ISSN: 1813-4890

A Review of Research on the Impact of Mobility as a Service (MaaS) on Travel Behavior

Peipei Wang

School of Traffic & Transportation, Chongqing Jiaotong University, Chongqing 400074, China

541506532@qq.com

Abstract

Since China issued the dual-carbon target, all industries have responded, and the transportation sector is no exception. As an industry with high carbon emissions, how to reduce carbon emissions is a hot topic for scholars to study, and the MaaS system is produced in this context, the purpose of the system is to provide a door-to-door service for the masses, and bring more choices to people's travel. The generation of this system will have a greater impact on people's travel behavior, especially when the system is combined with the carbon inclusive mechanism, it will change people's travel behavior to a greater extent, and people will tend to choose the route with less carbon emission and more convenient to achieve the purpose of travel. This paper firstly introduces the definition and development status of the system, then explains the impact of the system on people's choice of travel mode, and finally makes a summary and outlook, through this research, it can improve citizens' attention to low-carbon travel, and also improve people's awareness of the MaaS system, which will lay a foundation for the development of the system in the future.

Keywords

Mobility as a Service(MaaS); travel behavior; Impact studies.

1. Introduction

Human travel behavior is complex, and there are many factors that need to be considered in order to manage it effectively. Among them, effective management of "people" in transportation is an important part. Due to the different behavioral habits of individuals and the different transportation resources in their environments, there are differences in the costs and benefits that individuals need to pay when traveling. In the context of dual-carbon, MaaS systems have emerged as a one-stop shop for travelers, mainly to facilitate travelers at airports, stations, trains, ships and even automobiles, so that they can travel anywhere and at any time.

MaaS systems are an optional form of service that enables seamless connectivity between multiple people and provides a great travel experience for travelers.MaaS (Travel Destination Information) systems provide an integrated and efficient, sustainable and flexibly customizable information ecosystem through an integrated set of appliances and a database, which is a means of different types of information within an airport or station The system integrates different types of information within an airport or station and delivers this information into a common dataset to provide travelers with an accessible and customized way of serving their needs. It can be based on datasets rather than databases; it can be based on a single application rather than a single database; it can be used and accessed in a multi-selective manner; it can combine information and services based on the dataset or application of your choice; and so on.

The emergence of this system will change people's travel behavior to a large extent, this paper firstly introduces the definition and development status of this system, and then explains the impact of this system on people's choice of travel mode.

ISSN: 1813-4890

2. Definition of a MaaS system

MaaS is known as Mobility as a Service, which is a kind of transportation and travel concept or a transportation and travel service mode, not a kind of technology. Mobility as a service is through a service platform to provide a new travel service mode, combined with different means of transportation, to provide travelers with the optimal travel program, combined with the Internet and mobile payment platform, so that travelers can book in advance the January travel program development or according to their own needs to develop a program and pay[1].

MaaS, as a popular new concept of transportation management and service in recent years, is a new concept of people's future transportation service mode, and scholars' definitions of it are mostly reflected in the role of technology, the construction of ecology, and the integration of transportation modes in the three parts.MaaS system is a one-stop travel service mode that is based on the status quo's existing modes of transportation, and uses the technology to comprehensively match the passengers' travel costs in terms of time costs, money costs, and impacts on the environment. one or more modes of transportation to serve passengers' spatial location movement of the one-stop travel service mode [2].

3. Current status of domestic and international research on MaaS systems

3.1. current status of foreign research

Sochor J L,Karlsson M A scholars [3] categorized MaaS services into 5 levels according to the level of integration, which is graded in the Table 1:

Table 1 MaaS service hierarchy

Level	Name	Hidden meaning
0	quintuple integration	MaaS system provides separate services for different means of transportation
1	information integration	Integrate the travel information provided by travelers and develop multiple travel plans for travelers.
2	Integration of search, booking and payment	Optimized from level 1 to include booking and payment
3	Integration of transportation services into passes and travel packages	Added travel service providers as service recipients
4	Integration of social objectives	Reduction of unneeded demand through existing supply for the purpose of protecting the environment and the standard of living of urban dwellers

KAMARGIANNI, MATYASM,LI W and other scholars [4], on the other hand, from the point of view of integration, according to the size of the integration function of the MaaS service system is divided into the basic integration stage, highly integrated stage and customized mobile service packages integration stage, and it is believed that the travel-as-a-service system should

ISSN: 1813-4890

include the integration of information integration, payment and other integrations, and provide a complete travel service to the user.

3.2. Status of domestic research

3.2.1. Research on the development of MaaS systems

Yunxing Zhang and Dingnan Xue[5] combined the MaaS concept and mathematical model in the context of the "dual carbon" goal, and labeled the carbon emissions of each recommended route under the route, and proposed to rank the routes in this way, so that the travelers can choose the route with the lowest carbon emissions, in order to achieve the purpose of energy saving and emission reduction. And the idea is realized after solving the model by using step-by-step analysis, and at the same time, it provides a new way of thinking for establishing green travel model.

Haode Liu, Zhenguo Qian[6] analyzed the differences between MaaS system and traditional model, and proposed a new development route of MaaS system in China from the aspects of basic capability, key technology and application demonstration.

Liyuan Wang, Jia'an Bai[7] constructed the corresponding evaluation indexes by analyzing the characteristics and influencing factors of travel-as-a-service system, and meanwhile derived the evaluation method of service level of MaaS system by using gray clustering method in Guangzhou City as an example.

Xutong Qin, Wenyong Li[8] take small and medium-sized cities as the main research object, analyze the characteristics of the residents' travel chain in small and medium-sized cities, and put forward the suggestion of constructing MaaS system in small and medium-sized cities, so as to improve the level of public transportation service in small and medium-sized cities.

Yiyu Huang, Xiaoli Wen[9] combined MaaS system with e-tickets, nowadays smart phones have been popularized, to combine smart phones with travel service system, e-tickets is a good breakthrough.

3.2.2. A Study of the Impact of MaaS on Travel Behavior

Tang Shan, Tianyu Shen et al[10], on the other hand, start from the human travel service experience, through the analysis of foreign cases, put forward the new idea of combining the MaaS concept and driverless cars to optimize the connection of people, vehicles and roads, while improving the human travel service experience.

Wanying Li, Hongzhi Guan[11] et al. By studying the travel model selection of the traveling crowd, in the study, it was found that most of the travelers would choose to subscribe to travel service packages, and the influencing factors of the travelers' choices were mainly the attributes of the platform, and the economic situation of the travel place.

Tianshi Wang, Huapu Lu[12] in their investigation of MaaS travel choices in three cities, Gothenburg, London and Sydney, found that the system is more attractive to travelers who drive less frequently and the least attractive to those who use public transportation.

4. Impact of MaaS systems on travel behavior

4.1. Impact on public transportation travel

In recent years, the number of small cars in China has risen sharply, and public transportation has been affected more. Small cars have the advantages of convenience, comfort and so on, most of the travelers prefer to choose small cars, which also led to the public transportation gradually become the traveler's alternative. HENSHERD A scholars believe that[13] MaaS system is not suitable for the current traditional public transportation operation mode, the current public transportation is not based on the people's travel service, if we want to travel as a service system and the traditional public transportation. VAN AUDENHOVE F J[14] argues that the

emergence of MaaS systems can increase the importance of travelers to public transportation and improve the utilization of public transportation. MULLEY C,NELSON J D[15] focus on the dependence of the elderly population on public transportation, despite the current emergence of new modes of transportation will hit the traditional public transportation, but the public transportation travel is still the first choice for most of the travelers. MULLEY C[16], on the other hand, from the point of view of the environment, analyzed that the MaaS system can improve the utilization rate of the public transportation, which can work with other modes of transportation to achieve the effect of multimodal transportation. Thus, it can cooperate with other transportation modes to achieve the effect of multimodal transportation, which not only improves the utilization of resources, but also reduces carbon emissions, which has a positive effect on environmental protection. KARLSSON I C M[17] proposed that a single traditional public transportation operation mode has been unable to meet the people's growing travel demand, so the combination of the MaaS system creates a new service model, which has a large positive effect on the improve the efficiency of the service has a greater positive effect.

4.2. Impact on small vehicle travel

In recent years, with the rapid development of the country, the number of passenger cars has surged dramatically, leading to increasingly severe traffic congestion and a gradual increase in carbon emissions. This not only hinders the achievement of the "dual carbon" goals but also causes significant damage to the ecological environment. The proposal of Mobility as a Service (MaaS) can change the choices of travelers, thereby reducing the use of passenger cars and achieving the effects of alleviating traffic congestion and energy saving and emission reduction. BECKER H[18] start from the perspective of shared cars, believing that the introduction of the MaaS system can promote the development of shared cars. In the future, shared cars will be very popular because they can be used and parked on demand within the operating range, effectively solving the travel problems of travelers. Yixin Yuan, Wang Fang[19] and others analyze the development and changes of passenger cars under the system from the impact of MaaS on the strategy and operation of car companies. By analyzing the current Mobility as a Service system and combining the strategic decisions of car companies, they provide a good approach for the development of enterprises.

5. Summary

The MaaS system is the latest proposed travel service model, whose connotation is to improve service quality by reducing door-to-door travel time, increasing the reliability of transfer travel, and improving the accessibility and diversity of services. The MaaS system is no longer a simple collage of multiple independent mobile service systems, but a new model that integrates various modes of transportation to provide users with seamless replacement and one-stop travel.

One of the current challenges of the MaaS system is to reduce passenger car travel, improve the utilization rate of public transportation, and promote energy saving and emission reduction. The basis for the smooth operation of MaaS is a comprehensive urban public transportation network planning, and public transportation covering most areas. At present, China's public transportation network is not yet perfect, and the public transportation service system has not yet met the requirements of travelers. Most travelers will still consider passenger car travel first, so the development of public transportation is particularly important.

If the MaaS system wants to develop in China, the distribution of benefits is also a major issue. On the one hand, the distribution of interests between various transportation operators may limit multi-party cooperation; on the other hand, using an account to pay for all transportation costs will inevitably require additional investment in existing infrastructure, so the distribution of interests among managers, developers, and travelers cannot be ignored.

The development of the MaaS system provides travelers with another choice model. On an integrated platform, travelers can choose the mode of travel from the starting point to the destination. Most people can choose a more efficient mode of travel based on the data provided by the platform.

6. Outlook

The emergence of the MaaS system can not only enrich people's travel choices but also promote the achievement of dual carbon goals. For travel, people can choose reasonable modes of travel through electronic information platforms and experience door-to-door travel service models. At the same time, for public buses, as the economic level continues to improve, most people will choose private cars for travel, and the travel rate of public buses is gradually decreasing. Passenger cars have the advantages of convenience and comfort, and most travelers tend to choose passenger cars, which has also led to public transportation gradually becoming an alternative option for travelers. However, the emergence of the MaaS system can increase travelers' attention to public transportation, improve the utilization rate of public transportation, and achieve multimodal transportation in conjunction with other transportation modes, which can not only improve the utilization rate of resources but also reduce carbon emissions and have a positive effect on environmental protection. For passenger cars, the development of the travel and service system will reduce the travel rate of passenger cars to a certain extent, but for shared cars, the system can play a good role in promoting it. For bicycles, the MaaS system can promote its development, solving the last mile problem and making good use of bicycles to improve travel efficiency. The future development of the MaaS system is worth looking forward to. Under the setting of the national dual carbon goals, to achieve green travel, the system can be used in conjunction with carbon inclusive policies, in an incentive way, to let passengers choose low-carbon travel to obtain rewards, which can not only promote green travel and reduce carbon emissions but also improve people's attention to low-carbon travel.

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