Mobility as a Service (MaaS) approach implementation in Latvia

Riad Ashrafov
Computer Systems
ISMA
Riga, Latvia
riad8242@gmail.com

Nadezhda Kunicina
Riga Technical University
Riga, Latvia
nadezda.kunicina@rtu.lv

Jelena Caiko
Riga Technical University
Riga, Latvia
Jelena.Caiko@rtu.lv

***Abstract*—Mobility as a Service (MaaS) is a transformative concept that integrates public and private transportation services into a single application, providing users with smooth access to multiple types of transportation. Study explores the potential of MaaS in Latvia, focusing on integration of private transportation service such as Bolt, CityBee, Tuul and public transportation. Paper reviews global MaaS applications, identifies key challenges and examines user acceptance based on data gathered from focus groups. Designed MaaS application will provide real-time information, standardized ticketing, payment systems and optimized routing to enhance user experience. Additionally, the research discusses the regulatory and technological barriers as well as economic and environmental impact of implementing MaaS in Latvia. This study underscores the importance of collaboration between public and private sectors, user-friendly design and technological infrastructure for the successful deployment of MaaS.**

Keywords—Mobility as a Service (MaaS), smart city, urban mobility, transportation integration.

I. INTRODUCTION (*HEADING 1*)

A. *Concept*

Mobility as a Service (MaaS) is a concept that gathers various types of public and private transportation services. MaaS aims to ensure adaptive and convenient mobility services, that are separate, in booking, planning, ticketing and payment, in a single application interface. Because of unification of transportation services, it is possible to have mutual usage of resources in MaaS application itself and for transportation service providers too. MaaS focuses on providing information from transportations services, delivering personalized travel options in real time depending on personal preference and circumstances. Such smooth integration can be facilitated by cutting edge technologies, such as, APIs, it allows data and service sharing across types of transportations [1]. Research of [2] shows that , MaaS can be divided into 4 integration types, starting from 1, which is provision of basic information, up to 4, with full integration of ticketing, payment and travel systems. Implementation of MaaS is also a part of the smart city and smart transportation systems. MaaS in terms of these systems assists in reducing traffic jams, pollution and accessibility [3].

B. *Case studies of other applications*

Smile (Simply MobILE), UbiGo, MooneyGo (MyCicero), Floya and many other MaaS application have pioneered integration of public and private transportation services.

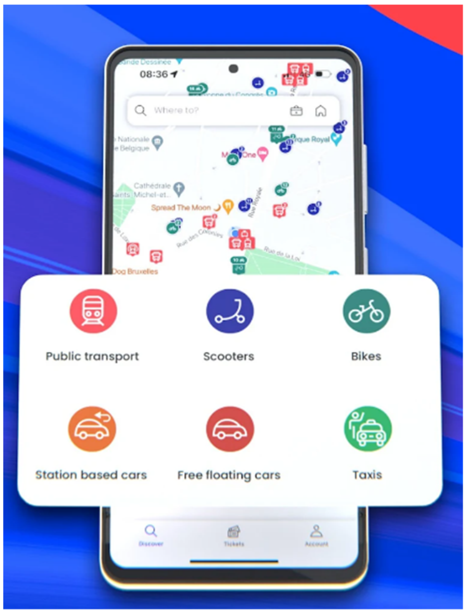

Fig. 1 UI of MaaS application Floya [4]

Some of this applications have been discontinued due to unpopularity, poor service provision, lack of transportation services or not user-friendly design. However, because of these companies, which pioneered in MaaS, it was possible to find out strong and weak points in creation of MaaS application [5].

It is possible to identify MaaS as pre-Covid (Smile, UbiGo) and post-Covid MaaS applications (Floya, MooneyGo). Main difference between pre and post Covid MaaS application is their accessibility, service, functionality and payment methods. In the time of pre-Covid MaaS applications, private transportation services were in the phase of development and were not so accessible and popular. Covid was the period of new technological improvements, especially in private transportation, because of this technological improvements' private transportation, such as bike sharing, car sharing and scooter sharing became more popular as a micromobility and now each of the applications offer their transportation services on their own dedicated applications. From business point of view this is very good solution, so it allows application to manipulate services, terms & conditions and functionality, from user point of view it is extremely inconvenient to download several applications, wait each of them to download their functionality until the moment it is possible to see available vehicles on the map, it takes too many resources of phone letting it lag or freeze and increases estimated time to launch the application.

Nowadays there is separate applications for private transportation services and public services. Bolt and Uber have their ecosystem where user can book rental, order a taxi ride or food delivery, unfortunately these ecosystems exclude any public transportation services. Implementation of MaaS application gathering private and public transportation services especially in Riga, which has around 7 separate applications only for transport on-demand. Bolt, Ride, Tuul, CityBee, Forus, Skok and CarGuru are transport on-demand applications, all of these applications could be integrated into a single application in order to save time on searching for demanded transport, increase user base, strengthen relation and data transfer between MaaS application and private transportation service companies.

There is no much application for public transportation services for which MaaS could be a good solution for entire Latvian urban transportation services. Public transportation services in Latvia are operated by each city's municipalities, Riga has own "Rigas Satiksme", Daugavpils has "Daugavpils satiskme" and so on. "Rigas Satiksme" application allows users to buy and scan ticket, check for routes, timetables and real-time map of public transports. Timey application has the same features except, it is not possible to buy and scan ticket, but it is possible to see the speed of public transport with the register number of the public transport.

II. METHODOLOGY

For this study, focus group methodology was chosen, it allows to collect data from various demographic groups of users. Focus groups are particularly effective choice for exploring preferences, concerns and expectations of potential MaaS users, which will help in creation of user-centered MaaS application. Such method allows to analyze perception and attitudes of user segments, such as daily commuters, occasional users, tourists and residents from different socioeconomic backgrounds [6].

Participants

There were four focus groups conducted, each consisting of 8-10 participants. Participants were divided into the following groups to show the diversity of the user base:

- Daily commuters: Individuals who rely on public transport, cycling or private cars for their daily commute.
- Occasional users: Residents which use transportation services less frequently, typically for social or recreational purposes.
- Tourists and visitors: Non-residents visiting city who require transportation for sightseeing and local travel purposes.
- Low-income and elderly residents: Individuals from economically disadvantaged backgrounds or older adults who may face barriers to accessing current transportation options.

Focus groups have lasted around 1.5 hours each and were managed by a researcher who have guided the discussion using a semi-structured interview report. Questions were mainly focused on participants current transportation routine, their openness to adopt a MaaS application, perceived benefits and problems, as well as preferences for specific features such as payment models, subscription types, modes of transport.

Data that have been collected from the focus groups was analyzed using thematic analysis to identify recurring themes and patterns in the participants' responses. User preferences, barriers to adoption, willingness to switch to MaaS, and concerns about pricing, accessibility and reliability themes were covered in data collection and analysis.

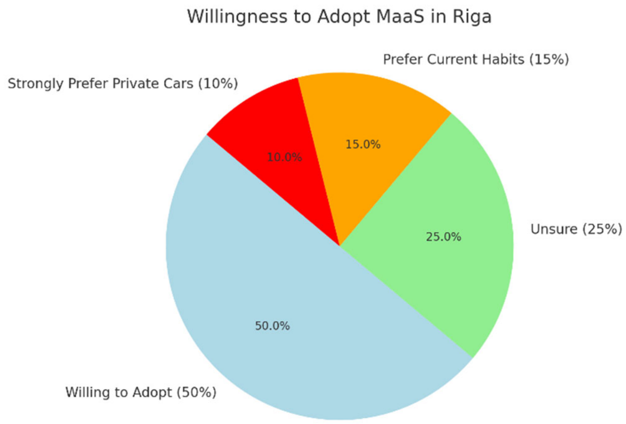

Fig. 2 Willingness to Adopt MaaS in Riga

Following pie chart demonstrates users' willingness to adopt MaaS (Fig. 1). 50% of the participants are more willing to adopt MaaS within the first year of the launch, 25% are unsure and would need to some time to see the system's efficiency before making a decision, 15% would prefer to keep their current transportation routine and less likely to switch, 10% strongly prefer to own and use private cars and do not intend to adopt MaaS.

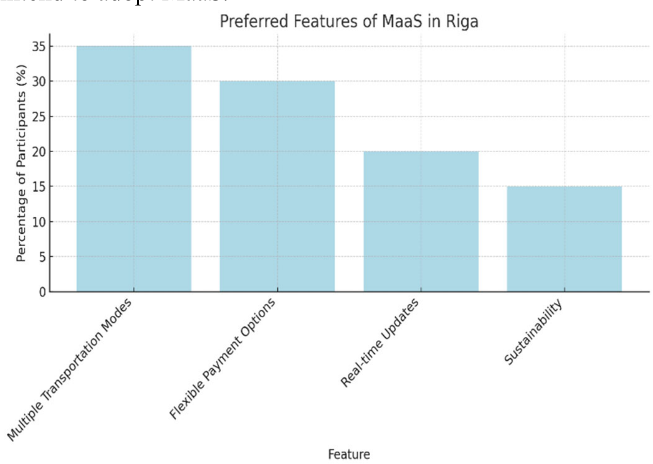

Fig. 3 Preferred features of MaaS in Riga

Fig. 2 highlights the most preferred features of the MaaS among the participants. With 35% the top feature is access to multiple transportation modes, such as car sharing, scooter sharing etc., 30% flexible payment options where users can pay per ride or have subscription based rides, 20% is real-time updates and notification and the last is 15% with sustainability and eco-friendly options.

III. PROPOSED ALGORITHM FOR MAAS

As it was mentioned before MaaS should integrate both public and private transportation services into a single user-friendly application and provide functionalities like mapping, routing, ticketing, payment and booking to ensure seamless and easy transportation experience. MaaS application will collect real-time data from multiple transportation providers so users can plan and execute trips across multiple modes of transport through one MaaS application. A TRIP-based travel demand model that uses microsimulation to evaluate the effectiveness of intelligent transportation system (ITS) measures. This model simulates traffic flow and demand, allowing the impact of different ITS strategies on availability and traffic management to be tested in real time. Implementing such a model into a MaaS platform can help improve system responsiveness by providing more accurate demand forecasts and assessing the effectiveness of different traffic management strategies [7]. Internet of Things (IoT) systems can further enhance the public transportation services by monitoring environmental conditions inside of the vehicle. Reference [8] developed an IoT prototype that can provide real time data on CO2 level, temperature and humidity in public transportation. Such system sends alerts when air quality thresholds are exceeded, ensuring healthier conditions for passengers and helping maintain sustainable, well-ventilated environments in uncertain epidemiological conditions. Integration of this IoT solution, MaaS application can offer enhanced safety features and improve overall passenger satisfaction. Application will use real-time data from all participating transportation services, both public and private in order to provide users live updates on the availability of transportation options. Private transportation services (e.g., Bolt, Ride, Tuul, Citybee) will provide real-time location and availability of the vehicles, meantime public transportation (e.g., Rigas Satiksme) services will share live tracking of buses, trolleybuses and trams, allowing the MaaS application to show accurate arrival times and route options. Ticketing and fare calculation will be unified in the MaaS application for all transportation modes, allowing users to purchase tickets for public transport and book private transportation services. Payment system will support multiple payment methods, such as credit, debit cards, digital wallets, like Google Pay, Apple Pay and direct bank transfers. Payment will be processed one a user confirms their transportation booking or transportation activation. It will be possible to offer flexible payment options, pay per use, monthly subscription and prepaid travel passes, also integrated discounts and loyalty points that can be used for future use in private transportation or public transportation tickets.

MaaS application will have routing options that optimize travel time, cost and sustainability, for instance eco-friendly transport options. Users will be able to input their destination and get multiple routing suggestions that will include a combination of public and private transports, walking distances to a services if needed and recommendations based on real-time traffic conditions and vehicle availability. Users will be able to also book private transports in advance, pre-book taxis from Forus or Bolt services and use application for public transportation trip schedule.

TABLE I LEVEL OF INTEGRATION

Subsector	Service provider	Routing	Booking	Ticketing	Payment
Urban public transport	Rigas Satiksme	Through MaaS app	Through MaaS app	Through MaaS app	Through MaaS app, Vending machine
Car sharing	CityBee, Carguru, Bolt	Through MaaS app	Through MaaS app	N/A	Through MaaS app
Taxi	Forus, Bolt	Through MaaS app	Through MaaS app	Through MaaS app	Through MaaS app
E-moped sharing	Skok	Through MaaS app	Through MaaS app	N/A	Through MaaS app
Scooter Sharing	Ride, Tuul, Bolt	Through MaaS app	Through MaaS app	N/A	Through MaaS app

IV. CURRENT TRANSPORTATION LANDSCAPE IN RIGA

Capital city of Latvia is Riga, it represents complex and evolving transportation environment, that reflects both historical context and pursuit to become a smart city. As it was mention before, Riga's public transportation system includes buses, trams and trolleybuses, along with rapid growing private mobility services. These services are integral part of daily drive for most of the population. Implementation of smart card system has increased effectiveness of public transport and opened a possibility to gather better and accurate data of passenger flow and contribution in dynamic control of services [9]. The development of energy efficient technologies for urban transport is crucial for reducing energy consumption and improving sustainability of transportation systems. One of the approaches can be integration of the energy efficient systems that utilize the renewable energy sources. Reference [10] proposes a comprehensive energy efficient system for urban transport, including electric buses with ultra-capacitor batteries and multifunctional solar panels for pavements. Recently, Riga has seen a rapid growth of private transportation services, which were warmly accepted by the public, offering a flexible alternative transportation mode, which is completing existing system of public transportation. Realization of these type of transportation modes reflects a change into more sustainable and convenient solution of urban mobility. Implementation of these services requires thorough integration with public transport to maximize their advantages. While private services of mobility have a potential of reducing traffic congestion and reducing impact on the environment by reducing dependence on personal car ownership, their high growth detected necessity in updating the regulatory framework. Effective control and integration have a key role for full realization of advantages of these services and avoiding potential problems, such as overlap and underutilization [11]. One of the challenges for Riga is to ensure that initiatives are comprehensive and effectively integrate to the existing systems. The ongoing efforts of the city to develop a multi type transportation hub within the framework of the Rail Baltic project is a promising step towards creating a more connected and effective transportation network [12]

Mobility as a Service (MaaS) in Riga is massive, showing the beginning of the revolutionary innovations of mobility in the cities. This can realize MaaS creating an integrated system of various types of transport suggesting enhanced use experience and promoting sustainable form. The following identifies some key considerations for the possible production and service holder of MaaS in Riga according to relevant literature.

A. Public and private sector roles

Realization of MaaS in Riga will need a strong relation and partnership both between public and private sectors. The public sector, which includes municipal authorities, would have the greatest impact on the implementation of Transportation as a Service by regulating and enforcing fair access to the transportation services. On the other hand, the private sector which works in conjunction with tech firms and transport service providers would be a major partner in the invention and management of the MaaS software. A lightweight structure is highly needed to form the transportation system which is efficient and flexible by using the advantages of both sectors [13].

B. Role of digital platforms and mobile applications

MaaS is essentially an app, an entire ecosystem to be more precise. These platforms should be easy to use, trustworthy and able to bring together multiple services without any problems. Potentially, Riga could use own extensive existing digital infrastructure for creating MaaS platform, linking all the available type individual and shared transport into an entire system from public to car-sharing service. To have a success, it will depend on ability to provide better information and user personalized travel options.

C. Challenges and opportunities

The introduction of MaaS in Riga comes with challenges and potential. There are regulatory and technology barriers including data sharing and interoperability in the different systems. At the same time, however, there are large system efficiency improvements that can be made to benefit transportation in Riga, les sen environmental damage and generally make life better for local residents. Similarly, one of the important factors is public acceptance and shift in habit from traditional ownership model by people as MaaS can only be successful when a high percentage share will adopt it [14].

It is possible that MaaS has a big potential in Riga, with the creation of an integrated, efficient and sustainable urban mobility system. Solving existing issues and using opportunities, Riga can be a leader of smart urban mobility in the Baltic Region.

V. CHALLENGES AND OPPORTUNITIES

A. Regulatory and policy challenges

There are considerable regulatory and policy challenges facing MaaS in any urban setting, whether it's Riga or another city. A core issue is the call for a regulatory system which can manage cobbling countless types of transport along (public transit, private automobiles, car-sharing and micro-mobility services like bicycles and scooters) with one another. The different types are often regulated in terms of separate entities and it is so complicated to include all under MaaS on the same platform.

Public transportation, for one thing—there are so many restrictions on how it can be operated safely and what its price or service criteria must meet. On the other hand, private transportation services such as car sharing are commonly less regulated. However, this can lead a lack of seamless integration needed for MaaS. Another limitation is the difficulty of sharing data on both sides, public and private. The idea behind MaaS is to provide an all-encompassing mobility service, which cannot function without an open and secure way of exchanging data about routes and schedules but also prices and user preferences. Privacy concerns and the fact that private companies are for-profit enterprises makes this process of sharing data inconvenient [2]. For policymakers it is also necessary to consider the monopolistic tendencies of MaaS providers. If there will be a single provider which controls a significant amount, this can lead to high prices for consumers and competition reduce. That's why regulations must ensure equal conditions, inspire innovations and protect consumers' interest.

B. Technological barriers

One of the important challenges is real time data access and its accuracy. There are many different obstacles that can influence your accessibility and performance as an end user. Among them sufficient real time traffic conditions data available to estimate journey times accurately. Remote sensing technology can provide a solution by allowing for accurate monitoring and analysis of passenger traffic flow dynamics in real time. Reference [16] have shown that such kind of technology can enhance the accuracy of traffic flow analysis, enabling more efficient transportation management and the optimization of MaaS application by suggesting a clearer understanding of traffic patterns and congestion points. Integration of this technology into MaaS could significantly improve the ability to adapt to traffic conditions. Moreover, with the implementation of the MaaS arises a need for strong cybersecurity to protect users' personal and financial data. As long as MaaS processes sensitive data, it is always an attractive target for cyberattacks.

C. Public acceptance and behavioral change

Public acceptance plays a major role in the success of any MaaS intervention. If customers don't embrace this, even the top MaaS system with the best and most integrated features in the world will fail. One of the biggest changes that needs to be made is in travel behavior, which can be a challenge for many. The majority of urban residents are used to owning private vehicles, which they use for daily drives. Thus, convincing them to abandon this lifestyle and move to an MaaS scheme that stresses more shared and public transport could prove difficult.

This is true in that a successful MaaS offering provides reliable and appealing services; the behavioral change predicted with car normalization requires effective communication and education. This includes educating consumers on the economic, social, and environmental benefits of MaaS (like cost savings). But also, they need to be convinced that this MaaS system will do a better job of meeting their transport needs than whatever else it is up against [17].

There also can be a number of social and cultural barriers in adoption of MaaS. For instance, in some regions owning a car is considered to be prestigious and the idea of shared transport can be ridiculed. Changing cultural relation to such things and demonstration of MaaS being valuable in practice is necessary if the public is going to take it seriously.

D. Economic and environmental impacts

MaaS solves the biggest problems, these are economical and environmental impacts and bring enormous benefits to humanity. Economically, MaaS means that users are going to pay less for the transport because it can be provided on demand services, which are more efficient. Besides reducing the costs of using transport resources, MaaS also helps service providers achieve operational savings. Moreover, MaaS platforms can unlock new sources of income, such as subscriptions, dynamic prices or value-added services [18]. Since, economic advantages of MaaS rely on achieving "financial viability" while at the same time generating revenue from a strong user base. Without strong user adoption or with high costs of development and maintenance, economic viability of MaaS will be under threat. Regarding environmental impacts, MaaS could make urban traffic easier and reduce greenhouse gas emissions. By encouraging shared and public transportation, MaaS could result in a reduction in the number of individual CO_2 producing cars on road, leading to less traffic congestion. According to research, widespread adoption of MaaS has the potential for huge reductions in carbon emissions, helping cities accomplish climate goals [19]. Converting internal combustion engine (ICE) vehicles to electric vehicles (EV) offers a cost-effective and environmentally friendly solution, especially for private transportation service providers. According to [20] conversion of ICE vehicles into an EV can result considerable operational savings due to lower maintenance costs, higher reliability and fewer emissions. Their research showed that for a converted ZAZ Lanos pickup truck used in delivery services, the conversion costs could pay for themselves within three years of operation. They also highlighted the importance of a robust charging infrastructure to support such transitions, stressing that the right infrastructure will improve the practicality and efficiency of electric vehicles in urban environments.

As Fig. 4 shows, SWOT analysis is one of the ways to shortly describe the strengths, weakness, opportunities and threats of MaaS in Riga.

Strengths:

- Integration of multiple transport modes: MaaS bring together public transport, private mobility services and shared transport into a single application, making urban mobility efficient and user-friendly.

- User convenience: MaaS application simplifies user experience offering, real-time data, seamless booking and integrated payment methods, upgrading overall travel comfort. -Sustainability: Promotion of shared mobility options and reducing reliance on private cars, MaaS can contribute in reducing of traffic jams and lowering carbon emission, supporting cities environmental goals.

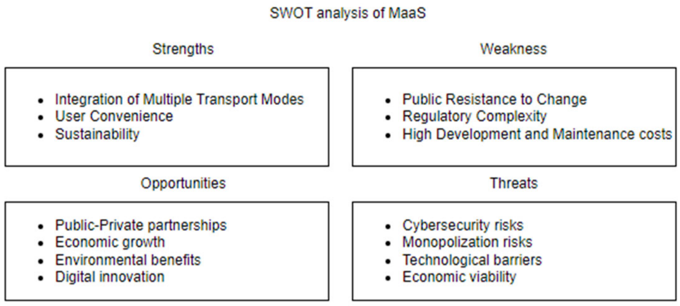

Fig. 4 SWOT analysis of MaaS

Weakness:

Public resistance to change: City residents, especially those who used to owning private vehicles, may be resistant to switching to MaaS, which could slow adopt rates.

Regulatory complexity: The integration of different transport services, especially between public and private operators, can create regulatory challenges that can delay implementation.

High development and maintenance costs: MaaS application development and ongoing operational charges can be expensive and require significant investment from both the public and private sectors.

Opportunities:

Public-Private Partnerships: Cooperation of municipal government and private transportation service providers suggests opportunities for innovation and expansion, enlarging overall transportation system.

Economic Growth: MaaS can open new revenue streams, offering subscription, pay per use and etc. for public and private stakeholders. This can stimulate economic growth in local mobility service sector.

Environmental Benefits: With wider implementation, MaaS could significantly reduce the number of private cars, reduce emissions and contribute to the sustainable development of the city of Riga.

Digital Innovation: Riga's ongoing efforts to become a smart city, such as the Rail Baltica project, could become the basis for digital innovations in the MaaS sector, allowing the city to take a leading position in the Baltic region in terms of urban mobility.

Threats:

Cybersecurity Risks: The centralization of personal and financial data on MaaS application database makes them a potential target for cyberattacks, raising concerns about data privacy and security.

Monopolization Risks: In case if a single company or application will dominate in MaaS market, it could limit competition, resulting higher prices and reduced service innovation.

Technological Barriers: Problems like real-time data accuracy, system errors or lack of interaction between services can negatively impact user trust and system performance.

Economic Viability: If user adoption rates are low or development costs are too high, the economic sustainability of MaaS in Riga may be at risk, which could lead to financial problems for both public and private stakeholders.

Nevertheless, MaaS can bring us closer to environmental benefits, though that is far from guaranteed. It all depends on the design and implementation of the service. Since ride hailing services are generally less efficient to operate than buses, promoting MaaS can cause a situation where more people will choose an app based service, likely causing higher traffic volumes and emissions. Hence, MaaS is a double-edged sword that can only be used to achieve environmental sustainability through careful planning and policy interventions.

VI. Conclusion

Implementation of MaaS in Latvia, especially in Riga has a potential to change urban mobility offering an integrated, user-friendly application that connects public and private transportation services. Through focus group analysis, this study identified key user preferences, concerns and willingness to use MaaS, underscoring the need for smooth integration, efficient routing and flexible payment methods. While MaaS shows a significant possibilities to reduce congestion, greenhouse gases and improve transportation efficiency, there are still remains regulatory, data sharing and technological challenges. Addressing these challenges and promoting public acceptance are the critical to the success of MaaS. By leveraging existing transport systems and collaborating with the private service providers, Riga has a potential to become a leader in smart urban mobility contributing to a more sustainable and connected future.

References

[1] Sochor J., Strömberg H. and Karlsson M., "Implementing Mobility as a Service: Challenges in Integrating User, Commercial, and Societal Perspectives," Transportation Research Record Journal of the Transportation Research Board, vol. 2536, no. 1, pp. 1-9, 2015.

[2] Kamargianni M., Li W., Matyas M. and Schäfer A., "A critical review of new mobility services for urban transport," Transportation Research Procedia, vol. 14, pp. 3294-3303, 2016.

[3] Zorig G., Fundamental of Smart City, ULAANBAATAR, 2020.

[4] "Floya," Google Play, [Online]. Available: https://play.google.com/store/apps/details?id=brussels.stib_mivb.floya&hl=en. [Accessed 9 September 2024].

[5] Jittrapirom P., Caiati V., Feneri A.-M., Ebrahimigharehbaghi S., Alonso González M. J. and Narayan J., "Mobility as a Service: A Critical Review of Definitions, Assessments of Schemes, and Key Challenges," Urban Planning, vol. 2, no. 2, pp. 13-25, 2017.

[6] Krueger R. A. and Casey M. A., Focus Groups: A Practical Guide for Applied Research (5th ed.)., SAGE , 2014.

[7] Zeņina N., Merkurjevs J. and Romānovs A., "TRIP-based Transport Travel Demand Model for Intelligent Transport System Measure Evaluation based on Micro Simulation," in International Journal of Simulation and Process Modelling 2017, 2017.

[8] Patļins A. and Beķeris M., "Development of IoT Solution Prototype for Reliable and Sustainable Transport System in Uncertain Epidemiological Conditions," in Transport Means 2022: Sustainability: Research and Solutions: Proceedings of the 26th International Scientific Conference. Part 2 2022, Kaunas, 2022.

[9] Pavlyuk D., Spiridovska N. and Yatskiv I., "Spatiotemporal dynamics of public transport demand: a case study of Riga," Transport, vol. 35, no. 6, pp. 576-587, 2020.

[10] Hnatov A., Patlins A., Arhun S., Kunicina N., Hnatova H., Ulianets O. and Romanovs A., "Development of an unified energy-efficient system for urban transport," in 2020 6th IEEE International Energy Conference (ENERGYCon), 2020.

[11] Gulbe M. and Barisa A., "Mobility as Service: How Changing Travel use Habits will Affect the Transition of Cities to Climate Neutrality," in CONECT. International Scientific Conference of Environmental and Climate Technologies, Riga, 2023.

[12] Yatskiv (Jackiva) I. and Budilovich E., "A comprehensive analysis of the planned multimodal public transportation HUB," Transportation Research Procedia, vol. 24, pp. 50-57, 2017.

[13] Wong Y. Z. and Hensher D. A., "Delivering mobility as a service (MaaS) through a broker/aggregator business model," Transportation, vol. 48, pp. 1837-1863, 2020.

[14] Butler L., Yigitcanlar T. and Paz A., "Barriers and risks of Mobility-as-a-Service (MaaS) adoption in cities: A systematic review of the literature," Cities, vol. 109, p. 103036, 2021.

[16] Patļins A. and Kuņicina N., "The Use of Remote Sensing Technology for the Passenger Traffic Flow Dynamics Study and Analysis," in Transport Means 2014: Proceedings of the18th International Conference 2014, Kaunas, 2014.

[17] Lyons G., Hammond P. and Mackay K., "The importance of user perspective in the evolution of MaaS," Transportation Research Part A: Policy and Practice, vol. 121, pp. 22-36, 2019.

[18] Jittrapirom P., Marchau V. and Heijden R. v. d., "Future implementation of mobility as a service (MaaS): Results of an international Delphi study," Travel Behaviour and Society, vol. 21, pp. 281-294, 2020.

[19] Pangbourne K., Mladenović M. N., Stead D. and Milakis D., "Questioning mobility as a service: Unanticipated implications for society and governance," Transportation Research Part A: Policy and Practice, vol. 131, pp. 35-49, 2020.

[20] Patļins A., Hnatov A., Arhun S., Hnatova H. and Saraiev O., "Features of Converting a Car with an Internal Combustion Engine into an Electric Car," in 2022 IEEE 7th International Energy Conference (ENERGYCON 2022): Conference Proceedings 2022, Riga, 2022.

[21] Smith G., Sochor J. and Karlsson I. M., "Intermediary MaaS Integrators: A case study on hopes and fears," Transportation Research Part A: Policy and Practice, vol. 131, pp. 163-177, 2020.

[22] "Mobility-as-a-Service," SkedGo, [Online]. Available: https://skedgo.com/what-is-mobility-as-a-service-maas/. [Accessed 9 September 2024].