



# Mobility-as-a-service transitions in China: Emerging policies, initiatives, platforms and MaaS implementation models

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## ABSTRACT

The concept of Mobility-as-a-Service (MaaS) is gaining increasing attention in both academic and policy discourses concerning the future of transport and mobility. The current understanding of the progress of MaaS is based on the handful of studies that have explored pilot initiatives carried out mainly in Europe and North America. In contrast, this paper extends the literature by exploring the evolution of MaaS in mainland China. It examines how the concept of MaaS emerged in China, identifies and maps on-going MaaS initiatives and platforms across Chinese cities, and investigates the most common approaches and models of MaaS delivery. The analysis reveals that while Chinese government policy has long discussed integrated transport, MaaS and related aspects, including 'one-stop' mobility services and 'Chuxing Ji Fuwu', which is the Chinese translation of Mobility-as-a-Service, have only appeared in recent times. At present, 41 Chinese cities are hosting ongoing MaaS initiatives and associated platforms. These are concentrated in the developed eastern regions, in cities with high political influence and larger populations. The geography of MaaS strongly reflects the prevailing digital divide in China, implying that deliberate policy choices are needed to avert widening transport and mobility inequalities in the age of MaaS. MaaS platforms currently only provide basic information and modal/service integration and are deployed either as bespoke applications or added to existing social media and navigation applications. Two main models of MaaS delivery were identified: *public-controlled* model that is predominant and centered primarily on integrating existing state-run public transport services, and *partnership* model that is emerging in cities such as Beijing to integrate more mobility services beyond conventional public transport. The complex landscape of actors associated with the emerging public-private partnership model presents new challenges for transport governance, especially in balancing an established tradition of strong public sector control over transport on the one hand, and the interests of the fledgling private sector mobility service providers on the other hand.

## 1. Introduction

Urban areas all over the world face major challenges concerning transport and mobility. A crucial concern in this sector regards the implementation of environmentally sustainable means of transport that can meet the mobility needs of different groups (Casady, 2020; Giesecke et al., 2016). The challenges faced by urban transport are inextricably tied to rapid urbanisation, which dramatically increases the number of personal vehicles in cities (Gakenheimer, 1999; Halpern, 2014; Han, 2010). In developing countries with high levels of recent urbanisation, the mismatch between the supply of transport infrastructure and urban residents' changing mobility demands is steadily increasing (Jarrah et al., 2019; Han et al., 2018; Sietchiping et al., 2012). As people become more

reliant on cars for transport, other issues arise, including air and noise pollution, road congestion, accidents and related deaths, high energy consumption, and growing CO<sub>2</sub> emissions (Canitez, 2019; Zavitsas et al., 2010; Shekhovtsov et al., 2020). Consequently, academic research and government policy are currently focused on reducing the pollution, energy consumption, and emissions tied to road transport to improve the quality of urban life.

One way to resolve these transportation challenges is to construct highly efficient integrated transport systems, the goals of which include achieving an all-encompassing level of physical, inter-modal, timetable, and fare integration to meet the travel demands of all urban residents (Buchanan and Crow, 1974; Audouin, 2019). Physical integration concerns the integration of infrastructure, including physical routes and

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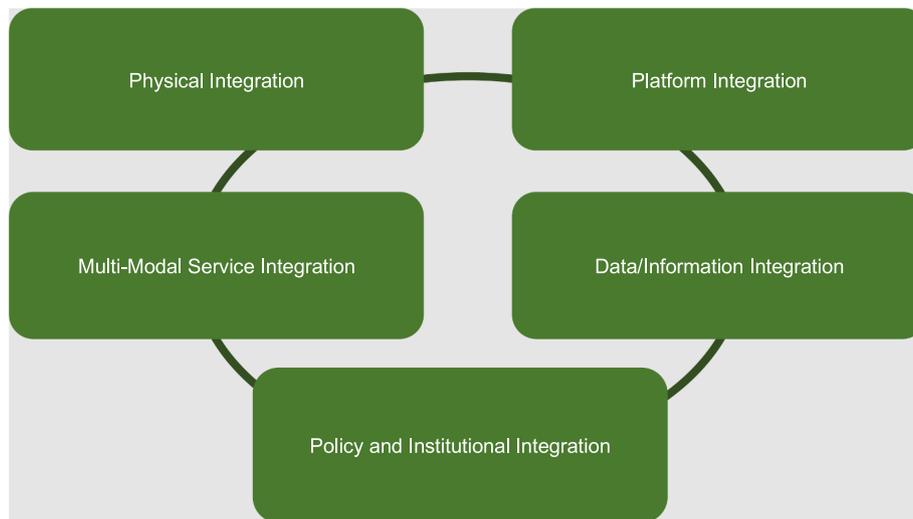


Fig. 1. Conceptualizing MaaS and the aspects of integration (Source: Authors, 2022).

facilities such as stations, stops, and transfer centres to minimise the number of transfers during inter-modal journeys and make the urban travel experience as seamless as possible (Saliara, 2014). Fare integration refers to the integration of booking and payment systems, while the integration of the timetables and scheduled departures of different transport services is needed for users to be able to use different modes with ease (Audouin, 2019).

Emerging transport technologies, together with the services they offer and mobility concepts they construct, are leveraging advances in Information and Communications Technologies (ICTs) and thus creating new possibilities for the integration of urban transport. Indeed, the development of ICTs has enabled the creation of Integrated Mobility Services (IMS), which are means of modal integration centred around aggregating different mobility services and making them accessible all at once via a single interface (Sochor et al., 2015; Mukhtar-Landgren et al., 2016). IMS have included various services, from shared mobility services such as car- and bike-sharing schemes to demand-responsive services such as Uber and Didi (Yun et al., 2020), with platforms integrating the booking and payment of a single travel mode (Mukhtar-Landgren et al., 2016).

Within the context of IMS, Mobility-as-a-Service (MaaS) has emerged to strengthen the current level of integration and customisation of mobility services. MaaS is thus a means to aggregate multiple transport services in a single channel or platform to facilitate customers' access to information about different mobility modes (Heikkilä, 2014; Giesecke et al., 2016; Cruz and Sarmiento, 2020; Hensher et al., 2021). The aim of these platforms is to provide users with the ability to customise their travel experience and seamlessly integrate various services (European MaaS Alliance, 2020; Smith et al., 2018; Holmberg et al., 2016; Rantasila, 2015; Heikkilä, 2014). Whereas integration focuses on harnessing the complementarities between modes of transport and making them readily available to users, the customisation offered by MaaS seeks to address users' preferences and enable seamless multi-modal journeys (Audouin, 2019). MaaS is considered to be a way of introducing a new regime of inter-modality, which will induce profound socio-technical changes (Audouin, 2019). This, however, also requires deep changes in individual behaviour and attitudes, notably to allow on-demand access and usage to replace ownership (Lajas and Macário, 2020). Moreover, MaaS must be supported by new business models that are more financially sustainable (Reck, 2021), and new actors for the aggregation of mobility services into one platform (Smith et al., 2018).

Since its emergence, MaaS has been gradually put into practice through various pilot initiatives. However, as a relatively new concept, research on this type of mobility service is still in its infancy. All of the

MaaS pilot initiatives that have been scientifically explored so far are either European (e.g., Finland, Sweden, Germany, Poland, and the UK), Singapore, or North American (see e.g. Zijlstra et al., 2020; Heikkilä, 2014; Goodall et al., 2017). Most of these studies have centred on governance issues, including governance approaches, policy instruments and implementation models (Smith and Hensher, 2020; Audouin and Finger, 2018; Hirschhorn et al., 2019; Vonk Noordegraaf et al., 2021; Mukhtar-Landgren and Smith, 2019; Pangbourne et al., 2020; Dadashzadeh et al., 2022), the role of public sector actors (Fenton et al., 2020; Audouin and Finger, 2019; Li, 2019), barriers and enablers to the development of MaaS (Karlsson et al., 2020), and evolving institutional configurations (Smith et al., 2018; Surakka et al., 2018). Others, instead, have focused more practically on the platforms themselves and the level of integration they provide. For instance, in this type of research, Sochor et al. (2018) categorised MaaS platforms into two main groups: platforms that only integrate mobility information (e.g., Qixxit), and those that integrate information, booking, and payment (e.g., Smile, Moovel, Whim, and Ubigo). A third research direction has addressed the business models adopted by MaaS providers (Hensher, 2017; Mulley and Nelson, 2020; Kamargianni and Matyas, 2017), while a fourth branch has researched users' acceptance and adoption behaviour (Ye et al., 2020; Schikofsky et al., 2020; Liljamo et al., 2020; Matyas and Kamargianni, 2019; Polydoropoulou et al., 2020).

The current understanding of the development of MaaS initiatives is limited to these few empirical studies carried out in developed Western countries. Hence, the evolution of MaaS in other national contexts is virtually unknown, especially in developing countries in the Global South. However, MaaS and IMS have recently started to be discussed in Chinese policies, and some pilot initiatives have either been planned or have already started in various Chinese cities, including Beijing. As such, this study aims to provide a broad, initial understanding of China's transition toward MaaS. Specifically, the paper addresses four main interrelated objectives which are: (a) assess the general policy context concerning transport integration broadly and MaaS specifically in China; (b) identify and map the geographical distribution of MaaS initiatives and platforms across mainland China (c) analyse the characteristics of on-going MaaS initiatives and platforms, including mobility service offerings and platform types and levels of integration within platforms; and (d) examine emerging MaaS implementation models/approaches. By exploring the current evolution of MaaS in China, this study provides a first contribution to the understanding of China's transitional progress, highlights similarities and differences with previous empirical scholarship on MaaS in other contexts and outlines directions for further research.

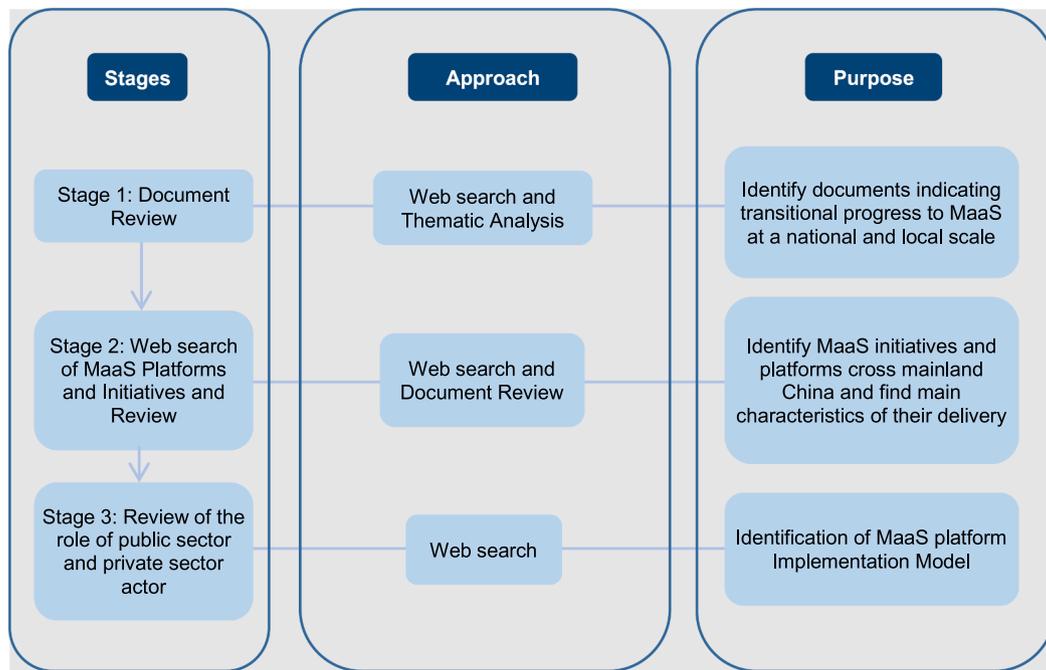


Fig. 2. Scoping Review and Analytical Process (Source: Authors, 2022).

This paper is divided into five sections. Following this introduction, Section 2 will outline the methodology of this study. Then, Section 3 will present the results of the analysis, followed by a discussion of the main findings and their implications in Section 4. Finally, Section 5 will make some concluding remarks before presenting directions for further research.

2. Methodology

2.1. Conceptualizing MaaS

In this study, the transition to MaaS is seen as the gradual emergence of an integrated mobility regime (Audouin, 2019) covering the integration of platform-enabled mobility services, data, physical infrastructure, and policy and institutions (Fig. 1). The first element can be interpreted as the integration of different mobility services into a single platform through which users can access information about different mobility options and book the services they need (Kamargianni and Goulding, 2018). For the realisation of this purpose of MaaS platforms, transport service providers should collect data concerning users’ preferences, available routes, ticket prices and timetables and be willing to share it with the platform (Kamargianni and Goulding, 2018). As such, service integration is partly tied to data integration, without which service providers could not make operational decisions. On a more practical level, physical integration concerns the effective and efficient coordination of transport infrastructure and facilities, including parking spaces and all the available transport networks in a given area (Audouin, 2019; Merkert et al., 2020). Finally, the realisation of efficient MaaS also requires relevant institutions to be integrated (Merkert et al., 2020). This, in practice, means that relevant institutional actors should collaborate for the implementation of coordinated policies and measures. For example, local governmental authorities may support the delivery of MaaS by developing a range of complementary cross-sectoral and cross-tier policies. In addition, institutional integration also concerns organisational integration, such as building collaborative bodies between MaaS deliverers.

Table 1

Document selection criterion and search terms.

Type and Source of Documents	Published official documents, including press releases and news bulletins, policy documents, reports, other records published by governments and companies, and academic literature.
Relevant terms	MaaS; Chuixing Ji Fuwu; integrated and intelligent mobility service; app-based mobility; integrated transport; mobility-on-demand; on-demand mobility; door-to-door mobility; demand-responsive transport/mobility; Metro and Bus One-Card Scheme; application.
Content coverage	Documents should contain information about transport integration, including data, service and infrastructure integration, government programmes, strategies and policy directions. Documents focusing specifically on MaaS initiatives were also considered.

Source: Authors, 2022.

2.2. Systematic scoping review

As mentioned before, this study aims to track the trajectory of the MaaS transition currently underway in mainland China. In line with this study’s exploratory nature, systematic scoping review, focused mainly on policies and initiatives, was adopted as its main research approach. This method entails the employment of a systematic approach to gathering, sorting, reviewing, and analysing relevant information from multiple sources (Daudt et al., 2013; Weber and Chaiechi, 2022). Fig. 2 shows the three stages of the systematic scoping review, each of which will be explained in the following sections.

2.2.1. Identification and review of documents

The first step of the scoping review involved gathering information about how MaaS emerged in China and how the surrounding policy context evolved both at the national and local levels. To this end, relevant documentary sources were selected based on the criteria presented in Table 1 and were then analysed. Although MaaS emerged relatively recently as an independent concept, the integration of transport has been a priority for Chinese policies since the early 2000s (Liu and Luk, 2009). Considering this fact, the review focused primarily on policy

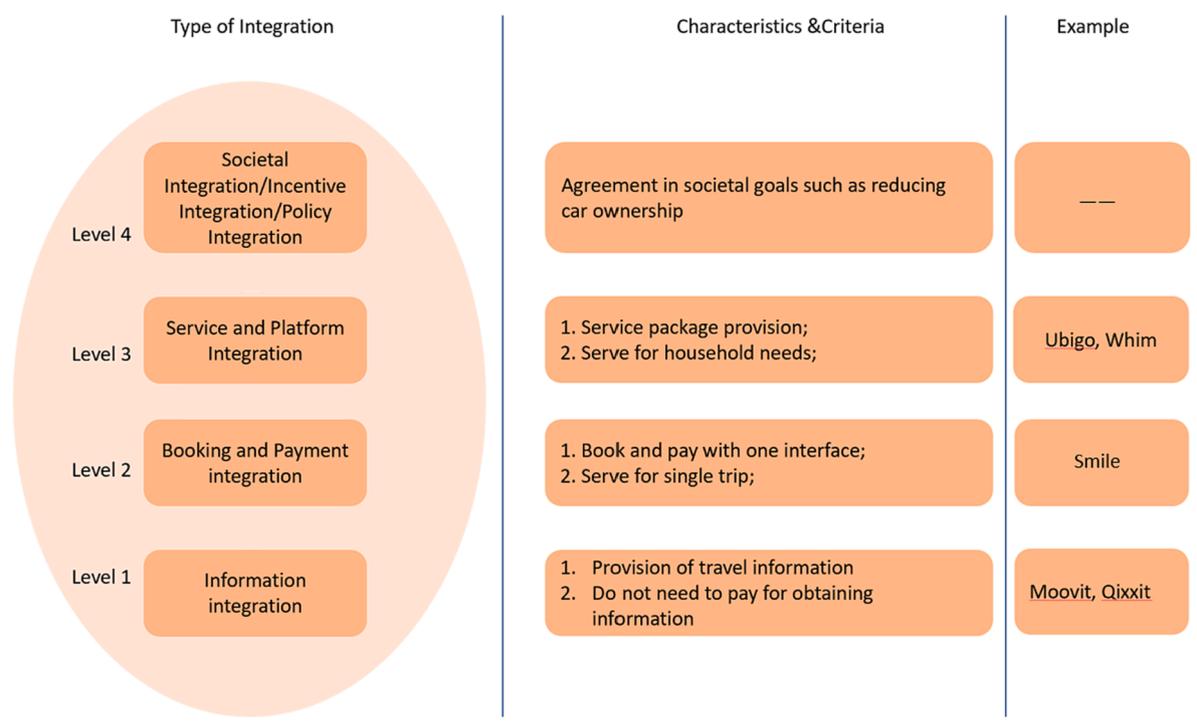


Fig. 3. MaaS Integration Level: Types, Criteria, and Examples (Source: Based on Sochor et al.,2018).

documents published from early 2000, with the intent of uncovering the broader Chinese political and policy agenda surrounding transport integration, and, specifically, the transition to MaaS. The documents collected included public-domain online news articles, official press releases, policy documents, and reports. Table 1 presents the keywords that were used to search for documents and assess how relevant they were to the study objectives. To avoid excluding potentially relevant information, the main keywords used for the search were 'Chuxing Ji Fuwu' and MaaS, followed by a series of related concepts such as 'integrated transport,' 'integrated mobility services,' and 'one-stop mobility service platform.' The web search for these terms resulted in a collection of 32 government documents and two relevant academic papers published on MaaS as of the time of conducting this research (see Appendix 1, Table A1). The documents were assigned alphanumeric codes ranging from 'DOC-01' to 'DOC-34' and systematically reviewed using thematic analysis.

2.2.2. *Inventorizing and mapping MaaS initiatives and platforms across China*

In addition to the document analysis, the second stage of this study involved the identification of MaaS platforms and initiatives across mainland China through a dedicated web search (Fig. 2). After identifying relevant pilot initiatives, Sochor et al.'s (2018) MaaS integration typology was used to assess the level of integration of different mobility services within Chinese MaaS platforms. The original typology divided MaaS into four levels, each corresponding to a certain degree of data, service, and policy integration (Fig. 3). Level 1 corresponds to the provision of basic information about multiple mobility modes. Level 2 refers to platforms that provide users with a single interface through which they can book and pay for different mobility services, but only for single trips. Platforms at Level 3 integration instead provide ticket bundles, periodic subscription services and service packages (Vitetta, 2022), thus meeting the travel demands of both households and individuals over periods of varying length (Sochor et al., 2018). The fourth and last level of integration concerns societal and incentive integration of all stakeholders, including both supply and demand ones, and their coordination for the delivery of MaaS (Sochor et al., 2018). This classification does

Table 2  
Implementation Model Identification Criteria.

MaaS Development Scenario/Model	Role of Public Sector Actors	Role of Private Sector Actors
Market-Driven	Mainly responsible with public transport ticket sales Mainly play the role of public transport providers and generally act as enabler but driving force	Play the role of integrating and operating mobility services The whole delivery process is driven by private sector actors with support of public sector
Public-Controlled	Public sector actors take the leading role of integrating and operating mobility services in addition to their traditional roles (e.g., selling public transport tickets) Public sector actors drive MaaS developments	Provide mobility services as what they do before delivering MaaS platforms
Public-Private	Take the role of MaaS integrator: public sector plays a mediating and enabling role, including providing technical, financial support to service providers/operators, and other activities	Take the role of MaaS operator: manage MaaS platform and deliver MaaS services to end-users through the MaaS interface

Source: Based on Smith et al., (2018).

not consider infrastructural integration, which was previously identified as an important component of MaaS (Fig. 1). Nonetheless, this framework remains a useful starting point to support the analysis of the differences between the types of MaaS platforms currently in place in Chinese cities and their capabilities.

2.2.3. *Identification of implementation models*

In the third research step, this study adopted Smith et al.'s (2018) classification of MaaS development scenarios to characterise the emerging implementation models that can be found in China. This

**Table 3**  
Summary of Policies for Transport Infrastructure Integration in China.

Policy Title	Year	Code	Summary of Content
Medium and long-term development planning of integrated transportation network	2007	DOC-32	Proposed to build commercial rail, road and air transport hubs in connection with urban rail transit, conventional public transport, taxis, and other transport modes to achieve a comprehensively integrated transport system
Notice of the General Office of the State Council Forwarding the Opinions of the Ministry of Construction and Other Departments on Prioritizing the Development of Urban Public Transport	2008	DOC-01	Build comprehensive transport hubs to facilitate transfers between different mobility modes (e.g., urban buses, railways, and other long-distance transport modes)
Notice of the Ministry of Transport on the announcement of the second batch of cities to be created by the demonstration project of public transport urban construction	2013	DOC-06-	Build new integrated transport hubs in 37 selected cities
“13th Five-Year” Modern Comprehensive Transportation System Development Plan	2017	DOC-12	Build 150 open and three-dimensionally integrated passenger transport hubs nationwide Achieve ‘Zero’ transfer distance between different transportation modes Urban railways should be integrated with airline stations and both large and medium-size high-speed rail stations
National Comprehensive Three-dimensional Transportation Network Planning Outline	2021	DOC-15	International airports should be integrated with more than two rail transport modes, including tramways and underground trains National train stations should be integrated with more than two modes of urban rail transport The planning and construction of rail transit in cities with international and national integrated transport hubs should take building comprehensive passenger transport hubs connecting these cities as a priority. Build about 20 international comprehensive transportation hub cities and 80 national comprehensive transportation hub cities.
“14th Five-Year” Modern Comprehensive Transportation System Development Plan	2021	DOC-19	The entrances and exits of the payment areas for different transportation modes should be less than 300 m apart 80% of airports should be integrated with railways and metros by 2025 More than 90% of harbours should be integrated with railways
Comprehensive transportation service “14th Five-Year plan” development plan	2021	DOC-17	Facilitate the passenger transfer of urban buses and bicycles within 100 m of all the main entrances and exits of railway stations

Source: Compiled by Authors.

framework proposes three MaaS development scenarios, distinguished based on the role of public and private sector actors in delivering MaaS (Table 2). The characteristics and interpretation of each development scenario correspond, in turn, to three different implementation models. Thus, in this analysis, the original scenarios proposed by Smith et al. (2018)—market-driven, public-controlled, and public–private partnership—are interpreted, respectively, as market-driven, public-controlled, and partnership models. This framework allowed for the identification of the currently existing MaaS operators and integrators in China, based on which the role of public and private sector actors in the delivery process was examined.

### 3. Results

#### 3.1. Policy context

##### 3.1.1. Origins of integrated transport imperatives in China

From the review of various documentary sources, it was revealed that MaaS was first mentioned in Chinese national policy in 2018, initially discussed under the umbrella label ‘one-stop’ mobility services. Later, in 2019, the concepts of ‘MaaS’, or ‘*Chuxing ji Fuwu*’, started to emerge in policy documents and reports. Before MaaS started to be discussed, integrated transport had already been a key point of national policy since the early 2000 s. The idea of constructing an all-encompassing integrated transport system was discussed for the first time in the 2007 policy *Medium and long-term development planning of comprehensive transportation network*. Since then, various other policies and projects for the integration of transport infrastructure, fare systems and mobility data have been proposed and delivered.

For the integration of physical infrastructure, the national government focused on integrating various means of public transport, concerning primarily bus, rail, and metro lines (see Table 3). In contrast, few policies addressed the integration of public and private mobility services (e.g., DOC-17/2021, Table 3). Moreover, national policies and strategies mainly focus on the integration of transport hubs to facilitate transfers between different modes of transport but are not as closely concerned with the overall journey, which would include, for example, connections between different hubs and access to transport facilities (Chowdhury and Ceder, 2013). In addition, China’s national government has openly addressed the physical integration of various intercity mobility modes, including rails, roads, and waterways. For instance, such policies discuss how to integrate urban railways with air transport or national train stations.

Another interesting finding was that the national government chose to differentiate the development of transport and thus prioritised regions as the scale for achieving transport integration goals across China. Under this system, the government selected some cities that would become ‘National Public Transport Demonstration’ or ‘Comprehensive Transportation Service Demonstration’ cities. These municipalities were thus given special funds to develop their urban public transport systems and, more specifically, build integrated transport hubs (see DOC-06/2013, Table 3). In addition to this, the central government selected large territories with relatively mature conditions (e.g., transport conditions, economic conditions) and endogenous demand, such as the Beijing-Tianjin-Hebei area, the Yangtze River Delta, and the Pearl River Delta, to take the lead in implementing one-card intercity transportation schemes.

As for the integration of transport data, the national government prioritises publicly operated transport services, while the data integration of private or partnership-operated mobility services is rather limited in government policy at all levels. Consequently, only a handful of policies and regulations were found to address mobility data sharing between the public and private sectors.

In addition to infrastructure and data integration, a range of national policies was also enacted to favour the integration of the public transport fare system. A key document regulating this area of transport

**Table 4**  
Transport data integration and sharing-related policies in China.

Policy Title	Summary of Content
“13th Five-Year” Development Outline of Urban Public Transport	Proposed to accelerate the establishment of a system to share urban public transport data and resources among ministries, provinces and cities. Promoted the construction of ‘one-stop’ information services covering all modes of transport that could span across regions.
“14th Five-Year” Development Plan for Digital Transportation	Proposed to improve the structure of comprehensive transport information platforms at the ministry and the provincial level and promote comprehensive transportation as a concept. Proposed to strengthen the integration and inter-service exchange of data and other resources.
Comprehensive transportation service “14th Five-Year plan” development plan	Promoted data sharing between inter-urban mobility modes, including air and rail transport.
Outline of Building a Strong Transportation Country	Promoted the construction of comprehensive transport big data centres for the development of intelligent transport.
“14th Five-Year” Modern Comprehensive Transportation System Development Plan	Proposed to strengthen the institutionalisation of transport data sharing.

Source: Compiled by Authors.

**Table 5**  
Summary of National Policies Related to MaaS.

City	Summary of Content
“14th Five-Year” Development Plan for Digital Transportation	Promoted the construction of integrated travel service platforms and advocated the concept of MaaS.
“14th Five-Year” Modern Comprehensive Transportation System Development Plan	Supported market entities to integrate resources and provide ‘one-stop’ travel services.
Comprehensive transportation service “14th Five-Year plan” development plan	Promoted the concept of “MaaS” and the development of ‘one-stop’ travel services based on smart terminals to actively achieve integration between air-rail, public-rail, public-air, public-water, air-water, and integration of other mobility modes.
Outline of Building a Strong Transportation Country	Proposed to develop shared mobility and realise ‘Mobility as a Service’.

Source: Compiled by Authors.

integration is the 2012 policy document *Guiding Opinions on Prioritizing the Development of Public Transport in Cities*, which emphasised the importance of working toward the popularisation of smart cards for intra- and inter-city transport. In 2020, more than 280 prefecture cities in China had already implemented smart-card schemes. Under these projects, a single card can be used to pay for bus, metro, ferry and light rail tickets, as well as taxis and public bike sharing (see DOC-14/2020).

3.1.2. *The emergence of MaaS in national and sub-national policies*

The first official policy documents and other government sources addressing the integration of mobility services in China appeared in 2018 (see Table 5). At the national level, the Chinese government has conceptualised ‘one-stop’ mobility services that closely resemble MaaS in their intents, purposes and service configuration. However, the existing policies describing these services are rather general and do not mention any specific MaaS projects or initiatives, nor do they set clear benchmarks and performance evaluation mechanisms for them. Furthermore, the few MaaS-related policies reviewed here do not identify the responsibilities of the various public and private actors in the process of delivering ‘one-stop’ mobility services. As summarised in

**Table 6**  
Summary of Local Policy Related to MaaS.

Document Title	Year of Publication	Code	Summary of main content for MaaS
Beijing Municipal Traffic and Travel Data Open Management Measures (for Trial Implementation)	2019	DOC-21	Promotes the exchange of urban mobility data in Beijing, specifically listing the type of mobility data that can be shared and the procedures for doing so.
Report of Qingdao Municipal Transportation Bureau on the revision and improvement of the pilot program for building a strong transportation country	2021	DOC-24	Set a timeline of 3 to 5 years for the realisation of a MaaS platform in Qingdao.
Jiangsu Province “14th Five-Year” Smart Transportation Development Plan	2021	DOC-25	Proposed to rely on Huai’an, Suzhou and other nearby cities to carry out MaaS initiatives in 2021.
Changsha Municipal Transportation Bureau’s decision on accelerating the construction of a new smart city demonstration city	2020	DOC-26	Proposed to build a MaaS one-stop travel service platform for public transport in Changsha.
Three-year action plan for traffic optimization and improvement in the central urban area of Xi’an (2020–2022)	2021	DOC-27	Proposed to develop a public mobility platform based on MaaS.
Hainan Province’s “14th Five-Year” Comprehensive Transportation Plan”	2020	DOC-28	Promoted the construction of a MaaS system on a pilot basis for urban public transport and tourism.
Dongguan City Transportation Development White Paper	2020	DOC-29	Advocated an “efficient, coordinated and green” future transportation system and the exploration of MaaS.
Several policies and measures of Shanghai to promote the digital transformation of cities	2020	DOC-30	Promoted the construction of a Shanghai-based MaaS system based on the improvement of data collection and sharing, as well as the provision of a unified payment model.
Shanghai Public Data Resource Opening 2020 Work Plan	2020	DOC-31	Proposed to open specific types of mobility data to support the development of smart transportation planning, among other fields. Allocated specific tasks to different public and private sector actors to further open the delivery of integrated mobility data.
2021 Beijing Municipal Traffic Comprehensive Management Action Plan	2021	DOC-22	Proposed to construct an integrated MaaS information platform for green transportation.
Beijing’s 14th Five-Year Plan for Climate Change and Energy Conservation	2022	DOC-23	Proposed to mobilise public enthusiasm to participate in green and low-carbon practices through a carbon credit mechanism.

Source: Compiled by Authors.

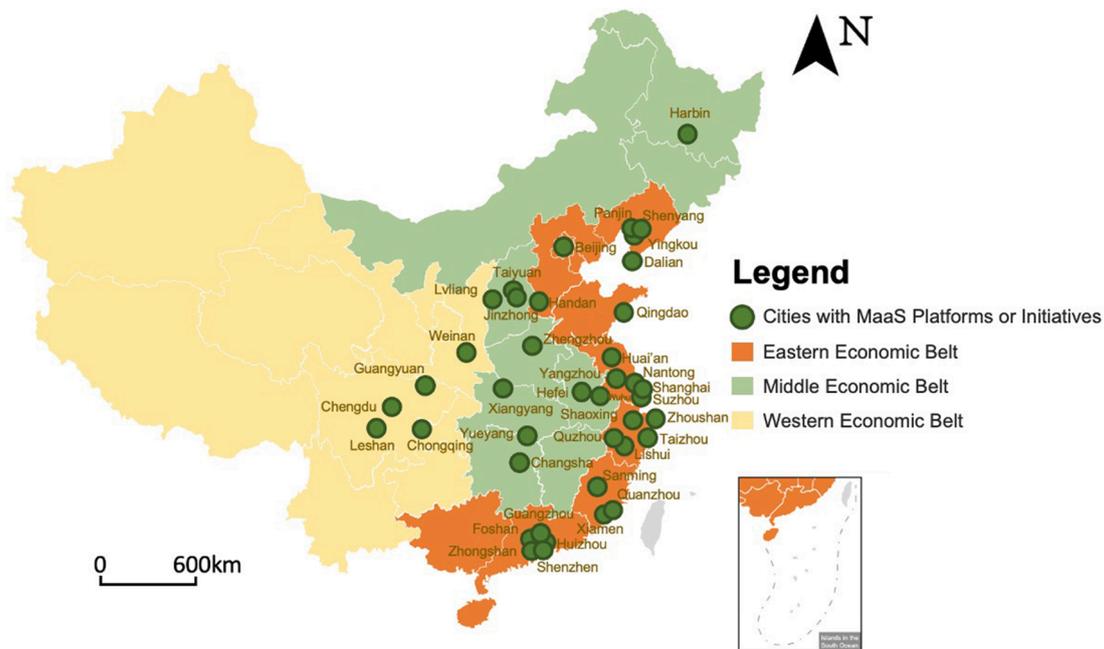


Fig. 4. Map of MaaS Platform Pilots in China Source: Authors, 2022.

Table 4, the national policies identified only addressed the integration of long-distance transport services, such as air and rail transport. Thus, it can be affirmed that MaaS has formally emerged in policy discourses and was clearly featured in the government’s long-term transport and mobility vision. However, no concrete plans and strategies for achieving MaaS have yet been proposed at the national level, and those concerning intra-urban mobility have been especially disregarded.

In contrast with national policies, local governments of various Chinese cities (e.g., Beijing, Shanghai, Qingdao, Changsha, Xian, Hainan, and Dongguan) and provinces (e.g., Jiangsu, Hainan) have enacted more MaaS-related policies (Table 6). However, these local policies suffer from the same shortcomings as the national ones. This means that they also fail to provide detailed strategies and action plans for the delivery of MaaS, outline the different roles and responsibilities of various public and private actors, and propose specific implementation evaluation mechanisms. At the same time, the governments of some cities, such as Beijing and Shanghai, have developed supplementary cross-sectoral policies to support the delivery of MaaS. Specifically, Beijing and Shanghai have proposed a series of supplementary policies addressing data management and data sharing between public and private mobility services for the optimal delivery of MaaS (see DOC-21/2019, DOC-31/2020). For example, in DOC-21/2019 developed by Beijing, it is affirmed that both static and dynamic urban public transport data, including urban rail and road transport, can be shared. Static data can refer to bus information, while dynamic data can include real-time updates on road congestion levels. Similarly, Shanghai proposed to provide wider access to transport data such as bus congestion levels and travel updates, among other types of information (see DOC-31/2020). Beijing has also initiated an incentive scheme including a carbon credit initiative to boost residents’ usage of the recently introduced Beijing MaaS platform (see DOC-23/2022). Briefly, this scheme promises to reward urban travellers with various discounts, such as free metro tickets, if they use the Beijing MaaS Platform to navigate via green travel modes, which include bus, metro, and bikes (Mobility Transition in China, 2021).

### 3.2. MaaS pilot initiatives and platforms across mainland China

In addition to the policies analysed above, several MaaS pilot initiatives across mainland China were also identified and examined. The Appendix 2, Table A2 contains a matrix detailing the characteristics of the platforms, indicating the cities where they have been implemented, their implementation model and integration level, the modal options they provide, and whether they are public or private. Each of these aspects is covered in the following sections.

#### 3.2.1. MaaS cities and characteristics

Across mainland China, 41 cities have developed and implemented a total of 43 MaaS platforms that integrate different mobility services (Fig. 4). The first step of the analysis entailed the review of some of the characteristics of these cities, including their political situation, population size, and geographical location (see Appendix 2, Table A2). This investigation revealed that cities hosting MaaS initiatives tend to have a relatively higher political level, larger population, and be located along the economically prosperous eastern belt of the country. Twelve of the cities identified are large prefectural cities and municipalities with a population of over 10 million, while 14 of the cities have a population between 5 and 10 million residents.

In terms of the cities’ political level, 24 of them have a higher political level or a significant influence over their surrounding areas. As shown in more detail in Appendix 2, Table A2, 16 of the cities examined are even more important than normal prefectural cities, as they are metropolitan, sub-provincial, capital cities of provinces, making them important centres for political administration, and central cities of Chinese provinces. The other eight cities are important for the economy or transport network of their provinces and the surrounding regions. For example, Wuhu has the second-highest GDP in the Anhui Province (Wuhu City Party History Office, 2022). Foshan, another of the cities examined, is a major node in the Guangdong-Hong Kong-Macao Greater Bay Area and a key economic and trade centre of the western Pearl River Delta region (Foshan Municipal People’s Government Office, 2022). Moreover, among the identified cities, those with a higher political level are generally more populous than those with less political relevance.

The geography of MaaS cities and platforms in China is depicted in

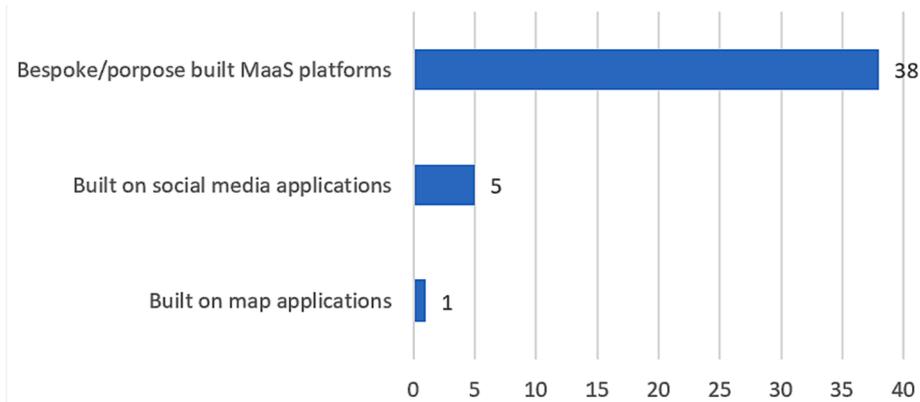


Fig. 5. MaaS Platform Types Source: Authors, 2022.

Fig. 4. In China's 7th Five-Year Plan (Central Committee of the Communist Party of China, 1985), which was pursued between 1986 and 1990, mainland China was divided into three belts based on a combination of economic development and geographical factors. These are the Eastern Economic Belt, Middle Economic Belt, and Western Economic Belt (Pan, 2019; Gao, 2008). Fig. 4 shows that most of the MaaS initiatives and platforms identified (29, with three platforms of them being in Beijing) were implemented in cities located in the prosperous Eastern Economic Belt, while the Middle belt hosts 9 initiatives, and the West one only presents 5 of them.

The Eastern Economic Belt presents the highest level of development in terms of transport infrastructure, economic productivity, and technological innovation. In contrast, the Western Economic Belt is the least developed, while the middle one ranks between the other two regions (National Bureau of Statistics, 2022; Hu, 2016). The superior advancement of the Eastern region is reflected in its output, which is almost twice as much as the other regions in terms of Gross Regional Product, city and urban-district population, and population density, among other aspects (National Bureau of Statistics, 2022). It is therefore understandable that this region would host the largest number of MaaS projects. On the contrary, the two poorer regions tend to have limited financial resources to invest in developing the basic infrastructure for the implementation of MaaS, such as widespread Wi-Fi access and smart ticketing systems for public transport (Hu, 2016). Indeed, having the infrastructure to support the internet of things (IoT) is crucial for the effective and efficient data transmission that is required for delivering MaaS (Kamargianni and Goulding, 2018; Cruz and Sarmiento, 2020). Hence, these factors can explain why the number of MaaS platforms and initiatives decreases as one moves toward the west of China.

### 3.2.2. MaaS platform deployment types and integration levels

The platforms identified can be divided into three types depending on their deployment model: 'bespoke' platforms, platforms built on existing social media applications, and navigation platforms (Fig. 5). Bespoke MaaS platforms are developed specifically for the integration of mobility services. In China, such applications include Tianfu Tong, Shengjing Tong, and Handan Transport. Users of these applications subscribe to the single MaaS platform operator to access the available mobility offerings through that specific interface. In comparison, some MaaS platforms are constructed on existing social media or mapping and navigation platforms. The ones used in cities such as Zhengzhou, Xiamen and Guangzhou rely on WeChat, a well-established privately-owned social media platform. In order to access mobility services in these cities, users must have a WeChat account, which will cause some of the information associated with the WeChat profile to be shared with the MaaS platform, such as the account name and phone number. Similarly, the Beijing MaaS platform was constructed relying on two existing applications, Amap (Gaode Map) and Baidu Map. The deployment models

are not mutually exclusive. Indeed, another MaaS platform, Yangcheng Tong, is a bespoke application and built on WeChat as an applet, so users can access the platform via two ways.

Regarding the level of integration, 24 of the platforms examined, such as those in Qingdao, Tianjin, and Zhengzhou, provided Level 1 integration, meaning that they only contained information about different modes of transport. Secondly, 19 other platforms integrated both general information and the fare systems of different mobility modes, being thus categorised as Level 2 integration. For example, urban travellers in Chengdu, Shenyang, and Changsha can use, respectively, Tianfu Tong, Shengjing Tong, and Xiangxing One-Card Tong to visualise information about local bus and metro services and purchase tickets for every journey they make. However, none of these platforms allows users to purchase transport subscriptions or mobility bundles that integrate different mobility services, even though passengers can use a single interface to buy tickets for any of the integrated travel modes. Overall, all of the platforms examined were considered to have reached either Levels 1 or 2 of integration, based on the criteria shown in Fig. 3. No platform has yet achieved Level 3 integration, as they do not offer periodical subscriptions that can satisfy the travel demands of daily commuters or an entire household. The most developed platform in terms of integration among the ones examined is the service package provided in 2020 for the residents of Guangzhou by a collaboration between Didi Chuxing and Guangzhou Yangchengtong Co., Ltd. This scheme, called 'green ticket,' entitles users to freely use the local bus and bike sharing systems during a set period, such as a week or a month (Yangcheng Evening News, 2020). However, at the time of this study, this service package had been suspended for reasons that could not be established. Additional information about the types and levels of integration of the MaaS platforms examined can be found in Appendix 2, Table A2.

### 3.2.3. Modal offerings within platforms

Another aspect of the MaaS platforms examined in this study concerned the extent to which they integrated different mobility modes and the scope of this integration. Two of the platforms examined only integrated transport modes that connect different cities, which normally include long-distance coach services, railways, and air transport (i.e., Panjin Mobility, Huimin Mobility). Interestingly, the Leshan Transport platform and Weinan on Hand platform provides a Level 2 integration for inter-city trains and coaches, offering both information and payment functions, but only integrates general information for urban buses.

Aside from the three aforementioned platforms, the other 39 MaaS interfaces integrate services and/or information for various urban mobility options. Among them, 10 only offer services and information relating to urban public transport, while the other 29 integrate both public (bus and metro services) and private mobility services (demand-responsive services). For 22 of these 29 platforms, only one type of demand-responsive service is addressed, which is normally either a bike-

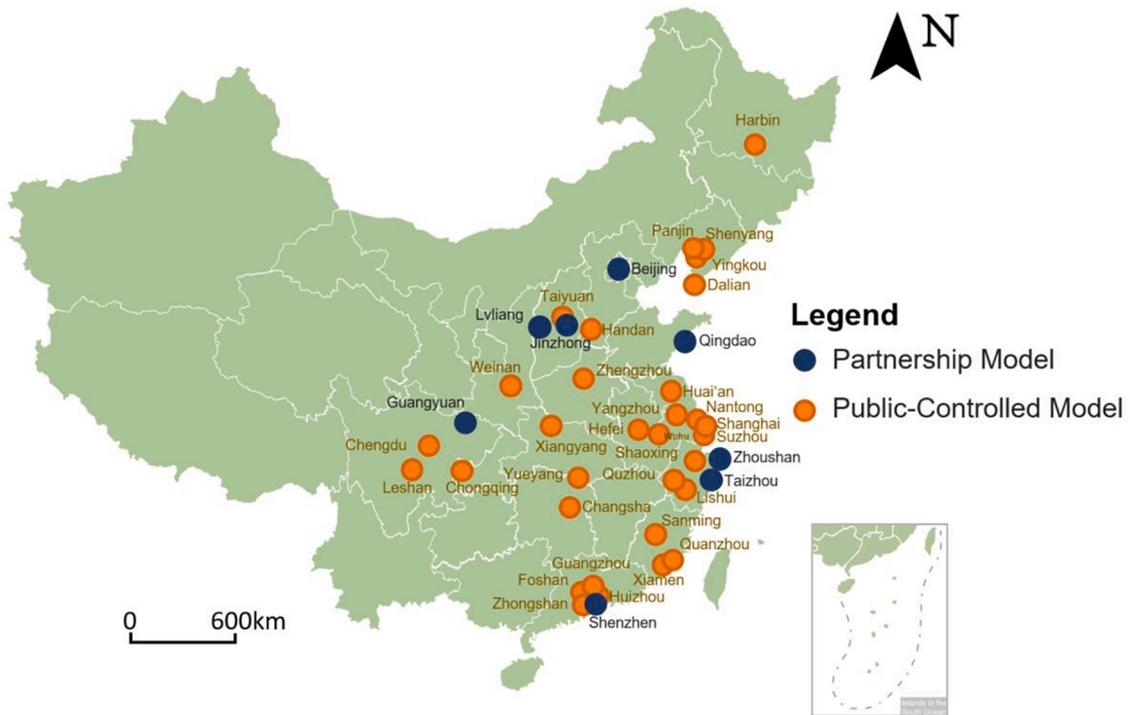


Fig. 6. Implementation Model of MaaS Platforms and Initiatives in Mainland China (Source: Authors, 2022).

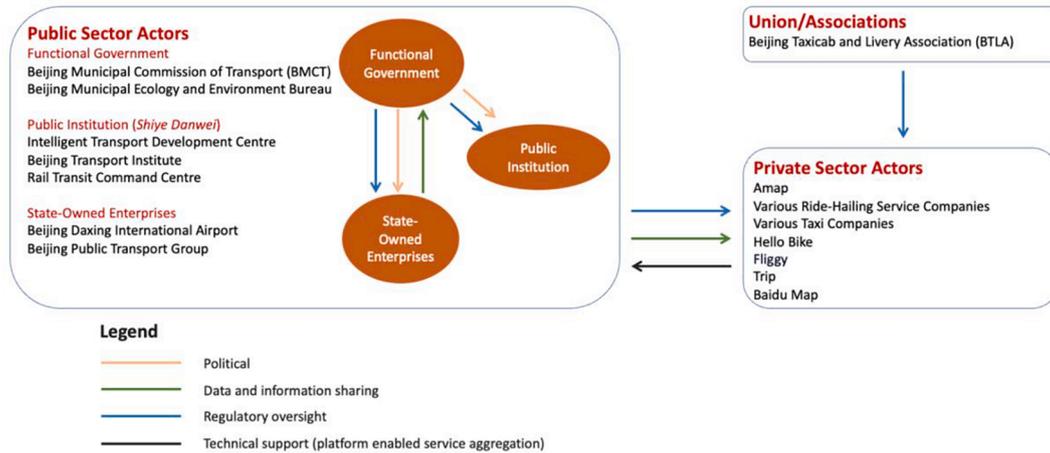


Fig. 7. Landscape of actors and relationships within the Beijing MaaS Platform Initiative.

sharing or ride-hailing service. Only 7 of the platforms examined include more than one private demand-responsive mobility service alongside urban public transport. This finding suggests a rather weak degree of integration between urban public transport and demand-responsive mobility services, which, in turn, reveals how public and privately managed transport services are not well integrated. The Appendix 2, Table A2 contains more details about the modal offering of each of the platforms identified.

3.3. MaaS implementation models

Among the three MaaS implementation models presented in Table 2 (Section 2.2.3), only two of them were found to be present in the initiatives and platforms examined in this study: public-controlled and partnership models. As shown in Fig. 6, only eight of the 41 MaaS initiatives identified are being delivered through a partnership approach, while all others are public-controlled. As there are several MaaS

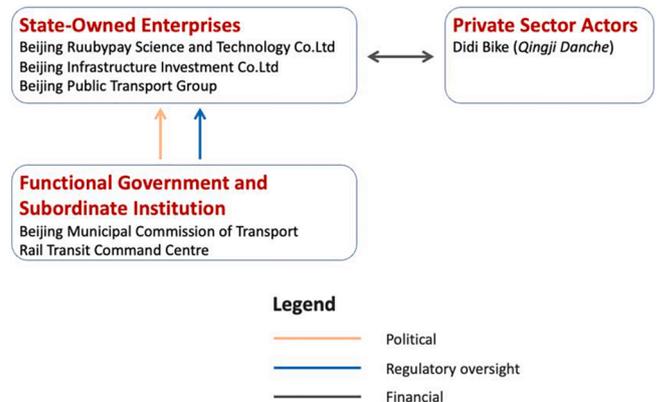


Fig. 8. Landscape of actors and relationships within the RUUBYPAY initiative.

platforms and initiatives underway across China, not all of which can be covered in this paper, the Beijing MaaS Platform initiative and RUUBYPAY initiative are used as illustrative examples of the partnership and public-controlled models, respectively. Appendix 2, Table A2 report the specific service providers of the Chinese platforms examined in this study.

Fig. 7 and Fig. 8 shows the landscape of key actors and their inter-relationships within the on-going Beijing MaaS Platform initiative and Ruubypay initiative, respectively. In the typology of relationships depicted (Figs. 7 and 8), interaction is characterized as *political* where it involves government agencies/department exercising political power and influence over other institutions in both the public and private sectors. *Regulatory* oversight responsibilities emanate directly from the mandate and political power of public sector institutions. *Technical* support relates to the development and management of the platforms by both public sector organizations designated for that purpose and private sector companies that are involved in the development of software applications. *Data and information* sharing captures transfer of mobility service-related information that underpins the MaaS platforms.

In general, the ‘partnership’ model sees private actors operating the MaaS platform while public sector actors act as service integrators. Beijing’s functional government, mainly the Beijing Municipal Commission of Transport (BMCT) plays the role of MaaS integrator and provides overall regulatory oversight over subordinate public sector institutions and private sector actors involved in the implementation process. BMCT facilitates and oversees the integration of transport data from various state-owned public transport operators, such as Beijing Daxing International Airport, the Beijing Public Transport Group, and the Rail Transit Command Centre. BMCT’s subordinate institutions, including Beijing Transport Institute (BIT) and the Intelligent Transport Development Centre, do not have power of publishing policies. Instead, they mainly provide technical input into the policy-making process and manage the Beijing MaaS Platform (Beijing Transport Institute, 2022a; 2022b). One example is the integration of information and payment of Wukesong Underground Parking Lot during the Olympic Games (Beijing Transport Institute, 2022a). This parking service was provided by Beijing MaaS Platform specifically for promoting citizen mobility during the Olympic Games in Beijing in 2022 (China National Radio, 2022).

The Beijing MaaS Platform leverages existing map applications built by private sector companies. Amap (also known as Gaode Map) and Baidu Map company are the two major private sector companies directly involved in the platform’s development and management. These companies also help integrate some of the mobility services provided by other private companies into the platform without direct involvement of public sector actors. A typical example is the way ride-hailing services, provided by Technological Network Companies (TNCs) and traditional taxi services were integrated first into Amap application and subsequently into the Beijing MaaS Platform. Prior to the introduction of the Beijing MaaS Platform in 2019, Amap had collaborated with various ride-hailing companies (e.g., Caocao Mobility, Yangguang Mobility) and integrated them into the Amap application two years earlier in 2017 (Ji, 2019). The same company, working with the Beijing Taxicab and Livery Association (BTLA), also integrated conventional taxi services into the Amap application. Thus, what is now the Beijing MaaS platform comprises Amap and the initial taxi and ride-hailing services the company integrated through their map application as well as public transport services provided by state-owned enterprises.

Unlike the partnership model where there is a complex landscape of actors and their interaction, under the public controlled model, the picture is much less complex, as shown in Fig. 8. MaaS platforms under the public-controlled model are operated by public sector institutions, such as local government departments or state-owned enterprises. The public sector institutions also help with the integration of mobility services, while private sector only provide a part of the services offered by the platform, such as selling tickets for services they own and operate.

The Beijing Ruubypay Science and Technology Co., Ltd (referred to

here as Ruubypay Corporation) is delivering RUUBYPAY, an example of the public-controlled model that has been introduced in Beijing since 2017. In this arrangement, the Beijing Infrastructure Investment Co.Ltd. (BII) is a state-owned enterprise that operates Beijing’s rail transit, mainly metro. Ruubypay Corporation is a subordinate company to BII and is responsible for operating the RUUBYPAY platform with oversight from BII. Moreover, Beijing’s functional government (BMCT), plays specific roles derived from its political and administrative mandate. For example, the BMCT, through an administrative order, mandated the development of a new ticket payment system, which then became a one-stop shop for users to purchase tickets/payment codes for both bus and metro services. Prior to this, the Beijing Public Transport Group for bus and BII for metro services sold tickets separately. This payment system is part of the RUUBYPAY platform, enabling service integration between metro and bus through a single payment platform. The operation of RUUBYPAY is also under the planning and guidance of the Beijing Rail Transit Command Centre (a subordinate institution to BMCT) (Science and Co, 2017). Therefore, various public sector actors in Beijing, including local government, subordinate institutions, and state-owned enterprises, directly control integration and operation of mobility services within RUUBYPAY platform. Thus, within the public-controlled model, the integration of existing public transport services is the key focus of MaaS, implying that state-run public transport naturally becomes the backbone of MaaS.

#### 4. Discussion: Key findings and their implications

This paper aimed to explore the current landscape of MaaS initiatives and platforms in mainland China. More specifically, the objectives of this study were to assess the general policy context concerning transport integration and MaaS, identify the geographical distribution of current MaaS initiatives and platforms, and explore emerging MaaS implementation approaches and their implications. In line with the main objectives identified earlier in the introduction, the key findings and their implications are outlined and discussed as follows:

##### 4.1. A supportive policy context and government commitment to MaaS in China

By analysing the selected official documents, it was revealed that the notion of MaaS has clearly emerged in China’s transport policies, both at the national and sub-national levels. National policy documents, alongside other official sources, explicitly state the overall intent to invest in the delivery of MaaS, demonstrating an overall supportive attitude from the national government toward this new mobility concept. Previous research conducted by Smith et al. (2018) in Finland established the importance of support from national governments in institutionalising an ecosystem for the effective implementation of MaaS. Thus, while concrete measures are yet to emerge in China, marked policy intents and support from the central government are effectively enabling a range of local government policies and MaaS initiatives in the country’s richest and largest cities such as Beijing. As established by other scholars, the nature of the government’s interventions determines whether the delivery of MaaS will be enabled or inhibited (Karlsson et al., 2020; Li, 2019; Fenton et al., 2020). This signifies that more specific institutional and regulatory reforms may become necessary in the long run, and China’s government will need to identify the level of regulatory support and interventions that will promote and support MaaS.

##### 4.2. The geography of MaaS initiatives and platforms reflects prevailing digital divide in China

Overall, many Chinese cities are currently attempting to implement their first MaaS initiatives. However, the majority of them are taking place in the developed eastern regions, in cities with high political and

administrative influence and relatively larger populations. The geographic distribution of these initiatives clearly demonstrates that cities with enabling conditions are being prioritised in this primary stage of experimentation. This is understandable, as, for example, a larger population concentration can suggest greater mobility demand and more significant mobility challenges, such as traffic congestion (Hammel, 1996; Zhao and Hu, 2019; Han et al., 2018) – issues that MaaS is seeking to address in different contexts. Thus, this study revealed that the local government of China’s most populous and urbanised cities is adopting MaaS as a critical part of their strategies to manage their residents’ travel demands. Furthermore, it must be noted that the Chinese government prioritises cities with higher political and administrative power in the allocation of resources for major capital investments (Nian and Wang, 2016; Li et al., 2016; Wang et al., 2017), which includes the integration of transport. In general, local governments are expected to follow the decisions of upper administrative departments, which can intercept available resources for the development of their cities while discouraging that of lesser ones (Li et al., 2016). Another influencing factor is the presence of a well-developed transport and ICT infrastructure, as they are vital for the transition to MaaS (Kamargianni and Goulding, 2018). In China, powerful cities tend to have stronger infrastructural foundations due to long-term investments in smart infrastructure systems, as well as knowledge and technology-intensive industries (Zubach et al., 2020; Huang et al., 2017). Hence, these cities have crucial enabling conditions for MaaS delivery.

Clearly, the geography of the emerging MaaS landscape in China, alluded to above, have equity implications. Previous research has already established existing inequalities in the coverage of and access to ICTs and new transport infrastructure and services in China. A large digital divide already exists whereby provinces in the more prosperous eastern coast of China have more developed ICT infrastructure compared to the provinces in the middle and western economic regions (Jia, 2006; Liu et al., 2017; Song et al., 2020; Wang et al., 2021). A similar pattern whereby new transport infrastructure such as High-Speed Rail (HSR) investments benefit the most economically developed east regions has also been established (see e.g., Wang et al., 2020; Communist Party of China News, 2017). The integration of different mobility services—a key aspiration of MaaS—can in principle, help regions that are underserved by public transport connect to transit networks and thus improve transit accessibility (Hasselwander et al., 2022). However, since MaaS platforms themselves leverage digital technologies, including ICT, and access to these platforms from the perspective of users also depends on access to ICT, it is likely that prevailing digital divides could have profound impact on access to ICT-mediated mobility solutions such as MaaS. In China, the unfolding transition so far suggests that MaaS could entrench existing inequalities of access between regions. Thus, deliberate policy choices, underpinned by equity considerations, are needed to avert a widening of inequalities of access to transport and opportunities in the age of MaaS.

#### 4.3. MaaS platforms leverage and evolve from existing ICT-enabled mobility applications

Furthermore, the evidence gathered through this study suggests that MaaS initiatives in China are leveraging existing solutions, rather than creating radically new technologies and platforms from the scratch. As the analysis showed, the Beijing MaaS Platform, for example, is not entirely new or revolutionary, but one that essentially takes advantage of initial service aggregation efforts involving Amap application and taxi and ride-hailing services on the private sector side of the transport industry and combines with traditional public transport services provided by state-owned enterprises. We believe this approach is a strategic and deliberate attempt by city governments to build the critical mass of users needed to sustain MaaS. In the case of the Beijing MaaS Platform, the original Amap application had already accumulated many users through the company’s initial mobility service aggregation efforts. Thus, when

the Beijing MaaS Platform was later inserted into Amap, it inherited, among other things, a large existing user-base, allowing for a seamless transition to the ‘new’ MaaS platform. In this regard, the transition to MaaS in China can be characterized as a continuous evolutionary process. In this evolution, existing innovations in digital platform mobility services are incrementally being aggregated to create opportunities for operators to evolve new business models and for users to access available mobility solutions via a single platform. Over time, radically new ecosystems and complex interactions emerge, as is the case of the Beijing MaaS Platform initiative, due to the multiple actors that become involved in the process.

#### 4.4. MaaS platforms currently provide basic information and modal/service integration

In terms of integration levels, all of the platforms examined are only integrated as far as Level 2. This means that none of them provides periodical subscriptions or service packages that can meet broader individual or household travel needs in the way a full-fledged MaaS system should. Moreover, while service integration is relatively advanced for public transport services, the integration of data and services between public and private operators has not been fully realized yet. The involvement of the private sector in this process would require the development of new business models and operational arrangements. This is because in general, private actors may be discouraged from participating in MaaS due to nearly all public transport in China being publicly owned and managed. Governments tend to focus on guaranteeing specific public welfare imperatives, which are not necessarily compatible with private companies’ profit-oriented goals (Tsamboulas et al., 2013). In China, direct public operation and management of mass transport ensures welfare benefits partly through low, subsidized fares set by government (Shen and Feng, 2020; Chang-fu and Yuan, 2011). Thus, the emerging private operators of on-demand mobility services that need to be integrated with existing public controlled mass transport services might be unable to independently determine their fares under MaaS. This, in turn, could hinder the full integration of public transport services and privately operated demand-responsive mobility services. These factors may explain why Chinese MaaS initiatives are so far struggling to deliver the same comprehensive service packages attempted by European projects, such as Whim in Helsinki, Finland and West Midlands, UK (Ramboll, 2019; Pangbourne et al., 2020). This struggle between private and public service providers underscores the need for MaaS in China to explore new ways to make these services sustainable and identify financial models that can benefit all MaaS stakeholders equally. Considering the increasing value of data (Torre-Bastida et al., 2018), a viable way to benefit all stakeholders might include the establishment of new partnerships and mechanisms for mobility data integration and sharing.

Moreover, MaaS platforms that only integrate urban public transport may fail to meet the so-called ‘last-mile’ mobility demands without integrating with private ride-hailing services (Kamargianni and Goulding, 2018). Considering that in China these platforms are mainly developed and managed by public actors, the persistent failure in integrating with services beyond urban public transport may be attributed to a lack of policy intent from national and sub-national governments. In the future, as the system evolves, a stronger level of integration between public transport and private demand-responsive mobility services may be sought.

#### 4.5. MaaS transition in China is path-dependent, dominated by the ‘public-controlled’ delivery model

The foregoing suggests a stronger presence of private sector actors in Global North contexts in the ongoing transition toward full-fledged MaaS, compared to the dominant public-controlled model observed in China. One reason is that China’s urban public transport, including rail

transit (metro and railway), ferry, and most buses, is owned by local or central governments and operated through state-owned enterprises (State Council, 2015; Zhang, 2017). Local government decides and fixes the price of urban public transport services (e.g., bus, metro, and taxi) in China (e.g., Beijing Municipal Commission of Development and Reform, 2019). Once prices are fixed, even the state-owned enterprises that operate public transport services cannot change them. In the context of the unfolding MaaS transition, it therefore seems natural and relatively easy for the public sector institutions to use their existing political powers and competences to bring about the integration of both the public transport services already under their control, and privately operated mobility services such as ride-hailing. Thus, one strength of the public-controlled model is that the public sector can leverage existing political and regulatory powers to direct and control the transition to MaaS in line with long-term strategic imperatives. Researchers have highlighted the important role of public transport if MaaS transitions would contribute to sustainability imperatives (see e.g., Mulley et al., 2018; Audouin, 2019). With a strong state involvement, the public controlled model in China ensures that public transport becomes the backbone of MaaS, creating one of the critical conditions for possible long-term socio-environmental sustainability benefits of a MaaS system that is built around public transport instead of car-based alternatives.

The transition to MaaS in China is therefore path-dependent, whereby established transport governance regimes, dominated by public sector control, profoundly shape the unfolding transition. Within this context, we argue that private sector-led, market-driven models of MaaS that can be found elsewhere in Europe and North America would be difficult to emerge in China. Instead, a partnership model involving public and private sector actors, but with a strong policy and regulatory oversight as well as direct operational control by the former, is more likely to emerge and become established, such as what we have observed in the case of the on-going Beijing MaaS initiative. Indeed, in the 35 public controlled MaaS initiatives examined in this study, public sector actors, such as local government or state-owned enterprises, directly run MaaS platforms and deliver the related services to end-users. In contrast, private actors are merely asked to provide the non-public transport services that are integrated into the MaaS platforms, such as ride-hailing and bike-sharing. This makes these platforms starkly different from some European and North American ones. For instance, in Helsinki, Finland, and Denver, USA, the public sector only serves to create an environment where MaaS can flourish but does not necessarily run these schemes itself (Li, 2019; Audouin and Finger, 2018). Similarly, when delivering MaaS in the West Midlands region of the UK, the public sector was only involved to moderate the collaboration between different private transport operators to deliver MaaS without being responsible for the operation of the platform nor the associated mobility services (Li, 2019; Hirschhorn et al., 2019).

#### 4.6. A 'private-public partnership' delivery model and a complex landscape of actors are emerging in response to MaaS

Regarding the private-public partnership model, eight cases were found thus far in China, although we envisage more private sector actors may choose to collaborate with the public sector to deliver MaaS in the future. The Beijing MaaS initiative serves as a good example of how this model is emerging and the potential benefits associated with it. It appears that the partnership model promotes fast and efficient pathway towards the realization of MaaS, considering that within a period of one year, 10 modes of transport and their providers have already been integrated within the Beijing MaaS platform (Beijing Municipal Commission of Transport (BMCT), 2020; Chen et al., 2022). This approach appears to optimize the relative strengths and competences of the public and private sectors. Specifically, with the enormous political power they wield, as well as being traditionally responsible for the operation of most public transport services, public sector institutions in China, such as local governments, can quickly realize data and service aggregation

imperatives required for MaaS. This is in contrast with contexts where such data and service integration efforts are often characterized by lengthy negotiations among incumbent public transport operators in the private sector who tend to have different and conflicting values and motivations that are challenging to reconcile (Audouin and Finger, 2018). An added advantage of the partnership model is that the private sector companies that are drawn in to realize MaaS have already developed platforms for ICT-mediated mobility services (e.g., ride-hailing and bike-sharing). Thus, as has been alluded to earlier, the partnership model allows for seamless integration of existing applications and mobility services operated by both the public and private sectors. This, in turn, can save both time and cost in deploying MaaS platforms (Smith et al., 2018; Zhou, et al., 2022).

Finally, the complex landscape of actors associated with the partnership model is expected to create new challenges and uncertainties for transport governance in the context of MaaS. This includes balancing different actors' interests, establishing new, profitable business models and mitigating investment risks and uncertainties that private sector partners are likely to face (Wong et al., 2018; Dulskaja and Bellini, 2023). Most importantly, with the lack of coherent policies for mobility data sharing and the dominance of the government over urban public transport, private sector actors may long remain unable to integrate with publicly managed transport data and services. This implies that for full-fledged MaaS schemes to be realized in China through the public-private partnership model, new data governance arrangements would have to be negotiated and become established. This would require balancing several essential tensions. Paramount among these would be reconciling the established tradition of strong public sector control over transport services with the interests of the fledgling private sector mobility service providers.

## 5. Concluding remarks and future research

This study has conducted a broad and detailed exploration of the current state of MaaS in mainland China by reviewing related policies, initiatives, platform characteristics and implementation models. The findings provide an initial understanding of how the concept of MaaS is being gradually put into action through pilot initiatives in China. Specifically, the findings show that despite being a relatively new concept, MaaS is gradually becoming a key priority of government policy and action at the national and sub-national levels, and is seen as crucial to realizing long-established multi-modal transport integration imperatives in China. Consequently, MaaS initiatives are receiving policy and government support across mainland China. That said, the study also found not all regions across China are equally being prioritized, at least at the initial stages of MaaS. Instead, the distribution of MaaS initiatives and platforms appears to prioritize or favour larger population centres and more economically prosperous and political influential cities, mirroring the prevailing digital divide in China. A third important conclusion from this study is that full-fledge MaaS platforms are yet to become established in China. Instead, the identified MaaS platforms build on and aggregate existing ICT-enabled mobility applications that provide basic information and service integration capabilities (i.e. Level 2 integration). Finally, the analysis has shown that the transition to MaaS in China is path-dependent, with a long-established tradition of public sector control over transport profoundly shaping how MaaS initiatives are conceived and implemented. Nevertheless, new models of private-public partnerships are being experimented with, but only in a handful of on-going MaaS initiatives. This new model, the associated business models and the complex landscape of actors involved are expected to present unique opportunities and challenges in a context with an established tradition of strong public sector control over public transport.

As this is a preliminary scoping study, it can be extended in multiple directions. For instance, this study focused primarily on policies and the platform integration of mobility services, while physical integration was

Table A1

Documents Collected for Review.

Document Title (English)	Document Title (Chinese)	Year of Publication	Type	Code	Source	Infrastructure		Data Integration	Service Integration	Fare System Integration One-Card Ticket/ scheme
						General Guidance	Experimental Project			
Notice of the General Office of the State Council Forwarding the Opinions of the Ministry of Construction and Other Departments on Prioritizing the Development of Urban Public Transport	国务院办公厅转发建设部等部门关于优先发展城市公共交通意见的通知	2008	Policy	DOC-01	<a href="http://www.gov.cn/zhengce/content/2008-03/28/content_5617.htm">http://www.gov.cn/zhengce/content/2008-03/28/content_5617.htm</a>	x				
The State Council on the implementation of the “National Economy of the People’s Republic of China” Outline of the Eleventh Five-Year Plan for and Social Development Notification of main goals and tasks division of work	国务院关于落实《中华人民共和国国民经济和社会发展第十一个五年规划纲要》主要目标和任务工作分工的通知	2008	Policy	DOC-02	<a href="http://www.gov.cn/zhengce/content/2008-03/28/content_1937.htm">http://www.gov.cn/zhengce/content/2008-03/28/content_1937.htm</a>	x				
Circular of the State Council on Printing and Distributing the National Main Function Zone Planning	国务院关于印发全国主体功能区规划的通知	2010	Policy	DOC-03	<a href="http://www.gov.cn/zhengce/content/2011-06/08/content_1441.htm">http://www.gov.cn/zhengce/content/2011-06/08/content_1441.htm</a>	x				
Notice on matters related to the development of the National Public Transport City Construction Demonstration Project	关于开展国家公交都市建设示范工程有关事项的通知	2011	Policy	DOC-04	<a href="https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315626.html">https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315626.html</a>	x				
Opinions on giving priority to the development of urban public transport	国务院关于城市优先发展公共交通的指导意见	2012	Policy	DOC-05	<a href="http://www.gov.cn/zwgk/2013-01/05/content_2304962.htm">http://www.gov.cn/zwgk/2013-01/05/content_2304962.htm</a>	x				
Notice of the Ministry of Transport on the announcement of the second batch of cities to be created by the demonstration project of public transport urban construction	交通运输部关于公布公交都市建设示范工程第二批创建城市的通知	2013	Policy	DOC-06	<a href="https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315069.html">https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315069.html</a>		x			
Notice of the Ministry of Transport on Launching the Construction of Demonstration Cities for Comprehensive Transportation Services	交通运输部关于开展综合运输服务示范城市建设的通知	2014	Policy	DOC-07	<a href="https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315105.html">https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315105.html</a>		x			
Guiding Opinions of the Ministry of Transport on Promoting the Healthy Development of the All-in-One Transportation Card and Accelerating the Realization of Interconnection	交通运输部关于促进交通一卡通健康发展加快实现互联互通的指导意见	2015	Policy	DOC-08	<a href="https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315144.html">https://xxgk.mot.gov.cn/2020/jigou/ysfws/202006/t20200623_3315144.html</a>					x
The Ministry of Transport issued the “Thirteenth Five-Year” Development Plan for Transportation Science and Technology	交通运输部关于印发交通运输科技“十三五”发展规划	2016	Policy	DOC-09	<a href="https://zjhy.mot.gov.cn/zzhxxgk/jigou/kjxxc/202007/t20200708_3428167.html">https://zjhy.mot.gov.cn/zzhxxgk/jigou/kjxxc/202007/t20200708_3428167.html</a>	x				
“13th Five-Year” Development Outline of Urban Public Transport	城市公共交通“十三五”发展纲要	2016	Policy	DOC-10	<a href="http://www.gov.cn/xinwen/2016-07/25/content_5094575.htm">http://www.gov.cn/xinwen/2016-07/25/content_5094575.htm</a>	x		x		

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Table A1 (continued)

Document Title (English)	Document Title (Chinese)	Year of Publication	Type	Code	Source	Infrastructure		Data Integration	Service Integration	Fare System Integration One-Card Ticket/ scheme
						General Guidance	Experimental Project			
The 13th Five-Year Plan for National Informatization	“十三五”国家信息化规划	2016	Policy	DOC-11	<a href="http://www.gov.cn/zhengce/content/2016-12/27/content_5153411.htm">http://www.gov.cn/zhengce/content/2016-12/27/content_5153411.htm</a>					x
“13th Five-Year” Modern Comprehensive Transportation System Development Plan	国务院关于印发“十三五”现代综合交通运输体系发展规划的通知	2017	Policy	DOC-12	<a href="http://www.gov.cn/zhengce/content/2017-02/28/content_5171345.htm">http://www.gov.cn/zhengce/content/2017-02/28/content_5171345.htm</a>		x			
Outline of Building a Strong Transportation Country	《交通强国建设纲要》	2019	Policy	DOC-13	<a href="http://www.gov.cn/gongbao/content/2019/content_5437132.htm">http://www.gov.cn/gongbao/content/2019/content_5437132.htm</a>				x	
Transportation card interconnection	交通一卡通互联互通	2020	Report	DOC-14	<a href="https://www.mot.gov.cn/zxft2020/jiaotongykt_nmg/index.html">https://www.mot.gov.cn/zxft2020/jiaotongykt_nmg/index.html</a>					x
National Comprehensive Three-dimensional Transportation Network Planning Outline	国家综合立体交通网规划纲要	2021	Policy	DOC-15	<a href="http://www.gov.cn/gongbao/content/2021/content_5593440.htm">http://www.gov.cn/gongbao/content/2021/content_5593440.htm</a>	x	x	x		
New infrastructure construction in the field of transportation Action Plan (2021–2025)	交通运输领域新型基础设施建设行动方案(2021—2025年)	2021	Policy	DOC-16	<a href="https://xxgk.mot.gov.cn/2020/jigou/zhghs/202109/t20210923_3619709.html">https://xxgk.mot.gov.cn/2020/jigou/zhghs/202109/t20210923_3619709.html</a>				x	x
Comprehensive transportation service “14th Five-Year plan” development plan	综合运输服务“十四五”发展规划	2021	Policy	DOC-17	<a href="https://xxgk.mot.gov.cn/2020/jigou/ysfws/202111/t20211118_3626733.html">https://xxgk.mot.gov.cn/2020/jigou/ysfws/202111/t20211118_3626733.html</a>	x		x	x	x
“14th Five-Year” Development Plan for Digital Transportation	数字交通“十四五”发展规划	2021	Policy	DOC-18	<a href="https://xxgk.mot.gov.cn/2020/jigou/zhghs/202112/t20211222_3632469.html">https://xxgk.mot.gov.cn/2020/jigou/zhghs/202112/t20211222_3632469.html</a>				x	
“14th Five-Year” Modern Comprehensive Transportation System Development Plan	国务院关于印发“十四五”现代综合交通运输体系发展规划的通知	2022	Policy	DOC-19	<a href="https://www.mot.gov.cn/zhuanli/shisiwujiytsfzgh/202201/P020220129657756692258.pdf">https://www.mot.gov.cn/zhuanli/shisiwujiytsfzgh/202201/P020220129657756692258.pdf</a>				x	x
Notice of the Ministry of Transport on Printing and Distributing the “Administrative Measures for National Public Transport Urban Construction Demonstration Projects”	交通运输部关于印发《国家公交都市建设示范工程管理暂行办法》的通知	2022	Policy	DOC-20	<a href="https://xxgk.mot.gov.cn/2020/jigou/ysfws/202204/t20220411_3650428.html">https://xxgk.mot.gov.cn/2020/jigou/ysfws/202204/t20220411_3650428.html</a>				x	
Beijing Municipal Traffic and Travel Data Open Management Measures (for Trial Implementation)	北京市交通出行数据开放管理办法(试行)	2019	Policy	DOC-21	<a href="http://www.beijing.gov.cn/zhengce/zhengcefagui/201911/t20191105_483739.html">http://www.beijing.gov.cn/zhengce/zhengcefagui/201911/t20191105_483739.html</a>					
2021 Beijing Municipal Traffic Comprehensive Management Action Plan	2021年北京市交通综合治理行动计划	2021	Policy	DOC-22	<a href="http://www.beijing.gov.cn/zhengce/zhengcefagui/202103/t20210324_2321573.html">http://www.beijing.gov.cn/zhengce/zhengcefagui/202103/t20210324_2321573.html</a>				x	
Beijing’s 14th Five-Year Plan for Climate Change and Energy Conservation	北京市“十四五”时期应对气候变化和节能规划	2022	Policy	DOC-23	<a href="http://fgw.beijing.gov.cn/fgwzgwkg/zcgk/ghjhwb/wnjh/202208/t20220824_2799575.htm">http://fgw.beijing.gov.cn/fgwzgwkg/zcgk/ghjhwb/wnjh/202208/t20220824_2799575.htm</a>				x	
Report of Qingdao Municipal Transportation Bureau on the revision and improvement of the pilot program for building a strong transportation country	青岛市交通运输局关于交通强国建设试点方案修改完善情况的报告	2021	Government Report	DOC-24	<a href="https://m.thepaper.cn/baijiahao_15268040">https://m.thepaper.cn/baijiahao_15268040</a>				x	
Jiangsu Province “14th Five-Year” Smart Transportation Development Plan	江苏省“十四五”智慧交通发展规划	2021	Policy	DOC-25	<a href="https://www.sohu.com/a/489636013_649849">https://www.sohu.com/a/489636013_649849</a>				x	

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Table A1 (continued)

Document Title (English)	Document Title (Chinese)	Year of Publication	Type	Code	Source	Infrastructure		Data Integration	Service Integration	Fare System Integration One-Card Ticket/scheme
						General Guidance	Experimental Project			
Changsha Municipal Transportation Bureau quickly conveyed the decision to study and implement the spirit of the 12th Provincial Party Congress on accelerating the construction of a new smart city demonstration city	长沙市交通运输局迅速传达学习贯彻省第十二次党代会精神关于加快新型智慧城市示范城市建设的决定	2020	Policy	DOC-26	<a href="https://www.changsha.gov.cn/zfxgk/zfwjk/srmzf/202010/P020201030521976478557.pdf">https://www.changsha.gov.cn/zfxgk/zfwjk/srmzf/202010/P020201030521976478557.pdf</a>				x	
Three-year action plan for traffic optimization and improvement in the central urban area of Xi'an (2020–2022)	西安市中心城区交通优化提升三年行动方案(2020-2022年)	2020	Policy	DOC-27	<a href="http://www.7its.com/html/2020/dongtai_0505/9077.html">http://www.7its.com/html/2020/dongtai_0505/9077.html</a>				x	
Hainan Province's "14th Five-Year" Comprehensive Transportation Plan"	海南省“十四五”综合交通运输规划	2021	Policy	DOC-28	<a href="https://www.hainan.gov.cn/ainan/flfgxzgfwj/202106/60f895385179412dbfc41f065d1a2a9.shtml">https://www.hainan.gov.cn/ainan/flfgxzgfwj/202106/60f895385179412dbfc41f065d1a2a9.shtml</a>				x	
Dongguan City Transportation Development White Paper	东莞市交通发展白皮书	2020	Policy	DOC-29	<a href="https://www.dg.gov.cn/zwgk/jdhy/zcjd/szfjqbm/content/post_3011067.html">https://www.dg.gov.cn/zwgk/jdhy/zcjd/szfjqbm/content/post_3011067.html</a>				x	
Several policies and measures of Shanghai to promote the digital transformation of cities	上海市促进城市数字化转型的若干政策措施	2021	Policy	DOC-30	<a href="https://service.shanghai.gov.cn/XingZhengWenDangKuJyh/XZGFDetails.aspx?docid = REPORT_NDOC_007913">https://service.shanghai.gov.cn/XingZhengWenDangKuJyh/XZGFDetails.aspx?docid = REPORT_NDOC_007913</a>				x	
Shanghai Public Data Resource Opening 2020 Work Plan	上海市公共数据资源开放2020年度工作计划	2020	Policy	DOC-31	<a href="https://www.shanghai.gov.cn/nw12344/20200813/0001-12344_64749.html">https://www.shanghai.gov.cn/nw12344/20200813/0001-12344_64749.html</a>			x		
Medium- and long-term development plan for the integrated transportation network	综合交通网中长期发展规划	2007	Policy	DOC-32	<a href="https://max.book118.com/html/2017/0622/117254376.shtm">https://max.book118.com/html/2017/0622/117254376.shtm</a>	x	x			
MaaS in China Research Paper	—	2021	Academic Literature	DOC-33	<a href="https://dutchmobilityinnovations.com/fileattachment?file = 13PHEABeNnpdmCQcM2GE2g%3D%3D&amp;v = 1&amp;isDownload = true">https://dutchmobilityinnovations.com/fileattachment?file = 13PHEABeNnpdmCQcM2GE2g%3D%3D&amp;v = 1&amp;isDownload = true</a>				x	
A Novel Development Scheme of Mobility as a Service: Can It Provide a Sustainable Environment for China?	—	2021	Academic Literature	DOC-34	<a href="https://www.mdpi.com/2071-1050/13/8/4233">https://www.mdpi.com/2071-1050/13/8/4233</a>				x	

Source: Authors, 2022.

**Table A2**  
MaaS Platforms in the Mainland China.

City Name	Political level and Geographical Importance	Population size (in 10 thousand)	Platform name	Platform Type			Platform Provider		Integration levels	modes
				Bespoke Application	Social media application (WeChat Public Account)	Map Application	private	public		
Shenyang	Capital City of Liaoning Province, Sub-Provincial City	907	Shengjing Tong	x				x	2	Metro, Bus
Dalian	Sub-Provincial City	745	Dalian Metro E Mobility	x				x	2	Ride-hailing, Metro
Handan	Normal Prefectural City	941	Handan Transport	x				x	1	Bicycle Sharing, Bus
Qingdao	Sub-Provincial City	1011	Qingdao Transport	x			x		1	Metro, Bus, Taxi, Subway, Airline
Yingkou	The second largest port city in Northeast China	233	Smart Yingkou/Huanyingban	x				x	1	Bus, Ride-Hailing
Panjin	Normal Prefectural City	131	Panjin Mobility	x				x	2	Ferries, Subway, Long-Distance Buses, Urban Bus
Zhengzhou	Capital City of Henan Province	1262	Zhengzhou Mobility Website		x			x	1	Bus, Metro, Inter-City ride-hailing service
Suzhou	One of the important central cities in the Yangtze River Delta	1275	Su E Mobility	x				x	2	Metro, Tram, Bicycle
Nantong	Normal Prefectural City	773	Travel Freely in Nantong (Changxing Nantong)	x				x	1	Bus, Urban Ride-hailing service
Huai'an	Normal Prefectural City	456	Cheng Ke e Jia	x				x	2	Bicycle Sharing, Urban Ride-Hailing, Bus, Urban light rail; Railway
Yangzhou	Normal Prefectural City	456	Easy Travel Yangzhou	x				x	2	Bus, Bicycle Sharing, Ride-hailing service
Xiangyang	Provincial sub-center city of Hubei Province	526	Xiangyang Mobility	x				x	2	Bus, Urban Ride-hailing
Changsha	Capital City of Hunan Province	1006	Xiangxing One-card Tong (Xiangxing Yika Tong)	x				x	2	Bus, Metro
Yueyang	An important regional central city in the middle reaches of the Yangtze River, the second largest economy in the province, a big city in Hunan Province, the only international trade port city along the Yangtze River in Hunan	505	Yueban Yuehao	x				x	1	Bus, Bicycle-Sharing service
Shaoxing	Normal Prefectural City	529	Shaoxing Metro	x				x	1	Bus, Metro
Quzhou	Normal Prefectural City	228	E-Qu Mobility	x				x	1	Bus, Bicycle Sharing service
Taizhou	Normal Prefectural City	663	Taizhou Mobility	x			x		1	Bus, Bicycle Sharing service
Lishui	Normal Prefectural City	251	Lishui Public Mobility	x				x	1	Bus, Bicycle Sharing service
Zhoushan	Normal Prefectural City	116	Zhoushan Transport	x			x		1	Bus, Taxi, Inter-City Bus, Ferry
Harbin	Capital City of Heilongjiang	1001	Harbin Mobility		x			x	1	Bus, Taxi

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Table A2 (continued)

City Name	Political level and Geographical Importance	Population size (in 10 thousand)	Platform name	Platform Type			Platform Provider		Integration levels	modes
				Bespoke Application	Social media application (WeChat Public Account)	Map Application	private	public		
Xiamen	Province, Sub-Provincial City Sub-Provincial City	518	Xiamen Transport		x			x	1	Ferry, Airline, Intercity Bus, Urban Bus, Urban metro, Taxi (under developing)
Quanzhou	One of the three central cities in Fujian Province	879	Quancheng Tong	x				x	2	Bus, Bicycle Sharing Service, Inter-City Ride-Hailing Service
Sanming	Normal Prefectural City	249	Sanming Jiaoyun	x				x	2	Bus, Bicycle Sharing Service
Zhongshan	Normal Prefectural City	443	Zhongshan Transport	x				x	1	Bus, Taxi, Bicycle Sharing Service, Railway, Airline, Ferry, Port
Foshan	The third city with an economic aggregate exceeding one trillion yuan in Guangdong Province. It is an important node city in the Guangdong-Hong Kong-Macao Greater Bay Area and the economic and trade center of the west wing of the Pearl River Delta region.	952	Foshan Transport	x				x	1	Taxi, Bus
Huizhou	Normal Prefectural City	606	Huimin Transport	x				x	2	Railway, Long-Distance Coach, Airline, Airport Shuttle Bus, Urban Bus
Taiyuan	Capital City of Shanxi Province	532	Tingjing	x				x	1	Metro, Bus
Jinzhong	Normal Prefectural City	338	Jinzhong Tong	x				x	1	Ride-hailing Service, Bus, Bicycle Sharing Service
Lvliang	Normal Prefectural City	339	Lvliang Tong	x				x	2	Bus, Ride-hailing
Chengdu	Capital City of Sichuan Province, Sub-Provincial City	2095	Tianfu Tong	x				x	2	Bus, Metro
Guangyuan	Normal Prefectural City	231	Guangyuan E Transport		x			x	1	Bus, Ride-hailing Service
Leshan	Normal Prefectural City	316	Leshan Transport	x				x	1	Long-Distance Rail, Train, Inter-city Coach, Urban Bus
Weinan	Its jurisdictions include a Provincial Municipalities with Independent Planning Status under the National Social and Economic Development	469	Weinan on Hand (Zhangshang Weinan)	x				x	1	Bus, Subway
Hefei	Capital City of Anhui Province	937	Hefei Tong	x				x	1	Bus, Taxi, High-Speed Rail,

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Table A2 (continued)

City Name	Political level and Geographical Importance	Population size (in 10 thousand)	Platform name	Platform Type			Platform Provider		Integration levels	modes
				Bespoke Application	Social media application (WeChat Public Account)	Map Application	private	public		
Wuhu	The total GDP ranks second in Anhui Province	365	Wuhu Public Transport	x				x	1	Long-Distance Coach Bus, Metro
Chongqing	Metropolitan City	3209	Chongqing Transport Services	x				x	1	Bus, Urban Light rail, Railway, Long-Distance Coach, Airline
Shenzhen	Sub-Provincial City	1763	Maishi Mobility	x			x		2	Bus, Metro, Bicycle Sharing, Shuttle Bus
Beijing	Metropolitan City, Capital City of China	2189	Beijing MaaS Platform			x	x		2	Bus, Metro, Ride-Hailing, Service, Shared-bicycle service, Long-Distance Coach, Airline, High-speed rail
			Beijing Public Transport	x				x	2	Bus, Metro
			Ruubypay	x				x	2	Bus, Metro, Bicycle
Tianjin	Metropolitan City	1387	Tianjin Integrated Transport on Hand (Zhangshang Lulutong Tianjin)	x				x	1	Bus, Metro
Guangzhou	Capital City of Guangzhou Province	1874	Yangcheng Tong	x	x			x	2	Bus, Metro, Urban Ride-Hailing Service on Autonomous Vehicles, Taxi
Shanghai	Metropolitan City	2488	Suishen Xing	x				x	2	Urban Bus, Metro, Ride-Hailing Services, Shared Bicycle Service, Taxi

only briefly addressed. Further investigations could thus explore infra-structural integration to better understand the current progress of Chinese cities’ transition to MaaS. Moreover, future studies could provide a deeper comparative understanding of emerging MaaS implementation models in China with other national and city contexts. For example, research into how public–private partnership models have been developed in contexts where public control and oversight over transport is dominant would help evaluate the feasibility of such projects in the Chinese MaaS environment. In relation to this, a key direction for future research would be to examine how institutions, governance traditions and transport business models will evolve in the context of the continuous expansion of MaaS in China and globally. In particular, further research is needed to understand how transport policy and governance will evolve to respond to the complex challenges associated with the emerging partnership models of MaaS delivery in China. Finally, the findings of this study points to potential equity implications of MaaS transition in China due to the disparities in the geographical distribution of initiatives and platforms that mirror prevailing digital divide in the country. We see the need for a deeper understanding of patterns of MaaS-related inequalities between and within regions, how this may change over time and the underlying policy drivers. At the urban and city scales, further research is needed to uncover the socio-spatial equity

impacts of MaaS, to uncover how the (dis)benefits of MaaS are distributed across different demographic and socio-economic groups as well as different locations in urban areas.

6. Declaration

All data and materials use in this study are publicly available online resources and official policy documents. The authors received no funding support for this study. We declare no conflict of interest.

CRediT authorship contribution statement

**Yuyuan Chen:** Conceptualization, Methodology, Formal analysis, Formal analysis, Writing – original draft, Writing – review & editing. **Ransford A. Acheampong:** Conceptualization, Supervision, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix 1

## Appendix 2

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