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Should MaaS bundles include home delivery services?

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Abstract

Mobility as a Service MaaS platforms aim to offer convenient, flexible, and sustainable transportation solutions, yet their widespread adoption has been sluggish, raising concerns about their future viability. Proposed solutions include reorienting MaaS as a service tool for non-car users and evolving it into Mobility as a Feature MaaF. Notably, including home delivery services in MaaS or MaaF bundles has received limited attention despite their rising demand. This study investigates the appeal of broadening MaaF bundles to include home delivery services through a survey conducted in Lisbon. Employing the "Buy-a-feature" prioritization model, coupled with exploratory analysis and generalized linear modeling, the study examines respondents' preferences and psychological factors influencing their allocation of transportation budget to home delivery services. Results indicate significant interest in home delivery services among respondents, particularly among employees, women, individuals with higher transportation costs, and those perceiving insecurity or harassment risks. Surprisingly, teleworkers and individuals experiencing psychophysical strain show lower inclinations towards it. Future research suggestions include incorporating spatial variables and employing structural equation modeling to understand allocation patterns better.

Keywords: Mobility as a service, Mobility as a feature, MaaS, MaaF, MaaS bundles, Home delivery services

1. Introduction

MaaS Mobility-as-a-Service platforms aspire to deliver users convenient, flexible, and sustainable mobility solutions. However, the transition from pilot projects to widespread implementation of MaaS has been sluggish, raising concerns about its future, including market-related issues Lopes et al., 2023. Various proposals have emerged to address this challenge. Orozco-Fontalvo & Moura (2023) advocate shifting focus from merely attracting car users to MaaS, suggesting it as a tool to cater to non-car users, deterring them from transitioning to cars.

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Hensher & Heitanen (2022) propose a market-driven evolution from MaaS to MaaF Mobility-as-a-Feature, advocating for bundles comprising not only mobility services but also including features such as insurance, aiming for holistic financial sustainability.Following the "as-a-feature" trend, a feature that has been relatively overlooked is home delivery services, which, by being integrated into mobility bundles, would replace trips for purchasing food, groceries, or retail items. These services have witnessed a surge in demand, particularly during the COVID-19 pandemic, as people prioritized social distancing (Apouey et al., 2020). Moreover, their growth trajectory has been evident for over a decade, paralleling the rise of the gig economy (Oviedo-Trespalacios et al., 2022; Useche et al., 2024). Incorporating these services into MaaS or MaaF bundles holds significant potential to enhance the value proposition for users and attract interest from major corporations. We hypothesize that given the rise of telework, congestion, availability, and convenience of these services, people would be willing to prioritize its inclusion in their bundle over other mobility services. Our research question is the following: Q1: Should home delivery services be included in MaaS bundles? Q1.2: Are potential users interested? If so: Q1.2: Who would be interested in it?

This study aims to assess the attractiveness of broadening the range of services offered in a MaaF bundle, including home delivery services such as food, groceries, and retail shopping. To achieve this objective, we surveyed Lisbon, utilizing the "Buy-a-feature" prioritization framework (Cuofano, 2024). Subsequently, we conducted an exploratory analysis of the results and estimated a generalized linear model to identify the factors that explain the allocation of these services.

We chose Lisbon as a case study because it already fully integrates most transportation modes under a monthly subscription that provides unlimited trips, putting the city ahead of many cities in creating a complete MaaS system. At the same time, several platforms offer food and grocery deliveries, as well as plenty of online shopping sites, similar to most European capitals. Following this introduction, Section 2 outlines the methodology. Section 3 presents the results, which are then discussed in Section 4. Finally, we conclude the paper with a summary of our findings and suggestions for future research.

2. Methodology

2.1. Survey

We designed a survey and applied it in Lisbon during December 2023, inquiring about travel patterns, sociodemographics, and a section based on the Buy-a-feature prioritization model, which allows users to "buy" or allocate virtual budget or credit points to different features or services they consider important, this design thinking technique is a collaborative decision-making tool widely used for product development or enhancement based on stakeholders preferences or constraints, as it allows for prioritizing, focusing or identifying the most relevant features of a product/service (Cuofano, 2024).

Table 1. Mobility services presented

FEATURES OFFERED
Public transport
Car sharing
Shared scooters
Shared bikes
Ridehailing
Taxis
Shared mopeds
Motorcycle taxis

Retail shipping

Food and grocery delivery

For our case, we first asked respondents to state their weekly transportation costs including parking and tolls, if applicable. Then we asked the question: “How would you allocate your transportation budget percentage-wise among the following services?” respondents used sliders to distribute their budget among ten mobility services Table 1 to create their ideal transport bundle. The list was a mix of traditional taxis or public transport and relatively new shared mobility transport modes, plus the inclusion of home delivery services food and parcel delivery. To avoid bias in the allocation process, the services were presented in a random order to each respondent . We also included the Multimodal Commuting Stress Scale (Useche et al., 2023) to evaluate whether psychological factors related to stress during commuting influenced budget allocation to home delivery services.

Figure 1. Example of respondents’ allocation to form the ideal transport bundle

For the data collection, we used an online form hosted in Limesurvey and applied it in face-to-face interviews, collecting more than 1,200 responses. However, we obtained a final sample of 806 responses after the responses' validation process. Table 2 presents the summary of the main sociodemographic characteristics of our sample.

Table 2. Sample characteristics

Variable	Categories	Sample distribution	Population distribution
Gender	Men	41%	48%
	Women	58%	52%

Age	Non-binary	1%	11%
	18-24	32%	42%
	25-54	59%	13%
	55-65	7%	21%
	65+	2%	55%
Occupation	Employee	61%	22%
	Undergrad student	25%	-
	Freelancer	4,50%	-
	Business owner	4,50%	-
	Other	5%	12%
Income	Less than €900	5.98%	17%
	€901-€1500	19.55%	30%
	€1501-€2500	33.50%	30%
	€2501-€4000	26.28%	11%
	€4001-€7000	11.46%	-
	More than €7000	1.25%	
	Other	1.99%	

2.2. Modeling approach

To investigate the integration of home delivery services into MaaS bundles, we employed a Generalized Linear Model GLM with a Quasi-Poisson distribution to estimate the factors influencing the budget allocation to these services. This method was selected because it extends the traditional linear regression, accommodating various response variables with non-normal distribution and relaxing the assumptions and restrictions of multivariate linear regression. This flexibility makes it useful for modeling real-world phenomena such as consumer behavior, as was our case with the home delivery variable within the MaaS framework.

GLMs consist of three main components (Washington et al., 2020). First, the random component defines the probability distribution of the response variable Y, which, in this case, is the normalized sum of the percentages allocated to food, groceries, and parcel deliveries. The dependent variable follows a Quasi-Poisson distribution to account for overdispersion $Var Y = \phi\mu$, where ϕ is the dispersion parameter. Second, the systematic component represents the linear predictor η, a linear combination of the explanatory variables that can be expressed as shown in Equation 1.

$$\eta = X\beta, \tag{1}$$

where X is the matrix of explanatory variables, and β is the vector of coefficients. The explanatory variables include sociodemographic, psychological, and travel patterns variables. All variables were treated as dummies except for "Age", Insecurity score, psychological strain score and the weekly transportation cost. Third, the link function connects the mean of the response variable μ= EY to the linear predictor η. We used the log link for the Quasi-Poisson distribution η= logμ. The general form of a GLM is given by Equation 2.

$$g(\mu) = \eta = X\beta, \text{ where } g. \text{ is the link function.} \tag{2}$$

The model estimation was performed using the glm function in the base R package. Variables included in the model and their description are presented in Table 3.

Table 3. Variable description

Variable	Type	Description
Employee	Dummy	If the respondent was an employee
Female	Dummy	If the respondent was a female
F2insecure	Continuous	Mean Insecurity perception score
F4Psytrain	Continuous	Mean Psychological strain perception score
Transcost	Continuous	Weekly transportation costs
Telework	Dummy	If respondent teleworked
Childrendum	Dummy	If there were children in the household
Age	Continuous	Age of the respondent
Car ownership	Dummy	If the respondent owned a car

3. Results

Our results show that 82% of respondents allocated a percentage of their transport budget to food or grocery deliveries and 80% to free retail shipping, which shows that the idea is at least interesting for most respondents. Moreover, Figure 2 shows the results of the average allocation. Notably, parcel and food delivery ranked third and fourth with approximately 13% each, meaning that if we aggregate them as "Home Delivery Services," they would become the most allocated service with a mean of 24.7% and a standard deviation of 18.8% For the *model estimation, we added the allocation given to retail shipping and food delivery to create a variable called "Home delivery."

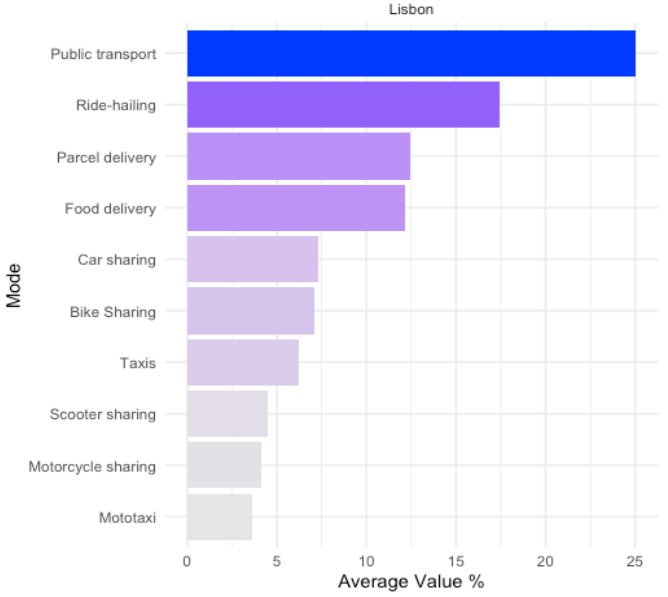

Figure 2. Average allocation % per service

Regarding the model results in Table 4, all the variables included were significant although some results were unexpected. The model indicates that employed respondents, women, those with higher weekly transportation costs,

* *Note: min = 0%, Q1=10%, Q2=20%, Q3%=35%, max=100%, we consider the maximum value obtained to be an outlier, as allocating all the transportation budget to these services is not sensible, still, we decided to keep it because it is still doable.*

and those living with children are more likely to allocate the transport budget to home delivery services. Considering the stress variables, those who feel more insecure or have a perceived risk of harassment "F2Insecure" are also more likely to include delivery services in their bundle. Car owners are also interested in these services, which the lack of parking spaces in Lisbon could explain.

On the counter-intuitive side of the results, we found that teleworkers are less likely to include the service. One explanation could be that spending most of the day at home leads individuals to prefer activities such as shopping, dining out, and grocery shopping. This behavior was observed during the pandemic when restrictions severely limited the ability to go out, as Hook et al. (2023) explained.

Table 4. Model results

Variables	Estimate	Std. Error	T value	Sig
Intercept	3.1123550	0.1324245	23.503	***
Emplodum	0.1327738	0.0599642	2.214	*
GendFem	0.0998244	0.0544980	1.832	.
F2insecure	0.1307935	0.0513939	2.545	*
F4Psytrain	-0.1556937	0.0431199	-3.611	***
Transcost	0.0016734	0.0006936	2.413	*
Telework	-0.2006601	0.1286830	-1.859	.
Childrendum	0.1556711	0.0595782	2.613	**
Age	-0.0047886	0.0022044	-2.172	*
Carown	0.1371475	0.0661212	2.074	*

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Another interesting result was regarding the psychophysical strain factor, which refers specifically to the emotional stress while commuting e.g., anxiety, frustration, and helplessness. This factor was also negative, meaning the respondents would be less prone to include "Home delivery services" in the MaaS or MaaF bundles. This may be related to the uncertainty of the deliveries and unexpected delays, making people with a higher level of anxiety or stress concerning their mobility patterns prefer to allocate their budget to other services. In the case of Lisbon, food delivery is often delayed, and the delivery time windows for retail shipping and grocery deliveries are usually within twelve hours (Vianna, 2024).

Variables such as income and transportation mode were tested but were not significant, indicating that latent variables may better explain the distribution of the transportation budget regarding this service. Including these types of services into MaaS or MaaF needs to be carefully reviewed, and wider integration for insight through agreements with supermarkets or retailers must be explored to guarantee the financial suitability of the system. On the other hand, it is worth mentioning that the food and grocery delivery services have been criticized because of the working conditions of their delivery riders (Useche et al., 2024). Hence, regulation is key for seamless integration and to avoid future issues that could affect the system.

4. Discussion

Building upon the previous discussion of results in Table 4, we add that teleworking emerges as a notable predictor. Although surprising, this observation aligns with previous research indicating that teleworkers, enjoying the convenience of working from home, may perceive less necessity for home deliveries. For example, Khaddar and Fatmi (2024) found that working from home in the post-pandemic era revealed a negative relationship with online food

ordering. Conversely, the presence of children in households presents a positive association with increased utilization of home deliveries, corroborating studies highlighting the convenience of such services for busy parents (Van Droogenbroeck & Van Hove, 2017)

Psychological strain, evidenced by stress or anxiety, surfaces as another influential factor, negatively affecting engagement with home delivery services. For instance, Krauß et al. (2023) found that individuals experiencing psychological strain may exhibit a decreased inclination toward adopting MaaS bundles. However, being employed emerges as a positive predictor, potentially attributable to time constraints associated with employment and the consequent desire for convenience, especially when households also have children (Spurlock et al., 2020). On the other hand, respondents with a higher fear of crime during their commute are more keen on using home delivery services, as the sense of insecurity directly impacts their travel patterns (Soto et al., 2022).

Gender also plays a role, with females exhibiting a greater propensity for online shopping and utilizing home delivery services, possibly driven by factors such as convenience and a greater willingness to adopt new technologies (Faqih, 2016). Lastly, higher transportation costs, while positively impacting the propensity to adopt home delivery services, may not be the primary driver of this adoption i.e., much less impact on the propensity to allocate household budget to home delivery services. Such increases potentially prompt individuals to opt for such services as a cost-saving measure, particularly for bulk or heavy items (Spurlock et al., 2020; Visser et al., 2014).

5. Conclusions

This research explored the possibility of widening the services offered in a MaaS bundle by considering integrating home delivery services. Our results show a high interest in these services, which, despite not being considered in previous studies as mobility services, play a crucial role in the current urban mobility dynamics. Hence, our results suggest offering them as a part of the mobility package options, ensuring a more holistic approach regarding today's mobility needs. Moreover, our results support the idea that MaaS needs further integration with non-personal mobility services as it evolves into a MaaF to attract more users and fulfill its expected potential. However, these results may vary in different contexts, making it necessary to conduct similar studies in other cities with different sociocultural and transportation network characteristics. Using indicators and factor analysis to define latent variables is highly suggested for future research. Also, including spatial variables in the model could prove helpful in explaining the allocation results better.

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