Mobility-as-a-Service: Tentative on Users, Use and Effects

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Abstract. Mobility-as-a-Service has been argued to lead to more sustainable mobility, but dissemination has hitherto been slow. Private and public actors have raised concerns as to the actual 'market' for MaaS as well as the desired effects. Based on an analysis of an excerpt of available literature, the paper attempts to provide tentative answers to the following questions: Who are the (potential) users of MaaS? And Does MaaS lead to any changes in users' travel behaviour? Prospective studies propose that some user categories (e.g. urban, digitally mature) are more positive than others. The same studies indicate that the services should not be offered as packages but customised to the individual's or household's particular needs for transport and their present travel patterns. Evaluations of pilots reveal a slightly broader user profile. Changes in travel behaviours are reported but also imply that MaaS must offer a higher level of multimodal integration in order for the service to result in noticeable changes in users' travel behaviours.

Keywords: Mobility-as-a-Service · Users · Usage

1 Introduction

1.1 Background

The need for transportation is predicted to continue to rise, resulting in an even further increase in emissions, noise, and congestion. Different more or less successful schemes have been implemented in order to support a shift from less to more sustainable travel including for example economic and legal measures (e.g. congestion charging), awareness campaigns, ICT-based information services (e.g. travel planners, real-time information), development of public transport (PT) vehicles etc., as well as investments into physical infrastructure (e.g. cycle paths). Along with societal trends such as digitalisation, servicification, and the sharing economy, Mobility-as-a-Service (or MaaS) has been argued as part of the solution to reduce the use of private cars and instead increase the use of more sustainable alternatives, such as for example PT and bicycle or car sharing services.

Fundamentally any transport service is a mobility service, i.e. for example public transport and taxi. However, the 'new' concept of 'Mobility-as-a-service' or MaaS includes some additional elements, described as, for example *"… mobility distribution model in which a customer's major transportation needs are met over one interface*

and are offered by a service provider ... //... The central element of Mobility-as-a-Service requires a mobility platform that offers mobility services across modes." (Hietanen 2014) or as *"... a digital interface to source and manage the provision of a transport related service(s) which meets the mobility requirements of a customer."* (Catapult 2016)

However, the implementation and dissemination of MaaS have until now been slow. Analyses have identified a number of barriers including legislation and regulations (e.g. König et al. 2016) as well as a lack of appropriate business models (e.g. Catapult 2016; König et al. 2016). However, another barrier among private as well as public actors concerns an uncertainty regarding the actual 'market' for MaaS (e.g. Kamargianni et al. 2015; Karlsson et al. 2020) as well as the actual effects of MaaS in term of for example a reduction of private car use (e.g. Karlsson et al. 2020).

1.2 Purpose and Method

The purpose of the paper is to present results from a review of an excerpt of publicly available MaaS literature. Included in the review was literature that describes empirical studies in which the service was referred to as an example of MaaS. Grey literature was not included. The following questions guided the review: Who are the (potential) users of MaaS?; What MaaS offers (of any) appear to be most attractive to which users? and Have MaaS been found to lead to any changes in users' travel behaviour?

2 Findings

A substantial part of the still limited empirical literature on MaaS is based on prospective studies with the intention to capture (i) travellers' idea of MaaS and (ii) their assumed willingness-to-pay for the service.

2.1 Prospective Studies

A substantial part of the (still limited) empirical literature on MaaS is based on studies with the intention to capture either travellers' idea of MaaS and/or their assumed willingness-to-pay for the service.

In 2014, ITSEC in Finland conducted a study to investigate people's attitude to MaaS - although no questions were asked about MaaS specifically (Sochor and Sarasini 2017). Instead, respondents were asked about their attitude to different scenarios. Some of these scenarios were perceived as positive, such as one "ticket" for all types of transport, mobility on-demand instead of regular PT and car sharing to save money. Other alternatives were perceived more negatively, such as replacing the private car with taxis and that all trips would be by PT. Differences in attitudes were found between groups. Women were generally more positive to the different alternatives than men, younger people were more positive than older people, frequent public transport users and non-car owners as well as those who used the car more rarely more positive

than those who used the car often and those living in cities were more positive than rural residents. A majority of the 1305 respondents were car owners (78%) and the majority also used the car frequently (66%).

Another study is a survey performed by Intermetra in Sweden (Intermetra 2018). The share of respondents (n = 1528 in total) who found the idea of MaaS to be an attractive alternative was 42%. Approximately 50% did <u>not</u> consider MaaS an alternative for commuter trips – but a possibility for other trips related to daily activities. Most positive were younger adults, women, people living in cities and those with a certain level of "digital maturity".

A common approach has been Stated Preference (SP) studies. An SP-based survey was for example distributed in the Helsinki area, Finland (Ratilainen 2017). The survey presented different MaaS "packages" including subscriptions of different combinations of public transport, bicycle sharing, car sharing, and taxi at different prices etc. Approximately half of the respondents (n = 252 in total) were considered positive to MaaS. The highest interest was found among respondents with PT tickets, younger respondents and those with lower incomes. The respondents were willing to pay for unlimited access to PT in combination with access to bicycle sharing, whereas taxi was of limited interest as was car sharing. In additional information collected by means of e-mails, one of the questions raised was the reason for pre-packaging of the service offer and several of the (limited number) of respondents would rather choose their own package as the suggested ones did not really fit their transport needs.

In another study, personal interviews were held with the 252 respondents in Sydney, Australia (Hensher et al. 2017; Ho et al. 2017). Also in this case different MaaS scenarios were presented but the alternatives were adapted to the respondent's actual possibilities (i.e. no driving license, no alternative included car sharing). One of the conclusions was that the group most prone to subscribe to a MaaS service was the non-frequent car users whereas the least interested were the frequent car users and those who already used PT, bicycle, etc. For these respondents, car sharing and discounts on taxi trips added to the value of the service offer.

The MaaSLab in London, UK, has in several studies addressed people's attitudes to MaaS in general and different MaaS offers. In one of the studies targeting citizens in London (Kamargianni et al. 2017), 70% of the respondents claimed that they would consider subscribing to a MaaS service provided that it offered certain discounts. However, approximately half reported a concern that the subscription would not cover their travel needs and 40% meant that they would feel 'locked in'. However, as many as 50% stated that they would try new modes of transport if provided by the MaaS. In this case the respondents had clear preferences for offers which included PT.

In summary, based on these studies MaaS appear to attract some user groups more than others (Table 1). What type of MaaS was perceived as the most attractive differed between different categories of users.

Table 1. Summary

Users more positive to MaaS	Users more negative to MaaS
Women	Men
Younger	Older
Non-frequent car users	Public transport users Frequent car users
Urban households	Rural households
Low income households	Higher income households
Individuals with a higher level of digital maturity	Individuals with a lower level of digital maturity

2.2 MaaS Pilots

Documentation from systematic and more thorough evaluations of MaaS pilots are (as yet) even more scarce than are the literature describing prospective studies.

MaaS type 1. An example of an early MaaS is Kutsuplus in Helsinki, Finland (2012-2015). A number of minibuses (with a capacity of nine passengers) drove a predefined route from one 'stop' to another. Users used a website to specify a trip and received an offer including time for departure, arrival time and cost. The service was based on advance payment. In a survey distributed after the cancellation of the service, a majority of the users were between 31 and 65 years old, of whom more than half owned a car or had access to a car (Weckström et al. 2018). A majority used the service to a limited degree. The service was used primarily for socio-recreational trips, less for commuting between for example home and work. A majority of users were less frequent car users. Motives for using the service were for example a lack of good PT connections and that the price was lower than for a regular taxi journey. Motives for non-use were that the service was not available at certain times (night) and/or the distance to the "stop" (Weckström et al. 2018).

Another service is Kyyti which today offers on-demand ridesharing for different organisations in different parts of the world. When introduced in 2017, the service was offered to travellers in Helsinki. Customers could choose between travelling alone according to a fixed timetable and at a higher price or to share trip with others at a lower price but then also with a more flexible timetable (Taskinen et al. 2017). Early investigations of who the users were, three different types were found: frequent users (8%), semi-frequent users (46%) and non-frequent users (46%). More than half owned a car and were frequent car users. The share of mode-mixers was larger than for the Finnish population at large (34% compared to 13%). The service was primarily used for trips during evenings and weekends and for transport to/from for example airports, railway stations, etc. in most cases replacing taxi trips rather than other modes of transport. The service did not appear to have affected everyday travel. However, the most frequent users (8%) used the service also for commuting.

In summary:

- Many of the users were car owners and car users although the services were mainly used by less frequent car users;

- The services were primarily used during evenings and weekends and for socio-recreational trips or for trips to/from airport, railway stations, etc.;
- The services were by many users perceived as affordable alternatives to ordinary taxi and more flexible than public transport;
- The services did not appear to significantly have affected everyday travel/commuting.

MaaS type 2. Two examples of multimodal mobility services and some form of evaluation has been documented and made available are SMILE in Vienna, Austria and UbiGo in Gothenburg, Sweden.

The SMILE pilot (2014–2015) aimed to test a prototype for information on and booking and payment of multimodal trips; PT, taxi as well as car and bicycle sharing according to a pay-as-you-go principle. The number of registered users was 1200, but when a survey was sent out to find out more about users and use this was answered by only approximately 25%. The respondents were mainly men (79%), between 20 and 40 years old, residents of Vienna and well educated with relatively high income (smile-einfachmobil.at; Karlsson et al. 2016b). The majority (60%) of these owned a car. Thus, the respondents differed from the average traveller in Vienna and its surroundings and possibly, but not necessarily, from the average SMILE users. The service was used daily by 6% of the respondents and by another 30% several times per week, mostly for private purposes (64%) and for leisure trips (59%). According to the respondents, access to the SMILE service had resulted in that approximately 48% had changed their mobility behaviour, 55% that they more often combined different modes of transport, one out of four (26%) had increased their use of public transport and 21% had reduced their use of the private car. One in ten stated that they often used the bicycle sharing service.

Although the results of the UbiGo pilot carried out in Gothenburg in 2013–2014 have been presented in many contexts, it is still one of the few pilots of an integrated service where there is fairly rich information on users, motives, and possible changes in travel patterns (e.g. Karlsson et al. 2016a; Sochor et al. 2016; Strömberg et al. 2018;). For example, data was collected before, during as well as after the pilot by means of surveys, travel diaries and personal interviews. Households subscribed monthly to a customized subscription, which included trips by public transport, bicycle and car sharing, rental cars and taxi. The trips were "cancelled" via an "app" where users could also check household travel balance, etc. UbiGo households were to greater extent families with children compared to the average Gothenburg citizen, but to a lesser extent single households, students and pensioners. The minimum cost of subscribing to UbiGo was probably a decisive factor for the latter groups, but the UbiGo households otherwise considered the service to be an economically advantageous alternative. Forty-two percent were downtown residents (compared to 23% when considering the entire city). At the same time, it was precisely these centre dwellers with good access to public transport and car sharing that were the actual target group for the pilot. Forty-eight percent of households had one or more cars, which on the other hand compared relatively well with Gothenburg as a whole. An important motive for becoming a UbiGo user was curiosity but over time this changed. Instead, it was the benefits of the service in terms of simplicity, increased accessibility, flexibility and economy that

made them want to remain users. The service was perceived as an alternative by households who considered investing in a car and especially those who would otherwise have invested in a "second car". At the end of the pilot a majority (64%) reported changes in their travel habits and 43% also reported changes in the choice of means of transport. The reported use of private cars decreased while the use of other modes of transport (including active modes: walking and bicycle) increased. Overall, the participants also became less positive towards private car use and more positive towards other means of transport. Furthermore, the participants became more satisfied with their transport solution after becoming UbiGo users, even though some more planning was required.

In summary:

- Many of the users were (also) car owners;
- Users were men and women, single people and families, well-educated with higher incomes and primarily living in urban areas;
- Both services led to increased (reported) use of public transport and other public transport, somewhat more in UbiGo compared to SMILE;
- Both services led to reduced (reported) use of the private car, a little less in the case of SMILE compared to UbiGo;
- The services were used for different trips including everyday travelling /commuting;
- In the case of UbiGo, changes in attitudes and increased satisfaction with available transport options were noted - even though the actual supply of transport options was not really changed.

3   Discussion and Implications

3.1   Users of MaaS

If one compares actual user profiles with the profiles generated in the prospective studies, there are both similarities and differences In the prospective studies (Sect. 2.1) women were more positive than men to the idea of MaaS, younger people more positive than older, urban households more positive than rural, and non-car owners more positive than car owners. In the pilots (Sect. 2.2), the profiles were more diverse. Users included men and women, car owners and non-car owners, families with children as well as without children. Among the users were also PT users. However, the main part of pilot participants were not really young people or older citizens. In addition, there were no rural households – but at the same time the described services were not designed for or targeted this group.

Based on the findings one can neither define 'the MaaS user', nor is it possible to conclude whether those who are attracted by or become users of a type A service differ from those users of a service type B. The studies suggest, however, that in order to be attractive to users MaaS must be customised to the individual's or household's and their particular needs for transport.

Nevertheless, two interesting groups emerge from the available data. One is mode-mixers, i.e. those travellers who already used different modes of transport (including

public transport). It could be argued that a MaaS which offers multimodal integration facilitates and reinforces an already established behaviour rather than requires radical behavioural changes. Another group includes users who experience a need for access to a car, or to a second car, but who do not necessarily need to <u>own</u> the car. In these cases, a MaaS service that offers access to various modes of transport, including car access, can be an alternative to becoming a "car owner" and thus the lock-in effects and perceived problems that this entails (cf. Strömberg et al. 2018).

3.2   Changes in Travel Behaviour

Does MaaS lead to changes in users' travel behaviour? Again, in order to understand the effects on travel behaviour, it is important to relate the results of different studies to what type of MaaS that was offered. The studies summarised in Sect. 2.1 and Sect. 2.2. describe for example unimodal and multimodal services, different principles of payment (in advance, pay-as-you-go, subscription) and services in which information services are integrated and services where it is not.

In order to describe different services, a structure consisting of 5 'levels', or rather typologies, was proposed by Sochor et al. (2017) (Fig. 1). Level 0 refers to services which offer no integration; Level 2 refers to information services, providing integrated information in terms of for example multimodal travel planners etc.; Level 2 services focus on single trips but offer a one-stop shop where users can find, book and pay through the same user interface. Level 3 offers an alternative to car ownership, focusing on a user's complete mobility needs. Level 4 represents a level where for example public authorities influence the impacts of the service by setting conditions for the operators so that they will create incentives for desired behaviours (ibid.)

4	**Integration of societal goals** Policies, incentives, etc
3	**Integration of service offer** Bundling/subscriptions, etc.
2	**Integration of booking and payment** Single trip – find, book and pay
1	**Integration of information** Multimodal travel planner, information on price etc.
0	**No integration**

Fig. 1. A proposed typology of MaaS. Source: Sochor et al. 2017

Another typology – or taxonomy - has been proposed by Lyons et al. (2019). This taxonomy concerns "operational, informational and transactional integration that is suggested to reflect a hierarchy of user needs." (ibid.) and consists of five levels. Level 0 refers here (again) to No integration (no operational, informational or transactional integration across modes) whereas Level 5 describes Full integration under all conditions (fully operational, informational and transactional integration across modes for all journeys).

However, even though both typologies attempt to facilitate descriptions of different MaaS and comparisons of their respective effects on, for example, users' travel behaviour, it is not evident how to classify different examples of MaaS. For example, according to the typology proposed by Sochor et al. (2017) the Kutsuplus service could be categorised as Level 0 (no integration of different modes of transport) but also as Level 2 (integration of booking and payment) whereas the UbiGo pilot could be categorised as a level 3 service as it offered a subscription to an integrated multimodal service but at the same time it did not include any integration of travel information (cf. Level 1). Hence, it is difficult to assess whether the impacts on travel behaviour of a service on a "lower integration level" differ from that of a service of a "higher" integration level.

Nevertheless, the Kutsuplus and Kyyti services appear to have changed users' choice of means of transport, but at the same time the changes seem limited to some situations and types of trips. One could even argue that one mode of transport has merely been replaced by another. The SMILE and UbiGo services appear to have had a greater impact on everyday travel as a whole. One interpretation is that a MaaS must include more than one modality in order for travellers to have access to the alternatives that are perceived best suited for the specific situation and for different types of travel and further that MaaS must offer a higher level of integration in order for the service to result in noticeable changes in users' travel behaviours.

However, one can also contemplate that some types of MaaS may create important mental as well as actual "steps" between the two endpoints "100% private car use" - "100% use of other modes of transport". It can for example be argued that Kyyti (as described in the literature referred) may have appeared as another form of taxi, a type of service which has similarities to something well known – but which is at the same time something else. Hence, the 'perceived risks' are likely to be small compared to other and more radical alternatives. Nevertheless, by daring to try this service (and given that it works satisfactorily), the individual's perceived action space can change (cf. Strömberg 2015) and in the long run lead them to dare try also other service options.

Considerably more empirical data is needed to draw but tentative conclusions regarding what type of MaaS attract which type of users and what the effects of different types of MaaS may have people's travel behaviour. This will require more pilots and pilots in which systematic and thorough evaluations are made.

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