that user satisfaction is shaped by a combination of reliability, accessibility, digital usability, and intermodal continuity. The coexistence of positive evaluations and notable uncertainty supports the need for further statistical analyses examining how perceived social and spatial accessibility influence overall satisfaction and mobility experience (Fig. 5).

4.1.3. Perceived spatial accessibility and experience (PSPA)

The descriptive findings related to perceived spatial accessibility reveal predominantly positive evaluations of the physical and navigational characteristics of airport-to-city mobility environments. Most respondents considered routes between airports and city centres to be direct, legible, and well-signposted (73.1% positive responses), indicating that spatial orientation and navigability are generally effective within the studied transport systems. Similarly, wayfinding within airport environments received favourable evaluations (69.3% positive responses), suggesting that directional guidance plays an important role in supporting mobility experiences.

Perceptions of the pedestrian environment surrounding transport

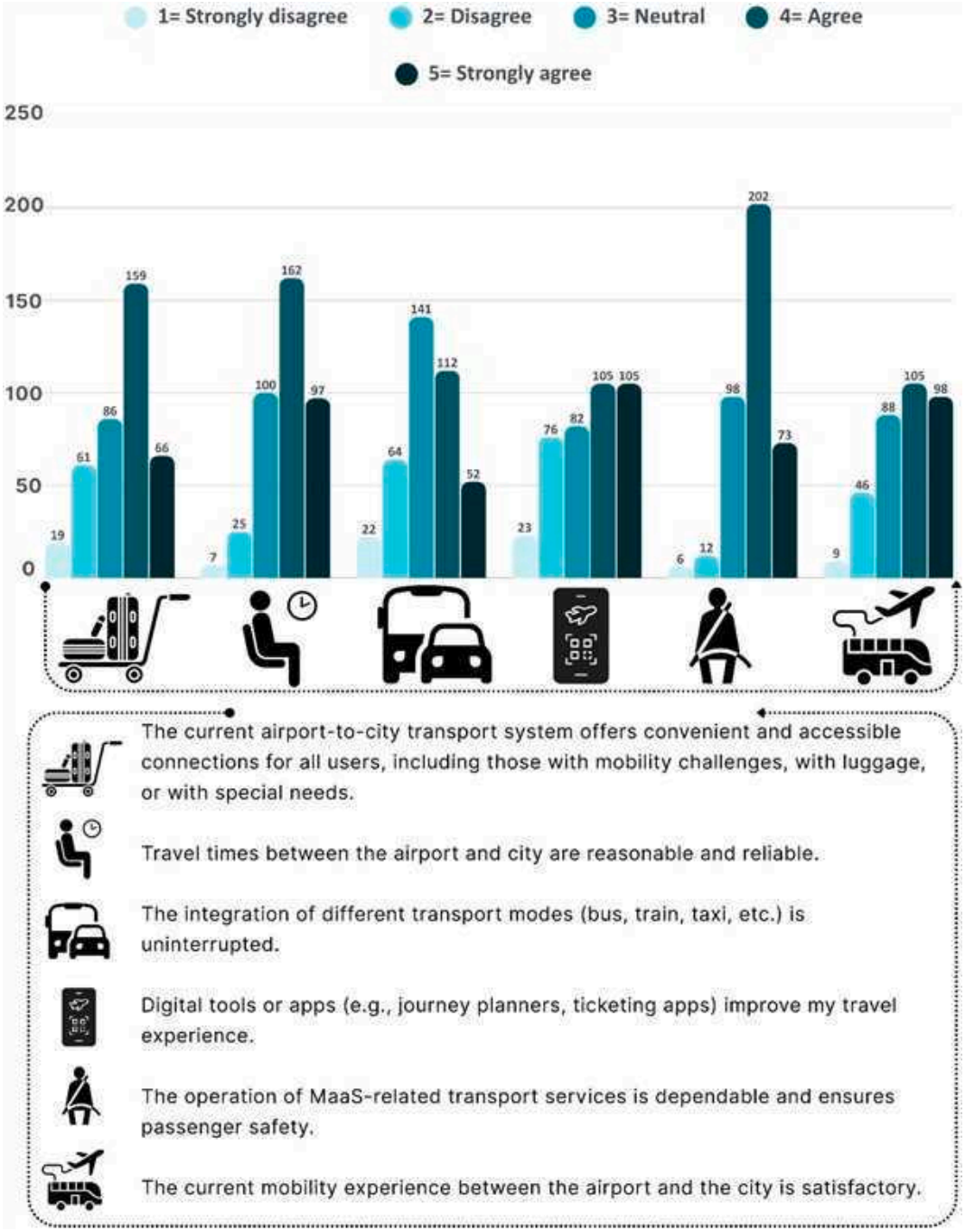

Fig. 5. Infographic representation of user experience and satisfaction with MaaS of the respondent group (Cronbach's $\alpha = 0.882$). The infographic was manually created by the authors using Canva based on the collected survey data.

nodes were also largely positive, particularly regarding safety, comfort, and ease of movement (65.7% positive responses). Nonetheless, the presence of neutral and negative evaluations (34.3% combined) indicates that the quality of pedestrian infrastructure is not uniformly perceived across all locations. More notably, evaluations of intermodal transfer convenience were comparatively less positive and exhibited higher levels of uncertainty, with nearly one third of respondents adopting a neutral stance (29.4%). This suggests that the spatial integration between different transport modes remains inconsistent despite the broader objective of seamless MaaS-based mobility.

The strongest consensus emerged regarding the influence of accessibility on overall journey satisfaction. An overwhelming majority of respondents agreed that perceptions of accessibility directly shape their travel experience (90.3% positive responses), reinforcing the central role of spatial configuration and mobility design in airport-to-city transport systems (Fig. 6). This finding supports the conceptual premise of the study that accessibility is not solely a technical or infrastructural condition, but also an experiential dimension affecting users' perceptions of mobility quality.

All together, these findings highlight the importance of navigability, pedestrian quality, and transfer efficiency in shaping perceived spatial accessibility. At the same time, the variability observed in responses concerning intermodal transfers suggests that spatial continuity remains an important challenge for MaaS implementation. These descriptive patterns provide the empirical basis for the subsequent inferential analyses exploring the relationship between spatial accessibility, social

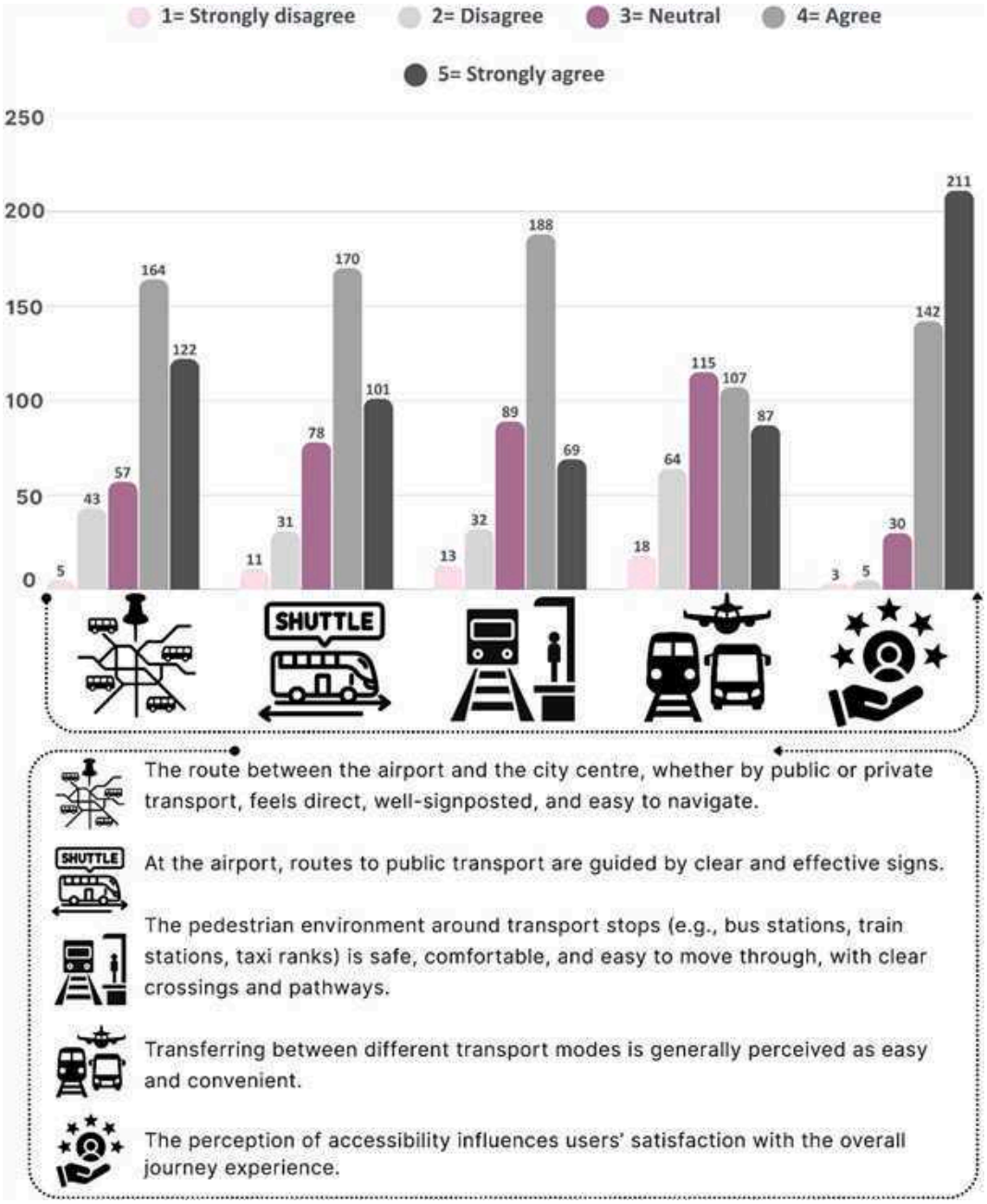

Fig. 6. Infographic representation of perceived spatial accessibility and experience of the respondent group (Cronbach's α = 0.695; acceptable for exploratory and multidimensional constructs). The infographic was manually created by the authors using Canva based on the collected survey data.

accessibility, and user satisfaction. Prior to inferential statistical analysis, an exploratory factor analysis confirmed the acceptable internal coherence and construct validity of the questionnaire items, supporting their aggregation into composite variables for subsequent correlation and regression analyses.

4.2. Statistical analysis

4.2.1. Pearson correlation among PSA, UXS, and PSPA

Pearson correlation analysis was conducted to examine the interrelationships among perceived social accessibility (PSA), user experience and satisfaction with MaaS (UXS), and perceived spatial accessibility and experience (PSPA). The results revealed strong and statistically significant positive correlations among all three composite variables ($p < 0.001$), indicating that users' evaluations of airport-to-city mobility are shaped by closely interconnected social, spatial, and experiential dimensions.

The strongest relationship was identified between PSA and UXS ($r = 0.801$), suggesting that perceptions of inclusivity, affordability, and usability are strongly associated with overall satisfaction and mobility experience. This finding suggests that perceptions of social accessibility are closely associated with more positive user experiences within MaaS-related mobility environments. In parallel, the correlation between PSA and PSPA ($r = 0.718$) demonstrates that users who perceive transport systems as socially inclusive also tend to evaluate their spatial characteristics more positively, including navigability, signage, and route clarity.

A similarly strong association was observed between UXS and PSPA ($r = 0.740$), reinforcing the importance of spatial legibility and intermodal continuity in shaping users' satisfaction with airport mobility

systems. Collectively, these findings suggest that perceptions of social accessibility, spatial accessibility, and user experience are closely interconnected dimensions within MaaS-related mobility environments.

Beyond confirming statistical associations, the correlation patterns provide important conceptual insights into the integrated nature of accessibility in airport-to-city mobility systems. The results support the study's theoretical framework, which assumes that users' mobility experiences emerge through the interaction of spatial configuration, perceived inclusivity, and service usability rather than through isolated infrastructural factors alone. Furthermore, the strength and consistency of the observed relationships provide a robust empirical foundation for the subsequent regression analyses aimed at examining predictive effects among these dimensions (Table 1).

4.2.2. Linear regression models

To further investigate the relationships among perceived social accessibility (PSA), user experience and satisfaction (UXS), and perceived spatial accessibility and experience (PSPA), hierarchical linear regression analyses were conducted. In both models, UXS was treated as the dependent variable. To improve the explanatory robustness of the analyses, selected socio-demographic and mobility-related characteristics, including gender, age, travel frequency, and purpose of travel, were first entered as control variables (Model 1). Subsequently, PSA and PSPA were separately introduced as the principal explanatory variables in the second block (Model 2). This approach enabled assessment of the extent to which perceived social and spatial accessibility contribute to user satisfaction beyond individual user characteristics.

The baseline regression model including only the control variables demonstrated a statistically significant but comparatively limited explanatory power ($R^2 = 0.130$, $F = 14.397$, $p < 0.001$), indicating that socio-demographic and mobility-related characteristics explain a modest proportion of variance in user experience and satisfaction. Within this model, gender ($\beta = 0.150$, $p = 0.002$) and travel frequency ($\beta = 0.294$, $p < 0.001$) emerged as statistically significant predictors, whereas age and travel purpose did not demonstrate significant effects. These findings suggest that mobility experience varies partially according to user profiles and travel habits.

In the first hierarchical regression model, PSA was introduced after controlling for socio-demographic and mobility-related variables. The inclusion of PSA substantially improved the explanatory power of the model, increasing the coefficient of determination from $R^2 = 0.130$ to $R^2 = 0.663$. The overall regression model remained highly significant ($F = 151.793$, $p < 0.001$). PSA demonstrated the strongest statistical association with UXS ($\beta = 0.766$, $p < 0.001$), suggesting that positive perceptions of inclusivity, affordability, clarity of information, and usability are strongly associated with higher levels of user satisfaction and positive mobility experience. Notably, the predictive influence of several control variables decreased after introducing PSA, suggesting that perceived social accessibility accounts for a substantial proportion of user evaluations beyond demographic characteristics alone.

The second hierarchical regression model examined the predictive effect of PSPA on UXS while controlling for the same background variables. The inclusion of PSPA significantly increased the explanatory capacity of the model from $R^2 = 0.130$ to $R^2 = 0.588$, with the overall model remaining statistically significant ($F = 109.952$, $p < 0.001$). PSPA demonstrated a strong positive association with user experience and satisfaction ($\beta = 0.700$, $p < 0.001$), suggesting that favourable perceptions of route legibility, wayfinding, pedestrian comfort, and intermodal continuity are closely associated with more positive mobility experiences Compared with the PSA model, the explanatory power of PSPA was slightly lower, although still considerable, indicating that spatial accessibility constitutes a critical yet complementary dimension of MaaS-supported airport-to-city mobility systems.

To further examine the relative and joint explanatory effects of perceived social accessibility and perceived spatial accessibility, an additional multivariate hierarchical regression model was conducted in which PSA and PSPA were simultaneously entered following the inclusion of the control variables. The combined model substantially improved explanatory power, increasing the coefficient of determination from $R^2 = 0.130$ in the baseline model to $R^2 = 0.713$ ($F = 159.294$, $p < 0.001$). Both PSA and PSPA remained statistically significant predictors of user experience and satisfaction. However, PSA demonstrated the stronger standardized effect ($\beta = 0.529$, $p < 0.001$), compared with PSPA ($\beta = 0.329$, $p < 0.001$), suggesting that perceived social accessibility exerts a comparatively stronger association with users' overall mobility experience. At the same time, the continued significance of PSPA confirms that spatial accessibility contributes independently to user evaluations beyond the influence of social accessibility alone. Multicollinearity diagnostics further indicated acceptable levels of shared variance between the predictors (VIF = 2.230 for PSA; VIF = 2.169 for PSPA), supporting the interpretation that the two constructs are conceptually related yet empirically distinguishable dimensions of accessibility within MaaS-related mobility systems.

Collectively, the hierarchical regression analyses demonstrate that both perceived social accessibility and perceived spatial accessibility remain highly significant predictors of user experience and satisfaction even after accounting for socio-demographic and mobility-related variability among respondents. Importantly, the multivariate regression results confirm that both dimensions retain independent explanatory effects when examined simultaneously, although perceived social accessibility demonstrates the comparatively stronger association with user satisfaction. The substantial increase in explained variance observed after introducing PSA and PSPA suggests that perceived accessibility conditions are more strongly associated with users' evaluations of MaaS-related mobility systems than demographic characteristics alone. These findings reinforce the conceptual premise that socially and spatially inclusive mobility environments jointly shape positive airport-to-city transport experiences (Table 2).

Table 1
The pearson correlation among PSA, UXS, and PSPA.

Variables	Correlation Measure	PSA	UXS	PSPA
PSA	Pearson Correlation	1	0.801	0.718
UXS	Pearson Correlation	0.801	1	0.740
PSPA	Pearson Correlation	0.718	0.740	1

Table 2
Hierarchical linear regression analyses examining the effects of perceived social accessibility (PSA) and perceived spatial accessibility and experience (PSPA) on user experience and satisfaction (UXS), including separate and combined multivariate models controlling for socio-demographic and mobility-related characteristics.

Variables	Model 1: Control Variables	Combined Accessibility Model
Gender	0.150**	0.066*
Age	0.005	0.001
Travel Frequency	0.294***	0.093**
Purpose of Travel	−0.060	−0.037
PSA	–	0.529***
PSPA	–	0.329***
R^2	0.130	0.713
Adjusted R^2	0.121	0.705
F-value	14.397***	159.294***
VIF (PSA)	–	2.230
VIF (PSPA)	–	2.169

Notes: Dependent variable = User Experience and Satisfaction (UXS).
Values represent standardized beta coefficients (β).
$p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Control variables include gender, age, travel frequency, and purpose of travel.

4.3. Space syntax analysis

4.3.1. Assessing objective accessibility through space syntax analysis

The Space Syntax analysis provided a comparative understanding of spatial accessibility across Sardinia's three main airport-to-city systems: Cagliari, Sassari, and Olbia. The global integration values revealed substantial variation in how each airport is embedded within the island's wider mobility network. Cagliari Elmas Airport indicated the highest integration value (2548), suggesting a more connected and accessible position relative to the overall street network. In contrast, Olbia Costa Smeralda Airport (908) and Alghero-Fertilia Airport (1055) showed considerably lower levels of integration, revealing a more peripheral spatial configuration. These disparities reflect the differing degrees of infrastructural connectivity across the island, highlighting Cagliari as the most structurally integrated gateway while positioning Alghero and Olbia as comparatively more isolated nodes within the transport system.

A closer examination of the integration values of the city centres further emphasises these contrasts. Cagliari's city centre shows the highest syntactical accessibility (3995), substantially exceeding the integration levels of Sassari (1720) and Olbia (1650). This suggests that Cagliari benefits from a more cohesive and well-connected urban fabric, facilitating smoother movement patterns and potentially supporting more efficient multimodal mobility. When assessing the integration values of the roads linking airports to their respective city centres, Cagliari again demonstrates a structurally superior configuration (3334), followed by Olbia (1225) and Alghero (948). These findings indicate that the spatial alignment between airports and urban cores is strongest in Cagliari, reinforcing its role as the island's most accessible airport-to-city corridor.

When the syntactical results are interpreted alongside the geographical visualisation (Fig. 7), clear differences emerge in how effectively each airport is connected to its urban environment. The roads connecting Cagliari Elmas Airport to the city centre appear highly integrated, forming part of a dense and continuous mobility network, whereas the routes serving Olbia and Alghero display more fragmented and segregated spatial patterns. These disparities suggest that users travelling through Olbia and Alghero may experience longer travel times, reduced directness, or a general perception of lower accessibility: factors that align with the user-reported experiences captured in the questionnaire. Overall, the Space Syntax analysis highlights the existence of objective spatial gaps in Sardinia's airport-to-city mobility system and provides a structural basis for understanding potential mismatches between objective accessibility and subjective or perceived accessibility reported by users.

4.3.2. Comparison of objective and subjective accessibility outcomes

The comparison between Space Syntax results and questionnaire-based perceptions reveals a notable degree of alignment between objective spatial accessibility and users' subjective experiences, particularly in the case of Cagliari. The Space Syntax analysis identified Cagliari Elmas Airport and its connection to the city centre as the most spatially integrated system in Sardinia, characterised by high global integration values at the airport, along the connecting corridor, and within the city centre. This structural advantage is reflected in the survey findings, where respondents using Cagliari Elmas Airport generally reported higher levels of perceived social and spatial accessibility, as well as greater satisfaction with the overall mobility experience. Positive evaluations regarding route legibility, ease of navigation, reliability of services, and overall satisfaction suggest that a well-integrated spatial configuration supports more favourable user perceptions and experiences.

In contrast, the lower integration values observed for Olbia Costa Smeralda and Alghero-Fertilia airports correspond with more mixed or moderate perceptions reported in the questionnaire. The Space Syntax analysis highlighted these airports as more spatially segregated, with weaker integration along airport-to-city corridors and less cohesive connections to their urban centres. This objective spatial condition is reflected in survey responses showing higher levels of neutrality or disagreement concerning clarity of transport information, ease of transfers, and inclusivity of services. Although users did not uniformly report negative experiences, the prevalence of neutral responses suggests uncertainty or inconsistency in perceived accessibility, which may stem from fragmented spatial layouts, indirect routes, or less legible transport infrastructures identified through the syntactical analysis.

Overall, the comparison indicates that while subjective accessibility is influenced by multiple factors, such as service quality, affordability, and digital support, objective spatial accessibility plays a foundational role in shaping user perceptions. Highly integrated spatial systems appear to facilitate clearer wayfinding, smoother transfers, and more reliable mobility experiences, thereby reinforcing positive perceptions captured through the survey. Conversely, spatially fragmented systems may constrain user experience, even when MaaS-related services are available. These findings suggest that improving MaaS performance in island contexts such as Sardinia requires not only service-level interventions but also spatially informed planning strategies that address underlying configurational constraints. The combined use of Space Syntax analysis and user perception data thus provides a comprehensive understanding of how objective and subjective accessibility interact within airport-to-city mobility systems. To synthesise the relationship between objective and subjective accessibility, the comparative outcomes derived from the Space Syntax analysis and the questionnaire survey are visually summarised in Fig. 8.

5. Discussion

5.1. Interpretation and discussion of results

The combined analysis of questionnaire data and Space Syntax outcomes reveals a nuanced understanding of airport-to-city mobility in Sardinia, demonstrating that accessibility is not solely a matter of infrastructural provision but is deeply shaped by users' social, economic, and experiential conditions. It should be noted that further interpretations regarding specific barriers, such as fragmented digital platforms, inadequate multilingual information, and pedestrian connectivity issues, were informed not only by the quantitative results but also by recurring themes emerging from respondents' open-ended comments. Overall, the survey results indicate moderately positive perceptions of social accessibility, user experience, and spatial accessibility, yet these aggregate trends conceal important internal disparities. While many users perceive airport-to-city mobility as generally functional, the findings suggest that accessibility is unevenly distributed across transport modes, user groups, and airport contexts. This reinforces the study's central premise that social accessibility within MaaS frameworks must be evaluated beyond technical efficiency, accounting for affordability, inclusivity, legibility, and ease of use.

A particularly salient pattern emerges in relation to affordability, which appears to be strongly contingent on users' primary mode of transport. Respondents who predominantly rely on public transport (especially buses and trains) expressed strong agreement regarding affordability, reflecting the relatively low fare structure (approximately €1.30 per trip). In contrast, users who depend on taxis, ride-sharing services, or car rentals (NCC) consistently reported dissatisfaction with costs, indicating a perceived economic barrier within the current airport-to-city mobility system. This divergence highlights a critical social accessibility gap: while affordable options exist, they are not equally viable or attractive for all users, particularly those with time constraints, heavy luggage, or limited familiarity with local systems. Consequently, affordability in this context is not merely a pricing issue but is closely linked to usability and situational constraints.

The results further reveal that digital fragmentation significantly undermines the effectiveness of MaaS-related services. Despite the presence of dedicated tools such as the BusFinder app, the absence of a

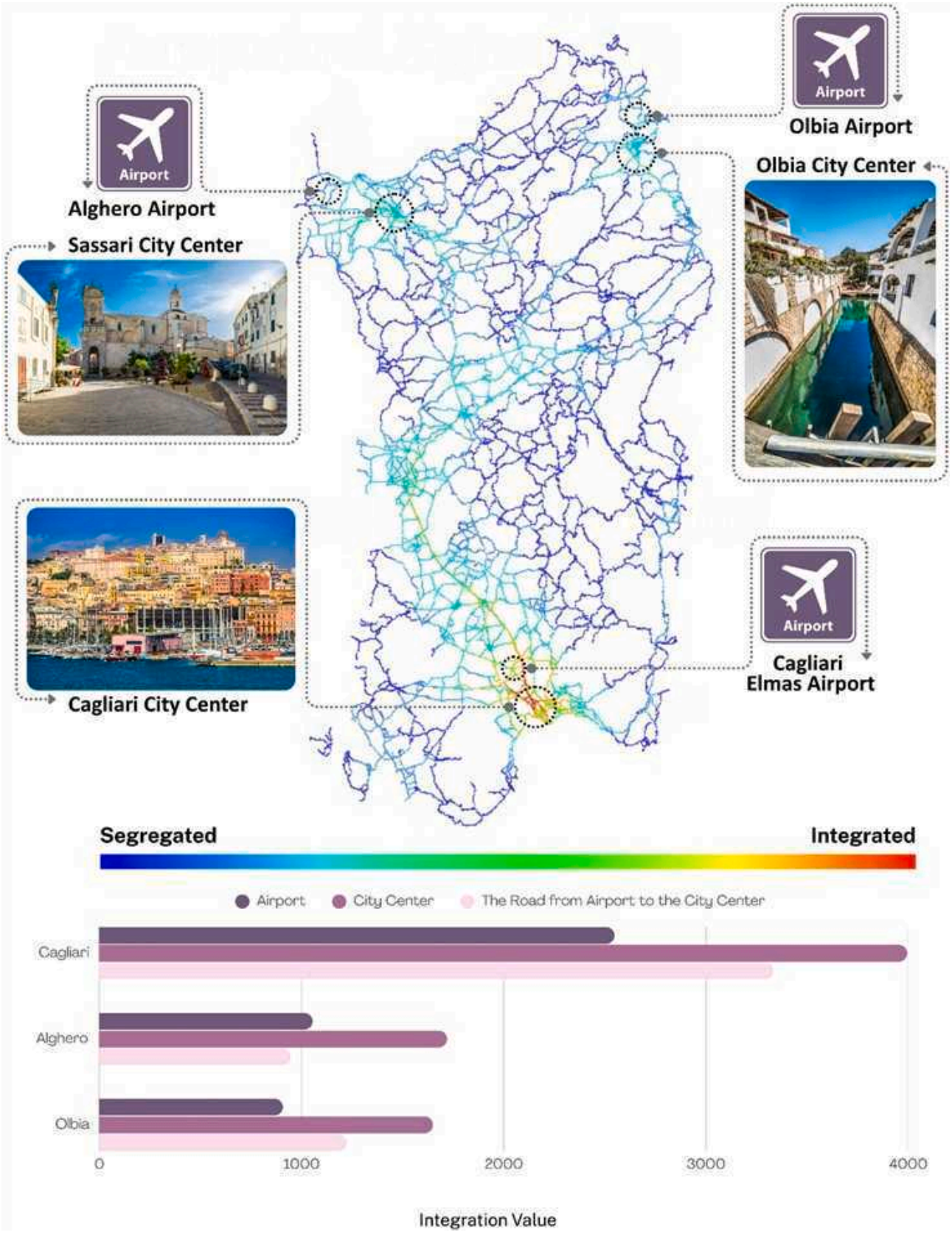

Fig. 7. Spatial accessibility analysis of Sardinia's airport-to-city mobility corridors using global Integration (HH) values. The map visualises the island's road network coloured from segregated (blue) to integrated (red) segments, highlighting the spatial configuration surrounding Cagliari Elmas, Olbia Costa Smeralda, and Alghero-Fertilia airports. For each city, three key elements are compared: the integration value of the airport, the city centre, and the principal road connecting the two. The bar chart illustrates these numerical differences, showing Cagliari as the most spatially integrated system, followed by Olbia and Alghero. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

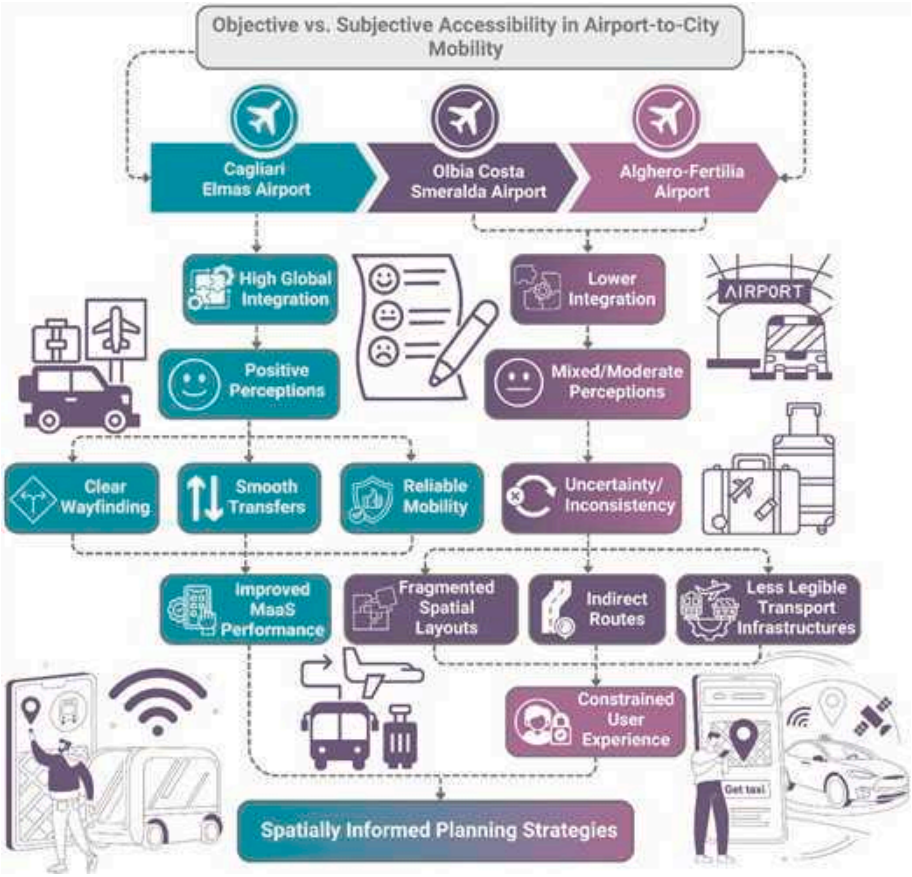

Fig. 8. Conceptual synthesis of objective and subjective accessibility in airport-to-city mobility, illustrating the relationship between Space Syntax values and user perceptions across Cagliari Elmas, Olbia Costa Smeralda, and Alghero-Fertilia airports.

unified, multimodal digital platform forces users to navigate multiple applications, ticket machines, and external websites to plan and pay for their journeys. This fragmentation weakens the core MaaS principle of seamless integration and partially explains the high proportion of neutral responses observed across several perceived accessibility and user experience indicators. Rather than reflecting indifference, neutrality here appears to signal uncertainty, cognitive burden, or inconsistent experiences. Users' feedback suggests that the lack of a single interface app integrating schedules, ticketing, and real-time updates for all available transportation means diminishes confidence and reduces the perceived reliability of the system.

Temporal reliability also emerges as a critical dimension shaping user experience. While train services were generally perceived as punctual and dependable, reported instances of significant delays (particularly during holiday periods) introduce a heightened sense of risk, especially for air travellers facing fixed departure times. These disruptions disproportionately affect users who rely on public transport as their primary affordable option, reinforcing the tension between economic accessibility and temporal reliability. This finding aligns with the strong statistical relationships identified between perceived social accessibility, spatial accessibility, and overall satisfaction, indicating that even isolated failures in service reliability can substantially influence broader perceptions of the mobility system.

The Space Syntax analysis provides an essential structural lens through which these subjective experiences can be interpreted. The high global integration values observed in Cagliari's airport-to-city corridor correspond with generally more positive user perceptions, suggesting that strong spatial embeddedness supports clearer wayfinding, smoother transfers, and greater confidence in mobility choices. Conversely, the lower integration levels identified for Olbia and Alghero help explain the more mixed or moderate perceptions reported by users, particularly regarding route directness, transfer convenience, and system legibility. Importantly, however, the findings also reveal that high spatial integration alone does not guarantee positive experiences. Issues such as long walking distances to transport stops, inadequate pavement quality for luggage movement, and insufficient multilingual information illustrate how micro-scale design and service provision can undermine otherwise well-connected networks.

All in all, these results suggest that the relationship between objective and subjective accessibility is neither linear nor automatic. Instead, it is mediated by factors such as digital integration, physical comfort, information clarity, and user diversity. The datasets collectively indicate that MaaS effectiveness in airport-to-city mobility depends not only on spatial configuration and service availability, but also on how these elements are experienced by different users in real-world conditions. This interpretation underscores the value of combining Space Syntax analysis with user-centred survey data, as it enables a more comprehensive understanding of where infrastructural efficiency aligns with, or diverges from, lived mobility experiences in island contexts. The visual summary of core identified notions is depicted in Fig. 9.

5.2. *The contribution of research in respect to precedent studies*

This study contributes to MaaS scholarship by empirically advancing the shift from technology-centred narratives toward accessibility- and experience-oriented evaluation frameworks. While early MaaS literature framed the concept as a generational or technological response to declining car ownership (Mulley et al., 2020), more recent critiques have called for evaluating MaaS through its capacity to deliver equitable accessibility outcomes under public governance (Hensher et al., 2023;

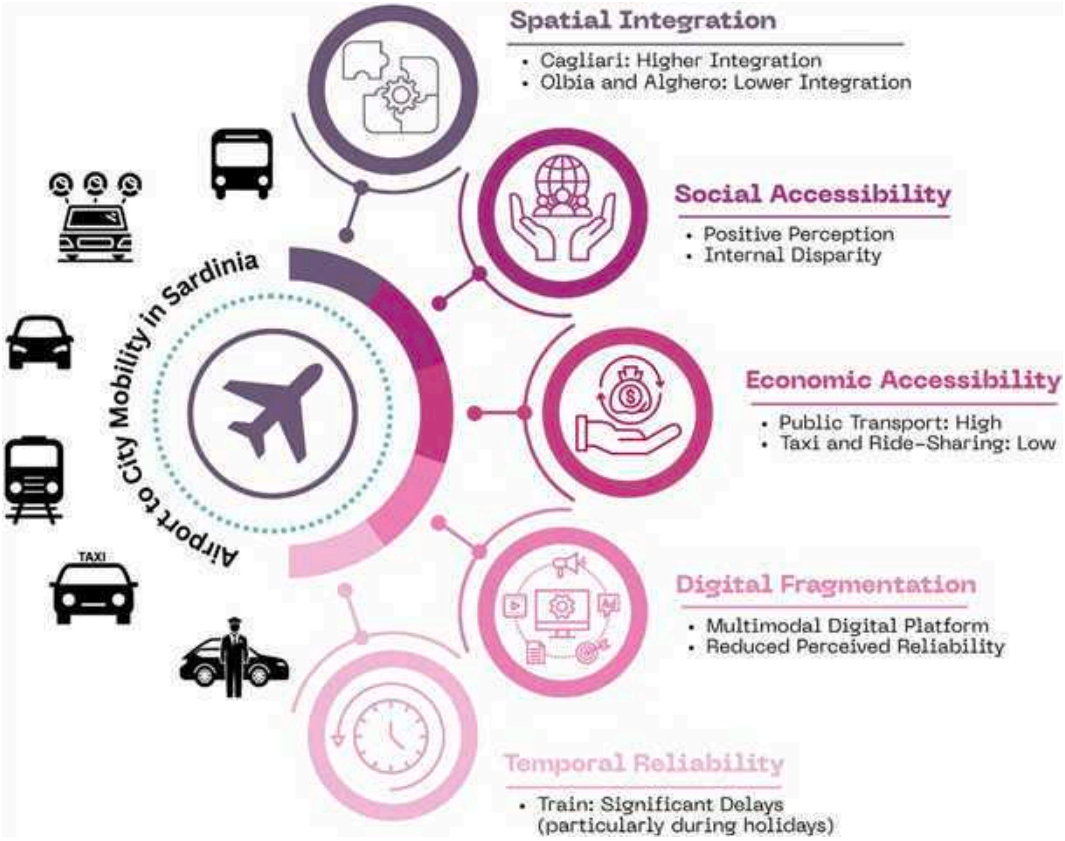

Fig. 9. A visual summary of core identified concepts associated with interpretive results of this study.

Orozco-Fontalvo & Moura, 2023). The present study directly responds to this call by operationalising social accessibility as a central analytical construct and empirically demonstrating its strong relationship with user satisfaction and perceived spatial accessibility. Unlike studies that assess MaaS primarily through adoption or modal shift metrics, this research foregrounds lived mobility experiences, thereby extending MaaS evaluation beyond aspirational discourse toward measurable social outcomes. Importantly, this study also contributes by explicitly addressing MaaS within a transitional and partially implemented context, where fully integrated platforms are not yet operational. By conceptualising and empirically examining "MaaS-related mobility systems" rather than idealised MaaS models, the research provides a more realistic and context-sensitive understanding of how integration, accessibility, and user experience interact in fragmented real-world mobility environments.

In contrast to studies examining MaaS adoption preferences and bundling strategies (Guidon et al., 2020; Jittrapirom et al., 2020; Sogbe et al., 2026a, 2026b), this research shifts attention from stated willingness-to-pay and service packaging to the conditions under which MaaS-related services are experienced as accessible. While prior findings show that user valuation of MaaS components varies by mode and user profile, the present study demonstrates that affordability, legibility, and reliability are not abstract preferences but are spatially and contextually embedded. The strong differentiation observed between public transport users and users of taxis or ride-sharing services reinforces earlier concerns that MaaS may reproduce cost-based exclusion if affordability is not treated as a core design parameter (Qin & Liao, 2024). By linking affordability perceptions to specific airport-to-city corridors, this study grounds adoption debates within concrete spatial settings.

Nevertheless, the interpretation of these findings requires caution. Existing MaaS and public transport literature consistently demonstrates that users' evaluations of mobility services are partially shaped by prior modal habits, familiarity with public transport systems, and self-selection effects (De Vos, 2019; Ingvardson & Nielsen, 2019; Ye & Titheridge, 2017). Individuals who already rely more frequently on collective transport modes may evaluate accessibility and service quality more positively regardless of objective system performance. In this respect, some variation observed among respondents may reflect pre-existing mobility preferences and behavioural adaptation rather than accessibility conditions alone. Although the inclusion of travel frequency and travel purpose as control variables partially addresses this concern, the present study cannot fully disentangle experiential evaluations from established mobility habits. Future research incorporating revealed behavioural data, longitudinal designs, or comparative modal tracking would provide a more robust basis for distinguishing between perceived accessibility effects and user self-selection dynamics.

A key contribution of this research lies in its focus on airport-to-city mobility, a domain that remains underexplored in MaaS literature despite airports representing critical accessibility thresholds for tourists, non-residents, and first-time users. While Bruzzone et al. (2025) extend MaaS analysis to long-distance travel, and Lu et al. (2025) examine suburban MaaS impacts, few studies explicitly address airports as socially sensitive mobility nodes. The findings suggest that airports amplify accessibility challenges related to luggage handling, time sensitivity, language barriers, and unfamiliarity with local systems—dimensions that are often overlooked in urban MaaS pilots. In doing so, it positions airport MaaS as a stress test for inclusivity claims, revealing gaps between nominal service availability and actual user experience.

Methodologically, this research advances accessibility evaluation by combining subjective survey-based measures with objective Space Syntax analysis, responding directly to calls for spatially explicit, multi-scalar MaaS assessment (Filipe et al., 2024; Papaioannou et al., 2023). While studies such as Tran and Draeger (2021) and Hasselwander et al. (2023) demonstrate the accessibility potential of mobility hubs and multimodal integration, they often assume spatial coherence and

legibility of the surrounding urban fabric as a given. In contrast, the present study demonstrates that even where services are available, fragmented spatial configurations—particularly in Olbia and Alghero—can undermine perceived accessibility and user experience. This finding resonates strongly with Askarizad et al. (2024), who show that although peripheral street networks may exhibit configurational accessibility, their labyrinthine and organic structures can significantly hinder wayfinding and spatial legibility. By revealing both alignment and mismatch between global integration values and user perceptions, this study complements equity-focused frameworks (Dadashzadeh et al., 2022, 2024), adding a configurational and experiential spatial dimension that has been largely absent from existing MaaS inclusivity metrics.

The island context of Sardinia further strengthens the originality of this contribution. While Garau et al. (2022), Trencher et al. (2024) and Alam et al. (2025) highlight the unique mobility challenges of insular and aging regions, empirical MaaS studies in such settings remain scarce. The findings suggest that island conditions—characterised by limited redundancy, seasonal demand peaks, and high dependence on air travel—intensify the consequences of service unreliability, spatial fragmentation, and digital disintegration. The findings confirm Lopes et al.'s (2023, 2025)) concerns that MaaS may exacerbate inequality when geographic coverage and physical connectivity are uneven, but extend this critique by showing how insularity magnifies these effects at key gateways.

At the same time, the observed fragmentation of digital mobility services should not be interpreted exclusively as a local governance deficiency specific to Sardinia. Similar challenges have been documented across peripheral, rural, and insular European mobility systems, where fragmented institutional responsibilities, seasonal demand fluctuations, limited market size, and uneven digital integration frequently constrain the development of fully unified MaaS ecosystems (Orozco-Fontalvo et al., 2026; Pangbourne et al., 2020; Papaioannou et al., 2023). In this regard, Sardinia may reflect broader structural limitations characteristic of evolving MaaS-related mobility systems rather than an isolated case of regional underperformance. This perspective suggests that digital fragmentation may represent a transitional condition within many peripheral mobility markets, where integration processes remain incremental, uneven, and strongly dependent on institutional coordination capacity.

Finally, this study contributes to governance-oriented MaaS debates by empirically substantiating critiques that technological integration alone is insufficient to ensure public value. Reflecting Lyko and Kębłowski's (2025) call for re-centring "publicness" in MaaS, the results indicate that users' dissatisfaction often stems not from the absence of services, but from fragmented ticketing systems, lack of unified digital platforms, and insufficient multilingual and accessible information. These findings align with Hensher et al. (2023) and Meng et al. (2020), reinforcing the argument that MaaS effectiveness is constrained more by institutional coordination and policy design than by technical feasibility. By situating these governance challenges within a spatially explicit and user-centred framework, this research offers a robust empirical foundation for rethinking MaaS as a socially accountable mobility system rather than a purely digital innovation.

5.3. Implications for policy and planning

The findings of this study suggest that improving MaaS performance in airport-to-city mobility requires policy and planning interventions that go beyond digital integration alone, addressing the physical and social conditions that shape user experience. Although public transport in Sardinia is generally perceived as affordable—particularly by regular bus and train users—this affordability advantage is undermined by infrastructural gaps that limit practical accessibility. Policymakers should therefore prioritise the physical continuity between airports and public transport nodes, ensuring that access routes are safe, legible, and suitable for users with luggage, reduced mobility, or sensory impairments. Investments in high-quality pavements, step-free connections, covered walkways, and weather-protected paths would significantly reduce experiential barriers and enhance the inclusivity of MaaS-supported journeys.

A second critical implication concerns the governance of digital mobility services. Survey responses highlight the absence of a unified MaaS platform integrating all available modes, ticketing systems, and real-time information. Despite the existence of mode-specific tools such as BusFinder, users are still required to rely on multiple applications, ticket vending machines, or external websites, creating fragmentation and cognitive burden. From a policy perspective, this points to the need for public authorities to act as MaaS orchestrators rather than passive regulators, fostering institutional coordination between transport operators. A publicly governed, island-wide MaaS platform that integrates bus, train, taxi, and shared mobility services—while offering multilingual interfaces and accessible formats—would directly respond to user needs identified in this study.

The results also reveal the importance of reliability and temporal coordination, particularly in an airport context where delays can have severe consequences. Although train services are generally perceived as punctual, reported disruptions during peak holiday periods expose users to the risk of missing flights, generating anxiety and dissatisfaction. Transport planning strategies should therefore incorporate buffer-time planning, increased service frequency during seasonal peaks, and contingency coordination between airports and public transport providers. Integrating real-time disruption alerts and adaptive routing options within MaaS platforms could further mitigate these risks, enhancing trust and perceived reliability among users.

Finally, the spatial disparities identified through Space Syntax analysis underline the necessity of spatially informed planning strategies tailored to each airport context. While Cagliari benefits from strong structural integration, Olbia and Alghero require targeted interventions to improve route directness, legibility, and multimodal connectivity. Planning policies should prioritise the redesign of airport-to-city corridors as strategic mobility pillars, supported by clear wayfinding systems, consistent signage, and coherent interchange layouts. By aligning physical infrastructure upgrades with MaaS service design, policymakers can ensure that digital innovation is grounded in spatial reality, ultimately supporting more equitable, reliable, and user-centred airport-to-city mobility systems in island contexts.

5.4. Limitations and future research agenda

Despite its contributions, this study has several limitations that should be acknowledged. First, the survey data rely on self-reported perceptions, which may be influenced by individual expectations, travel purpose, prior experiences, or temporary service disruptions at the time of travel. While perceptual measures are essential for understanding user experience and social accessibility, they do not fully capture behavioural responses or long-term adaptation to MaaS systems. In addition, the use of a five-point Likert scale, although appropriate for statistical analysis, may constrain the depth of nuanced attitudes, particularly in relation to complex experiences such as intermodal transfers or accessibility for vulnerable groups. Moreover, while open-ended responses provided useful contextual insights, they were analysed through an exploratory thematic review rather than a formal qualitative coding procedure and should therefore be interpreted as illustrative rather than exhaustive evidence.

A second limitation concerns the sampling strategy and contextual scope. Although the sample size exceeded the threshold suggested by Cochran's formula and included a diverse range of users, the convenience-based sampling approach may limit the generalisability of findings beyond Sardinia. Moreover, the study focuses on airport-to-city mobility within a single island context, characterised by specific geographic, institutional, and infrastructural conditions. As such, the results should not be directly extrapolated to mainland metropolitan

regions or highly integrated airport systems without caution. Similarly, the Space Syntax analysis, while effective in capturing configurational accessibility, does not account for temporal variations in service frequency, congestion, or real-time operational disruptions that may further shape accessibility outcomes.

A further limitation relates to the use of self-reported questionnaire data collected at a single point in time, which may introduce common method bias and potentially inflate correlations among perceptual constructs. Although several procedural remedies were implemented during survey design and administration, including anonymity, neutral wording, and thematic separation of variables, the relationships identified in this study should primarily be interpreted as perceptual associations rather than definitive causal effects. Future studies could extend this research through the integration of revealed-preference data, such as smart-ticketing records, GPS traces, or observed travel behaviour, enabling a more comprehensive validation of the relationships between accessibility, spatial configuration, and mobility experience.

Although structural equation modelling (SEM) may provide additional insights into latent relationships among the constructs, the present study employed composite-variable hierarchical regression analysis due to its suitability for examining predictive relationships among aggregated dimensions of accessibility and user experience. Given the exploratory and applied nature of the research, the adopted approach offers a transparent and interpretable framework for assessing the relative influence of perceived social and spatial accessibility on MaaS user satisfaction. Future studies may further extend this framework through SEM-based validation of latent pathways and mediating effects.

It should also be acknowledged that the Space Syntax analysis focuses primarily on configurational accessibility and does not incorporate operational transport variables such as travel time reliability, service frequency, waiting times, fare structures, or vehicle capacity. Consequently, the syntactic findings should be interpreted as reflecting the spatial and morphological characteristics of airport-to-city mobility networks rather than the full operational performance of the transport system. Future research may benefit from integrating configurational analysis with travel-time-based or generalised-cost accessibility models to provide a more comprehensive evaluation of MaaS-related mobility environments.

Accordingly, future studies could expand the analytical scope in several directions. Longitudinal studies would be particularly valuable for examining how user perceptions of accessibility and satisfaction evolve over time, especially following MaaS platform upgrades or infrastructure improvements. Incorporating revealed preference data, such as GPS tracking or smart-ticketing records, could complement survey-based findings and enable a more robust understanding of actual mobility behaviour. Future studies may also adopt mixed qualitative–quantitative designs, integrating interviews or focus groups to capture the lived experiences of specific user groups, including elderly travellers, people with disabilities, and international tourists.

Further research should also explore comparative and multi-scalar approaches to MaaS accessibility. Cross-island or cross-regional studies could help identify whether the accessibility challenges observed in Sardinia are inherent to insular contexts or reflect broader governance and infrastructural patterns. From a spatial perspective, future work could integrate Space Syntax with time-based accessibility measures, cost-weighted indicators, or simulation-based MaaS scenarios to better reflect real-world constraints. Finally, evaluating the impacts of unified MaaS platforms under different governance models would provide critical perspectives for policymakers, helping to align digital mobility innovation with equitable, resilient, and context-sensitive transport planning.

6. Conclusion

This study set out to investigate the role of social accessibility in MaaS and its impact on user experience, focusing on airport-to-city mobility in the island context of Sardinia. To address this aim, the research examined the extent to which existing MaaS-related services ensure socially accessible connections, explored how perceived accessibility influences user satisfaction, and compared subjective user perceptions with objective spatial accessibility measured through Space Syntax analysis. The findings demonstrate that while MaaS-related services provide a foundational level of accessibility, significant variations persist across airports and user groups, revealing uneven social and spatial performance. The combined use of survey-based analysis and spatial modelling enabled a comprehensive response to all three research questions, offering both experiential and structural insights into airport-to-city mobility systems.

The originality of this study lies in its integrated and context-sensitive approach. By focusing on airport-to-city mobility—an often-overlooked but critical interface between global and local transport systems—this research extends MaaS scholarship beyond conventional urban commuting contexts. The insular setting of Sardinia further enriches this contribution, highlighting how geographic constraints, infrastructural fragmentation, and seasonal demand shape MaaS accessibility outcomes. Methodologically, the study advances the field by combining subjective measures of social accessibility and user experience with objective Space Syntax indicators, thereby bridging a persistent gap between behavioural research and spatial analysis in MaaS studies, particularly within organically structured transport networks.

Beyond its empirical and methodological contributions, this study highlights the importance of rethinking accessibility as a multidimensional and context-dependent condition rather than a purely technical or infrastructural issue. The findings suggest that improving airport-to-city mobility in island regions requires greater coordination between spatial planning, transport governance, and digital service integration. In particular, the coexistence of relatively strong configurational accessibility with uneven user perceptions demonstrates that physically connected transport systems do not automatically translate into socially accessible or satisfactory mobility experiences. This has important implications for policy and planning, especially in peripheral and insular regions where fragmented governance structures, seasonal demand fluctuations, and limited infrastructural redundancy intensify the consequences of service unreliability and digital disintegration. Accordingly, future MaaS-related mobility strategies should move beyond technological integration alone and place greater emphasis on affordability, wayfinding clarity, multilingual information systems, pedestrian continuity, and institutional coordination. Future research could further strengthen this field by incorporating longitudinal analysis, revealed mobility behaviour, or real-time transport data to better examine the dynamic relationship between spatial accessibility, social inclusion, and user experience across different mobility contexts.

Authors' contribution

This paper is the result of the collaborative efforts of all authors. ‘Abstract’ and ‘Material and Methods’ (with all sub-paragraphs) were written jointly by the authors. C.G. wrote the ‘1. Introduction’, ‘2.1. Rethinking Accessibility in the Era of Smart and Integrated Mobility’, ‘4.3 Space Syntax Analysis’ (with all sub-paragraphs), ‘5.2. The Contribution of Research in Respect to Precedent Studies’ and the ‘6. Conclusion’. M.D. wrote the ‘2.3. Social Accessibility and Inclusion in MaaS Systems’, ‘2.6. Research Gap and Contribution’, ‘4.1. Descriptive Data Analysis’ (with all sub-paragraphs), ‘5.3. Implications for Policy and Planning’, and ‘5.4. Limitations and Future Research Agenda’. N.R. wrote the ‘2.4. Adoption, User Behaviour, and the Role of Service Design’, and the ‘2.5. Spatial and Contextual Dimensions of Accessibility in Complex Environments’. R.A. wrote the ‘2.2. MaaS: Promises, Potentials, and Limitations’, the ‘4.2. Statistical Analysis’ (with all sub-paragraphs), and ‘5.1. Interpretation and Discussion of Results’. The paper is supervised and coordinated by C.G. and R.A.

CRediT authorship contribution statement

Chiara Garau: Writing – review & editing, Validation, Supervision, Project administration, Methodology, Funding acquisition, Data curation. **Mana Dastoum:** Writing – original draft, Visualization, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nicoletta Rassu:** Writing – review & editing, Project administration, Funding acquisition. **Reza Askarizad:** Writing – original draft, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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.

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Data availability

Data will be made available on request.

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