

# 1 PEOPLE'S CURRENT MOBILITY COSTS AND WILLINGNESS TO PAY 2 FOR MOBILITY AS A SERVICE OFFERINGS

3 **Keywords:** Mobility as a Service; MaaS; Willingness to pay; Mobility costs; User perspective

## 4 **ABSTRACT**

5 Mobility as a Service (MaaS) is a concept that is based on the idea of providing customers with  
6 comprehensive mobility services by seamlessly combining various modes of transport. The  
7 scientific research on this theme has increased considerably over the last few years, but very  
8 little research has so far been conducted on people's willingness to pay for new MaaS services.  
9 This study presents the results of a survey (representative sample size 6,000, number of re-  
10 spondents 1,176, response rate 19.6%) conducted in Finland regarding people's willingness to  
11 pay for MaaS offerings. The study also estimates the current mobility costs of the respondents  
12 and relates their willingness to pay for MaaS to their mobility costs. Analysis includes also a  
13 linear regression model of willingness to pay for MaaS. As a result of the study, it was found  
14 that 43% of the respondents would be willing to adopt a mobility package, assuming it could  
15 cover all mobility needs of the respondent. For such a mobility package, the respondents were  
16 willing to pay approximately €140 on average, while their relative willingness to pay was an  
17 average of approximately 64% of their current mobility costs. However, it should be noted that  
18 due the limitations of the study, the results are mostly indicative and further research is called  
19 for to grasp the multifaceted qualitative elements related to willingness to pay for MaaS. This  
20 study shows some significant variation between user groups in the respondents' willingness to  
21 pay relative to their estimated mobility costs, as well as their absolute willingness to pay. The  
22 variation maybe due to the fact that MaaS is still largely unknown as a concept and the chal-  
23 lenge that the mobility package which fulfils individual needs differs from person to person.  
24 According to the results, MaaS should lower the mobility costs for users in order to be finan-  
25 cially attractive.

## 26 **1. INTRODUCTION AND LITERATURE REVIEW**

27 Mobility as a Service (MaaS) aims to fulfil individual's mobility needs in a sustainable way by  
28 combining different transport services to seamless trips (Utriainen & Pöllänen 2018). The idea  
29 is that the user does not need to own a car or a bike to be able to fulfil daily mobility needs. In

30 this model, trips can be prepaid (e.g. a monthly basis mobility packages including wanted ser-  
31 vices) or trips can be paid singly (pay-as-you-go) (Kamargianni et al. 2016). Planning of trips  
32 and the payment is made by using digital platform (Ho et al. 2018). For the users, a single  
33 application, which enables the payment and integration of multiple transport modes, is a benefit  
34 compared to the current system, in which individuals are responsible for integration of different  
35 transport modes with several ticket systems. The role of a MaaS operator is crucial as the op-  
36 erator integrates different transport services, such as bike-sharing, car-sharing and taxis, which  
37 enables the whole concept to be realized. (MaaS Alliance 2019)

38 Generally, willingness to pay can be defined as a maximum price a consumer is ready to pay  
39 for a certain product or service (Gall-Ely 2009). Willingness to pay for MaaS in this study  
40 refers to the amount of money people would be ready to pay for a mobility package that could  
41 cover all their mobility needs. Since the mobility needs as well as mobility packages that could  
42 cover all mobility need of an individual differ heavily from each other, there is considerable  
43 variation regarding the issue what to pay for. As Matyas & Kamargianni (2018) point out, a  
44 MaaS offering is a bundled product for which the consumer pays a special price, but the ele-  
45 ments of MaaS offerings are not yet solidified. This is a challenge for MaaS studies as the  
46 different offerings might be difficult to apprehend by the respondents.

47 There are a few previous studies on people's willingness to pay for MaaS. Ho et al. (2018)  
48 studied willingness to pay for MaaS in Australia by interviewing 252 people and concluded  
49 that 47% of respondents would subscribe MaaS as pay-as-you-go or as a monthly mobility  
50 package. For instance, respondents would be willing to pay 5.9 Australian dollars on a day  
51 ticket of public transport and 7.3 dollars on a car-sharing trip. 231 dollars was the average  
52 amount people would be willing to pay on a MaaS package with two car rental days, 15 hours  
53 of car-sharing (with 30 min advance booking time), 6 public transport days and discounts to  
54 taxi and ridesharing. This Australian study depicts the diversity, which is related to MaaS stud-  
55 ies as MaaS can be e.g. a pay-as-you-go solution or a monthly mobility package, and it can  
56 include versatile mobility services. The study by Ho et al. (2018) provides knowledge on peo-  
57 ple's willingness to pay for a defined MaaS offering, though the sample size is rather small and  
58 not representative. Ratilainen (2017) used stated preference method to study, how much survey  
59 respondents (n=252) would be willing to pay on different mobility services and MaaS packages  
60 in Helsinki metropolitan area, Finland. 49% of the respondents would be willing to choose at  
61 least one of the predetermined MaaS packages. Of the four predetermined packages, the pack-  
62 age with unlimited public transport, 6 bike-sharing trips, 3 taxi trips (10 km per trip) and 30  
63 min advance booking time with a price of €120 was the most popular. The results of  
64 Ratilainen's (2017) study are similar to the results by Ho et al. (2018) in terms of share of  
65 people interested in MaaS offering adoption, but instead of asking for the willingness to pay in  
66 terms of amount of money, Ratilainen (2017) asked of people's interest to adopt certain pack-  
67 ages with predefined prices.

68 Finnish company Solita carried out an internet panel survey with 1,125 adult respondents in  
69 2017. One part of the survey was related to MaaS. Based on the results over half of respondents

70 under 30 years of age were willing to give up car ownership if mobility services would be  
71 adequate. The willingness to pay for a monthly package covering all the mobility needs was  
72 relatively low as the respondents were willing to pay less than 150 euros a month on the aver-  
73 age, although 10% of the respondents were willing to pay more than 400 euros. (Solita 2017)  
74 Even though Solita's study had a large number of respondents, the survey was done with an  
75 internet panel without a representative sample of population which would have increased the  
76 reliability of the study.

77 Even though people would not be eminently willing to subscribe to mobility services, high  
78 costs of private cars, congestion and parking problems may direct car drivers to utilize MaaS.  
79 Kamargianni et al. (2018) examined Londoners' attitudes towards car-ownership and MaaS  
80 with 1,227 respondents in Greater London, UK, and found that the monthly costs of vehicle  
81 ownership is £233.5 excluding maintenance costs. More than half of the respondents consid-  
82 ered the cost as a notable expenditure. The results showed that 43% of the respondents would  
83 be motivated to subscribe to MaaS offering if it gave them financial benefits. Vij et al. (2018)  
84 surveyed 3,985 Australians nationwide to understand consumer demand and willingness to pay  
85 for MaaS in Australia. Based on the results, 32% of the respondents would adopt a MaaS ap-  
86 plication that includes pay-as-you-go access to public transport and taxi-services for a monthly  
87 cost of \$5 and 18 % of the respondents would adopt a MaaS package that offer unlimited access  
88 to local public transport and taxi services for a monthly cost of \$500. Vij et al. (2018) as well  
89 as Ratilainen (2017) focused in certain MaaS offerings with predefined prices, and therefore  
90 these studies do not reveal how much people would be willing to pay for a MaaS solution  
91 fulfilling all their mobility needs.

92 As one determinant for adopting MaaS is the financial advantage MaaS could offer to the in-  
93 dividual or household, the willingness to pay for MaaS should be considered in relation to  
94 current mobility costs. Mobility costs refer to the amount of money people use on mobility as  
95 a whole (including e.g. capital, maintenance and operating costs for vehicles one own and tick-  
96 ets for mobility services) in a certain time frame, e.g. a month. Previous studies on willingness  
97 to pay for MaaS have not considered people's current expenditure on mobility services and  
98 related to expenditure with willingness to pay.

99 Studies on the final consumption expenditure of households are conducted at regular intervals  
100 in Finland. According to the study on the final consumption expenditure of households con-  
101 ducted in 2016, Finns spent an average of €321 on transport per one consumption unit, within  
102 the meaning of the OECD-modified scale (the first adult member of the household equals one  
103 consumption unit, while other individuals in the household above the age of 14 equal 0.5 con-  
104 sumption units and individuals younger than 14 equal 0.3). In Finland, the monthly expenditure  
105 on transport per one adult aged 18 to 64 was €364 in 2016 in single-person households under  
106 the age of 65, childless couples under the age of 65, single-parent households and two-parent  
107 households. For these households, the expenditure on transport in Finland per consumption  
108 unit was also €364 per month in 2016. In statistics on consumption, transport costs include all  
109 money spent on transport, such as the procurement and servicing of modes of transport, fuel,

110 use of public transport as well as independent travel in Finland and abroad. (Statistics Finland  
111 2018) In principle, a MaaS offering could cover for all mobility needs and therefore the current  
112 spending on transport could be replaced by a MaaS solution.

113 In Finland, households' consumption on transport is calculated as a sub-category in the house-  
114 hold budget survey, which is done with a sample survey, for which data is collected from  
115 households with telephone interviews and diaries filled in by them, and from purchase receipts  
116 and administrative registers (Statistics Finland 2017). As transport is one of the largest sub-  
117 categories in the consumption survey, the relative mean error for the category is relatively  
118 small, 2.88% in the 2016 data. Household budget survey is one of the harmonised surveys in  
119 the European Union and thus the results of the surveys are mostly comparable to surveys in  
120 other EU member states. (Statistics Finland 2016b) For comparison, average transport costs in  
121 the USA are \$813 per month per consumer (United States Department of Labor 2018), which  
122 is approximately €737 at the exchange rate valid on 14 October 2019 (European Central Bank  
123 2019b).

124 According to the statistics, people aged 35 to 54 spend more money on mobility than older and  
125 younger age groups. Among people aged 18 to 64, the least amount of money is spent by people  
126 aged 18 to 24. (e.g. Foster 2015; Statistics Finland 2018) Women typically use a personal ve-  
127 hicle less often than men, but they use public transport more (e.g. Civitas 2014; Finnish  
128 Transport Agency 2018). Because the use of private vehicles usually accounts for a high per-  
129 centage of mobility costs, the differences between men and women with regard to their chosen  
130 mode of transport also reflect on mobility costs. It should be noted that people often tend not  
131 to be aware of their current mobility costs. According to Allard et al. (2014), households rarely  
132 calculate real mobility costs and they usually take into account e.g. only the costs of fuel in  
133 private cars.

134 MaaS may have a major impact on people's mobility in many ways in the future (Lyons et al.  
135 2019). However, we do not yet know how ready people are to pay for a MaaS offering and how  
136 their willingness to pay relates to their current mobility costs. There is a clear research gap  
137 related to people's willingness to pay for MaaS and whether people prefer monthly MaaS sub-  
138 scriptions or pay-as-you-go alternative (see e.g. Matyas & Kamargianni 2018). Willingness to  
139 pay and the relative willingness to pay (i.e. willingness to pay in relation to current mobility  
140 costs) is important for the viability of MaaS overall. This study aims to explore

- 141 1. whether Finns endorse some of the key aspects related to MaaS: combining several  
142 mobility services to be used with one ticket or application, replacing passenger car use  
143 with mobility services, and having a single monthly payment for all mobility costs,
- 144 2. how much money Finns spend on their mobility,
- 145 3. how well they are aware of their current mobility costs,
- 146 4. what is their absolute willingness to pay for MaaS, and
- 147 5. how much they are willing to pay relative to their current mobility costs.

148 These research questions will be answered with the help of the literature review and an exten-  
149 sive public survey. The article is laid out as follows: Following the introduction, the second  
150 section describes the research method, the implemented survey and the data collected through  
151 the survey. The third section describes the results of the survey and compares them to research  
152 results found in literature. Lastly, the fourth section examines the reliability of the study while  
153 the fifth section presents the conclusions drawn from the study.

## 154 **2. METHODS AND DATA**

155 In April - June 2018, a survey was conducted in Finland on the attitudes of 18-64-year-olds  
156 towards transport system and people's readiness and will to use new transport services like  
157 MaaS. The questionnaire consisted of five parts. Total number of questions was 23 and it took  
158 about 10-15 minutes to complete the survey. The survey was conducted in Finnish. English  
159 translation of the questionnaire and its instructions are presented in Appendix A.

160 The questions consisted of propositions with Likert scale 1 to 5, multiple choice, and open-  
161 ended questions. The survey also mapped the respondent's background information, such as  
162 age, gender, and whether the respondent had a driving licence, to help categorise the respond-  
163 ents. The survey section on background information did not ask for the respondent's place of  
164 residence, which was instead determined based on the postcode provided. The respondents'  
165 addresses' postal codes were connected through Statistics Finland's (2016a) database with the  
166 seven-level urban-rural classification by Finland's environmental administration (2017). To  
167 better facilitate our analysis, the places of residence were divided into three categories, which  
168 are I) densely populated urban area (includes inner city and outer city areas of the original  
169 classification), II) sparsely populated urban area (includes exurbs, local rural centre areas, and  
170 countryside near cities), and III) sparsely populated area (includes rural heartland and sparsely  
171 populated countryside). In this study, survey's questions number 3, 5, 6 and 7 are analysed.

172 Survey's question 3 presented seven statements, which the respondents answered using a five-  
173 level Likert scale (agree – disagree). Statements aimed to identify people's general views on  
174 MaaS and mobility. In this research, three statements are analysed: statement I (it should be  
175 possible to combine all mobility services and use them with single ticket and application (e.g.  
176 taxi, train and bus with the same ticket)), statement II (I would like to have all costs of my  
177 travelling to be included in a single monthly payment) and statement VII (transport transfor-  
178 mation from using private cars towards mobility services would be a desirable trend.)

179 In question 5, respondents were asked to define their current mobility habits, based on which  
180 they were also provided with an estimate of the average monthly mobility costs incurred from  
181 each mobility habit. The question took into account personal vehicle ownership, the use of a

182 personal vehicle as a driver or passenger, the use of local public transport, the use of long-  
183 distance public transport and the use of other transport services. The question was presented in  
184 the form of a matrix, with each section including four answer options.

185 The monthly cost was estimated for each answer option. For example, the first option presented  
186 the estimate that owning a car worth €10,000–25,000 would cause an average of €300 per  
187 month in costs, taking the costs of the car's upkeep, such as taxes, insurance policies, decrease  
188 in value and parking costs, into account. It was similarly estimated that if the annual usage of  
189 a personal vehicle exceeds 25,000 km, its monthly costs amount to an average of €300, taking  
190 the costs of fuel, servicing, tyres, washing and other maintenance into account. The monthly  
191 cost estimates for each option were determined according to the calculations made by the re-  
192 search team, based on typical costs in Finland. These 'typical costs' were considered from the  
193 viewpoint of typical user in Finland. We recognize that costs vary a lot depending e.g. on the  
194 car used (more expensive vs. less expensive car), taxi prices or ticket costs of public transport  
195 in a competitive environment vs. in a situation, where there is no competition (e.g. only one  
196 operator), or for what type of trips other mobility services are used (e.g. car rental for a long  
197 journey vs. taxi for a short trip). The typical costs for car use were assessed for a typical Finnish  
198 car (average age 12.1 years (Statistics Finland 2019)) and taxi and public transport costs in a  
199 competitive environment as most Finns live in urban areas. As the typical costs were intended  
200 to give an approximate estimate of the mobility costs, these were rounded up, also to make  
201 adding them up easy for the respondents in the next question. The answer options and the costs  
202 estimated for each option are presented as part of the questionnaire in Appendix A.

203 It is clear that current mobility costs cannot be particularly accurately calculated with this ques-  
204 tion format and on a paper questionnaire. However, the purpose of the question was to gain an  
205 indicative estimate of people's mobility costs, as well as prompt the respondents to consider  
206 their current mobility costs and what they comprise of, which is essential in examining their  
207 willingness to pay for new mobility services.

208 In question 6, the respondents were asked to calculate an estimate of their current monthly  
209 mobility costs based on the matrix question above. After this, the respondents were asked  
210 whether the amount in question approximately corresponds to their actual mobility costs. There  
211 were three answer options: 1) I agree, 2) I disagree, and the respondent is able to give an own  
212 estimate of the costs (in euros per month) or 3) the respondent is unable to say / do not know  
213 how much money they spend on mobility.

214 In question 7, an assumption was presented that a suitable mobility package that would include  
215 e.g. public transport, taxi and shared or rented cars (basically a MaaS offering) would be able  
216 to fulfil respondent's all transport needs, and related to this assumption, the respondents were  
217 asked to state a suitable price to start using such a package. The respondents had also the option  
218 to answer 'I do not know' or 'I would not adopt the package'. In the design of survey, it was  
219 recognised the MaaS is a new concept and likely unfamiliar to most respondents and therefore  
220 this question was formulated using the term 'mobility package' in a way that the respondents

221 could answer without prior knowledge about MaaS. The concepts of mobility services and  
222 mobility package were also described in the instructions of cover letter (Appendix A).

223 The sample group for the survey was randomly selected from the population register by gender  
224 and age group in proportion to population's gender and age distribution. Population Register  
225 Centre of Finland extracted the sample per procuration. For study purposes, the names, ad-  
226 dresses, ages and gender of the people were available in the sample data. Throughout our study,  
227 we followed Population Register Centre's terms and conditions related to data use, and in an-  
228 alysing the survey responses, we followed Finnish legislation and good academic practices.

229 The population of the sample consisted of 18-64-year-olds living in Finland. The size of the  
230 population was 3,263,361 people, based on the population projection of 2018 (Statistics Fin-  
231 land 2015). The sampling fraction was 0.2%, and the size of the sample was 6,000 people.  
232 Table 1 presents the sample, number of respondents, and response rate in terms of the various  
233 age and gender groups.

234 **Table 1.** *Sample group, number of respondents and response rate by age and gender.*

	Men			Women		
Age groups	Sample size	Number of respondents	Response rate	Sample size	Number of respondents	Response rate
<b>18-24</b>	415	50	12.1%	397	59	14.9%
<b>25-34</b>	666	86	12.9%	632	138	21.8%
<b>35-44</b>	662	107	16.2%	626	115	18.4%
<b>45-54</b>	635	111	17.5%	621	131	21.1%
<b>55-64</b>	663	176	26.6%	683	186	27.2%
<b>In total</b>	<b>3,041</b>	<b>530</b>	<b>17.4%</b>	<b>2,959</b>	<b>629</b>	<b>21.3%</b>

235  
236 Before the questionnaires were mailed, a pilot study was conducted. The pilot study was con-  
237 ducted in a shopping mall, where 20 respondents presenting different socio-economic groups  
238 were asked to respond to the questionnaire. The youngest respondent was 20 years old while  
239 the oldest was 84 years old. All the respondents in the pilot survey were interviewed after filling  
240 in the questionnaire. They were asked if there were any ambiguities or challenges in filling the  
241 questionnaire. A specific question was asked considering question number 5: was the question  
242 difficult to understand. Most respondents in the pilot study considered that the questionnaire  
243 was comprehensible and verified understanding question 5, too. Only the oldest respondents  
244 found the questionnaire in general difficult to fill in. The oldest respondents in the pilot survey  
245 were much older than the respondents who were invited in the actual study, who were 18 - 64  
246 years old. We checked all the responses of the pilot study and found that the questionnaires  
247 were filled in correctly, but we didn't discuss about all questions systematically with the re-  
248 spondents of the pilot survey. Interviews were quite brief and it is possible that people might  
249 have answered that they understood everything if they were, for example, keen to get on their  
250 way, but most of the respondents did not seem to hurry out of the interview situation. As a

251 conclusion of the pilot study, we found the questionnaire to be adequately clear and under-  
252 standable, and the actual questionnaire had the same format as in the pilot study.

253 All people, who were selected for the sample, were sent a postal questionnaire with a cover  
254 letter in April 2018. Cover letter included basic information and instructions for the respond-  
255 ents. As the topic and concepts related to mobility services and mobility package (the term,  
256 which was used instead of MaaS in other questions except of the question where we asked  
257 about the familiarity of MaaS as a concept), were assessed to be somewhat blurry to the re-  
258 spondents, we defined these in the cover letter. The two key definitions were:

- 259 • mobility services = services, which can be used to travel with several transport modes  
260 using one payment or one application
- 261 • mobility package = a package, for which a definite monthly payment is made, and  
262 which retains a certain number of trips with different transport modes.

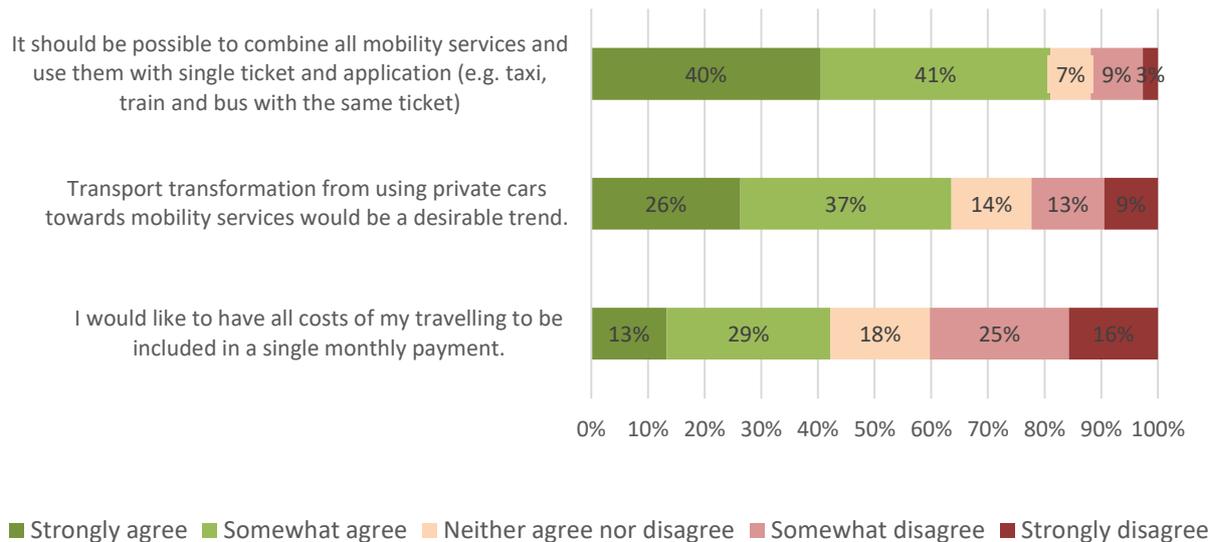
263 People had the option either to respond on the internet with an identification code or to send  
264 the questionnaire back by mail (postage paid). The last answers were received in June 2018. A  
265 total of 1,176 respondents participated in the survey, resulting to a total response rate of 19.6%.  
266 The mean age of all respondents was 45 years, for women 44 and men 45 years, respectively.

267 The survey results are presented as the number of respondents and frequency percentages of  
268 different responses. Also a linear regression model is composed to better understand the factors  
269 affecting willingness to pay. As the parameters usually deployed in sampling factors (age, gen-  
270 der and residential location) are analysed separately in this study, the results with sampling  
271 factors, which would make the results representative of the Finnish 18-64-year-old population,  
272 are not presented. As people's willingness to pay for MaaS is a very difficult topic to assess  
273 before MaaS is a household word and actual MaaS solutions are available, it should be noted  
274 that the results of this study are mostly indicative and should be supplemented with more in-  
275 depth future research.

276 The statistical significance of the distribution of answers is tested with the chi-square test. The  
277 means are compared by using an independent samples t-test between two groups and a one-  
278 way analysis of variance (ANOVA) between several groups. If the conditions for using a one-  
279 way ANOVA are not met, the differences in the means of several groups are tested with the  
280 Kruskal–Wallis test. The results are analysed with IBM SPSS software.

### 281 **3. RESULTS AND DISCUSSION**

282 In question 3, people's general views related to different MaaS' aspects were asked. Respond-  
283 ents' views about three statements are presented in Figure 1.



284

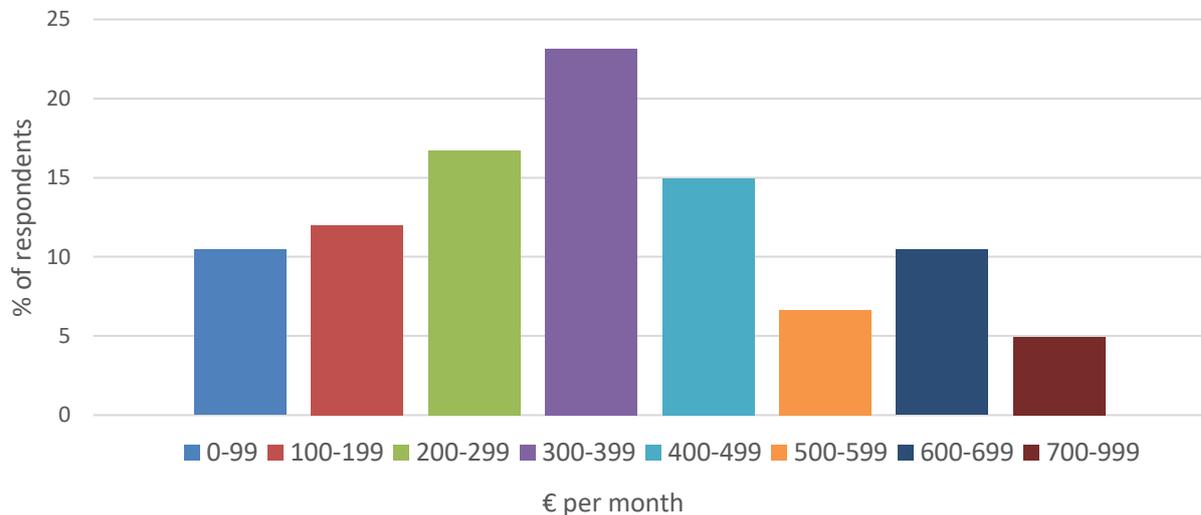
285 **Fig 1.** Respondents' (N=1,174) answers to the question Question 3, statements I, II  
286 and VII.

287 Figure 1 shows that over 80% of the respondents at least somewhat agree that it should be  
288 possible to combine all mobility services and use them with a single ticket and application.  
289 This can be interpreted so that the core idea of MaaS has strong support. According to answers  
290 to the second statement, over 60% of the respondents consider that transport transformation  
291 from using private cars towards mobility services would be a desirable trend. This is again a  
292 strongly positive view supporting the goals related to MaaS. However, only 13% strongly agree  
293 and 29% somewhat agree that they would like to have all costs of travelling to be included in  
294 a single monthly payment. This leads to the conclusion that a MaaS package with a bundled  
295 monthly subscription is not generally attractive, at least not at this moment. This indicates to  
296 need for pay-as-you-go pricing for MaaS services as this could interested also the ones, who  
297 would not like to subscribe to a monthly package. This should be taken into account when  
298 developing the MaaS schemes.

299 In question 5 of the survey, presented in matrix format, respondents were asked to specify their  
300 current mobility habits. Additionally, the answer options presented an estimate of how much  
301 each mobility habit costs per month on average. This makes it possible to calculate an estimate  
302 of each respondent's current mobility costs. It should be noted, that mobility cost estimates are  
303 somewhat inaccurate and therefore more indicative than precise as there are ambiguities in how  
304 respondents are able to assess their actual mobility costs as well as the limited amount of op-  
305 tions and rounded and approximate figures presented in question 5. The distribution of answers  
306 between different mobility habits is presented in Appendix B.

307 The estimate of the respondents' monthly mobility costs, calculated based on the matrix ques-  
308 tion, is presented in Figure 2. In accordance with the Figure, the most common estimate for  
309 monthly mobility costs was €300–399. Approximately 23% of the respondents fell into this  
310 cost group. The mean of the estimated mobility costs was €348, with the median being €320,

311 lower quartile being €200, upper quartile being €480, and the standard deviation being €198.  
 312 The highest estimate was €900 and the lowest €10. In approximate terms, the mean estimated  
 313 mobility costs correspond well with the results of the household consumption study, according  
 314 to which the average monthly amount spent on mobility by Finns aged 18 to 65 is €364 per  
 315 adult (Statistics Finland 2018).



316

317 **Fig 2.** *An estimate of the monthly mobility costs of the respondents based on the cur-*  
 318 *rent mobility habits presented in the matrix question. N=1,168.*

319

320 The respondents' gender, age and place of residence affected the responses to some degree.  
 321 According to the matrix question, the mean of men's estimated mobility costs is, to a statisti-  
 322 cally significant degree ( $t(1162)=-7.253, p<0.001$ ), higher than that of women. Similarly, the  
 323 estimated mobility costs of young age groups were lower than those of older age groups to a  
 324 statistically significant degree (Kruskal-Wallis:  $H=97.448, df=4, p<0.001$ ), though the differ-  
 325 ences between the 35–44, 45–54 and 55–64 age groups were not statistically significant. The  
 326 respondents' places of residence impacted the answers in that estimated mobility costs were  
 327 lower among respondents living in densely populated urban areas than among respondents liv-  
 328 ing in more sparsely populated areas. The differences were statistically significant (Kruskal-  
 329 Wallis:  $H=16.085, df=2, p<0.001$ ), but only between densely populated urban areas and  
 330 sparsely populated urban areas. The impact of the respondents' gender, age and place of resi-  
 331 dence on the mean of the estimated mobility costs are presented in Table 2.

332 **Table 2.** *The impact of gender, age and place of residence on the mean of the estimated*  
 333 *mobility costs, calculated based on the matrix question.*

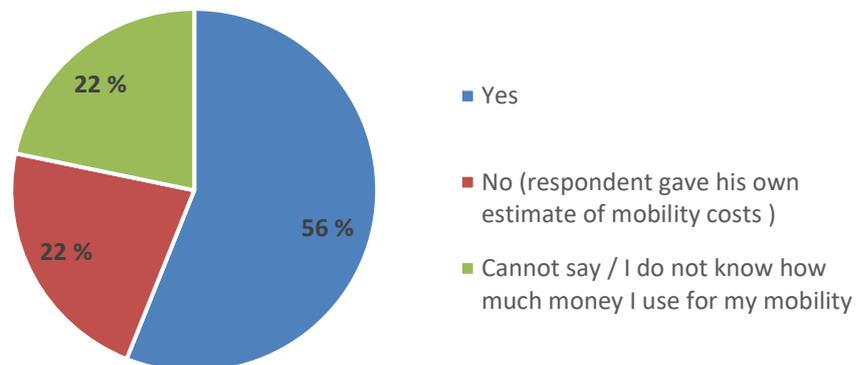
	Mean of mo- bility costs (€)	SD (€)
<b>Total (N=1168)</b>	348	198
<b>Gender</b>		
<b>Women (n=628)</b>	311	189

<b>Men (n=536)</b>	394	200
<b>Age groups</b>		
<b>18-24 (n=109)</b>	219	158
<b>25-34 (n=224)</b>	289	185
<b>35-44 (n=223)</b>	383	205
<b>45-54 (n=244)</b>	409	202
<b>55-64 (n=367)</b>	361	184
<b>Location of residence</b>		
<b>Densely populated urban area (n=588)</b>	327	210
<b>Sparsely populated urban area (n=368)</b>	376	189
<b>Sparsely populated area (n=211)</b>	359	173

334

335 Next, in survey question 6, the respondents were asked whether the estimate calculated based  
 336 on the previous question approximately corresponded to the respondents' actual mobility costs.  
 337 The question presented three options to the respondent: 1) agree on the estimated mobility  
 338 costs, 2) disagree with the estimated mobility costs and to provide an own estimate of the costs,  
 339 and 3) not able to say, indicating unawareness of the mobility costs. The distribution of the  
 340 answers is presented in Figure 3.

341



342

343 **Fig 3.** Respondents (N=1,169) answers to the question, do the estimated mobility costs  
 344 presented in the matrix question approximately correspond to the respondent's actual  
 345 mobility costs.

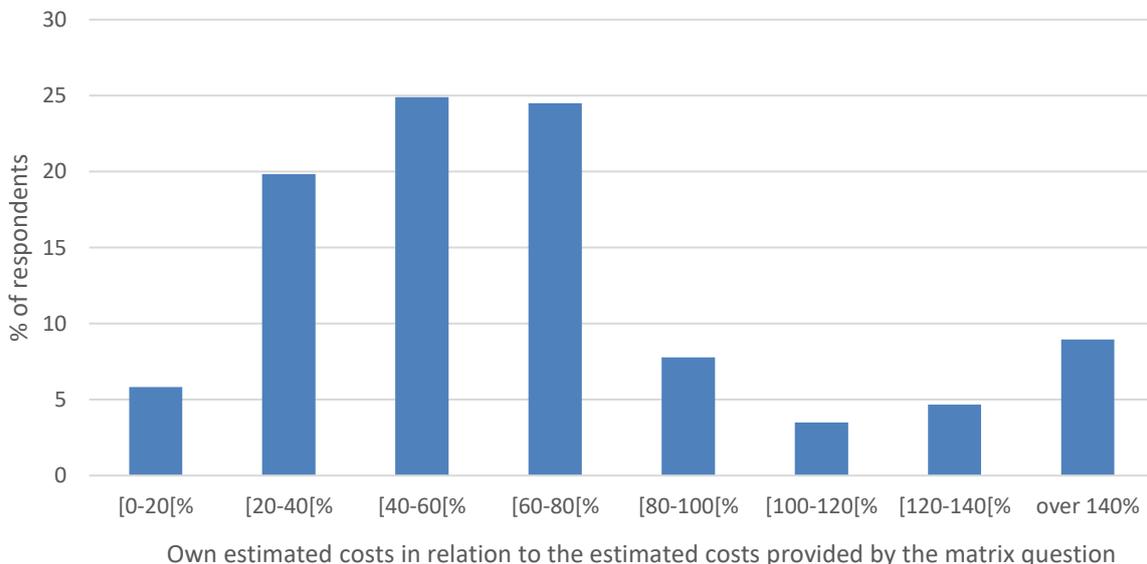
346 According to Figure 3, the majority, approximately 56%, considered the estimate to be approx-  
 347 imately correct. 22% of the respondents considered the estimate to be incorrect and presented  
 348 a closer estimate of their mobility costs. Another 22% of the respondents were unable to esti-  
 349 mate the amount's accuracy. Looking at the categories of estimated mobility costs (Figure 2)

350 formed based on the matrix question, the answers of those who spend €100–199 on mobility  
 351 per month differ from the other groups in that a clearly higher percentage of the respondents in  
 352 this cost category (more than 40%) deemed the estimate to be incorrect, whereas approximately  
 353 20% of the respondents in the other categories considered it to be incorrect. A situation that is  
 354 highlighted in the aforementioned group is one in which the respondents do not own a car, but  
 355 the cost estimate ends up being between €100 and €200, which some of the respondents feel is  
 356 too high.

357 The respondents' background information, i.e. age, gender, level of education or place of resi-  
 358 dence, have practically no impact on the distribution of answers. In other words, the respond-  
 359 ents' background does not affect how well the respondents are aware of their current mobility  
 360 costs or how well the respondents are able to evaluate the estimate of their current mobility  
 361 costs, which is formed based on their current mobility habits.

362 The respondents' own estimates of their current mobility costs varied between €0 and €1,500.  
 363 The mean was €211, with the median being €150. The majority of those who provided their  
 364 own estimate of their mobility costs considered the estimate that was formed for the matrix  
 365 question based on mobility habits to be too high. However, approximately 17% of the respond-  
 366 ents considered the estimate to be too low. On average, the respondents' own estimate was  
 367 approximately 70% of the value calculated based on the matrix question. Figure 4 shows how  
 368 many percent the respondents' own estimate of their mobility costs was in relation to the esti-  
 369 mate provided by the matrix question.

370



371

372 **Fig 4.** *The respondents' own estimate of their mobility costs in relation to the estimate*  
373 *provided by the matrix question. (n=257).*

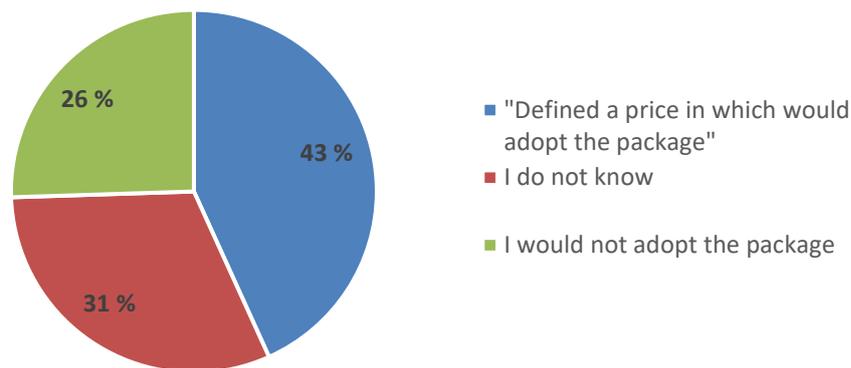
374 As shown in Figure 4, the estimate provided by approximately 25% of the respondents was  
375 roughly 40–60% of the estimate provided by the matrix question. Similarly, the estimate pro-  
376 vided by another 25% of the respondents was roughly 60–80% of the estimate provided by the  
377 matrix question. Additionally, approximately 9% of the respondents were of the opinion that  
378 their actual mobility costs were over 40% higher than the estimate provided by the matrix  
379 question.

380 As Allard et al. (2014) have stated, people are only seldom able to estimate their mobility costs,  
381 which may affect the reliability of the results. The matrix question (question 5) was formatted  
382 in a way which was intended to make it easier to perceive and calculate the costs. The format  
383 in question 6, where the first option was the easiest for the respondent, to agree with the esti-  
384 mated costs based on the matrix question, could lead the respondent to choose this option, as  
385 especially the second option would require more effort and thinking.

386 The use of the term 'approximately' in the question caused some variation in the answers. Some  
387 of the respondents provided their own estimate of their mobility costs, even though the estimate  
388 provided by the matrix question deviated less than 20% of the respondents' own estimate. On  
389 the other hand, many of the respondents may have considered an error margin of e.g. 20% to  
390 be so small that they responded that the estimate was approximately accurate. Furthermore, a  
391 large number of the respondents are likely unable to provide a particularly precise estimate of  
392 their actual mobility costs, which means that the respondents may consider the estimate to be  
393 approximately correct, even if the estimate provided by the matrix question in truth differs  
394 significantly from the respondents' actual mobility costs. The matrix question can also induce  
395 a learning effect in a way that the respondent is better aware of sub-categories related to mo-  
396 bility costs and therefore increasingly capable of estimating the mobility costs.

397 The next question assumed that a suitable mobility package could cover all of the respondent's  
398 mobility needs and asked what price would a mobility package comprising e.g. public  
399 transport, taxis and car sharing have to be in order for the respondent to adopt it. The content  
400 of the mobility package was not defined in any more detail. In addition to being asked to specify  
401 a suitable price, the respondents were provided with the alternatives 'I do not know' and 'I  
402 would not adopt the package'. The distribution of answers between different answer options is  
403 presented in Figure 5.

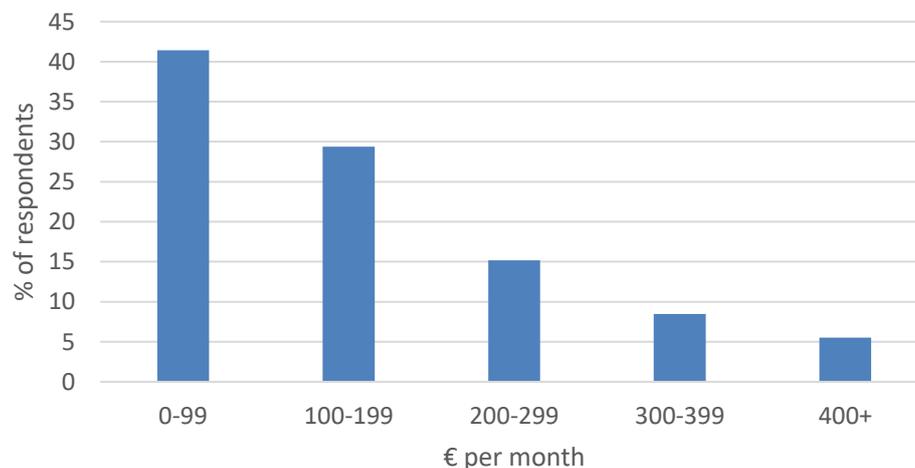
404



405

406 **Fig 5.** Share of respondents' answers to the question 7: Adopting a mobility package.  
407  $N=1,172$ .

408 As shown in Figure 5, 43%, i.e. a total of 507 respondents, provided some estimated amount  
409 in euros of a suitable price for a mobility package at which they would adopt the service. 31%  
410 were unable to say and 26% were not willing to adopt the service (at any price). The percentage  
411 of respondents who were willing to adopt MaaS is at the same level as in previous studies,  
412 which found that 47% (Ho et al. 2018) or 49% (Ratilainen 2017) of respondents were willing  
413 to adopt at least some type of MaaS. Figure 6 shows how the respondents were distributed  
414 based on their willingness to pay.



415

416 **Fig 6.** The willingness of the respondents to pay for a mobility package.  $n=507$ .

417 The estimates provided by the respondents of a suitable price varied between €10 and €700.  
418 The mean was €137, with the median being €100, lower quartile being €50, upper quartile  
419 being €200, and standard deviation €114. As shown in Figure 6, approximately 41% of the  
420 respondents were willing to pay less than €100 for a mobility package. As lower quartile was  
421 €50, this means that 25 % of people would be willing to pay less than €50 for MaaS. Approx-  
422 imately 29% were willing to pay €100–199, while approximately 29% were willing to pay

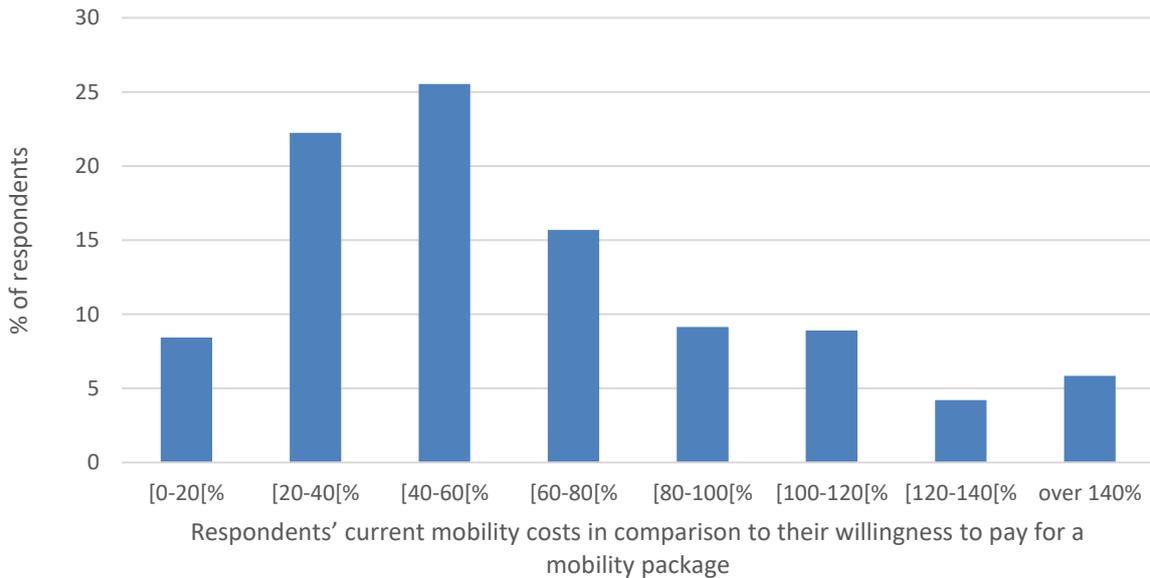
423 more than €200. In a study conducted in Australia by Ho et al. (2018), people were willing to  
424 pay, on average, AUD 231 for a MaaS package, which is approximately €143 at the exchange  
425 rate valid on 13 May 2019 (European Central Bank 2019a). However, this study had a very  
426 different research design and definition of a MaaS package, which is why the research results  
427 are not directly comparable. The results are also well in line with the results of Solita's (2017)  
428 study, where the internet panel respondents were willing to pay, on average, less than €150 for  
429 a MaaS package in Finland.

430 For comparison, the price list of Whim, a company that offers MaaS services in Helsinki, Fin-  
431 land, includes a MaaS package comprising of unlimited use of public transport and, with certain  
432 restrictions, use of city bikes, taxis, car sharing and rental cars at €499 (Whim 2019). On the  
433 other hand, a mobility package does not necessarily have to be unlimited in order to meet peo-  
434 ple's mobility needs, in which case people's willingness to pay and the prices of existing ser-  
435 vices are not directly comparable. These results include many uncertainties, which are dis-  
436 cussed in section 4. In the future research, these results should be supplemented with qualitative  
437 research to further understand people's willingness to pay for MaaS.

438 When the respondents' willingness to pay is compared to the estimate presented by the matrix  
439 question of their current mobility costs, it is found that all respondents who would be willing  
440 to adopt a mobility package are willing to pay, on average, approximately 50% of their current  
441 mobility costs for the mobility package (n=507). If the comparison is focused only on the re-  
442 spondents whose response to the previous question was that the estimate of their current mo-  
443 bility costs, provided by the matrix question, is accurate, then the willingness to pay relative to  
444 the mobility costs is slightly higher. On average, these respondents (n=286) were willing to  
445 pay approximately 56% of their current mobility costs for a mobility package. If the compari-  
446 son is focused on the respondents that provided a closer estimate of their own mobility costs  
447 than the matrix question for the previous question, the respondents (n=141) were willing to pay  
448 an average of approximately 81% of their current mobility costs for a mobility package. Rela-  
449 tive willingness to pay is calculated based on questions 5 (current mobility costs) and 7 (will-  
450 ingness to pay), which both include many uncertainties, and therefore the degree of approxi-  
451 mation increases in the results presented below.

452 Figure 7 shows how many percent of their current mobility costs the respondents were willing  
453 to pay for a mobility package that meets their daily mobility needs. The Figure only takes into  
454 account the respondents who considered the estimate of their current mobility costs, provided  
455 by the matrix question, to be approximately correct or who provided a closer estimate of their  
456 current mobility costs. The total number of such respondents was 427. On average, these re-  
457 spondents were prepared to pay 64% of their current mobility costs for a mobility package,  
458 with the median being 50% and standard deviation 61%.

459



460

461 **Fig 7.** Respondents' willingness to pay for a mobility package relative to their current  
 462 mobility costs. The Figure only includes the respondents who specified a suitable  
 463 price at which they would be willing to adopt a mobility package and who also con-  
 464 sidered the estimate provided by the matrix question to be correct or who provided a  
 465 closer estimate of their current mobility costs.  $n=427$ .

466 Next, we examine how the adoption of a mobility package and people's willingness to pay  
 467 varied in different mobility cost categories. This examination only takes into account the re-  
 468 spondents who considered the estimate provided by the matrix question to be approximately  
 469 correct or who provided a closer estimate of their current mobility costs. The total number of  
 470 such respondents was 907. In order to clarify the analysis, the respondents are divided into  
 471 three groups based on their current mobility costs: respondents who spend €0–199, €200–399  
 472 and over €400 on mobility. Each group consisted of 272–353 respondents. Table 3 shows how  
 473 the answers of the respondents in these groups were distributed in the question concerning the  
 474 adoption of a mobility package, which asked what price a mobility package would have to be  
 475 in order for the respondent to be willing to adopt it.

476 **Table 3.** Willingness to adopt a mobility package in different mobility cost categories.  
 477 The table only takes into account the respondents, who considered the estimate of their  
 478 mobility costs, provided by the matrix question, to be correct or who provided a closer  
 479 estimate of their current mobility costs.  $n=907$ .

	Current mobility costs		
	€0–199	€200–399	more than €400
"Defined a price in which would adopt the package"	55%	43%	45%
I would not adopt the package	18%	26%	30%
I do not know	27%	31%	25%
<b>In total</b>	<b>100% (n=272)</b>	<b>100% (n=353)</b>	<b>100% (n=281)</b>

480

481 As shown in Table 3, those who currently spend less than €200 on mobility more often ex-  
 482 pressed willingness to adopt a mobility package and defined a suitable price for the package  
 483 compared to others. Correspondingly, the higher mobility cost categories included more re-  
 484 spondents who were not prepared to adopt the service. All cost categories included a fairly  
 485 even share of respondents, who were unable to say. The differences presented in the table are  
 486 statistically significant (chi-square test:  $p=0.005$ ).

487 Table 4 shows the willingness of the respondents to pay for a mobility package in the different  
 488 mobility cost categories. The table shows the respondents' willingness to pay relative to their  
 489 current mobility costs as well as their absolute willingness to pay in euros.

490 **Table 4.** *Absolute willingness to pay and willingness to pay relative to current mobility*  
 491 *costs in different mobility cost categories. The table only takes into account the respond-*  
 492 *ents who specified a suitable price at which they would be willing to adopt a mobility*  
 493 *package and who also considered the estimate provided by the table question to be cor-*  
 494 *rect or who provided a closer estimate of their current mobility costs.  $n=427$ .*

		Current mobility costs		
		€0–199 ( $n=149$ )	€200–399 ( $n=152$ )	more than €400 ( $n=126$ )
Willingness to pay relative to current mobil- ity costs	0-40%	14%	37%	43%
	40-80%	30%	46%	48%
	80-120%	30%	15%	9%
	120+%	26%	3%	0%
Mean of willingness to pay relative to current mobility costs		96%	50%	43%
Mean of absolute willing- ness to pay		€69	€138	€244
Standard deviation of abso- lute willingness to pay		€38	€81	€140
Range of absolute willing- ness to pay		€10–200	€10–460	€50–700

495

496 According to Table 4, the more the respondent currently spends money on mobility, the less  
 497 one is relatively willing to pay for a mobility package. On the other hand, the absolute amounts  
 498 increase significantly according to how much each respondent currently spends on mobility.  
 499 This result is logical as such, considering that the respondents who spend less than €200 on  
 500 mobility often already use various transport services, as approximately 80% of the respondents  
 501 in this cost category do not own a passenger car, for example. Correspondingly, almost all  
 502 respondents in the other cost categories own a passenger car.

503 However, it should be noted that a MaaS service that meets people's current mobility needs  
 504 may be very different for different people. For example, at present respondents who either do  
 505 not own a car or do not use one much would likely not use the car rental and car sharing options  
 506 included in MaaS as much as respondents who currently drive a great deal. Therefore, these  
 507 respondents are prepared to pay a clearly lower amount for a mobility package than the other  
 508 respondents. On the other hand, these respondents are people who could increasingly adopt  
 509 MaaS as part of their car use, which could lead to an unwanted shift in mobility habits from  
 510 the perspective of sustainability.

511 Next, we examine the differences between groups of users with regard to their willingness to  
 512 pay. These examinations only take into account the respondents who specified a suitable price  
 513 at which they would be willing to adopt a mobility package and who also considered the esti-  
 514 mate provided by the matrix question of their current mobility costs to be correct or provided  
 515 a closer estimate of their current mobility costs. The absolute willingness of different groups  
 516 of users to pay and their willingness to pay relative to their current mobility costs is presented  
 517 in Table 5.

518 **Table 5.** *Absolute willingness to pay and willingness to pay relative to current mobility*  
 519 *costs and their standard deviation (SD) among different groups of users. The table only*  
 520 *takes into account the respondents who specified a suitable price at which they would be*  
 521 *willing to adopt a mobility package and who also considered the estimate provided by the*  
 522 *matrix question of their current mobility costs to be correct or provided a closer estimate*  
 523 *of their current mobility costs. n=427.*

	<b>Absolute wil- lingness to pay (€)</b>	<b>SD of abso- lute willing- ness to pay (€)</b>	<b>Relative wil- lingness to pay</b>	<b>SD of relative willingness to pay</b>
<b>Total (n=427)</b>	145	116	64%	61%
<b>Gender</b>				
<b>Women (n=221)</b>	119	92	66%	46%
<b>Men (n=205)</b>	174	145	63%	74%
<b>Age groups</b>				
<b>18-24 (n=42)</b>	91	113	81%	48%
<b>25-34 (n=105)</b>	121	100	74%	100%
<b>35-44 (n=91)</b>	163	131	61%	42%
<b>45-54 (n=88)</b>	180	122	57%	38%
<b>55-64 (n=101)</b>	145	102	56%	35%
<b>Location of residence</b>				
<b>Densely populated ur- ban area (n=234)</b>	128	112	72%	76%
<b>Sparsely populated ur- ban area (n=125)</b>	176	125	56%	30%
<b>Sparsely populated area (n=68)</b>	146	116	50%	36%

525 There was no statistically significant ( $t(424)=-0.508$ ,  $p=0.612$ ) difference between men and  
 526 women in their willingness to pay relative to their current mobility costs. In contrast, men's  
 527 absolute willingness to pay for a mobility package was higher than that of women to a statisti-  
 528 cally significant degree ( $t(363)=-4.988$ ,  $p<0.001$ ), which is explained by the fact that male re-  
 529 spondents' mobility costs were higher than those of women in the study. The standard deviation  
 530 of answers was also slightly higher among men than among women.

531 With regard to age groups, younger respondents seem to have been willing to pay slightly more  
 532 for a mobility package relative to their current mobility costs, but these differences were not  
 533 statistically significant (Kruskal-Wallis:  $H=9.230$ ,  $df=4$ ,  $p=0.056$ ). Older respondents were  
 534 willing to pay higher absolute amounts for a mobility package than younger respondents to a  
 535 statistically significant degree (Kruskal-Wallis:  $H=34.612$ ,  $df=4$ ,  $p<0.001$ ). Similarly, respond-  
 536 ents living in densely populated urban areas were willing to pay, to a statistically significant  
 537 degree (Kruskal-Wallis:  $H=11.346$ ,  $df=2$ ,  $p=0.003$ ), more for a mobility package relative to  
 538 their current mobility costs, but their absolute willingness to pay was lower (one-way ANOVA:  
 539  $F(2,424)=7.069$ ,  $p=0.001$ ) compared to respondents living in other areas.

540 To better understand the factors affecting the willingness to pay for MaaS, an explanatory linear  
 541 regression model is developed. The following explanatory variables are tested for the model:  
 542 current mobility costs (continuous, euros), gender, age (continuous, years), location of resi-  
 543 dence (dummy, densely populated urban area – others), household's income per month  
 544 (groups: 1 = €0–2000, 2 = €2000–4000, 3 = €4000–6000, 4 = over €6000), level of education  
 545 (dummy, primary and high school – bachelor's and master's degree) and people's recognition  
 546 of the term MaaS (dummy, have you ever heard or read about the concept of MaaS). SPSS's  
 547 backward-algorithm is used as a method to find the suitable variables to the model. In the first  
 548 round, there were a couple of divergent observations in the residuals plot, which is why the  
 549 highest values from variable 'current mobility costs' were removed. Three values, in which the  
 550 current mobility costs were over €1,000, were removed. The final model is presented in Table  
 551 6. Model formation with backward-algorithm is presented in Appendix C.

552 **Table 6.** *Linear regression model for willingness to pay for MaaS, final version.*

Coefficients <sup>a</sup>								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
5	(Constant)	-12.826	15.916		-0.806	0.421		
	Current mobility costs	0.324	0.023	0.575	13.813	0.000	0.772	1.296
	Gender	15.419	8.638	0.067	1.785	0.075	0.937	1.068
	Household's income	15.400	4.492	0.139	3.429	0.001	0.814	1.229

a. Dependent Variable: Willingness to pay for MaaS

553

554 In this model, coefficient of determination (adjusted R square) is only 44.1%. As the standard-  
555 ized coefficients in table 6 show, current mobility costs is the dominant factor in the model.  
556 Gender and household's income explains some of the variation and based on the model, other  
557 tested variables do not have statistically significant effect to the amount that people are willing  
558 to pay for MaaS services. This leads to the conclusion that current mobility habits explain some  
559 of the variance between responses, but other factors (such as age, gender and people's recog-  
560 nition of the term MaaS) have less influence on the willingness to pay for MaaS.

561 According to table 6, tolerance and VIF values of the variables are close to 1. Also Durbin-  
562 Watson value of the model is  $1.941 \approx 2$ . These values show that there are no problems with  
563 correlations between variables in the model. Residual plot and residuals' normal distribution  
564 pattern are presented in Appendix C. There are no serious errors in normal distribution pattern,  
565 but from residual plot it can be seen that variances of residuals are not equal. This decreases  
566 the reliability of significance level test of the model, but it does not mean that the model itself  
567 would be invalid. Based on ANOVA presented in Appendix C, the model is statistically sig-  
568 nificant ( $F(3,115)=110.970, p<0.001$ ).

#### 569 **4. VALIDITY AND RELIABILITY OF THE STUDY**

570 The research design caused some problems that may decrease the reliability of this study. In  
571 the study, current mobility costs were estimated with the help of a matrix question on respon-  
572 dents' current mobility habits. However, a survey implemented on a paper form limits the scope  
573 of the question, making several compromises necessary in the matrix question. Therefore, the  
574 question cannot deliver particularly precise estimates of the respondents' current mobility  
575 costs. Due to the limitation of this approach, the mobility habits and ranges in the matrix ques-  
576 tion are somewhat inaccurate, which is why the cost estimates are mostly indicative. On the  
577 other hand, most of the respondents considered the estimate presented in the matrix question  
578 to be approximately correct. Respondents may have answered this option because it is the 'eas-  
579 est' option, which decrease the validity of the question. Additionally, in question 6, we used  
580 the term 'approximately', which is not a specific term. These aspects might decrease the relia-  
581 bility of the results as described in the results and discussion section. Additionally, the given  
582 amounts in question 5 may have had a framing effect to the respondents when they consider  
583 giving their own estimate of mobility costs in question 6 (second option) as well as when ex-  
584 pressing their willingness to pay. However, the mean of the answers with regard to current  
585 mobility costs was very close to the outcome of the study conducted by Statistics Finland on  
586 Finnish people's mobility costs, making it reasonable to assume that the accuracy of the esti-  
587 mate on people's current mobility costs was at least moderate for most respondents.

588 In the question concerning the price of a MaaS package, the question was formulated in a way  
589 that the respondents could answer without prior knowledge about MaaS. A MaaS package was  
590 defined as meeting all of the respondent's current mobility needs through the use of public  
591 transport, taxi services and car sharing, for example. This already in itself causes a situation in  
592 which the MaaS package presented in the question is, in practice, different, with each respond-  
593 ent interpreting it from the perspective of their own needs. As a result, comparing absolute  
594 amounts in particular between respondents may cause distorted results. We did not want to  
595 define a MaaS package in any more detail in this study, as the target group in the research  
596 design included all Finns aged 18 to 64 living in Finland, and a possible suitable mobility  
597 package would have a very different content in rural areas and cities, for example. We sought  
598 to take this problem arising from the research design into account by also relating the answers  
599 to the respondents' current mobility costs. The current mobility costs formed based on the re-  
600 spondents' current mobility habits are also relatively representative of the respondents' mobil-  
601 ity habits. There was also a separate analysis of different genders, age groups and respondents  
602 living in different areas.

603 In order to improve the reliability of the results, the analysis of the respondents' relative will-  
604 ingness to pay for a MaaS package was conducted by using only respondents who considered  
605 the estimate drawn from the matrix question regarding the approximate amount of their current  
606 mobility costs to be correct or who provided a closer estimate of their current mobility costs.  
607 However, it should be noted that due to the uncertainties related to, e.g. some respondents  
608 choosing the approximate amount in the question 6 as it was the easiest option, the uncertainty  
609 affects also the relative willingness to pay. Also, the number of such respondents, who also  
610 specified a suitable price for a mobility package, was relatively low (n=427), making it impos-  
611 sible to conduct further analyses reliably. Furthermore, the standard deviations of answers were  
612 very large. This was expected as the large standard deviations indicate that the current mobility  
613 costs (and mobility habits) as well as willingness to pay vary considerably among the respond-  
614 ents. There is also considerable variation among these in the population overall (Finnish  
615 Transport Agency 2018). Nevertheless, the number of respondents is sufficiently high in order  
616 for the statistical significance of the differences between groups of respondents to be analysed  
617 by using statistical tests.

618 The questions used in the study and, for example, the calculation of the respondents' current  
619 mobility costs may be challenging for some respondents to understand. In the cover letter of  
620 the questionnaire, we instructed the respondent to assess mobility and mobility costs from in-  
621 dividual's point of view, instead of household perspective. As some of the mobility costs can  
622 be shared in a multi-person household (especially car costs), approaching mobility costs from  
623 individual's viewpoint is somewhat challenging. Also, the willingness to pay is related as the  
624 use of a car shared between household members, should be acknowledged from the perspective  
625 of the whole household. Development and marketing of MaaS should acknowledge the mobil-  
626 ity needs of individual as well as households, and MaaS could be offered as a household service  
627 instead of or in addition to a service for individuals.

628 The questions and structure of the questionnaire were simplified in the planning phase, and we  
629 found in the pilot study that the respondents were able to understand the questions, especially  
630 the critical question 5. Conducting the pilot study and interviews in a shopping mall may not  
631 have been the best way to verify the comprehension of the survey questions, but based on open  
632 feedback from the actual study, the respondents considered the questionnaire to be clear. Ad-  
633 ditionally, almost all respondents were able to fill in the form correctly, which, for its part,  
634 supports the conclusion that the questions were understood correctly.

635 Culturally, Finland is relatively close to other Western countries in Europe. However, there are  
636 significant differences between countries in the pricing of mobility. In Finland for example,  
637 the costs of owning and using a passenger car are relatively high compared to many other  
638 Western countries (Eurostat 2017). This may make it difficult to compare people's absolute  
639 willingness to pay between countries, which is why relative willingness to pay should also be  
640 taken into account in comparisons. All in all, these study results can be considered to be rela-  
641 tively applicable to other developed countries and to Europe in particular.

## 642 **5. CONCLUSIONS**

643 The aim of this study was to explore people's willingness to pay for new MaaS services as well  
644 as to collect data on people's current mobility costs and how they relate to people's willingness  
645 to pay with the help of a large survey with a representative sample. This is the first study where  
646 the mobility costs are compared with willingness to pay for MaaS.

647 Based on the study, Finns aged 18 to 64 spend, on average, €350 on mobility per month, which  
648 is also very close to the estimate of €364 per month that was determined in the consumption  
649 study by Statistics Finland (2018). However, due to many limitations of the study, respondent's  
650 current mobility costs are only indicative. In this study, 43% of the respondents specified a  
651 price at which they would be willing to adopt MaaS. The estimates provided by the respondents  
652 of a suitable price for a mobility package varied between €10 and €700, with the mean being  
653 approximately €140. Based on the results, the respondents were willing to pay, on average,  
654 approximately 64% of their current mobility costs for a mobility package. However, MaaS  
655 studies and the results related to willingness to pay for MaaS include many uncertainties. First,  
656 as MaaS and mobility packages are still unfamiliar to most people, there are ambiguities con-  
657 cerning people's understanding regarding the topic. Secondly, the mobility needs of people  
658 vary considerably, and thus also the mobility services which would cover these needs vary.  
659 Additionally, it can be questioned, how well the stated willingness to pay would relate to the  
660 actual use of money for a mobility package. People are not typically highly aware of their

661 mobility costs which has an effect on estimating the willingness to pay relative to current mo-  
662 bility costs, too. Due to the uncertainties, this study should be supplemented with the future  
663 research.

664 We found that the respondents who use least money for mobility (under €199 per month) are  
665 the ones, whose relative willingness to pay for a mobility package is the highest. The study  
666 also identified many differences between groups of users with regard to both their current mo-  
667 bility costs and willingness to pay, but based on the linear regression model, background infor-  
668 mation of the respondents explain only a small part of the variation in the amount people are  
669 willing to pay for MaaS. Willingness to pay for MaaS is mostly explained by current mobility  
670 costs and the related mobility habits.

671 The research highlights that MaaS should be able to be competitive in terms of costs as will-  
672 ingness to pay is relatively low when comparing it to people's current mobility costs. People's  
673 willingness to pay for a mobility package is still relatively far from the prices of existing MaaS  
674 services that combine several mobility services. Therefore, it is reasonable to consider whether  
675 MaaS has the potential to succeed on a large scale if people's willingness to pay does not meet  
676 the costs of delivering such a service. This means a considerable challenge for launching suc-  
677 cessful MaaS operations, especially when considering the lack of interest towards a monthly  
678 payment for all mobility costs. A pay-as-you-go MaaS solution may be the pathway for in-  
679 creasing the awareness of mobility packages as people in this study show that the general foun-  
680 dations for MaaS are shared: several mobility services should be available with one ticket or  
681 application and there should be a shift from private cars to mobility services.

682 This study defined a MaaS package as meeting all of the respondents' current mobility needs  
683 through the use of public transport, taxi services and car sharing, for example. In practice, this  
684 means that a MaaS service within this definition is different for the respondents, depending on  
685 their current mobility needs and, for example, the transport services available. Therefore, a  
686 comparison of the absolute willingness to pay in particular is not always meaningful, and re-  
687 sults must also be examined in the light of current mobility needs. The standard deviations of  
688 the research findings were also very large. However, large standard deviations were quite ex-  
689 pected result as the people's current mobility habits and costs also vary greatly.

690 Further research should focus on what types of MaaS services people wish to use, what their  
691 willingness to pay for these services is and at what cost level the provision of such MaaS ser-  
692 vices would be possible. It should also be examined how the attractiveness of MaaS services  
693 could be increased in order for people to be prepared to pay for them and be willing to adopt  
694 them. Further studies on people's willingness to pay should be conducted on a targeted popu-  
695 lation. For example, people's willingness to pay could be examined between cities and rural  
696 areas with different, targeted questions, with MaaS services defined more closely or in several  
697 different ways. Compared to this study, conducting a study only as an Internet survey would  
698 allow a more detailed estimate of people's current mobility habits and costs to be made, which  
699 would also improve the accuracy of the results with regard to people's relative willingness to

700 pay. Related to internet surveys' potential for MaaS studies, Matyas & Kamargianni (2018)  
 701 have highlighted the possibilities of advanced survey methods to capture the multidimension-  
 702 ality of MaaS offerings and people's mobility habits. We find that further research should also  
 703 approach MaaS also from the household point of view as the mobility services should be de-  
 704 veloped for both individuals and households point of views. Also the qualitative research  
 705 should be done to complement the overall understanding of willingness to pay for MaaS. It  
 706 should also be studied what types of effects adopting MaaS would have on people's mobility  
 707 habits with regard to the modal split or car ownership.

708 In future, it should be studied how the MaaS operator can offer a competitive scheme and run  
 709 a commercially viable business. If the costs of running a MaaS scheme are higher than will-  
 710 ingness to pay (indicated currently), MaaS should be able to offer more value for the money  
 711 and increase the willingness to pay, if not benefitting e.g. from public subsidies.

## 712 **ACKNOWLEDGEMENTS**

713 This work was supported by the Kone Foundation (grant number b4b919).

714

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785 **APPENDIX A QUESTIONNAIRE AND COVER LETTER INSTRUC-**  
 786 **TIONS**

787 **Instructions given for the respondents in the cover letter**

788 **Instructions for filling the questionnaire**

789 Current transport system is approaching a point, when mobility turns more into a service.  
 790 Transport is developed to be more seamless and an easier wholeness by the means of develop-  
 791 ing services. This can mean simplicity, e.g. a passenger can purchase the trip from door to door  
 792 with one payment and one ticket. The compilation on mobility services are often referred to  
 793 with the term MaaS, which comes from English words Mobility as a Service.

794 **Terms related to filling the questionnaire** (you may take this page close to you when filling the  
 795 questionnaire)

- 796 • **A mobility service** refers to a service, by which one can travel with many transport  
 797 modes by using one service or one application.
- 798 • **A mobility package** refers to a mobility service, in which one pays a fixed monthly  
 799 payment for a mobility package, which includes a certain number of trips with differ-  
 800 ent transport modes.
- 801 • **A shared car** refers to a car, which is owned by a company or community and which  
 802 can be used by the customers of the company or the members of the community. A  
 803 shared car differs from traditional car rental in that it can be booked also for a short  
 804 period of time and the booking is done with a mobile device or other smart device.
- 805 • **Long-haul public transport** refers to trips over 30km *in this survey*. Trips shorter  
 806 than this are referred to as **local public transport**.

807 **Instructions for different questions:**

- 808 • **In question 5** the right alternative is selected according to the current use. If you own  
 809 more than one car, answer to the question related to car ownership on the grounds of  
 810 the car, which you use the most.

811 The figure in the brackets describes how much each option causes costs on average in  
 812 a month. For example, if your car is currently worth 10,000 - 25,000 euros, it causes  
 813 about 300 euros of costs a month, when taxes, insurances, depreciation, parking, etc.  
 814 are considered.

815 We wish to have answers from all, regardless of owning a driving licence or an own car. If you  
 816 find that none of the alternatives offered in a question is not appropriate, you may choose the  
 817 alternative which is the least bad. When needed, you may elaborate on the answers in the open  
 818 comment fields in the end of the questionnaire.

819

## PART I

## 1. Have you ever heard or read about the concept of MaaS (Mobility as a Service)?

- Yes       No

## 2. What are your views on the following mobility pricing options?

a) **Package pricing:** a fixed monthly fee is paid for mobility. Mobility package can include for example unlimited local public transport and a certain amount of taxi rides or use of a rental car.

- Very positive       Somewhat positive       Neutral       Somewhat negative       Very negative

b) **Current form mixed pricing:** both fixed fees and taxes (e.g. vehicle insurance and vehicle tax) and fees based on use (e.g. fuels and single tickets in public transport)

- Very positive       Somewhat positive       Neutral       Somewhat negative       Very negative

c) **Usage based travel or kilometer-based pricing:** fee is solely based on the amount of use of mobility service or private car

- Very positive       Somewhat positive       Neutral       Somewhat negative       Very negative

## 3. What do you think of the following statements?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
It should be possible to combine all mobility services and use them with single ticket and application (e.g. taxi, train and bus with the same ticket).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would like to have all costs of my travelling to be included in a single monthly payment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think that the cost of my mobility is currently low enough so I can fulfil my daily mobility needs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think that it is difficult or cumbersome to use public transport (including long-distance public transport)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think that personal space, time and peace in private car are important criteria for me when choosing the mode of transport.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think that I can fulfil my daily mobility needs by using other modes of transport than private car.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transport transformation from using private cars towards mobility services would be a desirable trend.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## PART II

**4. How interested would you be in the following mobility services if they were available for use in your daily life or on holiday/business trips?**

**Shared taxi**

Works like a conventional taxi, but there may also be strangers as passengers so travel time can be slightly longer but the cost of travel is reduced

Very interested       Somewhat interested       Not at all interested

**Shared car**

Shared cars would be available nearby to be booked and claimed with a mobile device. The cost would be approximately 1 € / km

Very interested       Somewhat interested       Not at all interested

**5. Which of the following describes the best your current mobility habits and mobility costs? Choose one option for each row that best describes your current mobility habits.** In the parenthesis is the estimate of average monthly cost of each option (see the cover letter for more instructions).

<b>Owning a car</b> (incl. taxes, insurances, decrease in value, parking)	<input type="checkbox"/> No car (0 €/mo.)	<input type="checkbox"/> Car, value less than 10 000 € (150 €/mo.)	<input type="checkbox"/> Car, value 10 000 – 25 000 € (300 €/mo.)	<input type="checkbox"/> Car, value more than 25 000 € (450 €/mo.)
<b>Use of a car as a driver or passenger</b> (incl. fuel, maintenance, tires, washes etc.)	<input type="checkbox"/> No usage (0 €/mo.)	<input type="checkbox"/> Less than 10 000 km per year (50 €/mo.)	<input type="checkbox"/> 10 000 – 25 000 km per year (150 €/mo.)	<input type="checkbox"/> Over 25 000 km per year (300 €/mo.)
<b>Use of local public transport</b>	<input type="checkbox"/> No usage (0 €/mo.)	<input type="checkbox"/> Low usage (10 €/mo.)	<input type="checkbox"/> Weekly usage (30 €/mo.)	<input type="checkbox"/> Almost daily usage (50 €/mo.)
<b>Use of long-distance public transport</b>	<input type="checkbox"/> No usage (0 €/mo.)	<input type="checkbox"/> Usage a few times a year (20 €/mo.)	<input type="checkbox"/> Monthly usage (50 €/mo.)	<input type="checkbox"/> Weekly usage (100 €/mo.)
<b>Use of other mobility services</b> (taxi, rental car)	<input type="checkbox"/> No usage (0 €/mo.)	<input type="checkbox"/> Usage a few times a year (20 €/mo.)	<input type="checkbox"/> Monthly usage (50 €/mo.)	<input type="checkbox"/> Weekly usage (100 €/mo.)

**6. Using the table above, you can calculate an estimate of the monthly cost of your mobility. Do you think that this sum corresponds to the real costs of your mobility?**

- Yes  
 No, the real costs of my mobility are approximately \_\_\_\_\_ euros per month  
 I do not know how much money I use for my mobility

**7. Assume that a suitable mobility package could cover all your mobility needs. What price should the mobility package have so that you would buy it?**

The mobility package would include e.g. public transport, taxi and shared or rented cars.

- \_\_\_\_\_ euros per month  
 I do not know  
 I would not adopt the package

## PART III

8. Assume that you would buy a mobility package and you would not own a car at all. How much would you use the following mobility services? Choose one option for each row!

Shared or rented car	<input type="checkbox"/> Over 15 d/mo. (over 20 000 km per year)	<input type="checkbox"/> Approx. 10 d/mo. (10 000–20 000 km per year)	<input type="checkbox"/> Approx. 5 d/mo. (5 000–10 000 km per year)	<input type="checkbox"/> Less than 2 d/mo. (less than 5 000 km per year)
Use of local public transport	<input type="checkbox"/> Usage almost daily	<input type="checkbox"/> Weekly usage	<input type="checkbox"/> Monthly usage	<input type="checkbox"/> Usage a few times a year
Use of long-distance public transport	<input type="checkbox"/> Usage almost daily	<input type="checkbox"/> Weekly usage	<input type="checkbox"/> Monthly usage	<input type="checkbox"/> Usage a few times a year
Use of other mobility services (e.g. taxi, city bikes)	<input type="checkbox"/> Usage almost daily	<input type="checkbox"/> Weekly usage	<input type="checkbox"/> Monthly usage	<input type="checkbox"/> Usage a few times a year

9. Would you travel more often or longer trips, if

- a) The mobility costs were cheaper than currently?  Yes  No
- b) You had a fixed price monthly package that included an unlimited number of trips?  Yes  No

*The national energy and climate strategy of Finland aims to promote mobility services so that travelling alone by a car reduces and the growth of car traffic in urban areas stops despite population growth.*

10. What do you think of the following statements regarding the climate strategy?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Private car traffic should be limited to reduce emissions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public transport should be funded more with tax revenues to decrease headways	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transport investments should be allocated more to the construction of railways and tramways instead of road and street construction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The obligation of building parking spaces should be waived when building new apartments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In city centres, there should be more pedestrian and public transport streets and limited private car traffic.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shared cars should be exempt from car taxes and parking fees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Congestion charges should be implemented in the metropolitan area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The amount of the tax deductibility of commuting should be same for all mode of transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## PART IV

## 11. Would you want or need to own a private car, if

- a) Public transport connections were good enough to fulfil your daily mobility needs ?  
 Yes     No
- b) Rental or shared car were always available within 500 meters and the annual cost of using it was less than the annual cost of an own car?  
 Yes     No
- c) The annual cost of the mobility service (incl. e.g. public transport, shared taxis and shared cars) was significantly lower than your own car and you could fulfil all your mobility needs with it.  
 Yes     No

## Background information and open feedback

## 12. How old are you?

\_\_\_\_\_ years

## 13. What is your gender?

 Woman    Man    Other

## 14. Do you have a driver's license?

 Yes     No
15. How many people are in your household, yourself included?

\_\_\_\_\_ person(s)

## 16. What kind of house do you live in?

 Apartment house     Row house  
 Detached house     Other

## 17. Do you have any permanent injuries or illnesses that affect your driving?

 Yes     No

## 18. What is your household gross income per month?

 Less than 2 000 €     4 000–6 000 €  
 2 000–4 000 €     Over 6 000 €

## 19. How many cars do you have in your household?

\_\_\_\_\_ car(s)

20. Have you registered for one of the following mobility services: Whim, Kyyti, Kätevä Seinäjoki, DriveNow tai OP Kulku? (**MaaS operators in Finland**)
 Yes     No

## 21. What is your highest level of education you have graduated or studying at the moment?

 Primary school     High school  
 Bachelor's degree     Master's degree

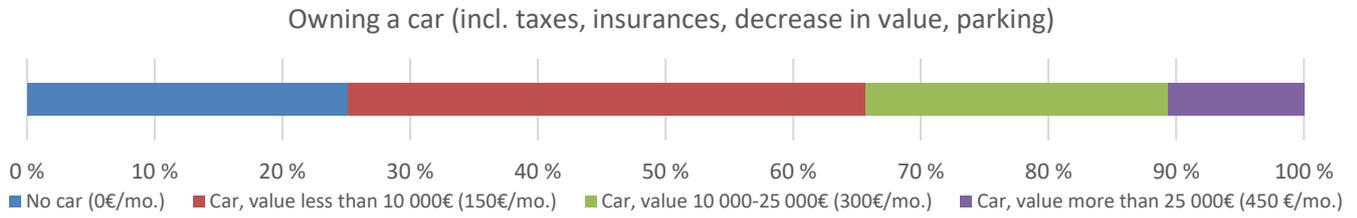
## 22. Open feedback regarding mobility services

## 23. Open feedback regarding this survey

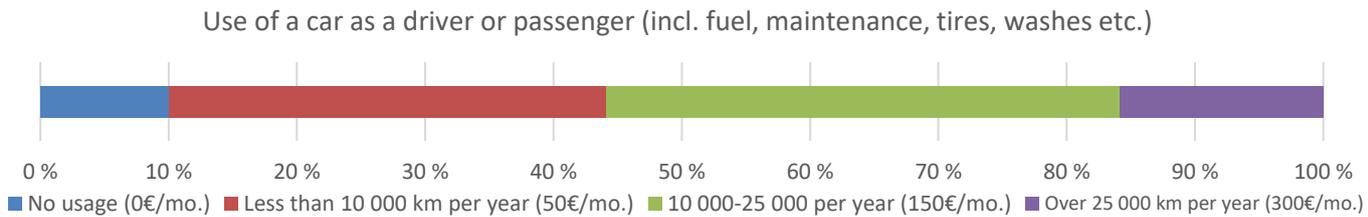
THANK YOU FOR THE PARTICIPATION!

824 **APPENDIX B THE DISTRIBUTION OF ANSWERS BETWEEN DIFFER-**  
 825 **ENT MOBILITY HABITS**

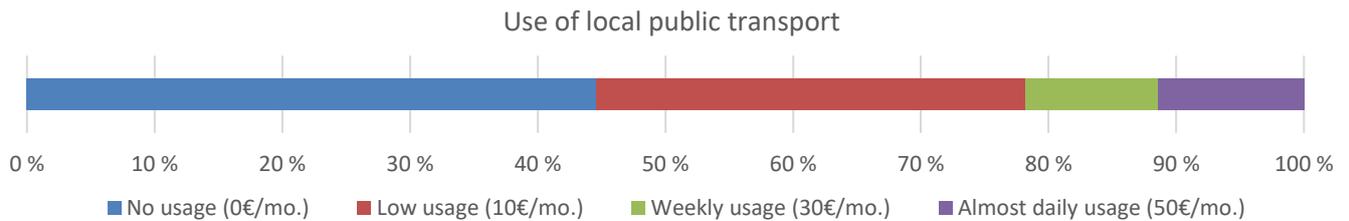
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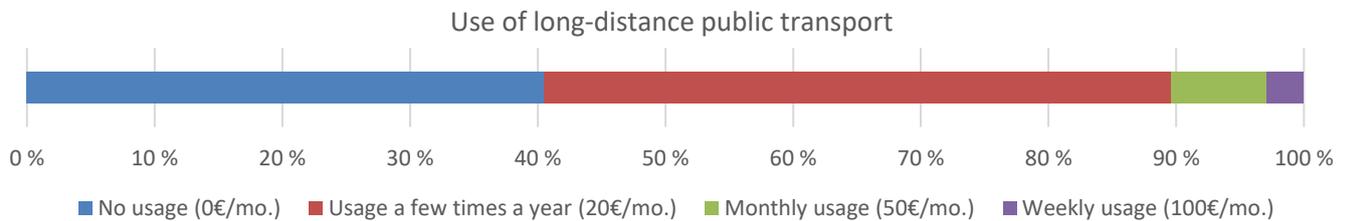
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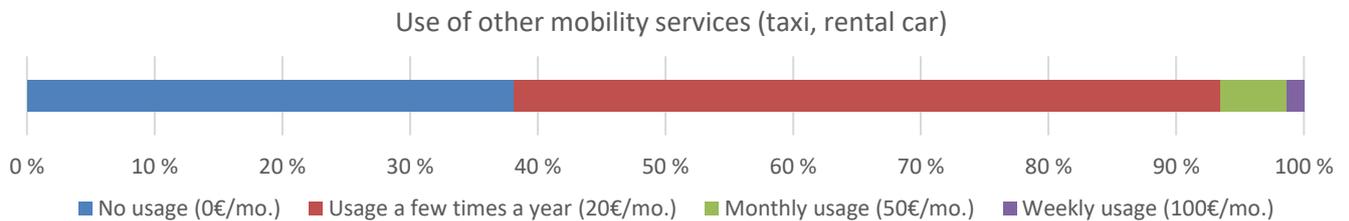


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830

831 **Fig B1.** *Distribution of answers to the question 5: Current mobility habits and estimate*  
 832 *of monthly cost for each option. N=1168.*



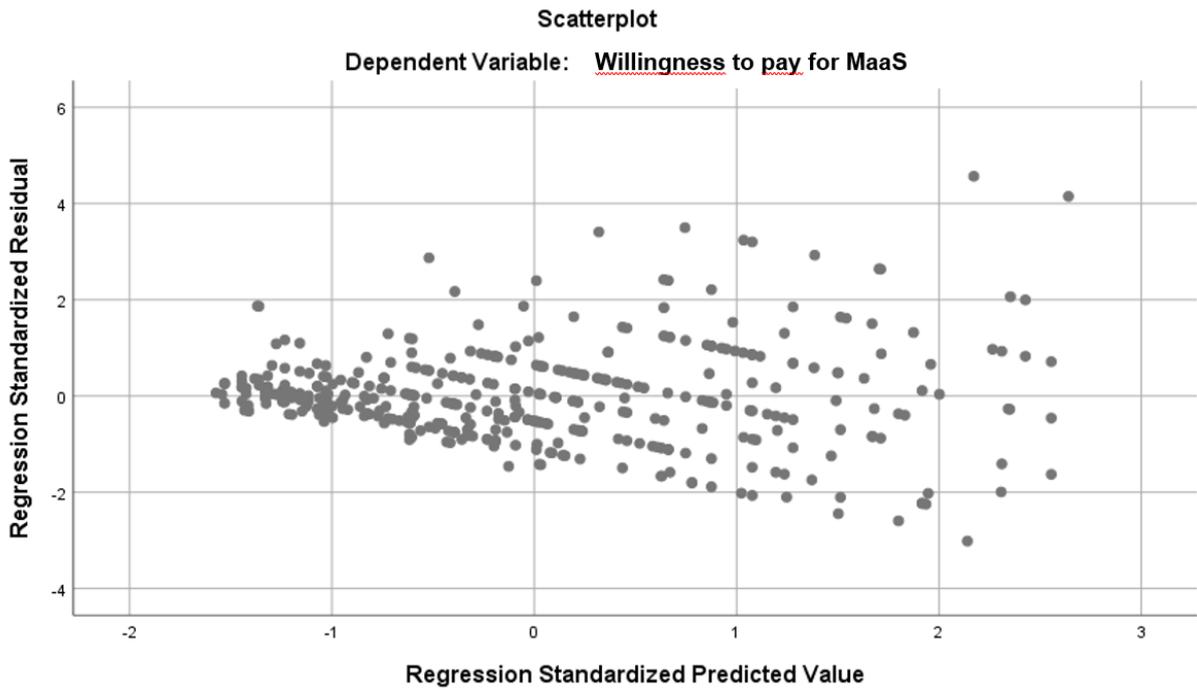
833 **APPENDIX C LINEAR REGRESSION MODEL**834 **Table C1.** *Linear regression model, backward algorithm.*

835

Model		Coefficients <sup>a</sup>						
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-9.390	34.823		-0.270	0.788		
	Current mobility costs	0.321	0.024	0.570	13.163	0.000	0.716	1.397
	Age	0.108	0.337	0.013	0.319	0.750	0.858	1.165
	Gender	14.021	8.856	0.061	1.583	0.114	0.894	1.118
	Household's income	14.785	4.558	0.133	3.244	0.001	0.793	1.261
	Level of education (dummy)	8.229	8.851	0.036	0.930	0.353	0.898	1.113
	Location of residence (dummy)	2.693	8.958	0.012	0.301	0.764	0.880	1.136
2	Heard of MaaS	-11.472	9.936	-0.044	-1.155	0.249	0.927	1.079
	(Constant)	-5.842	32.727		-0.179	0.858		
	Current mobility costs	0.323	0.024	0.572	13.528	0.000	0.748	1.338
	Age	0.122	0.333	0.014	0.366	0.715	0.876	1.142
	Gender	14.057	8.846	0.061	1.589	0.113	0.895	1.118
	Household's income	14.736	4.550	0.133	3.239	0.001	0.794	1.259
	Level of education (dummy)	7.777	8.712	0.034	0.893	0.373	0.925	1.081
3	Heard of MaaS	-11.418	9.923	-0.044	-1.151	0.251	0.927	1.078
	(Constant)	-1.192	30.124		-0.040	0.968		
	Current mobility costs	0.324	0.023	0.575	13.822	0.000	0.771	1.296
	Gender	13.953	8.832	0.061	1.580	0.115	0.896	1.117
	Household's income	14.966	4.501	0.135	3.325	0.001	0.810	1.235
	Level of education (dummy)	7.112	8.511	0.031	0.836	0.404	0.967	1.034
4	Heard of MaaS	-11.075	9.868	-0.042	-1.122	0.262	0.936	1.069
	(Constant)	12.322	25.404		0.485	0.628		
	Current mobility costs	0.325	0.023	0.575	13.832	0.000	0.771	1.296
	Gender	13.293	8.793	0.058	1.512	0.131	0.903	1.108
	Household's income	15.199	4.491	0.137	3.384	0.001	0.813	1.231
5	Heard of MaaS	-12.368	9.743	-0.047	-1.269	0.205	0.959	1.042
	(Constant)	-12.826	15.916		-0.806	0.421		
	Current mobility costs	0.324	0.023	0.575	13.813	0.000	0.772	1.296
	Gender	15.419	8.638	0.067	1.785	0.075	0.937	1.068
	Household's income	15.400	4.492	0.139	3.429	0.001	0.814	1.229

a. Dependent Variable: Willingness to pay for MaaS

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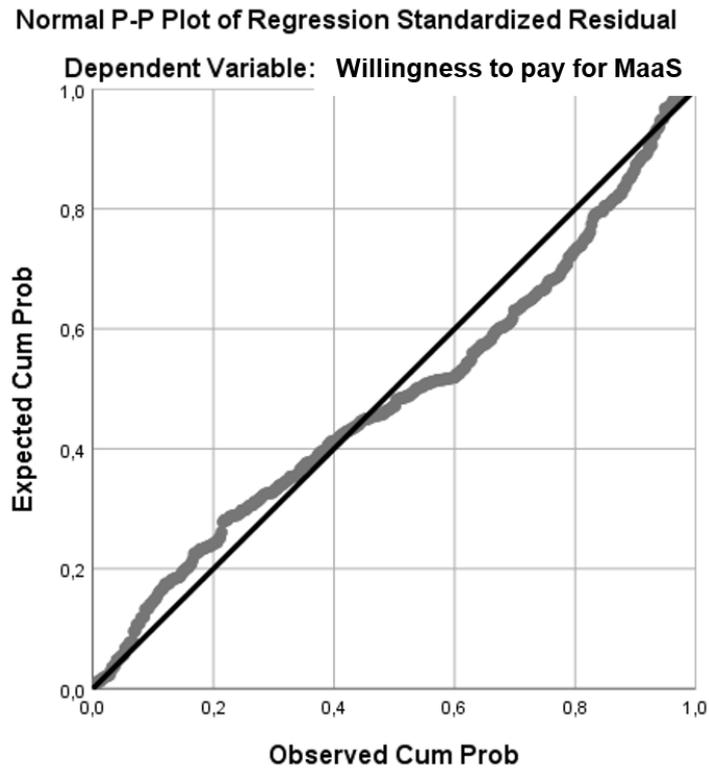


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**Fig C1.** *Residual plot of the linear regression model.*



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**Fig C2.** *Normal distribution pattern of residuals of the linear regression model*

843 **Table C2.** *Statistical significance (ANOVA test) of the linear regression model.*  
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ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2452076.965	7	350296.709	47.750	0.000 <sup>b</sup>
	Residual	3015144.606	411	7336.118		
	Total	5467221.570	418			
2	Regression	2451413.665	6	408568.944	55.816	0.000 <sup>c</sup>
	Residual	3015807.905	412	7319.922		
	Total	5467221.570	418			
3	Regression	2450435.026	5	490087.005	67.093	0.000 <sup>d</sup>
	Residual	3016786.544	413	7304.568		
	Total	5467221.570	418			
4	Regression	2445334.942	4	611333.736	83.753	0.000 <sup>e</sup>
	Residual	3021886.628	414	7299.243		
	Total	5467221.570	418			
5	Regression	2433572.688	3	811190.896	110.970	0.000 <sup>f</sup>
	Residual	3033648.882	415	7309.997		
	Total	5467221.570	418			

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