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User Preferences for Mobility as a Service (MaaS) Implementation in Germany

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DOI: 10.48494/REALCORP2024.8066

1 ABSTRACT

Mobility as a service is an innovative concept that has become important due to the vast demand for mobility options in smart cities and cities focused on sustainability. Many studies have been researched on smart mobility options, and the important element is mobility as a service. Many authors concluded that user acceptance is the key feature of MaaS. However, there is a research gap in the criteria evaluated by the users before accepting MaaS hence the below research questions were developed for this study.

Keywords: MaaS, Mobility as a Service, Smart Mobility, user preferences, Smart City

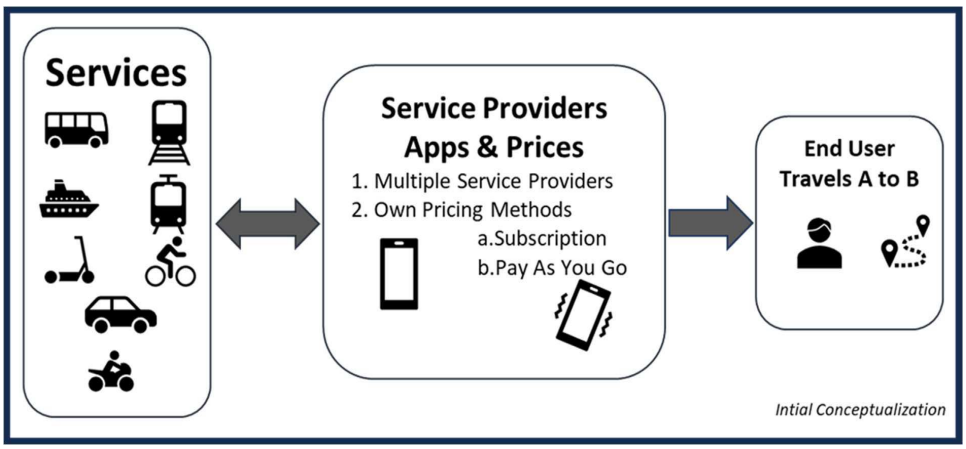
2 INTRODUCTION

The increasing demand for mobility and digitalization has boomed new mobility services. MaaS is known to be a key solution to limiting the ownership of private cars and promoting intermodal various transport options with the convenience of planning, booking, and payment via a single platform (Smith et al. 2019). Practical experience with this service is evident as some of the cities around the world have opted for MaaS for the transport sector. Even though the foundation of smart mobility MaaS The birth of existed in the late 1990s the birth of MaaS word was introduced by a thesis student in Finland, Sonja Heikkila in 2014 incorporating digital service and mobility ecosystem. The supervisor, Sampo Hietanen incorporated MaaS Global in 2015 and introduced the first ever MaaS platform “Whim app” in Helsinki, Finland (Citie-today, 2021).

Mobility as a service is deemed as an advanced ecosystem that leads to disruptive changes in the transport system (Alyavina 2022). This concept does not provide access to individual transport services but offers transport services when it is needed (Enoch 2023).

Germany located in the heart of Europe, has a vast range of mobility hubs that cover land, air, and water transport modes hence research on MaaS is an interesting phenomenon to understand the user acceptance for a single platform that provides all forms of transport options. Although the public and shared transport modes have a significant share in the transport system, Private car ownership was 48m in 2020 (ACEA, 2022). A study concluded that private vehicle owners have underestimated the cost of using a private mode of transport providing these facts will influence users to move to sustainable transport modes and reduce carbon emissions (Andor et al, 2020).

Annual growth of 11.95% is estimated for shared mobility from 2020-2026 and potential shared mobility users of 63.4m by 2026. The cost has been the main factor in opting for private or public and shared mobility modes (Skedgo, 2022).



This research focuses on user preferences when accepting MaaS in Germany. The smart city index analyzes all German cities in five categories. Administration, society, transport, IT infrastructure, and energy/environment. Hamburg has topped the smart city index for three consecutive years, 2019-2021. By 2030 Hamburg targets to achieve goals set in "ITS strategy" in 2016 (a-tour, 2021).

The coalition agreement signed in 2021 by the partners of the new government focuses on green and zero carbon emissions for the German economy. The highlights of the transport policy are a significant investment in rail transport over the road an increase in the rail freight share by 25% by 2030 and a 100% increase in existing passenger transport, 75% of the rail network to be electrified by 2030, support digital mobility services, innovative mobility solutions and promote long term strategies for autonomous and linked public transport, etc. (Changing Transport, 2021).

3 LITERATURE REVIEW

3.1 Smart mobility

Smart mobility is defined as an expert system that provides access to mobility services via a combined platform by Dorchery et al. (2018). These platforms enable the community to forecast the transport demand accurately also the platform provides details of prevailing smart infrastructure. As explained by Salvia et al. (2016). Sustainability and safety are the two main aspects that fulfill the smart mobility system. The mobility system should be integrated with intelligent systems which allows the users to get traffic information in real-time. The need for a sharing economy has driven many commercial sectors which has offered new business opportunities and scraped traditional sectors (Acquier et al. 2019). Mobility markets that follow a sharing economic model have been driven in many urban and rural cities across the world (Hamari et al., 2016; Yin et al., 2018). The first shared electronic scooters are in business use in Finland and drones are used in Finland to identify the need for package transport. Bike and Scooter-sharing options have boomed in many cities (Loidl et al. 2019).

3.2 Multimodal transport system (MTS)

MTS is commonly defined as using one or more transport modes to complete a trip (Aparicio et al. 2022a) cross mobility is another alternative word used for multimodality. The usage of MTS has enabled the transport system to be effective and coordination between different transport modes has proven to reduce congestion and provide alternative transport modes in case of a malfunction of the existing transport mode (Aparicio et al. 2022b).

With the initiation of sustainable development goals of the United Nations, the need to increase sustainable metropolitan approachability and cater the travelers with high-quality, long-term mobility within the cities has arisen. This can be achieved when sustainable mobility solutions are interconnected and diversified which allows the entire transport system to be effective and robust (Aparicio et al. 2022c).

Many Multimodal transport providers use marketing as a crucial tool when developing MTS. The transport providers promote MTS through service innovation including offering discounts via contracts or making the pricing model attractive by reducing the cost and increasing efficiency to be competitive in the market (Liu et al. 2022). MTS involves one or more individual service providers hence coordination amongst multiple carriers is required however there are many challenges faced by the service providers. One main challenge is to estimate the impact of the interruption of transport modes. The other challenges are organizing the time of transfer to reduce the number of transfers in the direct route and maximize the efficiency of the MTS (Dong et al. 2022). MTS can be offered via a mobile app, and not by transport mode itself as it will be more user-friendly for the traveler to plan the trip as the traveler could choose the desired option from the wide range of mobility options (Yifei et al. 2022).

3.3 Mobilty as a Service (MaaS)

MaaS concept was introduced by Hietnaen as an Ecosystem where customer demand and the suppliers' bundled mobility solutions are integrated via a digital interface of a service provider. Hietanen (2014), defined MaaS as "a single interface that combines different transport modes to offer a tailored mobility package, similar to a monthly mobile phone contract, which could include other complementary services, such as trip planning, reservation, and payment."

MaaS is not defined as a simple technology feature but instead a new feature as to how transport modes are provided and used (Audouin and Finger 2018).

MaaS evolves around the user and intelligent mobility management with the support of ICT and the service providers who offer various transport options for end users' demands via a single digital platform which allows the users to plan, book, and make the payment (Eltis. org, 2022a).

MaaS is where the mobility services are obtained via a package based on the users' demand and not purchasing the mode of mobility. Maas is a crucial element in discussions with future mobility. Due to intricacies in this field of research, MaaS can be addressed as an emerging field of future mobility that involves a broader vision in mobility, a new information and communication technology (ICT), Changes to traditional user behavior, or a change to overall transport option (Jittrapirom et al., 2017).

3.4 User preferences

The extant knowledge of MaaS users is carried out based on quantitative studies of people with no knowledge or in-depth insight into MaaS (Matyas and Kamargianni 2021). Many studies have been carried out to understand who would opt for MaaS. A study was carried out in MaaS operation countries Finland, England, and Australia and it was concluded that 40% of the adults are willing to opt for MaaS if their entire transport needs are met and the overall cost would be lowered ((Kamargianni et al. 2018; Liljamo et al. 2020; Vij et al. 2020).

A study conducted in Sydney concluded that 50% of the respondents would be subscribed to a MaaS plan. Also, infrequent users of cars have a high tendency to adopt MaaS. However, participants who use or do not use cars daily would not opt for MaaS (Ho et al. 2018).

Socio-demographic characteristics a key to the implementation of MaaS. A study conducted by Matyas and Kamargianni (2021) revealed that the age of the user is a key aspect of shifting to MaaS. A study in the Netherlands discovered the age group of 18 to 34 years tends to use MaaS platforms (Alonso-González et al. 2020) Another study carried out (Sochor 2021) affirmed that Socio-demographic factors commonly discovered as positive influences towards MaaS in density-populated areas. Early adopters of MaaS are extremely mobile, with increased socio-economic levels, higher levels of education, and personal income (Zijlstra et al. 2020).

3.5 Preferences of transport service providers

Service providers of MaaS are a crucial aspect to be analyzed. Public transport providers were identified as "the backbone of MaaS" and if the public sector takes over in operating MaaS it will be easier to work together with everyone being the mobility regulator and authority of the city. Kamargianni & Matyas (2017). Nevertheless, the public sector being a nonprofit organization and a bureaucratic structure, expanding to MaaS service provider, will take a consideration the time and limitations in terms of introducing innovative solutions. On the contrary, if the private sector is the authority to implement and manage `MaaS` overall operation will be quicker, and as the private sector has the capital to invest in innovative solutions. The public sector may not collaborate with the private sector as they think it will tarnish the brand image Kamargianni & Matyas (2017). A crucial element of the MaaS platform is to integrate the entire transport service providers not merely implement the existing transport modes into one platform. This should include "vehicle fleet optimization and relocation strategies" while designing the platform. When it comes to car, bike, and scooter sharing it is vital for the user to know where it needs to be dropped off at the end of the journey. A designated area, where the next user or maintenance team has easy access. The research carried out by Li and Voege (2017), revealed that incorporating public transport providers' real-time data is the key when serving customers via MaaS. This article concluded that some private and public transport providers are reluctant to share real-time information with MaaS service providers which is a limitation when implementing the MaaS platform. In the research conducted by Jittrapirom et al. (2018) on the public sector's view on framing policies for future MaaS implementation, the extended analysis conducted with the experts of public authority discovered that there are various barriers including the culture of the existing public administration, lack of proficiency of Maas Service providers, lack of regularity and insufficient mobility modes to be included in the platform, lack of collaboration with stakeholders, fear of losing control and monopoly of the public sector has been limitations when framing policies for MaaS.

4 RESEARCH DESIGN

The objective of this research is to examine the current demand for MaaS in Germany, the desired mobility modes and additional features and obstacles experienced by the users when opting for mobility solutions via a MaaS platform, and the desired pricing model the users are willing to pay for mobility services.

4.1 Research gap and research questions

Mobility as a service has become an important aspect due to the vast demand for mobility options in smart cities and cities focused on sustainability. Many studies have been researched on smart mobility options, and the important element is mobility as a service. Many authors concluded that user acceptance is the key feature of MaaS. However, there is a research gap in the criteria evaluated by the users before accepting MaaS hence the below research questions were developed for this study.

(1) What is the current customer demand for MaaS?

(2) Which modes of mobility, operational attributes, and obstacles you encountered while using the MaaS platform in Germany?

(3) Which pricing models will be most suitable when creating a MaaS platform in Germany?

5 RESEARCH METHOD

The ultimate objective of this research is to identify the influencing user preferences in implementing the MaaS platform. This chapter further explains the research gap and research questions as discussed in Chapter 1 and the research framework in depth including the selection of the research approach, sample selection, collection, and evaluation of data.

5.1 Research Design

Qualitative approach is chosen from the three commonly used research approaches. Qulitative,Quantitative and Mixed approaches. Since this research focus on user preferences towards MaaS platform, qualitative approach is selected as by nature, qualitative research is social. It takes insights from humans on behavioral models which are exclusive for the selected sample. Data gathered during the interviews are as per the interviewees' experience and observation which makes the information superior.

5.2 Research sampling

A simple random sampling method has been used for this study as the selected sample population. The population has an equal probability to be chosen as the sample population which is an unbiased representation of the population. As De. Jonckheere and Vaughn (2019) stated that respondents who have made themselves available for an interview with the knowledge and experience on the topic to be interviewed would be an ideal selection as the research sample. The sample size is 10 and includes 10 full-time employees within the age group of 30-42 years as per the literature review users with the latest technology usage have the highest potential in accepting MaaS were revealed hence the sample was focused on this age group. The sample was with a mix of both male and female as aforementioned with the insight

of the literature review to understand whether there is an influence in accepting MaaS and pricing mechanism based on the categorization of the gender. The interviews were carried out using Zoom, WhatsApp, and in person. The answers were saved on a password-protected Word document. The interview lasted approximately 30 to 40 minutes. Privacy of the respondents was maintained by the acronym the 10 "respondents" (R) by R1 to R10. The following table provides a summary of the respondents based on their occupation, the mode used for the interview, and the duration of the interview.

5.3 Research method of data collection

Structured interviews were used to gather data. The questionnaire consists of 7 general questions and 6 to cover the 3 research questions. The questionnaire was open-ended as the quality of data will be superior with the insight of the interviewee's experience and observation of the subject. However, the findings will be purely based on the individual's experience, truthfulness, and integrity of the participants which is a disadvantage of conducting a qualitative study. The interview was approximately 30 to 40 minutes.

6 DATA ANALYSIS

Answer scripts were analyzed using content analysis and segregated the findings to the three main research questions. The inductive reasonings were subcategorized. Deductive reasoning was analyzed and compared with the prevailing literature to understand the similarity or deviation. Inductive reasoning was analyzed to understand the requirement of a further research requirement, or any fields not covered by prevailing literature. A summary of the findings was constructed to arrive at the conclusion and recommendations.

7 RESULTS & FINDINGS

The results and findings which were gathered during the interviews are categorized under deductive and inductive which will be further discussed by comparing the point of view of the respondents.

7.1 Current demand toward the MaaS platform

The first research question focuses on understanding the current demand for the MaaS platform. The research is solely focused on the demand for the MaaS platform within Germany.

(1) There is a significant demand for the MaaS platform within Germany as 90% of the the sample is currently using mobile apps for commuting. The main reasons discovered during the interviews for opting for MaaS are, that this option is more cost-effective than owning and maintaining a personal vehicle, easy to use with no stress and focus needed while driving and the current transport system has good connectivity and saves time as there is an option to choose the best possible connectivity based on the time and mode is chosen to reach the destination. These are the main reasons the respondents stated the reason for choosing MaaS.

(2) The most used and desired mode of transportation to be incorporated into the platform is public transport options due to the vast coverage and the public sector operates as a nonprofit generating organization that provides low-cost transport options which is aligned with the literature by Kamargianni & Matyas (2017). All public transport options such as Tram, Bus, S-Bahn, and U-Bahn are the modes included in the platform and from the private sector, as the respondents use E-bikes scooters, and car-sharing options for these modes should be included in the platform. Also, a participant stated to include taxis on the platform as well which is the ideal solution for the time being for first and last-mile connectivity until the mass service providers arrive at a solution.

(3) One of the main factors in increasing the customer base for the MaaS platform by attracting private vehicle owners to shift to MaaS is the punctuality of the transport service providers hence transport providers need to improve on punctuality to attract more customers and increase revenue.

7.1.1 Effectiveness of the MaaS apps

One of the sub-questions under the first research question is to evaluate the effectiveness of the MaaS apps the respondents currently use. Most of the respondents stated that the apps they currently use are effective and have not come across any technical issues or system crashes the interface is easy to use, they are comparatively accurate information on train arrivals and delays, and route planning is efficient in terms of timings and mode of transport to be chosen. However, a few respondents stated that they have experienced issues in connectivity and getting real-time information such as when a ticket is purchased an email confirmation is received but the ticket does not appear on the app in real time, and the app needs to be refreshed for the ticket to appear. The respondent has also experienced the same issue with real-time information on train arrival and departure information. When a new initiative is introduced on transport such as the monthly travel pass to travel across Germany on selected transport options, the previously existing unused online tickets are shown on the app but the feature to use these tickets is disabled as a new product is purchased by the user. The user suggests refunding money for unused tickets or having the option to transfer the tickets to another user. Few respondents stated that some of the apps they frequently use are not user-friendly. When the user has subscribed to a monthly pass, the user would need to manually update the order number on the app and refresh the field monthly for the ticket to be active for the given month.

7.1.2 Usage of public and shared transport modes

The next sub-question of the first research question is to identify the current demand for public

and shared transport options. All respondents stated that they currently prefer to use public and shared transport options. A summary of the answers revealed that the coverage and connectivity of the German public transport sector are vast and cost-effective than owning and maintaining a private vehicle including parking charges and the monthly transport pass available across Germany has attracted more users to opt for public transport option and some corporations reimburse the ticket cost of the employees who use this option. However, if an employee owns a private car the fuel cost is not reimbursed. It could be an initiation drive towards sustainability. Ease of use is another highlight of opting for public transport options. The user can engage in another important task while travelling without any stress as driving a private vehicle. Shared transport options like e-scooters or e-bikes are used for short-distance travel where the travel time is less than the waiting time of the public transport modes. Even though all the respondents stated that they are using public and shared transport modes some respondents stated points to dislike commuting in public and shared transport modes. The main reason is the transport service providers not been punctual. If a transport need is time-bounded those users will opt to use a personal vehicle or shared vehicles to commute. The cost-effectiveness is subjective when a family of four average person's traveling to a destination via public transport option can be more expensive than using a personal vehicle. If the length of the travel is long public transport modes may not be the best option as using a private vehicle provides more flexibility and comfort for the travel. The respondents who use shared transport modes stated that the radius of coverage for e-scooters and e-bikes is less hence they have experienced issues in finding a place to park at the end of the destination.

7.1.3 Interest in MaaS Platform

Except for one respondent all respondents are interested in a MaaS platform. The one respondent who does not like it is not interested as the respondents' travel requirement to use public and shared transport is less and opt for walking as a mode of transport. The main reasons for the interest in the MaaS platform are that it does not need to use multiple apps for planning and booking it can be done via a single platform. All service providers who are integrated into the platform are managed by a centralized customer service hence it is easier to contact for any assistance than getting in touch with the individual service provider‘s customer service which is a tedious task if a trip is planned via two or more service providers the user has to contact all service providers for any assistance needed to modify or manage the booking, multiple users can be added and arrive at the best possible option which can be planned as a team within the range of their travel budget, the new platform will be able to solve the vacuum experienced in the prevailing apps. R9 stated that it will be useful for both short-distance and long-distance transport where one can view and opt for the most convenient transport option to complete the trip. The usage of public and shared transport options reduces traffic and reduces per-head carbon emissions on the road. However, there is a massive requirement to address the first and last mile of the trip as it is one of the main indicators for users to opt whether to complete the trip via public or shared transport modes or opt for a private vehicle.

7.1.4 Barriers to using the MaaS platform

The main barrier as per their point of view is the reliability of the platform. This is purely depending on the punctuality of the service providers integrated into the platform. For instance, if a multimodal transport mode is opted for a trip, if the user encounters a delay in the first leg it has sequent impacts for the rest of the transport modes selected. If a transport need is timebound, the user will have to take a risk in opting for a public or shared transport option. ICT infrastructure plays a critical role in platforms such as MaaS as the speed of connection and real-time information are the keys for a user to plan a trip. Arrival and departure times, route plan, transit, etc. support planning and booking a trip. Thus, the improvement of ICT infrastructure is a crucial aspect to consider when developing a MaaS platform. In summary, if a platform is created with high-level ICT infrastructure, the objective of the MaaS platform i.e. attracting private vehicle users to opt for public and shared transport options will be feasible. Some respondents stated that the current mobility apps are not user-friendly. Some apps are created in a way the user manually refreshes the ticket to be active, the order number of the ticket should be manually added to the user profile when a subscription pass is selected. One respondent stated that when a transport option is chosen with two transport providers seat selection is not available for the transport provider who is not within the group of the main transport provider. The essence of the findings on the ease of use, and user-friendliness of the platform is beyond

doubt all respondents with or without technical literacy if seeking for. All respondents are highly educated and most of the respondents are attached to the information technology sector with both academic and professional experience, yet they require less human intervention when using a mobile app. Payment option is another possible barrier highlighted by the respondents with the experience. Credit cards should not be the only payment mode.

Some users do not opt to use credit cards due to personal preferences and some would like to use but do not have the predefined criteria to obtain a credit card from an institution. The app should focus younger generation. The findings of the interviews revealed that credit cards issued by service providers outside Europe are at times not supported by the apps hence if a potential user experiences a similar issue there should be other modes of payments integrated into the platform. PayPal, Debit cards, Direct bank transfers, Vouchers, etc. The availability of non-optimal transport options is another barrier when promoting the MaaS platform. If the app provides services with limited-service providers, the best option for a trip will not be available hence the users will directly book from the service provider's site or mobile app. The first and

last-mile connectivity is a crucial aspect when a user decides on a transport mode (Chaturvedi and Srivastava 2022) hence it is critical to embed first and last-mile transport options to connect to and from the chosen transport mode. Two respondents stated that the availability of transport options in rural areas is limited and even the available modes operate infrequently. If a user is planning a trip to a rural destination with limited public or shared transport options, the user will likely opt for a private mode of transportation.

7.1.5 Priorities when selecting a transport mode

The criteria mentioned in the interview questionnaire are cost, convenience, time, safety, and environment. The majority stated cost to be the first criterion when opting for a transport mode. A respondent stated "It is costly to maintain a personal car in Berlin. The proportion of the lease, insurance, and parking costs is quite significant when compared with the take-home salary. Even though it is convenient to use a personal car due to the increased expenses I have decided to use public transport instead". The second priority of most of the respondents is convenience and time. Respondent 3 and Respondent 4 stated as both reside in the heart of Munich the connectivity for all public and shared transport modes are just a few minutes away. The requirement of the transport modes is very more even if the user misses one connection the next connection in the most frequently used transport modes within the city will arrive in five minutes during the daytime and a maximum of ten minutes during the nighttime. R4 stated that

public transport is a better option in terms of convenience than driving your car as driving can be stressful. R2 said "I prefer to work during my commute as the transport modes are comfortable and free and fast WIFI connections are available. Also, I choose a silent zone when I plan to work during my commute. It is a good initiative as the users have the option to select these zones when booking the ticket". If a travel need is time bounded Time is a crucial element when choosing the transport mode. For example. R1 stated as public transport is known to be delayed, the user is not willing to take a risk for a journey that is crucial to be at the destination on a pre-agreed time hence will use the private car to avoid any inconveniences. The users focus

on the cost and time for short-distance and time-bound travel and the cost and convenience of long-distance leisure travel. However, for business travel the users opt for cost, convenience, and time as the prioritizing factors when selecting a transport mode. Both R9 and R10 stated that they consider the environmental factor of carbon emissions when choosing a transport mode. R10 stated "I have no plans to buy my car and I will continue to use public and shared transport options. Also, I am willing to, and I have chosen to travel ten hours via the train rather than opting for a flight of two hours for a recent destination I traveled to. This is mainly due to the lesser or almost zero carbon emission." The research done by Statista revealed that 48% of

the carbon emissions worldwide are attributed to cars and vans (Statista,2023). Safety was the least priority the respondents selected as they consider safety is not an influencing factor when choosing a transport mode from driving their car or opting for public or shared transport mode.

7.2 Preference towards services provided

7.2.1 Preferences towards various mobility options

All the respondents are currently using and continue to use public and shared transport options hence the respondents stated that the platform should include various transport options as it will be beneficial for the

user to select the best possible transport option for the desired destination. However, the three female respondents are not using shared e-scooters. The necessity of including ferry transport was not stated during the interviews but the platform should consider incorporating public transportation via water is also an option across Germany.

7.2.2 Requirement of Additional Features

The important feature stated by all respondents is real-time information on train schedules, delays, and alternative options, etc. Another important feature to be included is an update on any disruptions. Due to the current experience of many trips getting delayed or canceled due to the ongoing strikes, an important feature to be integrated by a couple of respondents was to develop the refund policy in a way that the refund can be requested via the app rather than sending an email for an instance. It will be helpful to keep track of refunds requested and claimed.

7.3 Preferable pricing model and attitude toward using multi-modal transport system

The third research question was developed to understand which pricing model should be integrated into the platform. Whether the users are willing to opt for transport modes via a subscription-based payment plan or when the transport options are used “pay as you go”.

7.3.1 Desired pricing model

Most of the respondents opt for a subscription-based pricing model. The Deutschland ticket introduced in May 2023 has been one of the key factors in influencing the decision of opting subscription-based or pay-as-you-go option. The frequency of travel is another factor in determining the pricing model.

7.3.2 Attitude toward multi-model transport option

All respondents are open to opting for multimodal transport options to commute to an end destination however critical factor in determining whether to choose a multimodal transport option or a single mode of transport option purely based on the purpose of the travel. If the travel is time-bounded with the experiences of delayed transport modes, the respondents are not keen to seek for multimodal transport option as a delay in one connection has an impact on reaching on time for the next connection.

8 ANALYSIS AND DISCUSSION

The main objective of this research is to identify the user preferences for the implementation of

the MaaS platform and close the research gap. The first research question focuses on the existing customer demand for the MaaS platform. The second question pertains to the modes of mobility, operational features, and barriers you encountered while using the MaaS platform and the final question was about the most suitable pricing model to be considered when creating a MaaS platform. This segment provides a summary of the findings which will be discussed by comparing them with the prevailing literature and concluding the findings.

8.1 General information about the participants in this research

The general information of the respondents can be summarized as follows. 70% of the participants are within the age bracket of 36-40 years, 10% each in age brackets of 25-30 years,31-35 years, and 41-45 years. 70% of the participants are males and 30 % of the participants are females. 40% of the participants are single, 30% of the participants are married and the balance 30% are married and have a child under 10 years old. 100% of the participants are full-time employees with a hybrid work model. 80% of the participants are working in the information technology sector, 10% in the field of finance, and 10% in research. 10% own a private car and 50% own a bike however 100% of the participants use public transport options. Such as Bus, S-Bahn, Train, U-Bahn, and Tram, and the frequency is almost daily. 60% of the participants use shared transport options E-scooters, bikes, and cars. However, for 60% of the participants who use shared transport options, the frequency is rare. None of the participants were below 30 years all participants were employed in a full-time position, and all are working on a hybrid work model hence the results of the findings will be skewed towards the preferences of middle-aged, income-generating, and educated participants.

8.2 Investigation of the current demand for the MaaS Platform

8.2.1 Usage of transport mobile applications for mobility

90% of the participants were using mobile apps to plan, book, and purchase tickets for their commutes and only 10% did not use mobile apps to plan their commuting requirements.

8.2.2 Motivation to use MaaS platform

All participants are open to using public and shared transport modes. The main factors for most of the participants are cost, convenience, and time. Some also prioritize these options based on environment-friendly and safety aspects. All the participants informed that creating a MaaS platform is an excellent proposal as they will save money when using a single platform for all travel requirements, do not need to use multiple apps when planning, booking, and making payments towards a trip, and centralized customer service function of the app which will support irrespective of which service provider has been used.

8.3 Investigate service design preferences for MaaS

Modes of mobility, service functions, and obstacles encountered while using the MaaS platform.

8.3.1 Preferences towards multi-model options

MaaS platform should be purely based on the users' requirements hence it is crucial to understand the requirements of the users. Such as the transport options, support services, and additional services the users seek while using the application (Kamargianni & Matyas,2017). All the participants are using public transport options, and they will continue to use public transport due to the benefits they receive. 70% of the participants use shared transport options such as Über, Freenow, Bolt, Tier, and Bla Bla cars. The main reason to choose public transport is due to the efficiency in cost, ease of use and convenience.

8.3.2 Operational attributes to incorporate in the MaaS Platform

Based on the interviews the below findings were observed as primary and secondary features to be implemented in the MaaS Platform.

Primary Features: Real-time Information, Disruption warnings, Parking Information, Chatbot Option and AI-Integration, Trip planning, booking and payment, Alternative route Options. Secondary Features: Price Alerts, Description of the destination, Customization, Travel Point System, Request for refunds via app, Driver/owner rating on car sharing.

8.3.3 Potential barriers to overcome when creating the MaaS platform

As per the interviews, the participants informed that there are barriers they foresee when using a MaaS platform hence these barriers would need to be looked at when implementing the platform.

(1) Reliability

(2) Information and Communication Technology – ICT

(3) Complicated user interface and user experience

(4) Issues faced at the point of payment and ticketing.

(5) Nonoptimal transport options

8.4 Investigate Pricing mechanism for MaaS

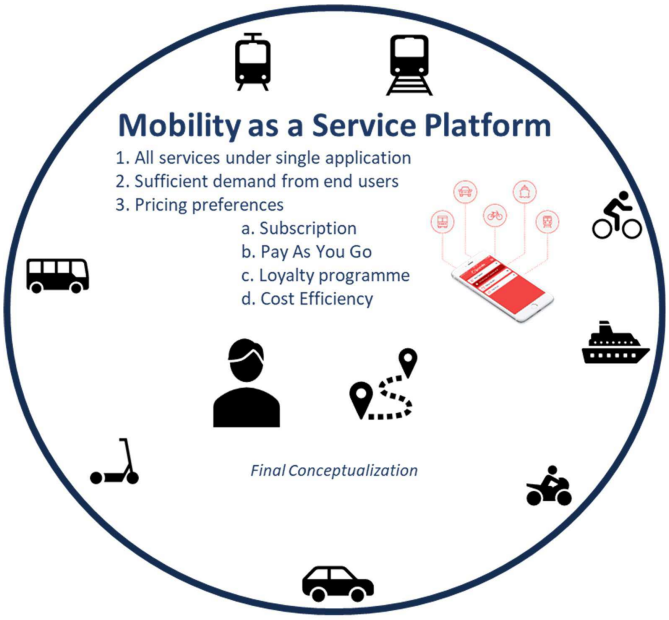
8.4.1 Preferences for Pricing

40% of the participants chose the pay-as-you-go payment option as the frequency they travel is less hence paying for a daily pass or monthly pass is expensive than purchasing tickets when the transport requirement occurs. However, 60% of the participants opt for subscription-based pricing packages as they travel frequently however with a flexible cancellation policy and without any penalties or contractual commitments. Some of the participants mentioned that the decision to opt for the preferred payment mode is seasonal as some prefer to use their bikes to commute in Summer and opt for public or shared transport modes during winter. Also the participants is only willing to pay a subscription for a daily commute and not

willing to pay a premium price for transport coverage outside the vicinity the participant is not commuting to.

8.4.2 Preferences for multi-model transport bundle packages

All the participants stated that they are willing to opt for multi-model transport options as the multi-model option will provide various alternative routes provided by the registered transport providers of the app and this will help to regulate pricing by service providers and reduce the monopoly created by the transport service sector.



9 CONCLUSION

The research is carried out to fulfill the research gap of identifying “user preferences in opting for MaaS in Germany”. The answers to the three research questions were analyzed based on content analysis.

9.1 Current demand for MaaS

This research question was constructed to understand the current demand for the MaaS platform in Germany. After analyzing the responses to this question, the below points can be concluded.

(1) All respondents are using the MaaS platform to fulfill their day-to-day travel requirements. Use of public and shared transport options are cost-effective, flexible, and more convenient modes of transport than using a personal vehicle. A single platform to plan, book, and pay benefits the users by saving time and convenience rather than using multiple apps for transport.

(2) All available public transport modes and shared transport options such as cars, escooters,e-bikes, and taxis of private transport providers should be integrated into the platform. Water transport options such as ferries were not mentioned during the interviews, but this mode is recommended to be included as well.

(3) The punctuality of the service providers has a great influence in opting for public and shared transport modes and converting private transport users to public and shared transport users.

9.2 Modes of mobility, operational attributes, and obstacles in the MaaS platform

(1) All forms of transport options should be included for the users to select the best possible connections.

(2) The below attributes are suggested to integrate to the application.

(3) The below obstacles should be overcome to attract and retain the users.

(a) Reliability – Real-time information should be accurate and inform the users of train delays and strikes well in advance for them to seek a possible alternative, a high level of transparency, and punctuality of the service providers.

(b) ICT – The platform needs to be developed based on advanced ICT infrastructure which will be the turning point for the users who use MaaS platforms created by other providers.

(c) Complicated user interface and user experience – User-friendly, easy, and minimum manual intervention of processes

(d). Issues faced at the point of payment and ticketing – All available credit cards and the facility of making payments via debit card, bank transfers, and PayPal should be an option for users who do not own credit facilities. Furthermore, invest in reliable payment getaways.

(e). Nonoptimal transport options – Usage of AI to understand the best routes in terms of cost and time savings.

Primary Features	Secondary Features
Real time information	Price alerts
Distruption warnings	Description of the destination
Parking information	Customization
Chatbot option and AI integration	Travel point system
Trip planning,booking & payment	Request for refunds via app
Alternative route options	Driver/owner rating on car sharing

9.3 Preferable pricing model and attitude toward the multimodal transport system

9.3.1 Pricing model

The preferred pricing model can be concluded as below.

(1) Subscription-based pricing model with monthly and annual subscriptions to attract

frequent travellers.

(2) Pay-as-you-go-single ticket purchases as and when travel requirement arises for

infrequent travelers.

(3) Consider discounts and bonus points for both subscription and pay-as-you-go options

to attract both types of travelers. i.e. Frequent and infrequent.

(4) “Cost-effective” is a critical factor considered by the users hence developing attractive cost-effective travel packages for all users.

9.3.2 Attitude toward a multimodal transport system

(1) Predesigned packages with several modes of travel will be attractive to users.

(2) Ability to create customized packages with various modes of travel options.

(3) Incorporate as many service providers as possible to provide multiple alternative travel options.

(4) Include service providers who provide taxi services to fulfill the first and last-mile requirements.

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