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Mobility as a Service: An Introduction

Paul A. Adekunte[1], Matthew N. O. Sadiku[2], Janet O. Sadiku[3]

[1]International Institute of Professional Security, Lagos, Nigeria
[2]Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA
[3]Juliana King University, Houston, TX, USA

ABSTRACT

Mobility-as-a-service (MaaS) is a technology-enabled provision of transportation-enhancing products and services that are new or may have being previously provided by the individual or employers. This is a concept which is now recognized in modern transport dialogues, where mobility functionality is the outcome of a service moving users from one location to another disassociated from any requirement for asset ownership, and typically arranged on a journey-by-journey basis. In MaaS, the users are placed at the core of transport services, offering them tailor-made solutions based on their individual needs. MaaS has the following features: transport on demand, subscription service, and potential to create new markets. This paper looks at the benefits, prospects, challenges, and solutions to the use of Mobility-as-a-service (MaaS) to humanity.

KEYWORDS: *Mobility-as-a-service (MaaS), transport on demand, subscription service, urban mobility, travel App, eco-friendly, MaaS Alliance, sustainable transportation, smart mobility*

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INTRODUCTION:

Mobility as a service (MaaS) is an innovative approach to transportation that provides urban residents with a more integrated way to travel around their cities, helping to reduce dependency on private cars, and thereby reducing traffic congestion, transportation costs, and promote the use of environmentally-friendly transportation options. The concept has a revolutionary potential to entice software developers, urban planners, as well as daily commuters to wonder as to what is mobility as a service and why is it the way of the future. MaaS is to combine the various modes of transportation, such as public transport, ridesharing, peer-to-peer rentals, and e-bikes/scooters into one unified platform – which allows users to efficiently plan, book, and get from point A to B through a single interface, such as a smartphone app. Mobility as a service presents the future of transportation due to the fact that: it is convenient, cost effective, and environmentally-friendly. MaaS refers to how individuals satisfy their transportation needs over a single interface that bundles together multiple transportation options such as mass transit, carsharing, and ridehailing [1]. Smart mobility is a concept that aims to capture the many faces of the digital transformation in transport and mobility systems, summed up as "Zero Emissions, Zero Accidents, Zero Ownership" [2].

HISTORY OF MOBILITY-AS-A-SERVICE

MaaS as a new concept in the transport service, is providing new ways of thinking about how the delivery and consumption of transport or mobility can be managed. There is relatively little literature on the planning and concepts of MaaS systems. However, MaaS as a concept was first described in 1996 as an "intelligent information assistant" for travel needs at the ENTER Conference integrating different travel and tourism services [3]. MaaS is described as a shift away from the privately owned modes of transportation and the move toward mobility solutions that are consumed as a service. Smart mobility refers to an intelligent transport and mobility network, connecting various elements of technology and mobility, and a rethinking of the transportation infrastructure used in daily life and business [4], as shown in Figure 1. Smart4cities are identified by the following six important aspects: information network

and broadband, digitalization of planning management, smart infrastructure, convenience of public services, modernizing industrial development, and sophisticated social governance [5]. A significant application of MaaS is the emergence of "shared transportation systems (STSs)." This shared transportation systems (STSs) are enabled by combining transportation services from person-to-person transportation providers through a unified gateway that creates and manages the trip. The key concept behind STS is to offer travelers mobility solutions based on their travel needs. UK's Transport Systems Catapult has predicted that by the end of 2020, more than 50 billion connected devices would collect more than 2.3 ZB of data globally [6].

Finland has claimed that its App, Whim, is the first MaaS Global solution in the world. Currently in Helsinki offers four types of MaaS services, which are Light, Medium, Premium, and Pay-as-you-go. The Whim app is an award-winning app, setting the pace for the global development of MaaS [7]. The Finnish mobility scale-up – which is active in Vienna, Antwerp, Helsinki, Turku, Tokyo, Birmingham and throughout Switzerland – filed for bankruptcy in March 2024. Following the acquisition, umob has now gained the technology behind Maas Global and the Whim app [8].

UbiGo in Gothenburg, Sweden, is said to cover a wider range of transport modes than Whim in Helsinki. Apart from public transport, taxi, and car rentals, UbiGo also offers one stop access to car-sharing and bicycle and of which the subscription can be modified on a monthly basis according to personal needs at different periods of the year.

The "Go Denver" in US offers an integrated travel plan service with single payment. The user can use the service to find various route options and use the app to the chosen option. The "Go Denver" is considered as a basic version of MaaS [9].

There is the vision to enable a user to use the same app to travel in indifferent cities worldwide and to have the same level of services as in the home city. Uber [10] has realized the vision for taxi services, in which the Uber user can use the same app to call an Uber car anywhere in the world where Uber services are available without worrying about costs and different currency. In order to realize this vision of global availability for MaaS, the MaaS Alliance [11] was created in 2015 and was officially established in Brussels on 3 June 2016, as a public-private partnership, aimed at creating the foundation for the mass market uptake of MaaS in Europe and beyond. Much of the current work of the MaaS Alliance is focused on openness and interoperability of data, roaming cost, billing and clearing, and business rules of different actors.

CONDITIONS FOR OPERATING MaaS

Regardless of the different business models, the implementation and operation of MaaS service requires a single identity for a user, open data, and open payment methods from various transport modes. Due to the fact that people often say that "they often forget their public transport cards but they rarely forget their mobile phones" [12], has given birth to smart phones becoming people's new "ID". Therefore, the use of the new "ID" to travel through different transport modes in a city is feasible. The basic conditions that must be fulfilled in order to develop and operate MaaS in a city are as summarized below:

- Availability of a wide range of transport modes in the city,
- Majority of the transport operators open their data including real-time data to a third party,
- Majority of the transport operators allow a third party to sell their service, and
- Majority of the transport operators offer an e-ticket or e-payment to access their services.

A city must have adequate public transport services to allow users to travel in the city easily without having to own a car i.e. MaaS can only be operated in a place where users are willing to move away from car-dependent daily transport. This is feasible where the public transport services are already quite good and many residents do not see the essentials of owning a car, in which case MaaS can be seen as an alternative choice to owning a car while enjoying equally convenient transport services. This can also be used in lower income countries to provide mobility solutions to those who cannot afford owing a car.

CHALLENGES TO IMPLEMENTATION OF MaaS

Even if all the conditions have been met in a city, implementation of MaaS will face some significant challenges on users' perspectives, business model and policy support, even though seen by transport professionals as a paradigm shift towards a more sustainable urban mobility. The transportation industry is a critical component of the US economy, providing an essential link between producers, manufacturers, distributors, and consumers. Challenges MaaS technology still has to confront before it can manage full implementation in some countries are: payment integration, subscription model, ticket-validation, ability to share information from transportation providers, legal framework, data sharing, and willingness of the users [13]. Some of

the challenges faced by the transportation industry are [14-16]:

1. *Capacity:* this has to do with a basic constraint concerning appropriate capacity, both along a transport route and at the terminal. This is often restricted by its circulation bottlenecks and expensive to improve.
2. *Transfer:* transfer points are crucial as they serve as the interface between different transport systems, a role commonly served by hubs or gateways e.g. a port is the interface between maritime and land systems of circulation, and while an airport is the hub connecting different air networks such as regional and international.
3. *Reliability*: this is a multidimensional problem which concerns the expectation that a movement will occur within a specific time and cost range. Even, if a route is shorter, it may not be as reliable as a longer route. There is also the problem of congestion that impairs the reliability of a transport system as it can cause inconsistent time delays and additional costs.
4. *Integration*: this involves the exploiting of each transport mode so that flows become more reliable or less costly. Integration is sort by intermodal transportation, but also by airline companies connecting different parts of the world.
5. To make a user shift from a familiar travel app to one single app is a challenge for MaaS providers. The users' perspectives toward MaaS have not been well studied and understood yet.
6. MaaS will face strong competition from existing travel apps already offering global services (as MaaS aims at a Pan-European or global market). This is apart from Uber app, eCab, a taxi app, taxi booking and payment services using one single account in 6 European countries as well as in India, Canada, and Lebanon.
7. The willingness to share data and services with MaaS providers – this is due to the fact that public transport companies will not be willing to abandon their own data formats. When Google Transit becomes widely available, many transport operators will voluntarily supply their data following the pre-defined data format of Google Transit, for two main reasons i.e. 1. They want their public transport services to be included in the Google map and navigation services which enjoy a dominant position worldwide, and 2. That Google Transit APIs, General Transit Feed Specification (GTFS) and GTFS Real Time, are simple and user-friendly.
8. There are also concerns for competitiveness of MaaS market when it becomes global, where Small and Medium Scale Enterprises (SMEs) will face unfair competitions from big players.
9. Infrastructure bottlenecks such as lack of highways, bridges, and tunnels, resulting in increased congestion, longer transit times, and higher transportation costs.
10. Lack of investment in transportation technology e.g. automated cargo handling systems, real-time tracking, and monitoring tools.
11. Cost of implementing new technologies and automating processes can be very expensive, and businesses must carefully consider the returns on investment.
12. Resistance to change.
13. Last-mile delivery.
14. Increasing fuel costs.
15. Environmental issues/concerns.
16. Shortage of qualified or skilled drivers to meet growing demand.
17. Increased regulations affecting drivers and equipment.
18. Geopolitical environment, trade policies, political instability and security.
19. Regulatory compliance and legal considerations.
20. Collaboration and partnerships in the industry.
21. Mobility disability.

OVERCOMING THESE CHALLENGES

Transportation and distribution are crucial aspects of our economy, but they come with their own set of challenges, ranging from infrastructure to last-mile delivery, of which businesses must navigate the hurdles to enhance smooth operations. This can be achieved through the implementation of the right strategies and leveraging technology by companies to ensure efficiency to meet with the evolving needs/demands of consumers. In the US the challenges faced ranges from infrastructure bottlenecks to regulatory compliance. Infrastructure bottlenecks can be solved by investing in transportation infrastructure, such as highways, bridges, and tunnels to reduce congestion and transit times. There is also the need to adopt transportation technology e.g. automated cargo handling systems and real-time tracking and monitoring tools in order to enhance efficiency, reliability, and safety. In addition, businesses can leverage data analytics to optimize transportation process, identifying

bottlenecks and developing the strategies to mitigate them.

There is the need for efficient supply chain (via Transportation Management System, TMS), the adoption of technology and automation to revolutionize the industry by the use of Radio Frequency Identification (RFID) tags that can track inventory and shipments in real-time. The application of "lean management principles" for Supply Chain Operations is used to improve the efficiency of supply chain operations through eliminating waste, streamlining processes, and continuous improvement. Collaboration and partnership in supply chain operations is also essential by working together, such that businesses can share resources and expertise, reduce costs, and improve efficiency via Vendor Managed Inventory (VMI), and engagement with "third-party logistics providers (3PLs)."

Embracing Technology and Automation – this is through the use of "tracking technologies," such as GPS, RFID, and barcodes; and use of autonomous vehicles such as self-driving trucks and drones.

Required as well are innovative solutions to overcome the challenge of last-mile delivery, as shown in Figure 2, which has to do with navigating through traffic congestion, finding suitable parking spaces, and dealing with inefficient and outdated delivery processes – these could be overcome using the following strategies among others: deploying electric vehicles, the use of drones, partnering with local businesses (collaborating with local shops and stores to offer pickup locations for packages), and implementing smart lockers to reduce costs, optimize delivery processes, and meet customer expectations.

Collaboration and partnership can also help businesses overcome challenges and drive/ensure efficiency by working together to share expertise, and reduce costs. The many benefits of technology and automation are numerous and include:

1. Improved efficiency and productivity.
2. Reduced costs and wastes.
3. Enhanced safety and security.
4. Better customer experience, and
5. Growth opportunities.

Transportation companies must also ensure "environmental sustainability" by adopting "green solutions" e.g. by the use of electric vehicles instead of gas-powered trucks to reduce CO_2 emissions while providing efficient performance, reduce carbon footprint by implementing eco-friendly packaging, reducing waste, and recycling materials, leading to sustainable transportation [17], as shown in Figures 3 and 4.

Regulatory compliance and legal considerations – the failure to comply with relevant regulations and laws can result in heavy fines, legal disputes, and reputational damage. All staff members in the transportation and distribution operations must receive regular training on safety, security, and compliance issues. Therefore, companies must work with legal experts to navigate the complex web of laws and regulations at the federal, state, and local levels.

Collaboration and partnerships in the industry – this will help businesses to work together and leverage each other's strengths and fill in the gaps where necessary e.g. as between Walmart and Schneider Logistics; and the SmartWay program between the Environmental Protection Agency (EPA) and various business sectors to reduce transportation-related emissions [18].

Mobility disability: this is an obstacle to persons with disability. These people make use of wheelchair, crutches, etc. Physical barriers should be removed or reduced as a prerequisite for people with reduced mobility and physical disability to access transportation network. Use of websites and mobile applications e.g. wheelmap and access earth, the indoor navigation app Evelity, and handicap-accessible transportation as provided by Uber and Lyft, among others, as shown in Figure 5 [19].

CONCLUSION

The benefits that are available using mobility-as-a-service (MaaS) have been enumerated as well as the challenges facing the transportation industry. Despite the aforementioned obstacles or challenges facing MaaS, the future prospects for the project is very bright and can be surmounted. Developing countries must of necessity key into this laudable global transportation system so that they are not left behind as it will help develop their economy by creating more jobs, reduce poverty in the land, facilitate tourism development, technology transfer, more infrastructural development, etc. Governments at the federal, state, and local levels should take the bull by the horns to develop the transport sector via massive investment involving public-private sector partnership/collaboration and as well as providing the enabling environment through workable legal/regulatory policy frameworks devoid of corruption/bureaucracy by government officials.

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Figure 1. Smart Mobility.

Source: https://upload.wikimedia.org/wikipedia/commons/7/71/Smart_mobility_image.png

Figure 2. Last mile (Transportation) – Wikipedia

Source:https://www.google.com/search?sca_esv=c749765cd04b072f&sxsrf=ADLYWII2aJSK862coY2xBW0JuIn5TkXx4Q:1715225164696&q=images+on+shared+transport+as+a+service+from+wikipedia&tbm=isch&source=lnms&prmd=ivnsbmz&sa=X&ved=2ahUKEwjG6JrVz_FAxUtTEEAHby0CQgQ0pQJegQIDRAB&biw=1366&bih=625&dpr=1#imgrc=2bXfi4mtdqf4NM

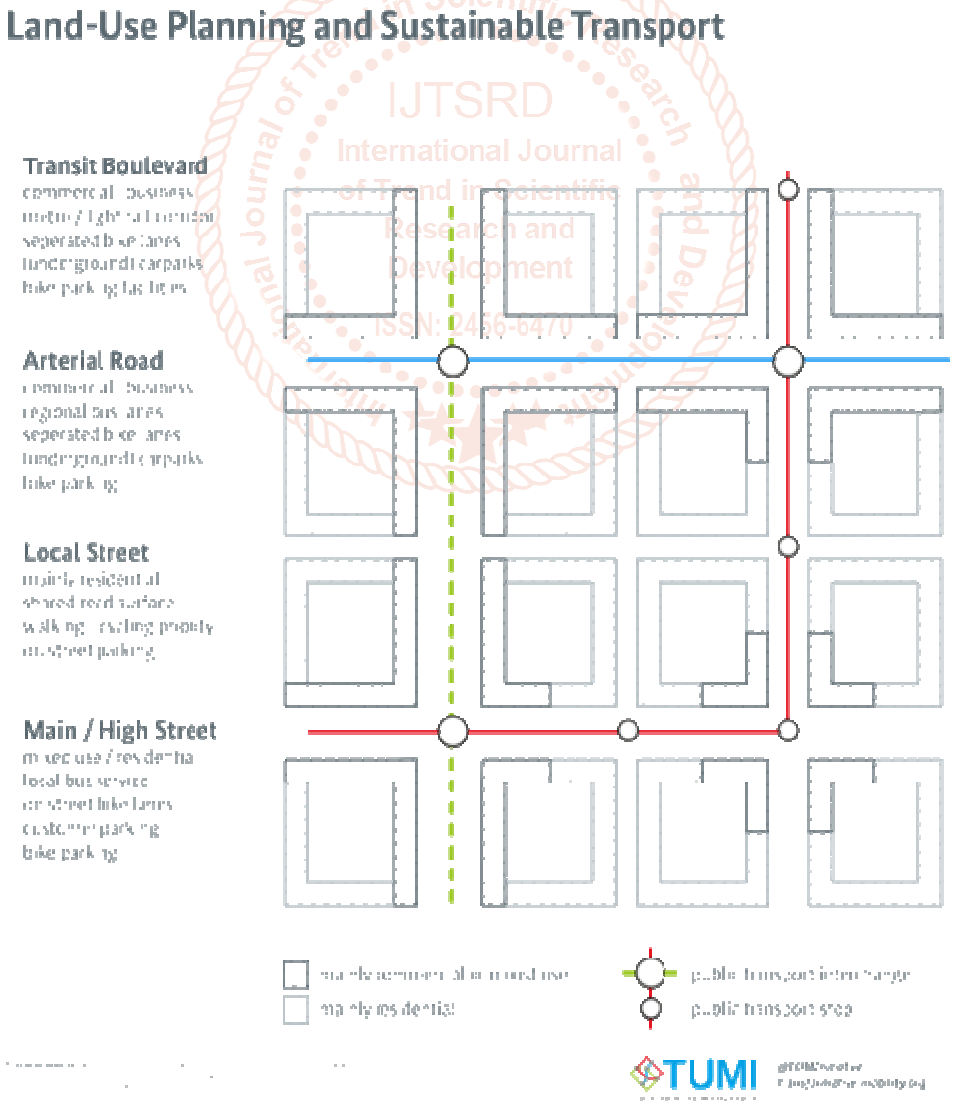

Figure 3. Land-Use Planning and Sustainable Transport - Wikipedia

Source: https://en.wikipedia.org/wiki/File:Land-Use_Planning_and_Sustainable_Transport.png

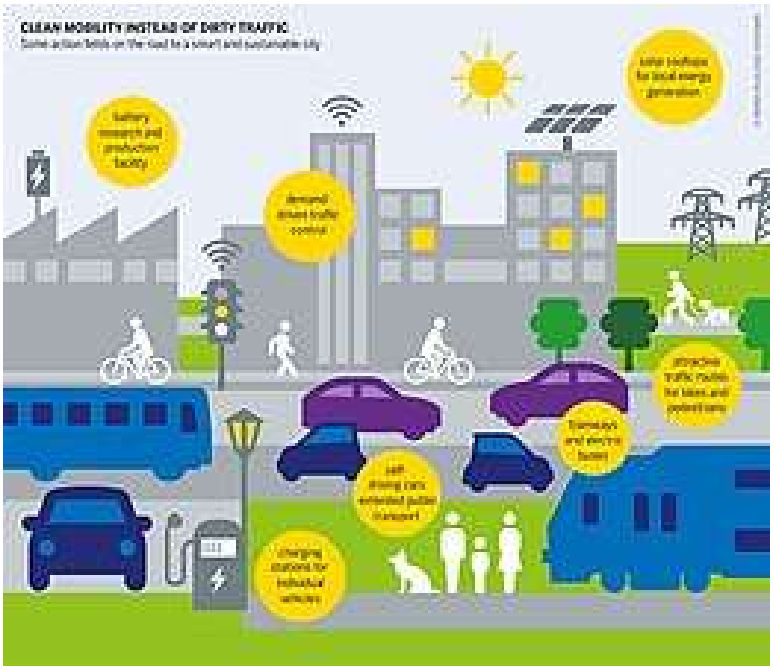

Figure 4. Sustainable Transport - Wikipedia

Source: https://www.google.com/search?sca_esv=cd9a55a255ee4ca7&sxsrf=ADLYWIKFJV-lddOBh3ZnRYNRSA2cRMEyQ:1715332941144&q=images+on+shared+transport+as+a+service+from+wikipedia&tbm=isch&source=lnms&prmd=ivnsbmz&sa=X&ved=2ahUKEwiNhYOV4YKGAxW2S_EDHVyqCkEQ0pQJegQIDRAB&biw=1034&bih=539&dpr=1#imgrc=4z2sEFQynBaGCM

Figure 5. Disability - Wikipedia

https://www.google.com/search?q=images+of+challenges+to+mobility+as+a+service+by+wikipedia&tbm=isch&ved=2ahUKEwiChcv31f-FAxWdnCcCHWXiD4QQ2-cCegQIABAA&oq=images+of+challenges+to+mobility+as+a+service+by+wikipedia&gs_lp=EgNpbWciOmltYWdlcyBvZiBjaGFsbGVuZ2VzIHRvIG1vYmlsaXR5IGFzIGEgc2VydmljZSBieSB3aWtpcGVkaWFIqoYBUJsJWNdYcAB4AJABAJgBmQKgAasWqgEFMC43Lje4AQzIAQD4AQGKAgtnd3Mtd2l6LWltZ8ICBBAjGCeIBgE&sclient=img&ei=30g8ZsKZGJ25nsEP5cS_oAg&bih=580&biw=1366&prmd=invsbmz#imgrc=7b8hWxJgT7iQPM