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Urban, Planning and Transport Research
An Open Access Journal

ISSN: 2165-0020 (Online) Journal homepage: www.tandfonline.com/journals/rupt20

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To cite this article: Victoria Labajo & Stefanie Nagel (2025) Delivering seamless urban mobility: expert recommendations and best practices for consumer-centric Mobility-as-a-Service solutions, Urban, Planning and Transport Research, 13:1, 2501999, DOI: 10.1080/21650020.2025.2501999

To link to this article: https://doi.org/10.1080/21650020.2025.2501999

Published online: 09 May 2025.

URBAN, PLANNING AND TRANSPORT RESEARCH
2025, VOL. 13, NO. 1, 2501999
https://doi.org/10.1080/21650020.2025.2501999

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Delivering seamless urban mobility: expert recommendations and best practices for consumer-centric Mobility-as-a-Service solutions

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ABSTRACT

This paper provides a general framework and practical guidance for the key stakeholders involved in the Mobility-as-a-Service (MaaS) concept, identifying specific domains requiring targeted development. It adopts a holistic approach to explore three crucial levers: consumer perspective, payment model, and public – private cooperation, aiming to pinpoint the aspects essential for the further development of the concept. The MaaS concept is still at an early stage of development. A deeper understanding of appropriate measures for its continued evolution is needed to achieve sustainable mobility through an integrated multimodal transport platform. After a comprehensive analysis of existing models, literature, and expert interviews, three critical dimensions were identified – sustainability, scalability, and viability – as key to ensuring the long-term success and stability of MaaS. Recommendations for further development focus on these identified areas and underscore the need for effective cooperation between public and private actors to accelerate the concept's advancement.

ARTICLE HISTORY
Received 23 January 2025
Accepted 30 April 2025

KEYWORDS
Sustainable mobility; urban challenges; shared mobility; Mobility-as-a-Service (MaaS); MaaS ecosystem

1. Introduction

In the context of increasing urbanization, many cities face the challenges of growing inner-city traffic, congestion, and air pollution. These developments, as well as increased environmental awareness due to climate change, are intensifying calls for more sustainability in the mobility sector (Hickman & Banister, 2007). The sustainable mobility paradigm rests on the imperatives of sustainable development: accessibility to transport to satisfy mobility needs, justice in terms of equal access to services, and environmental preservation (Holden et al., 2020). To achieve this goal, shifting user patterns from individual to shared mobility has emerged as one of the most widespread proposals, reflecting the evolution of mobility consumption and the growing demand for 'on-demand mobility'. This development plays a decisive role in urban areas, as it has the potential to have a lasting impact on the urban landscape and the quality of life in cities – making their spaces more efficient, equitable, and sustainable (Banister, 2008; Barfod

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et al., 2018; Köhler et al., 2009). Addressing this shift requires a transportation model based on shared mobility infrastructures that can respond to individual needs while simultaneously achieving societal, economic, and environmental objectives (Cohen & Kietzmann, 2014). This trend is giving rise to the concept of MaaS.

MaaS, or Mobility-as-a-Service, represents a user-centric approach to mobility, made feasible through the amalgamation of Information and Communication Technologies (ICT) and the capabilities of Transport System Models (TSM), particularly concerning energy-related decision-making (Musolino et al., 2022; Rindone, 2022; Russo & Rindone, 2023). The ultimate objective of MaaS is to present viable alternatives to the unsustainable transportation of both people and goods, with a primary aim of optimizing the utilization of available resources, notably energy resources. The operational framework of MaaS hinges upon the provision of on-demand access to mobility services via an integrated digital platform (Arias-Molinares et al., 2023). Recent studies have shown that MaaS can play a fundamental role in supporting sustainable transitions within smart cities by integrating various transport modes into seamless digital platforms, thereby fostering more sustainable mobility behaviors (Costa & Delponte, 2025). In this model, a unified digital interface consolidates the transportation options provided by diverse mobility service providers into a single, centralized access point (Jittrapirom et al., 2017). Users, in turn, gain access to this extensive spectrum of transportation alternatives through the digital platform, which facilitates the planning, booking, and payment processes for multi-modal trips, all within a singular interface. Consequently, MaaS encompasses all stages of a multi-modal journey within a seamless user experience, thereby enhancing ease of use and the efficiency of travel (Kamargianni & Matyas, 2017). The core features of MaaS include integrated planning and payment systems, real-time updates, and tailored service packages (Arias-Molinares & García-Palomares, 2020).

Drawing from a diverse array of MaaS practices, Sochor et al. (2018) developed a classification model to delineate the degree of integration within a MaaS service as shown in Table 1. The maturity scale spans five levels, starting at Level 0, which reflects no integration at all – where services exist independently without coordination – and progressing through Level 1, which involves basic information integration, up to Level 4, which represents full alignment with societal goals. At this highest level, incentivized behavioral change and institutional cooperation are pivotal to achieving sustainable, user-centered mobility ecosystems.

Table 1. Level of maturity a MaaS concept.

Levels				Description
Level 4. integration of societal goals	Level 3. integration of the service offer	Level 2. integration of booking and payment	Level 1. Integration of information	Level 0. No integration
				Timetable data
				Multimodal journey planning
			Deep Linking	
			Master Accounts	
		Pay-As-You-Go (PAYG)		
		Subscription Services		
	Providing financial incentives			
	Bundle discounts			
	CO2 Challenges			

Source: Adapted from Sochor et al. (2018).

Although academic interest in MaaS has grown, the literature is still fragmented. Prior studies have defined conceptual frameworks (Kamargianni & Matyas, 2017), examined user behavior (Kriswardhana & Esztergár-Kiss, 2023), and identified institutional or technical barriers (Karlsson et al., 2020; König et al., 2016; Mukhtar-Landgren et al., 2016), yet few offer a truly systemic perspective. Notably, most research isolates specific dimensions – users, governance, or technology – without modelling their interactions. Some recent contributions have begun to adopt an ecosystemic lens (Cisterna et al., 2023), but comprehensive, empirical operationalizations remain scarce (Kamargianni et al., 2016; Utriainen & Pöllänen, 2018).

Beyond academic contributions, institutional agendas have increasingly influenced the MaaS discourse by highlighting the need for coordinated strategies that connect public policy, service integration, and user engagement. Recent frameworks, such as the *Shared Mobility and a Sustainable Transport Future Report* by the World Resources Institute (Davidson et al., 2024), as well as regulatory white papers from the MaaS Alliance (MaaS Alliance, 2024), provide concrete recommendations for aligning these elements under a shared sustainability vision. Alongside contributions from entities like POLIS (POLIS Network, 2025) or UITP (UITP, n.d.), these institutional efforts – still underrepresented in MaaS scholarship – underscore the urgency of advancing public – private collaboration, adaptive governance models, and integrated mobility services that scale beyond pilot initiatives (Servou et al., 2023).

However, despite the growing attention and expectations surrounding MaaS, its long-term contribution to sustainability objectives remains open to debate. The outcomes of MaaS systems are deeply contingent on contextual factors such as governance models, business incentives, user behaviors, and technological integration – elements that vary widely across cases and geographies. Recent studies emphasize that without clear public leadership, appropriate governance frameworks, and inclusive design, MaaS may fall short of its envisioned social and environmental benefits (Akse et al., 2024; Hensher et al., 2021; Servou et al., 2023). Empirical evidence from pilot implementations further supports this uncertainty, showing that MaaS may have limited impact on reducing private car use in practice (Storme et al., 2020). This complexity calls for critical, empirically grounded approaches to assess both opportunities and limitations.

This article aims to bridge these gaps by proposing a multilevel analytical approach to the MaaS ecosystem. Our contribution lies in identifying critical variables at macro (institutional and regulatory), meso (platform and service integration), and micro (user behavior and preferences) levels, and in mapping strategic leverage points for collaborative development. Through this holistic perspective, we respond both to academic fragmentation and to institutional agendas calling for integrative, actionable frameworks for MaaS implementation.

2. Materials and methods

Drawing from a state-of-the-art literature review and an analysis of existing initiatives and pilots around Europe, critical factors for the future advancement of MaaS were identified. The literature review was conducted by systematically searching multiple academic databases, including Scopus, Web of Science, and Google Scholar. The search strategy combined keywords such as ‘Mobility as a Service (MaaS)’,

'sustainable mobility', 'MaaS governance', and 'stakeholders'. To ensure a comprehensive and up-to-date analysis, priority was given to peer-reviewed articles published within the last 10 years, although seminal earlier works were also considered when relevant. This review provided the analytical foundation for developing the interview framework, guiding the selection of thematic areas and initial assumptions to be explored.

To validate and complement these findings, nine expert interviews were conducted, serving as an independent source of data. These dialogues with experts facilitated a more in-depth exploration of the MaaS subject matter, particularly concerning the complexities arising from three overarching themes: the heterogeneous customer base, the payment model, and the collaboration between public and private stakeholders within the MaaS ecosystem. The integration of the literature review and interviews followed an iterative, exploratory logic. Insights from the literature were used to formulate guiding questions, while findings from the interviews helped nuance or challenge the assumptions derived from previous studies (e.g. Mukhtar-Landgren et al., 2016; Smith et al., 2019).

The methodological process can be summarized as follows:

- Step 1: State-of-the-art literature review on MaaS implementation challenges and stakeholder dynamics
- Step 2: Identification of key thematic areas (user behavior, payment models, governance mechanisms)
- Step 3: Design of semi-structured interview protocol informed by the literature
- Step 4: Expert selection and interview execution
- Step 5: Grounded theory-based coding and analysis using NVivo
- Step 6: Triangulation between literature findings and interview insights to formulate recommendations

The exploratory nature of these interviews aimed to gather comprehensive information regarding the identified areas and to formulate targeted recommendations for the development of the MaaS concept. It is worth noting that the use of semi-structured interviews with experts has been instrumental in addressing challenges related to the adoption and development of the MaaS concept, as evidenced in prior cases (Corbin & Strauss, 2008; Mukhtar-Landgren et al., 2016). While prior studies have explored stakeholder roles in MaaS ecosystems, our approach adds value by combining literature-based assumptions with qualitative stakeholder insights to build a layered understanding of the system's complexity.

The participants in these interviews represent a diverse sample of senior executives within the mobility sector, and their profiles are detailed in Table 2. The interviews were conducted until theoretical saturation was achieved, following the approach outlined by reference (Charmaz, 2006).

The interview protocol was structured into three distinct sections, aligning with the topics that required further exploration:

- Consumer Perspective: drivers and barriers influencing the adoption MaaS
- Platform Interface design and considerations for a suitable payment model.

Table 2. Profiles of the experts interviewed.

Id. Code	Industry	Location Company headquarter	Location Expert	Job Position Expert
E1	Shared Mobility	Spain	Spain	Founder
E2	Technology	Spain	Spain	Head of operations and consultancy
E3	Mobility as a Service	Spain	Spain	CEO and Co-founder
E4	Shared Mobility	The Netherlands	Spain	Area Manager Spain and Portugal
E5	Automotive	Japan	Spain	Business Development
E6	Management Consulting, focus mobility	Germany	Germany	Consultancy
E7	Automotive	South Korea	Spain	Head of subscription services products for Spain
E8	Automotive	France	Spain	Director for strategic mobility development Spain
E9	Academy and Research Sustainable Mobility	Spain	Spain	Director of Observatory for EV and Sustainable Mobility

Source: own elaboration by authors

- Cooperation among Mobility Sector Actors: role played by public agents in crafting the MaaS concept and their involvement in aggregating private shared mobility providers within a unified platform.

The questions were intentionally phrased in an open-ended manner to encourage open discussion and provide the experts with ample room for their insights and ideas. This approach facilitated the generation of a substantial amount of information.

Experts were contacted through email or LinkedIn. Upon their agreement to participate in the interviews, written consent was obtained to record the interviews, which was done to facilitate subsequent evaluation. Ethical considerations were adhered to in the invitation to be part of the study, ensuring that participants were aware that their responses would be anonymized. The interviews were conducted in February 2023 via MS Teams and typically lasted an average of 50 minutes. All interviews were voice-recorded to streamline subsequent analysis.

In this research, the qualitative grounded theory methodological approach (Locke, 2005) was adopted for data collection and analysis, following the content analysis steps recommended by Charmaz (2006). The initial coding phase was carried out inductively, informed by extensive readings and discussions aimed at identifying primary categories. Subsequently, during the focused coding phase, information was thematically organized into parent and child nodes, a process aided using Nvivo 15 software. In the axial coding phase, coding was systematically reviewed category by category through a triangulation process involving both researchers, to enhance the coherence of the emerging analysis. Lastly, in the theoretical coding phase, the analysis was drawn from the data, shaping the results.

Visual aids, such as mind maps, were employed to visually represent the clustering of identified categories. This visualization technique helped elucidate the interrelationships between categories discussed during the interviews, providing a clearer understanding of how various factors were interconnected and influenced one another. This was especially important for comprehending the intricate dynamics within the last two questions concerning public-private cooperation, which were marked by complexity and interrelations.

3. Results

Following the analysis of the narratives provided by the interviewees, and in alignment with the three overarching themes previously identified, a total of 44 refined codes emerged. The subsequent analysis will be organized by topic, corresponding to the specific areas explored during the interviews. This analysis is further supported by selected quotations from the experts, each attributed to the corresponding code assigned in Table 2.

3.1. Consumer perspective

3.1.1. Drivers for consumer adoption of MaaS

Interviewees consistently cited key factors driving consumer adoption of MaaS. They identified three primary drivers, which, when consolidated across all experts, revealed four factors mentioned more than 50% of the time.

- Price: Almost all experts deemed price crucial, with some asserting it as the foremost factor influencing users' decision to adopt MaaS: *'That's usually the first factor for the user to decide, to use or not to use this service'*(E4).
- Availability and Flexibility: These aspects offer users a sense of autonomy akin to private vehicle ownership, enabling spontaneous travel decisions and preferences, crucial for a seamless user experience, and encouraging customer adoption (E6).
- Customer Experience: Closely linked to availability and flexibility, it encompasses simplification and transparency, impacting overall satisfaction and future usage (E2). Factors include payment ease (E3), charging, and parking availability *'All the final experiences especially, for example, parking, which seems simple, but it is not, should also be simple, right, . . . if you go with a car and you are going to go downtown, you know for sure that you are going to be able to park it'* (E2), and customization options (E6).
- Convenience: Proximity to mobility options, Expert 4 highlighted by a study indicating users' unwillingness to walk more than two minutes to a vehicle is vital for adoption, given that the average length of a trip is only 12 minutes.

Furthermore, the experts highlighted several other factors that are important for driving the adoption of a MaaS service. These factors include social inclusion of the service, like age-appropriate access (E9), platform modernity and responsiveness (E8), customer engagement (E3), and safety and infrastructure (E4). Customer engagement involves using platform and product features to increase customer loyalty '(. . .) *cross-selling promotion and communication settings, so people are still like really engage in this. . . If you give them points to jump into a pass. They will use it and you can force certain consumption patterns through gamification mechanisms*' (E3). Safety and infrastructure relate to the necessary conditions that the mobility operator and the city infrastructure must fulfill in a joint effort to provide a mobility service that is safe and free from customer concerns.

3.1.2. Barriers to consumer adoption of MaaS

The most significant hurdle to consumer adoption of MaaS is an inadequately tailored service offer that fails to align with customer requirements. Experts identified several reasons contributing to unattractive service offers and customer churn during interviews. To meet customer needs and preferences effectively, services must address these aspects.

- One key issue hindering customer requirements is the absence of customer segmentation, impeding the development of services that cater to specific needs (E3). Government regulations can further compound this challenge by limiting mobility operators' ability to create solutions aligned with consumer preferences, resulting in unattractive offerings: 'But of course, if they go too far, if they put too many obstacles or regulate too much. In the end, mobility as a service is not so attractive for providers and they don't offer competitive solutions, right?' (E2).
- Adaptation to local customer preferences regarding transportation modes is crucial (E3). Services should be tailored to meet local demands, considering customer willingness to pay, with price sensitivity being a notable concern (E4). Beyond this, finer customer preferences such as privacy, freedom, and peace during travel must be addressed to present a compelling alternative to private car ownership 'as users are not only concerned with getting from point A to B quickly and comfortably' (E6). The service's success also hinges on providing a seamless, integrated, and user-friendly experience, encompassing simplified payment processes (E3), parking availability (E4), and charging stations, among others (E8). Reducing barriers to multimodal travel enhances the prospects of customer adoption.
- Another significant barrier identified in the interviews is the lack of convenience and availability, which complements the previous barrier. Experts emphasized that for a service to be adopted, it must encompass all stages of the user journey through the platform (E3) and provide a level of flexibility equivalent to that of a car (E1). Streamlining and unifying the user experience throughout the journey (E3) is crucial, allowing for a 'quick entry point to mobility' (E6). Expert 8 illustrates the importance of consolidating conveniences within a single service platform: 'If I want to use the City, I have to download the City APP if I want to charge, I do not know where I need the Iberdrola app if I want to take a taxi I have to download the Cabify app, the Uber app or whatever. I have an electric car and I carry about 15 cards in my wallet for charging on public roads'. Furthermore, shared mobility providers face the operational challenge of ensuring the high availability of their vehicles across diverse locations, as emphasized by an expert from the automotive industry (E5).
- Service security emerged as a key factor in preventing customer churn. It encompasses both user and pedestrian safety and requires collaboration with municipalities to develop infrastructure such as dedicated parking spaces and bike lanes. As Expert 4 noted: 'We tended to focus a lot on user safety, but now we've shifted a bit towards pedestrian safety . . . We're also developing a lot of initiatives to make sure that users use the bike lanes or use the city infrastructure where they need to be and to avoid them riding on sidewalks' (E4). Ensuring vehicle quality is also essential, as Expert 7 emphasized by highlighting their policy of operating only vehicles less than three years old, equipped with the latest safety technology (E7). Furthermore,

integrating technologies like geo-positioning can enhance security and monitor user behavior (E4). Finally, service security extends to protecting sensitive personal data, which is crucial for building customer trust and minimizing churn risks (E6), as further discussed in Section 3.2.

- Concerning payment methods, specific aspects that can favor adoption include the need for a simple and straightforward payment process, ideally utilizing QR codes (E3). Transparency in the payment model is essential to maintain customer trust, allowing subscribers to maintain control over their subscriptions with easy cancellation policies (E6). Some users may prefer established payment intermediaries to handle sensitive account details (E6).
- Lastly, the failure to develop a scalable concept poses a substantial challenge. The success of a MaaS concept hinges on its scalability for mass adoption in urban areas, requiring technological and infrastructural readiness and a sufficient supply of mobility providers to meet customer demand. Inability to scale effectively may lead to increased customer dissatisfaction and reduce the likelihood of adoption. '. . . from the first moment of the conception of this model it must be something that technologically and structurally allows you to start with 10 users and scale to a million' (E9).

3.2. Payment model

The payment model is primarily defined by three key factors: the consumer, service format, and payment method. These interconnections are illustrated in Figure 1, emphasizing that MaaS, as a customer-centric concept, requires a comprehensive understanding of the target user base to develop an effective and responsive payment model.

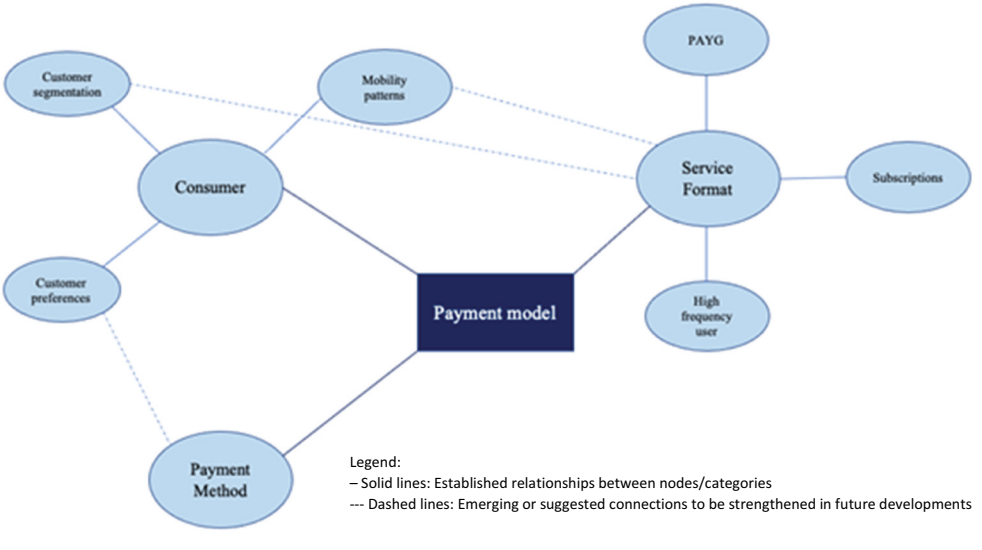

Figure 1. Payment model nodes and interconnections resulting from the interviews. Source: own elaboration by authors

3.2.1. Consumer

Experts consistently emphasized the imperative initial step in developing suitable service formats is a comprehensive understanding of the customer's needs. They highlighted various aspects crucial for establishing this understanding:

- Customer Segmentation: Experts from the research community and shared mobility sector (E1, E9) underscored the importance of segmenting customers based on factors like service usage frequency, travel behavior, and commuting purposes (e.g. work, leisure, weekend trips). Additionally, analyzing mobility patterns within a city (E9) helps discern movement patterns, typical routes, gaps in transport infrastructure, and the most suitable modes to bridge these gaps, particularly optimizing radial connections from suburbs to city centers (E9).
- Customer Preferences: Identifying customer preferences for a digital mobility service like MaaS is pivotal. Experts highlighted considerations such as customer price sensitivity and assessing willingness to pay (E3, E4). Price-worthiness, closely linked to service reliability, was emphasized: "So, imagine buying our monthly ticket for the metro and finding out that 50% of the times there is no metro. So, I would not renew my monthly pass, right . . . "(E4).
- Simplified Payment Process: Ensuring a straightforward payment process (E3) is essential. Transparency and flexibility in payment and subscription cancellation processes (E6) are vital. Cultural factors influencing payment preferences should be considered, such as Germans' caution regarding data privacy and the popularity of the 'Bahn Card' for train discounts (E6). Successful new mobility offerings must integrate these local preferences into innovative service formats.

3.2.2. Service format

The expert interviews revealed a range of perspectives on tariff models within MaaS platforms. While opinions differed on the relative merits of PAYG and subscription formats, a number of recurring themes emerged. The following synthesis outlines key aspects discussed, highlighting both opportunities and challenges associated with each approach, as well as the conditions necessary for their effective implementation.

- No one-size-fits-all approach: Experts agreed that MaaS platforms must offer a range of tariff formats, as there is no universally optimal model. Given the diversity of user needs and mobility behaviors, both PAYG and subscription models are necessary to accommodate different usage patterns (E1, E2).
- PAYG vs. Subscription: PAYG models are often preferred for their flexibility and perceived fairness, especially among users who wish to pay only for what they consume (E3, E6). In contrast, monthly subscriptions are valued for their convenience, particularly by frequent users who appreciate a seamless travel experience (E1, E9). However, some concerns were raised about the limited transparency and reduced user control associated with subscriptions (E6, E8).
- Service personalization challenges: Designing subscription packages that are both attractive and adaptable to a fragmented customer base is seen as complex. As a result, some experts suggest using PAYG as an onboarding mechanism, offering a 'light' version of the service with fewer personalization options (E3).

- Profitability and cost trade-offs: While subscriptions that include complex services such as car rentals increase operational costs for providers (E7), they also enhance perceived user flexibility. Despite variability in individual usage, these models are considered profitable from a provider's standpoint. As one expert noted: *'Subscription models are of course super lucrative for companies, that's just the way it is'* (E6).
- User segmentation: Frequent users are more likely to benefit from and prefer subscription models, which offer hassle-free travel without repeated transactions (E9). In contrast, intermittent users often opt for PAYG due to its flexibility and lower commitment (E6). Some experts highlighted the need to offer volume discounts or unlimited access tiers to meet the expectations of high-frequency users (E1).
- Adoption conditions: Experts emphasized that subscription models will only become broadly attractive once the MaaS platform has reached a sufficient level of maturity in terms of integration and service reliability (E2). Improved service availability is also seen as a key factor in increasing adoption of monthly plans (E4). As summarized by one interviewee, *'It makes sense if they really use it every day'* (E6).
- Revenue transparency issues: From the provider's perspective, a major concern relates to the lack of transparency in how revenues are distributed under subscription models. This ambiguity can undermine trust and perceived fairness in multi-provider ecosystems (E8).

3.2.3. Payment method

The key to an effective payment method is ensuring simplicity and transparency. Expert 3 highlighted two options: 'pre-payment', involving fixed fees charged before using the service (e.g. Uber), or 'post-payment', where variable fees are charged after service usage (e.g. E-scooter concepts). Some services automatically charge users, determining the best fee based on usage duration (e.g. New York Subway). Regardless of the approach, user comprehension is vital, and users should benefit from favorable deals: "When you are putting into the equation payments and money, the people are extremely sensitive "(E3).

Payments can be processed through platforms using established payment intermediaries or via an account-based system, requiring users to link their bank accounts directly. However, as mentioned in the previous section on adoption barriers (epigraph 3.1.2), data privacy is a critical concern for service security and customer trust, particularly concerning private bank data. Users may hesitate to link their bank accounts to a mobility platform, emphasizing the need for multiple payment options (E6). Expert 5 proposed separating customer journey management and MaaS concept logistics due to their complexity. MaaS providers can enhance the customer experience, address payment issues, ensure data security, and offer straightforward experiences, while mobility operators can focus on operational challenges.

3.3. MaaS ecosystem

3.3.1. Role of the public actors

The public sector's role in the MaaS ecosystem is intricate. While opinions on the extent of public control vary among experts, they agree that public actors primarily hold

regulatory responsibilities rather than engaging in the concept's development, which is left to the private sector. Figure 2 outlines the key factors shaping the public sector's role, categorized into four major aspects: public coordination, private-public interface coordination, capacity management, and mitigating public sector weaknesses.

- Public coordination: Experts pointed out the challenges stemming from vertical integration, where global mobility goals are implemented at the municipal level, resulting in fragmented local regulations (E9). This lack of harmonization creates confusion for users and hinders business scalability. They emphasized the need for clear, consistent laws across regions to support sector growth: 'If you have 150 different ways of doing business … firstly the laws have to be very clear and if possible, the same in every single city' (E7). In parallel, horizontal integration – the coordination of mobility regulations across related industries – was seen as essential to minimize negative spillover effects and ensure cohesive urban planning.
- Private-public interface coordination: A well-functioning cooperation mechanism between public and private actors was considered vital to align goals and responsibilities. Experts proposed establishing direct dialogue at the municipal level, such as through a mobility laboratory, to foster mutual understanding and facilitate the implementation of shared solutions (E6, E9). This interface allows public authorities to ensure that EU-level objectives, such as the green transition, are integrated into local mobility systems, while empowering private providers to innovate within a clear regulatory framework (E4).

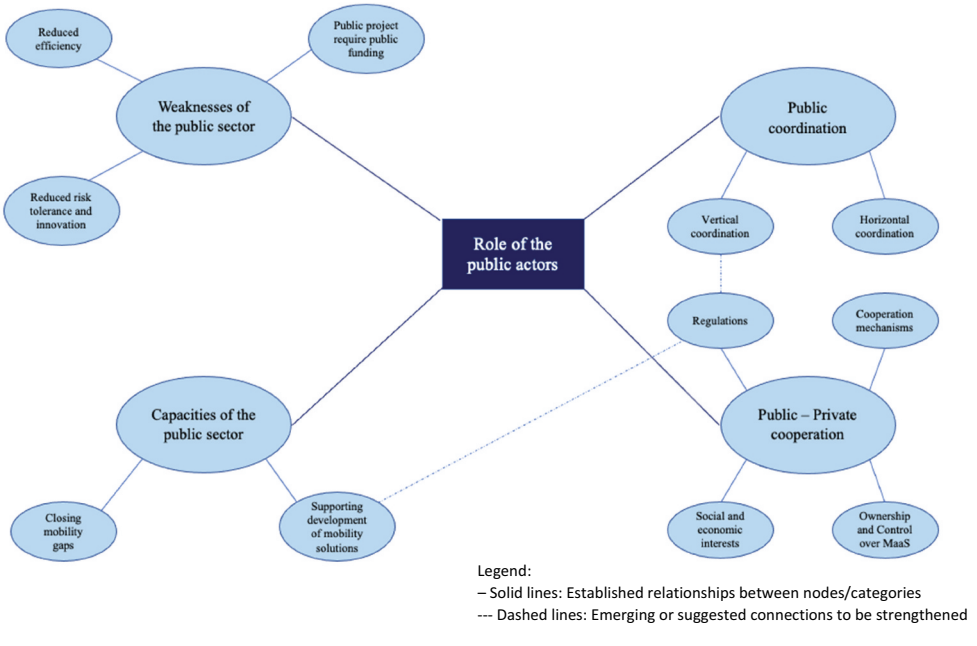

Figure 2. Role of the public actors' nodes and interconnections resulting from the interviews. Source: own elaboration by authors

- Capacity management: Experts agreed that the public sector plays a crucial enabling role rather than a developmental one. Its key capacities include creating favorable regulatory conditions and investing in infrastructure (e.g. parking, charging stations) to support private MaaS operators. Additionally, public actors are uniquely positioned to address mobility gaps – areas or populations underserved by the market – by deploying targeted subsidies (E1). These actions complement private efforts and contribute to equitable urban mobility.
- Mitigating public sector weaknesses: Several experts highlighted structural limitations that make the public sector less suitable as a MaaS provider. These include reliance on subsidies, lower operational efficiency, and limited capacity for innovation (E1, E4). Moreover, direct public participation in mobility services was seen as potentially distorting market competition: 'The public sector shouldn't try to compete with the private' (E2). Instead, experts argued for a clear division of roles, where the private sector implements and continuously improves MaaS offerings, while the public sector focuses on oversight and long-term system coordination" (E5). To fulfil this role, public actors should apply two main levers: (1) smart regulation to ensure legal clarity and consistency (E7), and (2) strategic investment to close infrastructure gaps and enhance service value (E8).
- Regulatory perspectives: Although expert views diverged regarding the intensity of public regulation, there was consensus that regulations should be designed to enable innovation, not restrict it. Some emphasized the importance of agility and simplification in regulatory processes to keep pace with fast-evolving market dynamics (E1), while others stressed the need for robust oversight, particularly regarding mobility data governance and safety standards (E4, E9). A flexible, responsive regulatory approach was seen as essential for maintaining trust and promoting sector-wide alignment.

3.3.2. Aggregation of private mobility providers

In the discussion on the involvement of mobility operators in a cooperative MaaS model, experts identified several key factors that influence their willingness to participate. These include competition, which incentivizes collaboration to enhance service quality; economic benefits, such as expanded customer reach and promotional opportunities; and the role of public intervention, necessary to safeguard fair competition, embed sustainability principles, and ensure data governance. These factors, also visualized in Figure 3, outline the foundational drivers and challenges shaping the aggregation of mobility providers within the MaaS ecosystem.

- Competition: Collaboration among mobility operators was seen as a strategic response to competitive pressures. By working together, providers can offer more reliable services, simplified payments, and promotions that enhance the user experience 'I think there are some synergies in the ecosystem that you can only exploit if you collaborate' (E3). Participation also allows operators to expand their customer base, especially when integrated with public transportation (E3, E5, E9). The MaaS platform was compared to Amazon's marketplace, where competitors share space – suggesting that smaller, non-competing providers could be a viable starting point for ecosystem building (E5).

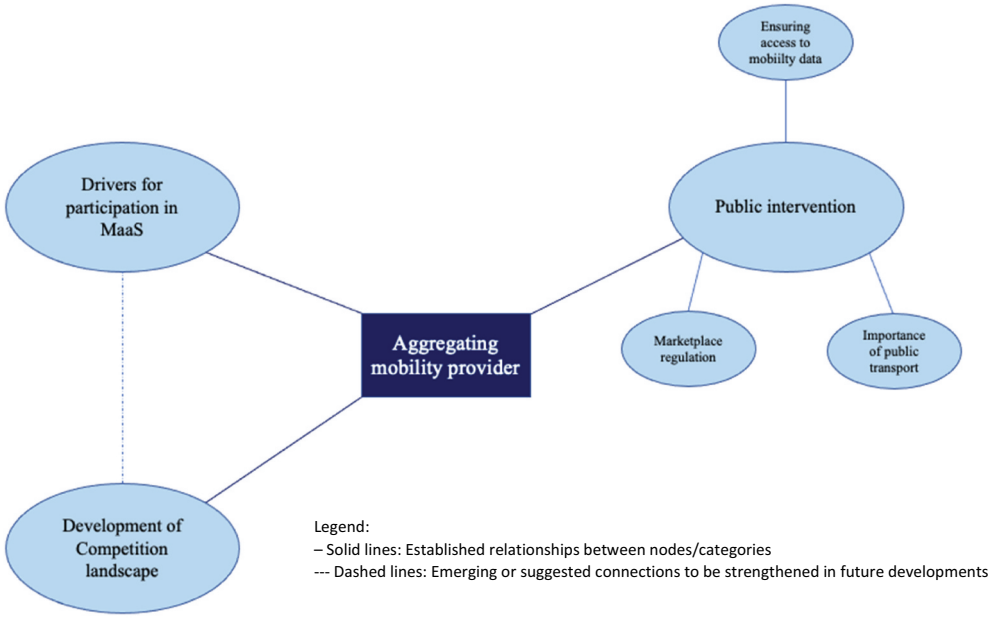

Figure 3. Aggregating private mobility providers nodes from the interviews. Source: own elaboration by authors

- Economic incentives: Promotional tools and access to broader customer segments were highlighted as major economic motivators. By joining a MaaS platform, mobility providers can increase visibility and benefit from integrated, value-added services that enhance market reach.
- Concerns over market-based platforms: Experts expressed concern that privately run MaaS platforms may mimic marketplace dynamics, with aggregators imposing additional fees that could threaten operators' viability: '. . .we might run out of money or even be unprofitable simply due to a top 5% margin. . .' (E4). These risks underline the importance of regulatory oversight to maintain fair competition and avoid market distortion.
- Public intervention: To safeguard the balance of the MaaS ecosystem, several areas were identified where public involvement is essential:
- Fair competition: Authorities may need to mandate provider participation to ensure equitable access and prevent monopolistic practices (E9).
- Sustainability integration: As environmental considerations are not typically decisive for users, public actors must ensure sustainability is embedded in the platform design (E2).
- Public transport inclusion: The success of MaaS depends on the integration of public transport operators, who hold a central role in the system (E5, E9).
- Data governance: Mobility user data was recognized as a valuable resource for optimizing infrastructure and service planning. Public control over data access is necessary to ensure its public value (E9).

Experts also stressed the strategic value of managing user mobility data, as it offers insights into travel patterns and supports infrastructure planning. Public authorities play a key role in regulating access to this data to ensure it contributes to broader mobility efficiencies (E9). In parallel, the competitive landscape of shared mobility is still evolving. While clear market leaders are expected to emerge as the sector matures (E6), the optimal model for MaaS provision remains uncertain. Ensuring fair competition and user choice, without favoring specific providers, remains a core challenge for future MaaS platforms. Figure 4 illustrates the complex interrelations between public and private sector actors identified in the expert interviews.

4. Discussion

This section evaluates the research findings in dialogue with the existing literature, following the same structure used in the results section.

4.1. Consumer perspective: drivers & barriers to adoption

The interviews confirm the main adoption drivers identified in the literature, particularly price, service reliability, and transport availability. Literature suggests that perceived price-worthiness influences willingness to pay (Sochor et al., 2018), while experts stress that reliability strongly shapes that willingness (E4). These elements are interdependent: a drop in reliability may reduce perceived value, triggering user churn. Both sources also highlight service flexibility and

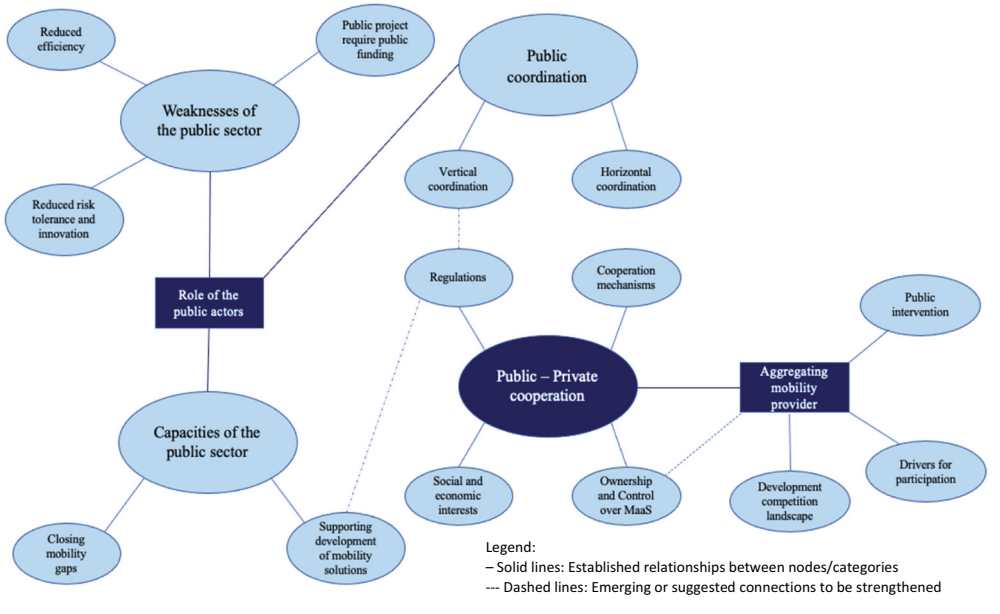

Figure 4. Maas ecosystem complexity and interconnections resulting from the interviews. Source: own elaboration by authors

convenience as critical to encouraging adoption, especially for those accustomed to private vehicle use.

Trust is also key. Literature points to trust as a precondition for sustainable adoption (Huang, 2022), and experts specify that this includes safety, data protection, and pedestrian security (E4, E6). Customer engagement features may further enhance loyalty (E3).

On the barrier side, both literature and interviews identify the failure to meet user expectations and appeal to car owners as central obstacles (Butler et al., 2021). Security concerns – physical, data-related, and operational – are also crucial (E4, E6), alongside the absence of a robust, scalable service model (E9).

These findings reinforce that consumer adoption depends not only on technological or pricing factors, but on the creation of a trustworthy, inclusive and context-adapted user experience. Moreover, they invite caution regarding overly optimistic assumptions about MaaS as a tool for shifting private car use, as real-world evidence shows mixed results (Storme et al., 2020).

4.2. Payment model

The main debate centers on which tariffs to include: PAYG or subscriptions. Most existing services offer both, a combination endorsed by literature and user research (Ho et al., 2020). Subscriptions provide convenience and appeal to frequent users, while PAYG offers flexibility for occasional or new users (E6, E9). Expert opinions reflect this diversity, noting the risks of subscription models being too rigid (E3) and their potential to alienate users who prefer customization.

Literature also supports subscriptions as a tool for promoting more sustainable mobility patterns, especially when designed to discourage unnecessary car use, as shown in the UbiGo case (Fluidtime, n.d.). Free or bundled access to modes like bike sharing can also encourage greener choices (Ho et al., 2020).

Personalization is vital: experts, literature, and practice (e.g. Whim) agree that segmenting users and tailoring packages accordingly enhances value (E9). Transparency and flexibility are also essential: giving users control over their data, spending, and subscription terms can increase trust (E6). While literature suggests growing trust in digital payments, experts recommend further research into user preferences, especially around privacy concerns.

Revenue models remain complex. Subscriptions can be profitable due to varying user intensity (E6), but this poses challenges for fairness and stability. Some propose separating customer management and logistics to reduce costs and share value more clearly (E5), though others warn this may not work for operators with tight margins (E4). Remuneration models also raise transparency concerns, particularly for smaller or unsubsidized providers (E8).

Overall, the findings reflect both the opportunity and fragility of MaaS business models. Their viability depends not only on technical efficiency or market segmentation, but also on equitable cost distribution and long-term public trust.

4.3. MaaS ecosystem

Both literature and experts underscore the central role of the public sector, especially due to its regulatory authority and its role in public transport.

First, the need for clear, harmonized regulatory standards is repeatedly emphasized. Bureaucratic obstacles and inconsistent vertical coordination hinder scalability (E7, E1, E9). Similarly, managing access to and use of mobility data is critical. Literature supports open APIs (Cerema, 2019), while experts stress the value of user data for planning and optimization (E9). However, data protection and governance must be ensured, as misuse or exclusion risks undermining trust and participation.

The debate on MaaS ownership remains open. While most current models are public-led, some literature favors private providers due to their agility and technical capabilities (Sochor et al., 2018). Experts are divided: some cite the private sector's innovation, risk-taking, and operational efficiency (E1, E9, E5), while others argue for public regulation or ownership given the societal role of transport (E4, E9, E5).

Critically, the assumption that MaaS is inherently aligned with sustainable or inclusive mobility is contested. Experts and literature caution that without strong public leadership, MaaS could reinforce inequalities – for example, by excluding those unwilling or unable to share data or access digital platforms. These risks highlight the importance of treating MaaS not simply as a market innovation, but as a tool to be shaped by public goals.

Public authorities are thus expected to play a proactive role in shaping the MaaS ecosystem. This includes investing in infrastructure and addressing mobility gaps that the private sector may overlook (E1, E9), establishing regulatory frameworks that promote equity and sustainability, and – where appropriate – requiring private operators to participate in public MaaS platforms (E4). Ultimately, their role extends beyond facilitation to acting as guardians of the public interest, ensuring that MaaS contributes meaningfully to long-term social and environmental goals.

5. Conclusion and managerial implications

In summary, findings from field research, literature analysis, and expert interviews suggest that public transport operators have had an easier time implementing MaaS concepts compared to private companies, based on existing MaaS models. However, improved access to mobility data and standardized regulatory conditions are likely to open up opportunities for startups and promote business expansion, accelerating MaaS development. It remains uncertain how the public sector will respond in the long term, especially if public transport infrastructure diversifies, potentially making it the default MaaS provider, aggregating smaller private mobility operators.

Reviewing findings across these domains reveals that sustainability, scalability, and viability [6] are critical for MaaS success. The concept must prioritize sustainability to drive the transition to sustainable mobility effectively. It should also be designed for scalability and mass adoption to ensure long-term success. Additionally, the business concept itself must be viable to gain acceptance from all stakeholders. Table 3 summarizes our proposed recommendations and best practices for public and private actors within the MaaS ecosystem, aiming to support the successful further development of

Table 3. Proposed recommendations for public and private actors in MaaS development.

Context	Dimension	Recommendations
Private sector	Sustainability	• Encourage sustainable mobility patterns by subsidizing "less appealing" options such as bike sharing and e-scooter usage to promote increased adoption.
	Scalability	• Leverage advanced technologies (e.g. Roaming services) to expand the geographic reach of MaaS and establish as a leading provider.
	Viability	• Carry out customer segmentation to identify specific user groups. • Research price sensitivity and adapt offers accordingly. • Investigate customer attitudes toward digital payment options. • Offer PAYG in addition to subscription models to lower entry barriers. • Provide "light version" access for PAYG users. • Allow monthly cancellation in subscription services. • Enhance customer retention through trust, security, and engagement features. • Ensure high security standards of transportation modes. • Consider public/private subsidy differences for fair remuneration models. • Develop a sustainable revenue model balancing attractive pricing and stable income.
Public sector	Sustainability	• Create a mobility laboratory to facilitate dialogue with the private sector and integrate societal goals into MaaS development.
	Scalability	• Streamline vertical and horizontal integration to strengthen public control and harmonize regulations. • Manage open access to non-sensitive user data and leverage it to optimize urban mobility infrastructure.
	Viability	• Rationalize bureaucratic processes to adapt regulations swiftly to market changes. • Develop open APIs to foster competition. • Manage user data access carefully to protect sensitive information and maintain customer trust.

Source: own elaboration by authors

MaaS services. These proposals are intended to assist both actors in aligning their actions and collaborating effectively to accelerate development and enhance customer value.

As shown in Table 3, the proposed recommendations reflect a differentiated yet complementary set of actions for public and private sector actors. While the private sector is expected to lead innovation and service delivery, the public sector plays a vital enabling role through regulation, infrastructure, and data governance. Together, these efforts are essential to advance the MaaS ecosystem in line with sustainability, scalability, and viability goals. By translating key insights into actionable guidance, these recommendations aim to support the implementation of MaaS and provide a foundation for future development efforts. This study has provided practical recommendations to key stakeholders involved in the development of Mobility as a Service (MaaS) and identified priority areas for targeted improvement. However, several limitations must be acknowledged.

The selection of experts allowed for a wide range of insights from the mobility sector, yet it notably lacked direct representation from public sector actors. This limited the depth of understanding regarding governance mechanisms and public-private collaboration. To partially address this, we integrated findings from the literature. However, due to the strong regional variation in local government approaches to MaaS, single interviews with public authorities would have had limited generalizability. Future research should undertake a more systematic engagement with public sector stakeholders, ideally through large-scale qualitative or mixed-method designs, to examine their perspectives on provider roles, governance, and inclusion.

Another limitation concerns the scope of analysis on mobility package composition. While this study focused on the factors influencing payment model design, it did not

explore in depth which combinations of services best respond to flexibility and personalization demands. Future work should investigate user preferences and behavioral responses to various package configurations to inform the development of modular, user-centric MaaS offerings.

A further critical issue raised during the study is the complexity of building a financially viable MaaS business model. Both literature and expert input point to the difficulty of creating revenue structures that balance profitability with provider participation and user affordability. The lack of transparency in revenue sharing and the tension between operational costs and competitive pricing remain major unresolved challenges. Further empirical research is needed to explore sustainable financial models, particularly in multi-stakeholder environments.

Finally, this study calls for more critical reflection on the foundational assumptions behind MaaS. While often presented as a pathway to sustainable mobility, empirical evidence remains limited regarding its actual impact on reducing car usage or achieving modal shift (Storme et al., 2020). In addition, issues such as digital exclusion, data privacy concerns, and the commodification of public transport raise important questions about the equity and accessibility of MaaS systems. Moreover, the environmental implications of MaaS-related digital infrastructure – particularly in terms of energy consumption and system complexity – remain underexplored. Likewise, the normative debate around whether public transport should function as a universal public good or be reframed as a marketable service within MaaS ecosystems requires further scrutiny. Future research should adopt a broader, interdisciplinary lens that includes social, ethical, and environmental dimensions, to ensure MaaS contributes meaningfully to inclusive and sustainable urban mobility.

Acknowledgments

The authors would like to acknowledge the Observatory of Electric Vehicles and Sustainable Mobility (OVEMS), Universidad Pontificia Comillas, for its support in the identification of experts.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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