

Citation: LIU Yang, Chen Suping, Jiang Yang. Mobility management: Innovative International Cases and Application in China [J], Urban Transport of China, 2018 (06): 54–59.

Mobility management: Innovative International Cases and Application in China

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Abstract: Mobility management can change the behaviors of travelers, promote sustainable transportation development, help traffic congestion alleviation, and enhance the quality of urban environment. This paper summarizes the mobility management measures based on the studies of innovative international cases, such as the database development model to assess road facilities and travel environment in Porto of Portugal, a riding feedback system to collect the cyclists' travel problems in Brussel of Belgium, utilizing the onstreet parking space for Parklet Day in San Francisco Bay Area, the No-Driving Day Program to decrease car usage on weekday through incentives in Seoul Korea. Based on the case studies, questionnaire surveys and interviews in Tianjin, the paper makes several suggestions on how to make other countries' achievements into China's successful applications by new techniques, incentive system, and promoting events. **DOI:** 10.13813/j.cn11-5141/u.2018.0607-en

Keywords: mobility management; green transportation; Car-Free Day; public participation; Tianjin

0 Introduction

The rapid development of urban motorization in China is posing significant pressure to urban traffic management. According to the public data offered by the Traffic Management Bureau of the Ministry of Public Security, by the end of 2017, the total number of vehicles in China has reached 319 million accompanied by the momentum of continuous rapid growth^[1]. According to the report published by Amap, in 2017, over 26% cities nationwide saw traffic jams during rush hours, while 55% cities experienced slow-moving traffic during these periods^[2].

The supply-demand imbalance in traffic systems has been a common challenge to large cities across the world. Some developed countries have realized that only increasing the road supply will not help resolve traffic jams. To gradually shift into the human-oriented mobility management from traditional traffic planning patterns that center on motor vehicles, these countries are incorporating mobility management into governments' action planning as a measure supporting green travel. China, due to its slow progress in the innovation and implementation of mobility management, still lacks proper planning methodologies and incentive mechanism designs for green travel. It is on the ground of various aspects like planning ideas, techniques, policy mechanism, and the disparity in development stages.

Against the background of growing urban motorization and traffic jams nationwide, it is urgently necessary to study and draw lessons from the management practice and innovation experience of developed countries' mobility.

1 Connotation of mobility management

As a new perspective for traffic planning, mobility management has earned widespread attention in developed countries and regions like Europe and America in recent years. According to the definition^[3] by European Platform on mobility management (EPOMM), "mobility management is a concept to promote sustainable transport and manage the demand for car use by changing travellers' attitudes and behavior. At the core of mobility management refers to 'soft' measures like information and communication, organizing services and coordinating activities of different partners." The connotation of mobility management overlaps with that of Travel Demand Management to a considerable extent, and the former is more frequently used in Europe.

In contrast to traditional traffic planning patterns that focus more on road capacity and the speed of means of transportation, mobility management shifts its focus to human behaviors as well as people's pursuit for public service quality and the accessibility of facilities, laying emphasis on diverse dimensions such as economic vitality, social equity,

Received: 2018-06-06

Supported by: World Bank technical assistance project (the third batch of loan) for Tianjin "Development Strategies of Green Transportation in Central Urban Area of Tianjin (Phase = 1)" (P148129)

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public health, and environment quality. Due to the shift of focus in mobility management, in the context of a data and information era with developed internet media and the wide public participation, the practice of mobility management has gone far beyond traditional traffic planning patterns. It has become a kind of practice across industries, sectors, governments, enterprises, and social organizations, which has gone deep into social public lifestyle in a more intensive and innovative manner. The practice and innovation of mobility management measures can be found in various aspects like techniques, incentive mechanisms and promoting events. Regarding the practice effect, mobility management is an economical approach with significant effect in mitigating traffic jams.

2 Innovative international cases

2.1 Porto in Portugal

In 2015, Porto developed a Smart Pedestrian Net (SPN) model to recognize, analyze and improve current pedestrian networks. As a part of the strategic plan, SPN employs the multi-criteria analysis based on GIS and is applied in the core area of historical districts in Porto. Combining both GIS and space syntax tools, the SPN model adopted in this study works out the optimal path for pedestrian activities, which analyzes and assesses the walking friendliness of walkways and the connectivity of pedestrian networks. The two main modules adopted in the model are used to execute the multi-criteria analysis as follows: 1) the technology of space syntax is used to analyze the connectivity of streets; 2) plenty of criteria and sub-criteria are defined to evaluate the influence on walking capability. Major criteria here include urban functions, built environment, accessibility, and urban environment, which cover gradient, population size, visual scale of buildings, land application, population density, public transit facilities, public transit service level, greenbelt, and microclimate conditions, etc. This model prioritizes streets, and the priorities help guide the urban planning and relevant decision-making in Porto.

2.2 Brussels in Belgium

In Brussels, Belgium, the riding feedback collecting system enables bikers to affect bicycle infrastructures. “PING if you care!” is the slogan of this program, where bikers can identify insecure traffic conditions or less satisfactory bicycle infrastructures. Through connecting to the wireless Bluetooth devices on bicycles or bikers, the system can send the feedback to the back-end of the app (see Figure 1). After bikers arrive at their destinations, these Ping points specified by them would be displayed on the feedback roadmap. Each Ping point can be classified based on categories including road surface, signal lamp, sight, and infrastructure design. All the routes can be displayed on the thermodynamic map

of Brussels, and bikers can also comment on their riding experience. Based on the collected information, this system conducts analysis and offers the result to the municipal government of Brussels, providing a basis for future investments into bicycle infrastructures.

2.3 The bay area of San Francisco in USA

In 2005, Rebar, an urban designer team from the Bay Area of San Francisco transformed a car park into public space open to local residents, and the paid parking lots became a temporary public park. This project was named “Park(ing)”, where Rebar decided to expand their influence with their own strength and compiled a tutorial for participants. Accordingly, the Park(ing) program evolved into an art program with public participation, namely the Parklet Day that lasts for one day (see Figure 2). Contents of this program include “occupying” parking lots in global large cities for a day in a peaceful manner. San Francisco allows commercial or resident groups to transform underutilized street space into micro-parks, where facilities such as benches, tables or even micro-sized golf courses are allowed to be installed.

Mayor Newsom of San Francisco defined the Parklet Day as an official urban redevelopment project, aiming to enable enterprises and residents to transform underutilized street spaces into welfare living areas that better serve communities by creating favorable conditions and atmosphere through the government. Besides, the City Design Group of San Francisco Planning Department launched a festival event titled Market Street to replace the inefficient management mechanism through public participation and innovation. After the Parklet Day program was implemented in San Francisco, pedestrians here increased by 37%, and residents resting and sitting here also increased by 30%^[5]. Till now, more and more cities worldwide have joined this event, and application procedures have also been simplified significantly (see Figure 3). In particular, the *Urban Street Design Guide* by National Association of City Transportation Officials provides special guide for the design of parking-lot-based parks (see Figure 4).

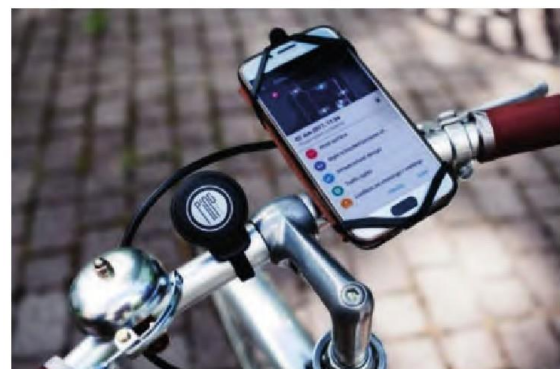


Figure 1 Belgian’s mobile terminal design and Bluetooth device for the riding feedback system “PING”

Source: Reference [4].



Figure 2 2009 Parklet Day in San Francisco

Source: Filmed by Colleen McHugh.



Figure 3 Mobile application interface of Parklet Day in USA

Source: <https://www.civicdesigncenter.org/events/parking-day>



Figure 4 Parklet design

Source: Reference [5].

2.4 Seoul in South Korea

After entering the 21st century, Seoul, the capital of South Korea employed a series of measures to promote public transit. In 2003, the Ministry of Land, Infrastructure and

Transport began to implement the Weekly No-Driving Day Program, encouraging citizens to lay up their private cars in any day of weekdays each week. Through incentives to participants, the department encourages citizens to join this program proactively of their own accord, aiming to ease the burden of oil consumption, mitigate air pollution, and reduce the complexity of local traffic in South Korea. In contrast to previous mandatory restrictions based on the last digit of license plate numbers, this policy minimizes the disturbance to people's daily travel. Under this policy, citizens participating in the program spontaneously will enjoy discounts in charges: 20–30% discount to parking fees; 50% discount to the toll of specified routes; and after 2005, vehicles engaged in the program for a year will be free from the car tax. Starting from 2010, through cooperating with 13 insurance companies, the government provides 8.7% discount to the premium paid by citizens engaged in the program. To facilitate the implementation of this policy, South Korea developed and adopted the RFID technology, namely that each car is fitted with an RFID sticker to identify whether it is operating (see Figure 5). During 2007–2012, the participation rate of the Weekly Driving Day Program kept rising steadily (see Figure 6).



a An example of the RFID sticker (it shows the owner does not use the car each Monday)



b Reading device

Figure 5 RFID electronic sticker and reading device

Source: Reference [6].

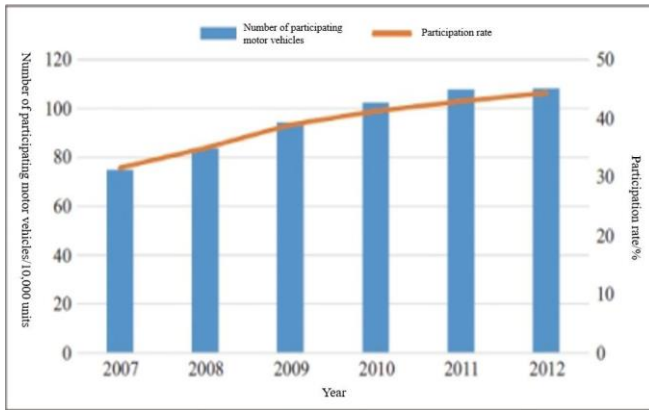


Figure 6 Number of participants and participation rate at the Weekly No-Driving Day

Source: Reference [6].

According to a study carried out by Seoul in 2014 [6], this program helped the city reduce its car traffic volume by 1.1%, which, despite being lower than the expectation, still indicates a significant effect given the low cost of this program. The reduction of 1.1% in car traffic volume translates into the yearly decrease in around 180 million km trip mileages and CO₂ emission of 36 000 tons (0.36% of the total emission from Seoul's transport sector). In terms of fiscal issues, the reduction in the traffic volume indicates the reduction in travel expenses and the return from air quality improvement by total KRW 144.4 billion each year (around RMB 890 million).

2.5 Summary

In accordance with the foresaid cases of advanced cities, the trend in international mobility management can be summarized as follows:

1) Reinforcing the integration with new technologies

Mobility management focuses on human behavior patterns, yet in traditional transportation planning, data related to human behaviors are difficult to collect. Along with the popularization of mobile internet, travel data based on smart mobile terminals will become more and more accessible, which helps to establish a planning and management feedback system oriented to green transportation users, and then improve the public participation and scientificity of decision-making.

2) Implementing complete and effective incentive policies The effective implementation of mobility management relies on rational and feasible incentive or punitive measures, as well as a series of supporting economic policies such as taxation and insurance. In practice, restrictive measures and incentives can complement each other, and further stimulate individuals' action and will of using green travel.

3) Initiating novel and characteristic promoting activities The publicity of green travel combined with cultural activities or events can not only act as a stimulus to wide

public participation and personal creativity of participants, but can also be a city card, contributing to the region's economic vitality.

3 Reflection on the mobility management of Tianjin

3.1 Current development

In recent years, along with the acceleration of motorization, Tianjin is facing growingly serious traffic jams. Accordingly, the government has been enhancing its actions related to mobility management. In 2013, Tianjin adopted the measures combining lottery and bidding of motor vehicle license plates to control the yearly growth within 100 000 units. In 2014, it implemented the policy of traffic restriction in weekdays based on the last number of license plates and targeted at vehicles from other cities. These restrictive policies on the operation and purchase of motor vehicles once significantly eased the city's traffic jams. In 2015, Tianjin promulgated the *Scheme for the Reform in the Parking Charge for Motor Vehicles in Tianjin Municipality*, whereby the district-based differentiated parking charge policy was enacted. In 2016, together with the World Car Free Day each year, Tianjin Bus teamed up with Alipay and launched the activity titled "922 Green Travel: Enjoy Discounts in Bus Fares by QR-Scanning". In the same year, as a response to the central government's reform in business vehicle usage systems in city-level public institutions, general business vehicles were gradually disused, and those going on general business trips shall then regard public transport as the first choice with certain travel allowance. In addition, governmental departments in Tianjin kept expanding the big data application during decision-making. For instance, during the formulation of the *Urban Master Planning of Tianjin Municipality (2017–2035)*, with diverse data resources like cell phone signaling data, POI data from service facilities, data of commercial outlets, and thermodynamic data for crowds in different time periods, key points that affect urban economic quality improvement and public facility optimization were found.

However, in the context where bonus from restrictive policies on car operation and purchase is disappearing, there are growing challenges to the mobility management in Tianjin. In 2017, the authors had an interview with a governmental department engaged, and carried out a questionnaire survey on local residents' green travel through the internet, with totally 10 004 effective questionnaires received, including 773 ones from residents owning cars. Upon analyzing, the following problems were found:

1) Problems like curb parking and illegal parking were frequent due to car owners' coveting lower parking costs.

2) Current traffic allowance tilts to non-green travel modes, and the allowance in public institutions or

enterprises is mainly done through reimbursement. Under a traffic allowance mechanism of such kind, users of private cars can apply for reimbursement with the actually obtained vouchers for parking and refueling, while those going on business trips through green travel modes (like public transport and bike) cannot get their deserved allowance. According to the analysis on the questionnaires (from 773 informants), among current traffic allowance forms, allowance for non-green travel modes, namely the allowance for refueling and discount in the fee of parking in workplaces, cover 32% and 27% of the total respectively, while the allowance oriented to green travel only accounts for 18% (see Figure 7).

3) The participation of residents in green-travel-related activities needs to be improved. Since the Car Free Day is mainly organized in a top-down form, which pays little attention to the public's own demands, the public participation is mainly passive with limited influence. According to the survey result (10 004 informants), 27% of the respondents never heard of activities like "Car Free Day", "Bus Day" and "Metro Day", and 53% of them once heard of these activities yet have never participated, while only 19.6% of them had experience in these activities [7].

4) The public participation during the decision-making of urban planning lacks significant support from organizations or social communities, and the depth of public participation is quite limited, which in many cases becomes a mere formality without the interaction and information input from decision makers.

3.2 Innovation in techniques

In the context of highly-popularized mobile internet and smart phones, it is feasible for the Tianjin Municipal Government to establish an online public participation platform and develop a mobile app to enrich the methods of public participation in urban planning. Traditional polls for urban planning often feature the following demerits: significant workload in offline questionnaire surveys; inadequate samples due to time and spatial limits; insufficient feedback information due to excessive choice questions; difficult interaction between users and decision makers due to the one-way participation; and the lack of follow-up in temporarily organized surveys. In the era of mobile internet, it is possible to realize the combination of data and public participation through more efficient technologies. Taking Pinstreet as an example, through social-media-like user comment approaches in the function design of this platform, the authority can solicit public opinions on the improvement of streets and public space (see Figure 9). Upon backend data analysis, these opinions can form an effective planning feedback mechanism, offering significant scientific basis for further actions. As a medium between government and the public, the mobile app platform provides possibilities of coordinating various interests and leading stakeholders to an agreement, which will then facilitate urban planning and

boost the sound development of green transportation.

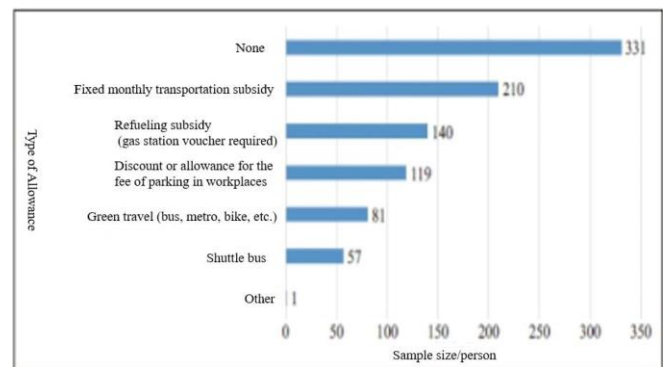


Figure 7 Types of transportation subsidies provided by employers (pick one or two options)

Source: Reference [7].

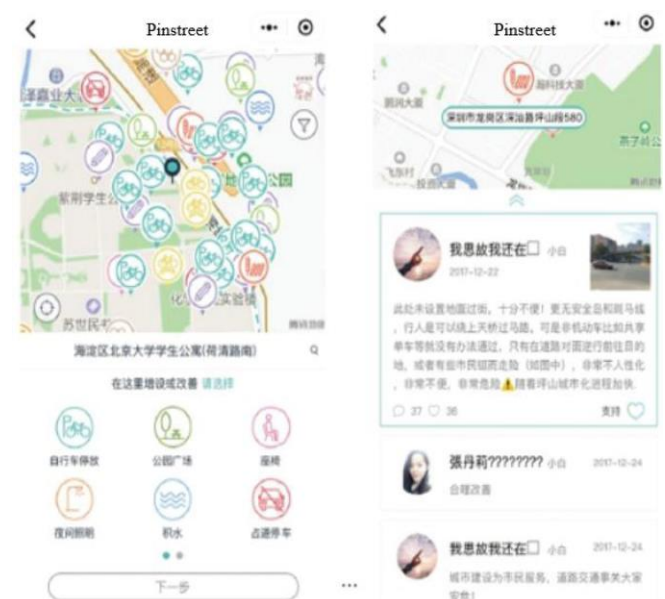


Figure 8 Pinstreet: A public participation platform based on mobile terminal devices

Source: Reference [7].

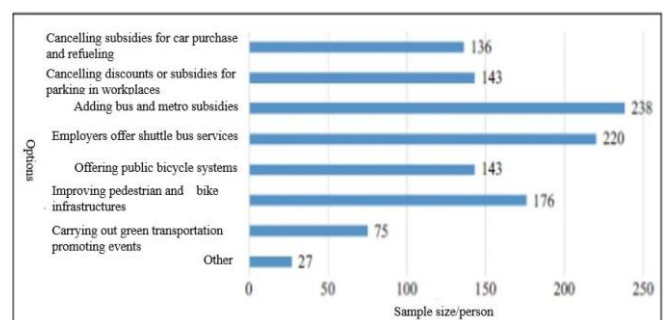


Figure 9 Questionnaire survey on green travel recommendation (pick one or two options)

Source: Reference [7].

3.3 Innovation in incentive mechanisms

The analysis on questionnaires collected (773 informants)

indicates that, mobility management measures including increasing public transport allowance, offering commuting bus services, canceling preferential policies for parking in workplaces, and canceling car purchase subsidy or refueling subsidy can stimulate green travel effectively, for which supporters cover 30.8%, 28.5%, 18.5% and 17.6% of the total respectively (see Figure 9). Hence, it is suggested to lift the allowance to green travel modes in the incentive mechanism, e.g. reimbursement for bus card charging, while reducing existing allowance funds to motorized travel modes like refueling and parking fees.

Besides, apart from restrictive mobility management measures, it is suggested to add certain incentive mechanisms that combine with economic leverage as a supplementary. Referring to the experience in Shenzhen, the authority can gradually implement incentive measures that combine spontaneous lay-off of cars with the extension of commercial insurances and discounts in traffic fines, so as to encourage citizens' participation in green travel and spontaneous lay-off, thereby reducing the demand for driving motor vehicles. Traffic police department of Tianjin can also carry out activities themed as "Embracing Green Travel by Reducing the Use of Private Cars", encouraging the public to apply for green-travel-related preferential treatment. Moreover, through further coordination among governmental departments, the traffic police department, the Tianjin Insurance Association and local insurance companies can jointly release preferential policies for the premium of commercial insurances as well as reduction in traffic fines for users laying off their private cars. For car owners who apply for green travel preferential treatment and have laid off their cars for a certain period (e.g. 30–90 days), they can enjoy the extension of their commercial car insurance contracts or reduction in their traffic fines.

3.4 Innovation in promotion activities

Another innovation in mobility management manifests itself in the close integration with urban event planning and the practice of cultural creative industries, which helps create effective promoting activities for green travel. The most typical case is the "Parklet Day" that has been on-going in European and American cities for long. It is suggested for Tianjin Municipality to carry out short-term or long-term activities of "Transforming parking lots into parks" on streets with historic scenes like Wu Da Dao and banks of Haihe River combined with the unique urban characteristics here. These activities not only help facilitate tourism economies and the environmental improvement in districts, but also boost the green travel in these areas. These activities only target at inactive space that was used for parking, which will be transformed into micro-parks only during specific periods (like the National Holiday) as an expansion of the pedestrian space, offering service facilities and greenery to people's street activities. Organizers can attract people to these areas via events with wide participation.

The public can fully engage in the specific transformation and design as either users or designers. The rebuilt micro-parks can either be temporary or permanent ones based on the feedback from users, and the activity period can be adjusted according to short-term effects or social response. Spatial transformation of such kind fully demonstrates the urban construction philosophy of being human-oriented. In areas lacking urban parks, adequate pedestrian space, or places available for street activities, micro-parks of such kind help increase pedestrian space but reduce the occupation of parking lots to walking space, which would then encourage walking and bike travel. At the meantime, combined with tourism and art shows, it attracts more tourists and consumers via its unique public space, develops potential clients, facilitates inter-community exchanges, fosters community awareness, and thereby fully boosts local economic and social advancement. Cities like Beijing and Shanghai have already had similar experience^[8], where several parking lots on streets were transformed into mini-squares, nursery gardens or parks (see Figure 10).

4 Conclusion

Along with the continuous advancement of economy, society and technologies, mobility management measures are becoming indispensable tools for urban traffic management. In particular, in this era of digital information that features developed internet media and growing public awareness of participation, the government should give priority to mobility management during policy making. This article sketches the innovative practice of mobility management in developed countries, discussing the feasibility of these measures in Chinese cities represented by Tianjin. China's studies on mobility management are just at the beginning stage, which have been adopted in several large cities yet still lack systemic policy studies and practice. Therefore, China has supposed to further study the feasibility of mobility management ideas and policy application by grasping the opportunity of its economic development, so as to provide guarantees to the vision of "a country with powerful transportation" as well as its sustainable development strategies,



Figure 10 Parklet activities in Beijing

Source: <http://www.designboom.cn/news/show.php/itemid-6100/>

and to improve local cities' infrastructure of green gravel and the quality of life continuously.

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