THE USE OF MAAS SERVICES: AN EXAMPLE OF THE POLISH Y GENERATION

AGNIESZKA SZMELTER-JAROSZ

Chair of Logistics, Faculty of Economics, University of Gdańsk (UG)

Socio-economic changes and evolving IT environment led to the emergence of new mobility solutions, very popular in urban areas. New Mobility Services (NMS), including Mobility-as-a-Service (MaaS) are now an integral part of short- and long-distance transportation service portfolio in many countries and are offered both by companies (public or private) and individual bidders. The challenge for the service providers is now to adjust the business models of those solutions to the customers' needs. The particular layers of designing MaaS solutions are crucial to meet the requirements of users, especially young adults (Y generation), considered as the primary target group for MaaS offer. Therefore, the study aims to examine the level of awareness of the MaaS market offer and, in addition, a range of use of those solutions.

Keywords: Mobility-as-a-Service, MaaS, IT, public transport, mobility choices, y generation, software development, mobile applications

1. Introduction

Changes in the area of the terrestrial mobility (especially increasing number of travels) and good access to modern technologies create new challenges for mobility service providers, both private- and public-owned, but also a new, emerging ones – the individual bidders. Because of the sharing economy trend, the traditional model of ownership has changed. To address all the problems related to customer-oriented or customer-centred approach in the area of mobility services, Mobility-as-a-

Service solutions (MaaS) will play a huge role. They would probably solve the problems with congestion and a lack of parking space, especially in the city centre areas. In addition, MaaS can address some issues specified in sustainable urban mobility plans (SUMPs) created for many cities around the world. What is more, most of the MaaS offers are related to car use, and compatible with so-called "car culture", presented by many societies, especially in Europe, Japan and USA.

The study aims to examine the level of awareness of the MaaS providers among young adults in Poland and in addition, a level of use of such solutions. After achieving this objective, some directions can be drawn for further research on the discussed topic and for the development of those solutions.

The best of the researcher's knowledge, this area has not been empirically studied for Y generation in Poland. In addition, the literature review carried out to prepare this paper did not address this issue. Therefore, there is a research gap to be filled in by examining the choices of the Polish young adults. Taking into consideration the above-mentioned arguments, the main research question in this paper is:

RQ1: Do the Polish young adults know and use the MaaS solutions?

The answer to this question addresses the problem of developing such solutions and can be helpful for MaaS providers to improve their offer.

The paper is organised as follows. The first section gives a review of the literature on the studied topic, according to the chosen literature review procedure, search engine and search criteria. The second part of the paper presents the methodology of the main research, namely survey. The third section contains research results divided into general ones and those for the specified respondents' group. The last one part concludes the paper, presents its limitations and specifies areas for future research.

2. Literature review

2.1. Procedure

To obtain reliable results of the literature review, the chosen procedure for defining the publication base have been used. The analysis was aimed at identifying critical areas of knowledge on the use of MaaS, then to verify them among the group of respondents and compare with the results obtained by other researchers.

The procedure chosen for this study was based on the Denyer and Tranfield's approach [1], which is defined as proper for exploratory socio-economic research. This standardised research procedure makes research in this paper transparent, replicable, exclusive, aggregative and heuristic. It aims to identify trends and main characteristics of the studied subject to continue research work using other methods.

To objectify the process of building the literature database in the stage on determining primary literature, Boolean logic was used, in which the merit criterion was publication title ("mobility-as-a-service" or "MaaS" in title), and the technical one- full-text records. The time criterion was not specified, although naturally, due to the novelty of the main research topic, the selected articles were published from 2011 to 2018. The EBSCOhost search engine was used to carry out the search procedure.

2.2. Results

After the implementation of the literature review procedure, including removing duplicates and analysing the abstract and text of chosen literature, only 14 papers were identified as those strictly related to the studied subject and object.

Mobility services are a group of traditional and new solutions offered by individual bidders, public and private companies to customers to travel the route from the starting point to the destination point [2]. New Mobility Services (NMS) are a part of the market offer and emerged ca. 2010 as a result of last socio-economic trends. The mentioned trends include the sharing economy with its part - shared mobility. Within the group of NMS, a subgroup of Mobility-as-a-Service (MaaS) can be derived, delivered both by private car owners (C2C) and by fleet owners (B2C, B2B, B2A), with use of web portals or (in most cases) mobile applications.

The basic level of integration is the partial integration of MaaS, that makes it impossible to exploit the full benefits from the integration of different mobility solutions (for example a lack of tickets buying services on the MaaS platform), only checking and analysing the possible journey routes. Advanced integration is represented by most of MaaS solutions, and its core is aimed to integrate the public transport with car sharing, taxi systems, long-distance travel services and car rentals. Its more developed form is advanced integration with mobility packages, offering pre-purchasing of service packages, also for specific socio-economical groups like families and businesses.

MaaS systems consist hardware (especially important when offering semi-autonomous or in near future – fully autonomous cars), and software (mapping, identifying localisation, dynamic virtual bumper, booking system, planning and steering control, external communication, detecting objects and their path) [3]. The structure and nature of the elements that make up such a system should take into consideration environmental factors, human factors (intuitive user interface), law issues (safety, anti-vandalism), security (data privacy, hacking resistance) and scalability. Devices that operate in MaaS environment communicate with each other using the D2D communication (device-2-device) by building a communication network. Those systems contain a built-in complex analytical system that allows, for example, preparing routes map based on the user's profile, analysis of previous routes and declared goals that make up the person's mobility pattern [4].

MaaS can be developed in different variants in different countries. Well-known approaches in this area are market-driven scenario, public controlled development and public-private development. In public transport, many values are essential to be established and improved, such as competence structure, brand value, access to MaaS, business model [5].

Elements of MaaS IT solutions are, according to Bouwman et al. approach [6], divided into four groups: service design, technology design, organisation and finance design gathered from different sources and presented by Szmelter [2; see Table 1]. The service design is a part of the important in the value creation process.

MaaS is inspired by cloud computing in the field of transport. The complex structure of those systems, especially modelling and forecasting of data, is hidden by user-friendly interface [7]. Therefore, a good Business Intelligence tool should be developed to analyse big data from various sources in real time. Usually, they are administrated and owned by mobility operators (still called by most researchers and practitioners "transport operators"). The best way to create the mobility market is cooperation between those operators (federation of operators). In this way, they can attract the offer by allowing the use of their services jointly with those of the partner. This generates substantial synergy effects for both transaction parties. MaaS provide two kinds of functionalities: transport on demand, subscription service (kinds of buying the ticket, fixed or pay-as-you-go), and additionally – the potential to create new markets [8]. Two features describe them: technology and availability. They are intended to provide benefits for individual users, public and private sector.

MaaS services address the whole journey on short distances and the first and last mile of the journey in long distances by offering developed public transport services and other mobility services provided by private companies. The main characteristic of all MaaS is the possibility of using it by booking the means of transport with use of the mobile application. It can be short- or long-distance travel, but as it was said before, the main focus is made on short-distance travel. This, in turn, will result in lower private-own car number, and less traffic congestion and greenhouse gases. In turn, customers expect a short waiting time, travel time and great comfort, which is why the most popular solutions are car sharing and ridesharing. The challenges on the MaaS market are many and require the use of, among others: advanced forecasting and agent-based day-to-day adjustment process, advanced pricing models [9], MaaS development scenarios by use of interviews [5], trials with autonomous shared cars [3], building and testing tier-structured MaaS solutions [7], presenting device-level information-centric networking architecture [4], network modelling (simulation) according to price fragmentation approach [10], semi-structured interviews with users [8], capability-driven approach [11], or simulation of functioning such a system [4]. Adjusting the current state of the

transportation systems to the market needs can also be done by using the patterns from MaaS applications [2,12,13], implementations in cities [14], and new approaches to MaaS development like, for example, end-to-end virtual mobile networks [15]. Further, much more detailed analysis of all MaaS systems in 2017 was made by Jittrapirom et al. [16] and Johansson [17].

Table 1. Functionalities and elements of MaaS IT solutions

Area	Element/functionality
Service design	Journey searching (fastest, cleanest, cheapest)
	Trip planning
	Trip advising
	Trip comparison
	Traffic analysis
	Price analysis
	Journey booking, integrated booking
	Activating tickets/trips
	Checking trip history
	Customer service (24/7 service)
	Application and web solutions
	Detection of passive deviations (e.g. Weather) and active (e.g. driving too slowly)
	Navigation system
	Online information about delays
	Feedback messages system
	Integrating other city mobility services
	Travel diary and its analysis
	Integration with planned meetings and mobility assistance
	Intermodal routing analysis, inter-solution routing analysis
Technology design	Integration of real-time data including open data (e.g. timetables), social media data, sensor data and crowd data (e.g. user device data)
	Data safety
	RFID
	Real-time service
	Compatibility with iOS, Android and other operating systems
	Big data analysis
	Trip forecasts system
	Fleet management options
	Integration with Decision Support Systems
	Cohort analysis and forecasting
	Layout personalization possibilities
	Real-time connectivity between vehicles (V2V) and between vehicles and infrastructure (V2I)
	Integration with calendars (MS Outlook, Google Scholar)

Table 1. Functionalities and elements of MaaS IT solutions (cont.)

Organization design	Integration of service providers (including e-mobility providers and public transportation)
	Organizing a partnership model with other providers
	Project management issues
	Product lifecycle management
	Integration with partners
	Defining data sharing policy
	Revenue and cost-sharing agreement
	Defining geographical scope (regional, regional and urban, only urban)
	Defining a number of modes
Finance design	Payment
	Price models
	Checking balance
	Currency rates integration
	Charging
	Calculating fixed costs
	Payment possibilities
	Common payment tools and clearing procedure

3. Research method

The primary research method was the survey method, an online, anonymous survey. The main tool in this method - the questionnaire contained questions regarding attitudes, behaviours and opinions. Its part contained questions about MaaS use and opinions about these solutions. The questions were modelled on the available interview sheets, and questionnaires in current literature on the mobility of young adults, also called the Y generation, and if that was impossible to reach these questionnaires in the selected literature - based on the research results and conclusions described in these papers. After the pilot study and amendments in the questionnaire, a survey among representatives of the Y generation was preceded. The surveyed persons were recruited with use of a purposive strategy [18,19] based on the inclusion criteria that the participant should be born between 1981 and 1999 and be a Polish citizen (see Table 2). As an additional approach, a snowball sampling method was used [20] to increase the number of participants because random sampling procedure in the case of this study was hard to reach. The survey was held from March to November 2018. 437 people took part in the survey. The data collected while conducting the survey was mainly qualitative, two- or multi-level data. Variables were described on nominal and ordinal scales. For this reason, as the first, descriptive statistics and cardinality tables were used to characterise the surveyed group and present some general results for young adults as one group.

4. Research results

First of all, the MaaS idea was familiar to the respondents. What is extraordinary, every surveyed person knew the MaaS solutions (see Table 3). As it turned out, the most popular MaaS services are provided by Uber, myTaxi and BlaBlaCar. What is surprising, the first and second of them appeared on the Polish market very recently (Uber in December 2013, myTaxi in February 2013), and not only in every big city at the same moment (most of those solutions were launched firstly in Warsaw, then in other Polish cities). This fact shows the dynamic growth in the number of clients using taxi and para-taxi services with the use of mobile applications. In general, the car-related MaaS are popular in Poland (except to 4Mobility, available only in Warsaw). On the other hand, the applications enabling the scooter rental (Blinkee, Scroot, JedenŚlad) were not popular in the surveyed group, however, if the study was repeated only among the residents of the Polish capital city, the results would undoubtedly be higher, because for this city usually the other residents' attitudes and choices can be presented than for other Polish cities.

Table 2. Characteristics of the research sample

Category	Result
Year of birth	1981-1990 19,22%; 1991-1999 81,78%
Sex	Female 56,50%; Male 43,50%
Student status	Bachelor students 53,3%; Master students 9,8%; Doctoral students 0,7%; Graduate 35,5%, Non-student 0,7%
Personal status	Single 41,4%, in a relationship; 51,9%; married 6,6%
Place of residence	City 500.000p or more 19,0%; City 200.000-500.000p 39,4%; City 100.000-200.000p 7,1%; City, 50.000-100.000p 8,5%; City less than 50.000p 15,6%; Countryside, suburban zone 6,2%; Countryside 4,3%
Housing status	Own flat/house (without mortgage) 23,1%, Own flat/house (mortgage) 4,3%, Flat/house owned by family 29,1%, Rented flat 38,7%, Dormitory 4,8%
Household size	One person 6,6%; Two persons 41,0%; Three, four or five persons 48,5%; More than 5 3,9%
Kids in the household (0-16 years old)	Yes 9,8%; No 90,2%
Monthly income per person	500 PLN or less 2,7%; 500-1000 PLN 8,7%; 1000-1500 PLN 18,1%; 1500-2000 PLN 20,8%; 2000-3000 PLN 20,8%; 3000-5000 PLN 15,3%; more than 5000 7,3%

The respondents in this survey use practically only taxis or parataxis, the most popular of which are Uber and myTaxi (short-distance), then BlaBlaCar (long-distance) and Traficar (short-distance). An unusual case of the free-floating car-sharing system in Poland is Traficar, currently operating in 6 locations (Tricity, Warsaw, Wroclaw, Poznan, Cracow, Silesian agglomeration), launched in October

2016. The number of the Traficar users grow rapidly, what is confimed by the data in this paper. 62,5% of respondents know this MaaS solution, and almost 10% use this for travelling within the city and suburban areas because those locations are the most popular among the Traficar users. This solution is based on the network of stations (usually the gas stations of one of the most popular gasoline supplier) and the free-floating car-sharing system (the user can leave the car wherever he wants), so the business model of this solutions is very new, and the services – flexible and individualised.

The potential for the development of MaaS services can also be considered through the prism of young people's opinion on these solutions because this will affect the future value of the market and the participation of individual service providers in the mobility sector. Due to the young age of economic activity in the sphere of mobility, such opinions should be taken into account. According to research, more than half of young people use mobile applications to order a taxi and more than 10% of respondents use MaaS services at least once a week (see Table 4). More than half of the respondents admitted that they use those solutions, although the frequency of using them is various. About 77,5% of respondents positively perceive the introduction of para-taxis (e.g. Uber) on the mobility market. 57,74% of respondents confirm that the concept of car sharing is well-known. About 20% present the opposite opinion, perhaps due to the fact that most of these people do not use MaaS services. Surprisingly, over 58% of young adults believe that the introduction of urban cars on demand, in the hourly rental system, would be beneficial for modern cities.

Table 3. The awareness of MaaS brands in Poland among young adults

Knowing the MaaS	No. of people	% of people	Use of MaaS	No. of people	% of people
Generally	437	100%	Generally	244	55,8%
Uber	431	98,6%	Uber	206	47,1%
BlaBlaCar	430	98,4%	BlaBlaCar	89	20,4%
Ecocar	268	61,3%	Ecocar	12	2,7%
iTaxi	240	54,9%	iTaxi	23	5,3%
myTaxi	385	88,1%	myTaxi	128	29,5%
Traficar	273	62,5%	Traficar	40	9,2%
Taxify	93	21,3%	Taxify	12	2,7%
Blinkee	73	16,7%	Blinkee	6	1,4%
Scroot	40	9,2%	Scroot	5	1,1%
JedenŚlad	51	11,4%	JedenŚlad	2	0,5%
4Mobility	50	11,4%	4Mobility	2	0,5%
Other	87	19,9%	Other	33	7,6%

All the above results indicate a positive perception of the mobility market offer in the field of MaaS services by young Poles, generation Y. The respondents declared both the use of these solutions at a high level and a high assessment of their suitability for society. The results of the study give the group some optimism when it comes to predicting the future of this services market. Certainly, with time, positive assessments of participants who do not use MaaS will result in the use of these solutions.

Table 4. The opinions of young Poles about launching the car-related MaaS on the market

Question	Result
Do you use the mobile application to call a taxi?	Yes (55,84%), No (44,16%)
I use the mobile application to call a taxi or para-taxi or shared vehicle.	Yes, every day (1,60%), Yes, couple times a week (4,12%), Yes, once a week (8,01%), Yes, less than once a week, more often then once a month (16,93%), Yes, once a month or less (23,80%), No (45,54%)
Launching the Uber and similar solutions is good, I like it	(1- I completely disagree; 5 - I definitely agree) 1 (1,60%); 2 (2,52%); 3 (18,31%), 4 (34,10%), 5 (43,48%)
I like the concept of the shared cars or renting cars on demand.	(1- I completely disagree; 5 - I definitely agree) 1 (2,97%); 2 (9,61%), 3 (19,68%), 4 (32,04%), 5 (35,70%)
Urban car (public, rented per hour) is a good solution for cities.	(1- I completely disagree; 5 - I definitely agree) 1 (4,58%); 2 (9,38%), 3 (27,69%), 4 (38,67%), 5 (19,68%)

5. Conclusions, research limitations, future research directions and plans

This research showed the attitudes of Polish young adults to use Mobility-as-a-Service solutions. The answers of the respondents enabled achieving the study goal. The travel behaviour of Polish young adults characteristics and tendency to present specific behaviours within the area of mobility can be the basic assumptions for mobility services development, including IT solutions. The strong tendency to use MaaS solutions is visible, taking into consideration the pace of growth in this market worldwide, but especially in Poland. Solutions launched to the market only a few years ago are definitely recognisable and used by a large percentage of the respondents, so can be a contribution to believe that similar results can be achieved for the entire population.

Though, the idea of MaaS is very promising regarding the level of its awareness on the Polish market. The next steps of the data analysis will be focused on the examination of the differences between the men and women, younger and older cohorts, urban, suburban and rural residents, and according to their marital and parental status, housing status and level of disposable income. The obtained results should be compared to those available for other societies.

Though, it should be noted that this research has few limitations. Firstly, the literature research method concerns only papers with particular search criteria. Therefore, there is a risk of omission of papers related to the studied topic. Secondly, no random sampling method was used to carry out the survey. Therefore, the presented research results can be less reliable. Consequently, the results of this survey cannot be extrapolated to the whole population of Polish young adults.

Despite those limitations, the described research results are promising and can serve as a basis for further research, comparisons, developing the software or verifying the existing one. Further research should be conducted to obtain more data on Y generation mobility choices, the use of mobile MaaS applications, and other dimensions of screening the mobility market. In addition, comparative analysis can be made not only for young adults in different countries but also for different age groups (generations) to provide the guidelines for the development of MaaS software dedicated to various user groups.

Technological considerations are one of the main issues related to smart city creation and its operations [21]. That is the reason for developing the research in the areas of real-time big data analysis, the creation of a communication network, for example, development of D2D network schemes [4]. These and many other issues in the area of generations' mobility should be addressed in future theoretical and empirical research.

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