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Keys to MaaS development. A qualitative approach based on the expectations of potential users

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ABSTRACT

Mobility is undergoing a major transformation, driven by the development of new technologies applied to transportation and the emergence of new, more sustainable forms of travel. One of the emerging trends that is attracting the most interest from researchers, entrepreneurs and policy makers is Mobility as a Service (MaaS). MaaS is a personalized mobility service that is adapted to the specific needs of customers, as it tries to provide the best transport solution from the perspective of the end user. Access to MaaS services by all segments of the population is essential.

The objective of this study is to explore in depth motivators and barriers in the intention to adopt MaaS by potential users, as well as to identify features that MaaS should offer according to their expectations and needs. The work focuses on the city of Malaga, where a qualitative study is carried out through semi-structured interviews. This methodological approach is valuable for capturing transport user needs, preferences and attitudes that are difficult to identify with quantitative methods.

Usefulness in travel planning has emerged as the main motivator from the point of view of potential users. While the Need to learn how to use the MaaS apps is the most important barrier to adoption. Multimodality is the main MaaS feature demanded by all age groups, although there are others that differ by age. The research results provide useful criteria for decision making by stakeholders (public administrations, policy makers, transport planners, transport operating companies, etc.), by identifying some key insights that must be considered for the successful adoption of these technologies in society.

1. INTRODUCTION

Mobility is currently undergoing a major transformation, promoted to a large extent by the

emergence of new, more sustainable forms of travel, driven by the development of new technologies applied to transportation. One of the emerging trends that is attracting the most interest from researchers, entrepreneurs and policy makers is Mobility as a Service (MaaS).

MaaS can be defined as a type of service that, through a digital platform, allows users to plan, book and pay for multiple types of mobility services. The idea is to move from a model based on vehicle ownership to a model based on services, which includes shared modes of transport (cars, motorcycles, mopeds, bicycles, electric scooters, personal mobility vehicles, etc.), as well as integration between them and with public transport (Hensher et al., 2021). This trend represents an opportunity to achieve sustainable mobility goals, such as decreasing transport emissions and traffic congestion by reducing private vehicle ownership.

Access to MaaS services by all population groups is essential. MaaS is a personalized mobility service that is oriented to the particular needs of customers, as it seeks to offer the best transport solution from the point of view of the end user (Jittrapirom et al., 2017). The published literature has highlighted the need to address MaaS research that pay more attention to the role of end users (Casady, 2020). Identifying the key factors affecting potential user acceptance and better understanding their needs is an important support to ensure the success of MaaS (Ye, Zheng & Yi, 2020).

Based on these premises, the aim of this work is to gain a deeper understanding of the motivators and barriers of the intention to adopt MaaS by potential users, as well as to explore the features that MaaS should offer according to their expectations and needs. This will allow us to identify the key elements that must be taken into account for the successful adoption of these technologies in society.

The research focuses on the city of Malaga, where a qualitative study is carried out through semi-structured interviews. Qualitative methodologies, such as interviews, are a valuable tool for capturing the needs, preferences and attitudes of transport users that are difficult to identify through quantitative approaches (Clifton & Handy, 2003). Moreover, qualitative research approaches focusing on the point of view of potential users in cities that are in the early stages of MaaS development, such as Malaga, can yield useful results for the successful implementation of MaaS.

2. CHARACTERISTICS OF MAAS: A LITERATURE REVIEW

In accordance with the literature, MaaS is based on three main elements that, together, allow users to make seamless intermodal trips (Kamargianni et al., 2016):

- Ticket & Payment integration. MaaS aggregates all mobility services available in the city and provides integrated ticketing and payment systems.
- Mobility package. MaaS offers customized multimodal solutions based on personal transport requirements and allows the user to pre-pay for a specific combination of various transport modes as one product.

- Information and Communication Technologies (ICT) integration. MaaS is provided to travelers through a single application or online interface that can be used to access information (including real-time travel information) about the modes of transport.

Subsequently, nine core characteristics of MaaS were identified (Jittrapirom et al., 2017):

- Integration of transport modes. Public transport, taxi, car sharing, ridesharing, bike sharing, car rental, on-demand bus services. It can even be extended to long distance buses and trains, flights and ferries.
- Tariff option. Two main types: "mobility package" and "pay-as-you-go".
- One platform. A digital platform (mobile app or website) to access all necessary travel services: trip planning, booking, ticketing, payment and information in real time. It can offer additional services (e.g. weather forecast).
- Multiple actors. The MaaS ecosystem is based on interactions between different groups of actors through a digital platform: mobility demanders, transport service providers and platform owners.
- Use of technologies. MaaS requires the combination of: Devices, such as smartphones; a reliable mobile internet network; GPS; e-ticketing and e-payment system; database management system and integrated infrastructure of technologies.
- Demand orientation. MaaS seeks to provide the best transportation solution from the customer's perspective.
- Registration requirement. The end user must subscribe to the platform to access the available services, which enables personalization/customization.
- Personalization. Specific recommendations and tailor-made solutions based on user profile.
- Customization. Allows to modify the service option offered according to user preferences.

A study conducted by Durand et al. (2018), concluded that an appropriate design of the MaaS app user interface is one of the features that support travel behavior change. These should include the following four features: customization to the user, information and feedback, commitment, and an appealing and simple design. However, these features alone might not be sufficient conditions to influence travel behavior. There are other value-added aspects of MaaS closely related to a high degree of mobility integration such as increased convenience, freedom of choice, etc. that can also potentially influence travel behavior.

3. METHODOLOGY

3.1 Case study: Malaga city

Malaga was selected as a case study of a medium-sized city that is in the early stages of MaaS development. Malaga is the second most populated city in Andalusia (Spain) and the sixth in Spain, covering an area of 394.98 km² and with 579,076 inhabitants (IECA, 2023).

In terms of transport systems, there are 48 city bus lines, 2 metro lines, as well as 11 metropolitan buses lines and 2 suburban rail lines that serve travelers to or from Malaga city. In recent years, various shared mobility services have been implemented (moto-sharing, bike-sharing, e-scooter sharing) (OMM, 2022). Transport operators are trying to expand their services through their own mobile apps (line consultation, real-time information on waiting time for the next bus at stops, etc.). In addition, some trip planning tools are currently available in the city (Google Maps, Moovit, CityGo, etc.). However, there is no MaaS app that integrates all modes of transportation and especially payment or e-ticketing.

3.2 Semi-structured interviews

The semi-structured interview technique was selected as the most appropriate for obtaining detailed information on the attitudes toward MaaS of potential users.

Semi-structured interviews include a set of predetermined open-ended questions as well as other possible questions that may arise from the dialogue between interviewer and interviewee. This qualitative methodological approach helps shed light on the decision-making process underlying travel behaviors, allowing for a more comprehensive examination of the mobility needs of potential users, bringing a unique breadth and depth to transportation research (Clifton & Handy, 2003).

In the context of MaaS, this methodology allows information to be collected directly from end users, providing a wealth of answers that helps researchers to understand the complexity of their problems and the extent of their constraints. In fact, this can be of great help in detecting aspects of MaaS that researchers may have overlooked or that have not been previously identified in the literature. The objective of the interview was to explore in depth the expectations and needs of potential users about MaaS services. For this purpose, a questionnaire was designed focusing on their attitudes about MaaS.

As for the procedure for conducting the interview, the participant was first introduced to the concept of MaaS and its characteristics. Next, questions on attitudes towards MaaS were asked and responses were collected. Finally, the information was completed with the participant's demographic and socioeconomic characteristics.

Participants were recruited using snowball strategy, a sampling technique widely used in qualitative research (Noy, 2008). The interviews were conducted in May 2022. A total of 46 people residing in Malaga city participated in the study. The interviews were conducted in Spanish and lasted between 20 and 30 minutes.

3.3 Data analysis

The data were analyzed following a thematic analysis to identify and interpret recurring patterns in the participants' comments (Clarke, Braun & Hayfield, 2015). To do this, the material were manually reviewed, coded, and synthesized from the common themes that

emerged from the interviews. The coding system was developed manually from the literature review. In particular, the focus of the analysis was on what are the motivators and barriers in the intention to adopt MaaS, as well as what features MaaS should offer according to the needs of the participants.

The identification of motivators and barriers for MaaS adoption revolved around statements from participants on three main questions: Do you think it would be easy for you to use MaaS applications? Why would you use them? And if you do not intend to use them, for what reasons? These results were synthesized using word cloud graphs, to visualize in a simple and effective way the most frequent themes in the statements of the participants during the interviews.

In addition, participants were asked about the features that the MaaS service should include in order for them to be able to use it for their needs. These were classified according to the published literature on the subject, which served to contrast them with those previously identified in other studies.

A comparative analysis was carried out, using age as the main criterion to represent the reality of four distinct population groups: 18-26 years old, 27-44 years old, 45-64 years old, 65 years old and over. Age is recognized as a key socio-demographic factor in assessing end-user expectations of MaaS mobile technologies (Dastjerdi et al., 2019; Lopez-Carreiro et al., 2020; Caiati, Rasouli & Timmermans, 2020).

4. RESULTS AND DISCUSSION

4.1 Motivators and barriers to MaaS adoption intention by potential users

The following word cloud figures show the motivators (Figure 1) and barriers (Figure 2) detected in the statements of the participants, highlighting by their size those themes of greater importance according to the frequency of repetition.

Fig. 1 – Motivators to MaaS adoption intention by potential users

Usefulness in travel planning is observed as the main motivating factor, a fact that is consistent with findings from literature, which emphasize that the existence of a centralized platform that integrates all mobility services (including functions such as trip planning, booking and real-time information) is a main element of MaaS (Kamargianni et al., 2016).

Going deeper and comparing by age group, we find differences in the patterns of motivating factors that are worth highlighting. Thus, participants aged between 18 and 26 highlighted as the main motivators for using MaaS apps their already high ease of use of new technologies and their familiarity with other travel apps: "*Travel planning apps are common to me and I am familiar with them, so it would be intuitive for me to use MaaS*". They also alluded to the usefulness of these apps in travel planning and in saving time and travel costs. Participants between the ages of 27 and 44 focused more on the usefulness in travel planning: "*Makes day-to-day life easier*" or "*Helps you move faster around the city*". Some participants also mentioned ease of use of new technologies and saving time in travel. Participants between 45 and 64 years of age highlighted as the main motivating factor that the app interface was simple: "*Being easy to use ensures success in its use*". They also mentioned the usefulness in travel planning. Finally, older participants (65 years and over), only considered using these apps if it really implied a significant improvement in their trips (planning and execution).

Fig. 2 – Barriers to MaaS adoption intention by potential users

In terms of barriers, the Need to learn how to use the MaaS app stands out as the most frequently mentioned. This finding is in line with previous studies that identified the effort required for people to learn to use the new service as a deterrent MaaS use, relating it to habits as a barrier MaaS (Karlsson et al., 2020).

Analyzing by age group, participants between 18 and 26 years of age noted the existence and use of other similar travel planning apps as the main barrier: "*Google Maps is very easy and I am happy with it*" or "*Google Maps gives me what I need*". They also alluded to some inconveniences related to the smartphone battery and memory consumption by MaaS apps: "T*hese apps tend to waste a lot of battery and storage*". One participant pointed out that his car is more useful to him, which may be explained by the fact that current unimodal car users are the least likely to adopt MaaS (Alonso-González et al., 2020). Interviewees between 27 and 44 years of age, stated ignorance as an obstacle to adopting MaaS apps: "*I ignore these apps. If I knew about them and they interested me, I could use them"*. To overcome this barrier, it would be interesting to develop marketing campaigns aimed at raising awareness of the new MaaS app, as it has been shown that MaaS promotion actions have a positive impact on potential adopters of these systems (Hensher et al., 2021). Participants between

45 and 64 years of age, cited the need to learn how to use the MaaS apps as the most important barrier to adoption: "*It would take some getting used to, as I would have to learn how to use it*". They also mentioned the difficulty of using new technologies or that they do not like this kind of apps: "*I only use my mobile phone to contact people*". Low technology adoption had already been detected in the literature as one of the main barriers that can block the adoption of MaaS (Alonso-González et al., 2020). In addition, insecurity or fear of contagion when using public transportation was also expressed. Finally, participants over 65 years of age remarked ignorance or the unattractiveness of MaaS apps for them since they do not need them for their travels: "I*n my case it is not necessary to use it*". Lack of attractiveness had already been detected in another study as an obstacle to MaaS demand by older generations (Butler, Yigitcanlar & Paz, 2021).

4.3 MaaS features demanded by potential users

This subsection presents the results on the features that MaaS should offer according to the needs of potential users, distinguishing them by age group.

Participants between 18 and 26 years old especially required more functionalities related to real-time information offered by the MaaS app, specifically, about travel mode, travel time, public transport waiting time, travel route, travel cost and traffic conditions. This is the group that demanded a greater variety of services in relation to real-time information. Requirements such as good app performance or no battery consumption in the background are also noteworthy. The affinity of this age group with new technologies (Dastjerdi et al., 2019), would explain their concern for the good performance of the MaaS app. They also mentioned multimodality and integrated ticketing as demanded features of MaaS.

Respondents between 27 and 44 years old, in addition to multimodality and real-time information on travel modes, required information on greener travel options. Another requirement was parking availability at the destination in real time, which is consistent with a previous study that also identified this mainly in these ages (Lopez-Carreiro et al., 2020). The literature has shown that willingness to use MaaS is strongly correlated with age and life cycle stage (Vij et al., 2020). The demand for the parking availability service can be explained by the greater use of the car at this stage of life due to the presence of minor children at home. People with children at home have more complex commuting patterns than those without (Caiati, Rasouli & Timmermans, 2020). Specifically, households with two or more children are significantly less likely to subscribe to MaaS than households with up to one child, as car use increases with the number of children in the household (Ho et al., 2018). Finally, there were also those who demanded non-mobility-related information services, such as nearby restaurant suggestions.

Participants between 45 and 64 years old, also referred to multimodality and real-time information on travel mode and travel time. However, they also emphasized that they need the platform to have a user-friendly interface, a feature that was not required in either of the

two previous groups. This can be interpreted because, in general terms, the older the age, the lower the digital skills of the population. Finally, they demanded personalization (flexible schedules adapted to the user's needs) and real-time information on nearby gas stations with the lowest updated prices. This last requirement was also identified in a previous study as a new service (Lopez-Carreiro et al., 2020), however our findings add the display of updated prices of nearby gas stations in the MaaS app. This feature denotes car usage by this population segment as well as the current concern about high fuel prices.

The group over 65 years of age did not propose any characteristics because they stated that they did not need to use this type of applications for their trips. It is common to find in the scientific literature the lower intention to adopt MaaS among the older generations (Butler, Yigitcanlar & Paz, 2021).

Finally, it should be noted that multimodality is the requested feature common to all age groups (except for those over 65 years of age, who did not propose any feature). This requirement is one of the main characteristics of MaaS, whose objective is to optimize the transport network, taking advantage of the benefits of each service, and thus maximize its use by travelers (Jittrapirom et al., 2017).

5. CONCLUSIONS

For MaaS ecosystems to spread worldwide, transportation must adopt a new customer-oriented approach (Casady, 2020). This study has explored in depth the motivators and barriers in the intention to adopt MaaS by potential users, and has identified the features that MaaS should offer according to their expectations and needs. Our findings provide some key insights for developing MaaS systems that are successfully adopted by society.

Usefulness in travel planning has emerged as the main motivator from the point of view of potential users, being mentioned in all age groups. While the Need to learn how to use the MaaS apps is the most important barrier to adoption, especially after the age of 45. To overcome this obstacle, it is essential to provide training aimed at developing the digital skills of the population over 45 years old (and not just focused on the older generations, as usual). And particularly in the MaaS context, it would be interesting to develop marketing campaigns aimed at raising awareness of the new app, using various tools such as promotional material, informative workshops, videos demonstrating how it works, etc.

Multimodality is the main MaaS feature demanded by all age groups. It is therefore key, in order to ensure the acceptance of these systems, to determine how to integrate the different transport operators and offer their services as a single product. In this sense, and to facilitate the use of the MaaS app, public-private collaboration mechanisms should be established to integrate all modes of transport as well as payment (or e-ticketing) in existing platforms already in common use by the population (such as Google maps or similar), thus avoiding the duplication of MaaS apps.

We have observed that some of the MaaS features requested by potential users differ considerably by age group. In particular, to attract young users, MaaS should offer a wide variety of accurate real-time information (travel mode, travel time, public transport waiting time, travel route, travel cost, traffic conditions, incidences, etc.) and integrated ticketing. While to attract older users it is essential to ensure that the platform has an intuitive and visual interface design that facilitates the use of the MaaS app.

In addition, complementary services could be included to attract car users and also families with minor children (characterized by a higher car use at this stage of life), such as real-time information on parking availability at the destination or nearby gas stations with updated prices, offering them transportation alternatives and comparative information on time and costs to encourage them to replace the car or use it in combination with other more sustainable transport modes.

To attract potential users from other market segments, it could also be of interest to include non-mobility-related information services, such as recommendations of nearby restaurants, hotels or leisure establishments, and agreements can be established with them to obtain discounts for MaaS users.

The main limitation of this study is the impossibility of generalizing the results obtained due to the qualitative approach. However, it has allowed us to identify relevant variables that could be validated through surveys as future lines of research.

The results provide useful criteria for decision making by stakeholders (public administrations, policy makers, transport planners, transport operators, etc.) to establish MaaS systems adapted to the needs of users, ensuring the successful implementation of these systems and thus promoting equity and sustainability of mobility.

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REFERENCIAS

ALONSO-GONZÁLEZ, M.J., HOOGENDOORN-LANSER, S., VAN OORT, N., CATS, O. & HOOGENDOORN, S. (2020). Drivers and barriers in adopting Mobility as a Service (MaaS) – A latent class cluster analysis of attitudes. *Transportation Research Part A: Policy and Practice*, 132 (2020), pp. 378-401.

BUTLER, L., YIGITCANLAR, T. & PAZ, A. (2021). Barriers and risks of Mobility-as-a-Service (MaaS) adoption in cities: A systematic review of the literature. *Cities*, 109 (2021), pp. 103036.

CAIATI, V., RASOULI, S. & TIMMERMANS, H. (2020). Bundling, pricing schemes and extra features preferences for mobility as a service: Sequential portfolio choice experiment. *Transportation Research Part A: Policy and Practice*, 131 (2020), pp. 123-148.

CASADY, C.B. (2020). Customer-led mobility: A research agenda for Mobility-as-a-

Service (MaaS) enablement. *Case Studies on Transport Policy*, 8 (2020), pp. 1451-1457.
CLARKE, V., BRAUN, V. & HAYFIELD, N. (2015). Thematic analysis. In: J.A. SMITH (ed.), *Qualitative psychology: A practical guide to research methods*. 3rd edition. SAGE Publications Ltd, pp. 222-248.
CLIFTON, K.J. & HANDY, S.L. (2003). Qualitative Methods in Travel Behaviour Research. In *Transport Survey Quality and Innovation*. Emerald Group Publishing Limited, pp. 283-302.
DASTJERDI, A.M., KAPLAN, S., DE ABREU E SILVA, J., NIELSEN, O.A. & CAMARA PEREIRA, F. (2019). Participating in environmental loyalty program with a real-time multimodal travel app: User needs, environmental and privacy motivators. *Transportation Research Part D: Transport and Environment*, 67 (2019), pp. 223-243.
DURAND, A., HARMS, L., HOOGENDOORN-LANSER, S. & ZIJLSTRA, T. (2018). *Mobility-as-a-Service and changes in travel preferences and travel behaviour: a literature review*. KiM Netherlands Institute for Transport Policy Analysis.
HENSHER, D.A., HO, C.Q., RECK, D.J. & SMITH, G. (2021). *The Sydney mobility as a service (MaaS) trial: Design, implementation, lessons and the future*. Australian Government.
HO, C.Q., HENSHER, D.A., MULLEY, C. & WONG, Y.Z. (2018). Potential uptake and willingness-to-pay for Mobility as a Service (MaaS): A stated choice study. *Transportation Research Part A: Policy and Practice*, 117 (2018), pp. 302-318.
IECA (2023). *Andalucía pueblo a pueblo - Fichas Municipales. Málaga* [online]. Sevilla: Instituto de Estadística y Cartografía de Andalucía. Available in: https://www.juntadeandalucia.es/institutodeestadisticaycartografia/sima/ficha.htm?mun=29067.
JITTRAPIROM, P., CAIATI, V., FENERI, A.M., EBRAHIMIGHAREHBAGHI, S., ALONSO-GONZÁLEZ, M.J. & NARAYAN, J. (2017). Mobility as a service: A critical review of definitions, assessments of schemes, and key challenges. *Urban Planning*, 2 (2), pp. 13-25.
KAMARGIANNI, M., LI, W., MATYAS, M. & SCHÄFER, A. (2016). A Critical Review of New Mobility Services for Urban Transport. *Transportation Research Procedia*, 14 (2016), pp. 3294-3303.
KARLSSON, I.C.M., MUKHTAR-LANDGREN, D., SMITH, G., KOGLIN, T., KRONSELL, A., LUND, E., SARASINI, S. & SOCHOR, J. (2020). Development and implementation of Mobility-as-a-Service – A qualitative study of barriers and enabling factors. *Transportation Research Part A: Policy and Practice*, 131 (2020), pp. 283-295.
LOPEZ-CARREIRO, I., MONZON, A., LOPEZ, E. & LOPEZ-LAMBAS, M.E. (2020). Urban mobility in the digital era: An exploration of travellers' expectations of MaaS mobile-technologies. *Technology in Society*, 63 (2020), pp. 101392.
NOY, C. (2008). Sampling knowledge: The hermeneutics of snowball sampling in qualitative research. *International Journal of Social Research Methodology*, 11 (4), pp. 327-344.
OMM (2022). *Observatorio de la Movilidad Metropolitana. Informe OMM 2020 - Avance 2021*. Madrid, Spain: TRANSyT, Ministerio de Transportes, Movilidad y Agenda Urbana.
VIJ, A., RYAN, S., SAMPSON, S. & HARRIS, S. (2020). Consumer preferences for Mobility-as-a-Service (MaaS) in Australia. *Transportation Research Part C: Emerging Technologies*, 117 (2020), pp. 102699.
YE, J., ZHENG, J. & YI, F. (2020). A study on users' willingness to accept mobility as a service based on UTAUT model. *Technological Forecasting and Social Change*, 157 (2020), pp. 120066.