Citation: QUAN Yongshen, Wang Ting, Yu Liu. Issues on Urban Transportation [J], Urban Transport of China, 2018 (02): 1–8.

Issues on Urban Transportation

QUAN Yongshen, Wang Ting, Yu Liu

Beijing Transport Institute, Beijing 100073, China

Abstract: China is experiencing a critical period of economic and social transformation, and the external ecological environment in which the transportation system originates and evolves has undergone tremendous changes. Therefore, the traditional transportation development modes and planning theories are facing challenges. In response to these changes, this paper proposes some strategic questions that need to be examined and discussed on the following topics: the method in response to the uncertainties in the existing urban transportation planning system; the reform of supply mode in transportation services; the structural reorganization of the comprehensive transportation system; the development of transportation planning objectives and the indicator system; the implementation of public transportation priority policies and the construction of public transportation metropolis; the rational perspective on the development of new transportation services; the development of intelligent transportation system; and the theoretical and technical innovations on urban transportation. **DOI:** 10.13813/j.cn11-5141/u.2018.0003-en

Keywords: urban transportation; marketization; comprehensive transportation system; transportation indicators; public transportation priority; transportation sharing; intelligent traffic system; theoretical and technical innovations

0 Introduction

China is currently in a critical period of economic and social transformation, when the urban development model, the socioeconomic growth model and the scientific and technological development model are all in transitions. The external ecological environments depending on which the urban transportation system originates and evolves has also undergone tremendous changes.

First comes the transformation of the urban development model. As clearly proposed in the *National Plan on New Urbanization* (2014–2020), a new people-oriented urbanization will be promoted [1]. Implementation of this new urbanization strategy means that the urban development will abandon the extensive urbanization model from the past and enter a new stage that focuses on the improvement of quality.

Second comes the transformation of the socioeconomic growth model. Under the new normal economy, more attention will be paid to the decisive role of the market in the allocation of resources. The economic growth will shift from a model relying on resources such as capital, land and manpower to a model driven by knowledge innovation, technological advancement and transformation of management system. The *Guiding Opinions on Innovating the Government in Allocating Resources* [2] will further advance the reform of the national socioeconomic system. One of its focuses is to transform government functions and enhance the government's ability on social governance, which means that the national administrative system is also facing reforms.

Third comes the transformation of the scientific and technological development model. Information Communication Technology (ICT), as a product of deep interdisciplinary integration of Information Technology (IT) and Communication Technology (CT), has triggered a revolution in the scientific and technological development. Prosperities of new technologies including big data, Internet Plus and cloud computation have promoted new industries to emerge. The reform of the national innovation system has for the first time defined the subject of technological innovation as the market and enterprises, which changed the government-led model that existed for a long time in the past under the planned economic system.

Transformations of the aforesaid three development models share the following important characteristics. First, the people-oriented Scientific Outlook on Development leads the economic and social development and seeks for the overall harmonious development between human and nature, human and society, and human and human. Second, they pay more attention to the improvement of quality and efficiency driven by innovation, rather than the expansion of quantity and scale driven by capital (resource) input. Third, the decisive role of the market in resource allocation is clearly emphasized.

There is no doubt that the transformations of the

Received: 2017-10-11

First author: QUAN Yongshen (1941–), male, from Jinzhou, Liaoning Province, senior engineer, former Director of Beijing Transport Institute, is mainly engaged in the research of transportation planning and traffic engineering. E-mail: quanys@bjtrc.org.cn

socioeconomic pattern and the urban development model will inevitably result in deep changes in the urban transportation system. This involves not only the redefinition of goals and socioeconomic attributes of the transportation service, but also the reform of the supply mode, the supply tactics and the supply system. The technological innovations and breakthroughs in modern information and communication will also provide sound technical support to the transformation of the urban transportation model.

1 Establishment of a new planning model in response to future uncertainties

1.1 Technical difficulties of transportation planning: uncertainty

The current urban transportation planning is facing many uncertainties, including planning objects such as urban spatial form, function allocation, land use and social culture and economy, but also including the game of the will of different stakeholders in the process of planning and implementation [3]. In the context of dramatic changes in space and society, the traditional approach and process of survey–analysis–prediction–planning have some limitations.

First, the traditional deterministic planning approach predicts future development based on the development trends in the past. Constrained by the limitations of existing knowledge, it fails to reflect the changes of the multiple complex driving factors that affect the future development.

Second, the traditional urban planning emphasizes the ultimate ideal blueprint or vision rather than the process of realizing the long-term goal. All the measures and layouts proposed in the plan do not fully take into account the variability and uncertainty of relevant factors that affect travel demand during the long implementation process, which results in a large reduction in the reliability of the planning forecast and may even lead to erroneous results. The one-stop planning guided by this kind of deterministic thinking is not flexible, and it will inevitably stand in an opposite position against the future reality.

Third, the relationship between the state of a transportation system and its internal structural factors or various external environmental factors is not a fixed relationship as independent variables and dependent variables. It is not a simple linear causality relationship, either. Instead, it is a more complex correlation of reciprocal causation, which makes it hard for a model established on the basis of linear causality to simulate and predict.

In this sense, the new concept of continuous planning and dynamic adjustments should replace the traditional concept of relying on an ultimate blueprint to determine everything. What is good in the traditional survey–analysis– prediction–planning method and work mode should be kept, and what is not should be abandoned.

1.2 Tracking, planning and strategic regulation of the evolution of urban uncertainty

The application of big data in transportation provides important technical support for monitoring the interactive evolution between a city and its transportation system. Based on the advantages of big data and the full utilization of planners' insights and coordination abilities, it will be a feasible new path for the transformation of planning mode to establish models with deep uncertainty in various uncertain circumstances. These models will track the evolution process of urban uncertainties and make proper planning responses and strategic adjustments.

1) To establish models with deep uncertainty in uncertain environments

The three existing major models with deep uncertainty are: the expected value model, the chance-constrained model and the dependent-chance programming model. In addition, there is also an analytic planning model that changes the ultimate planning into the process planning based on the comprehensive perception of the interactive relationship between transportation and urban development. Among many uncertainty planning theories and methods, the scenario planning is considered to be one of the best methods to deal with dynamic, complex, nonlinear and uncertain environments [4]. The scenario planning aims to find a balance between under-prediction and over-prediction, namely that it describes the future state of the system and the pathway for the current state to evolve to the future state based on the combination of a series of qualitative or quantitative variables. It gets a picture of the future based on a comprehensive consideration of the extrapolation of historical experience, identification of future terminal status and prediction of events [5]. The scenario planning lays emphasis on the interactive process between planning and uncertainty environments, so it is a real process planning.

2) To track the evolution of urban uncertainty and make proper planning responses and strategic adjustments

The implementation and evolution of a plan is far more complex than the final result. The strategic measures applied in the planning stage may differ from the final planning strategy, and the balance between the two and the timing should be considered with extreme caution. For example, it is an extremely long process (at least 10–20 years) to realize the ultimate goal to relieve the function of the urban center with new districts and sub-centers. During this process, the supports of public resources from the urban center are required, which inevitably intensifies the transportation connection with the urban center, and further enhances the dependence relationship. In the event of improper tactics and timing, this dependence will be solidified, and the goal to relieve urban center functions and guide the shift of

population and industries from the main urban area of a megacity to its periphery and other towns will eventually go in vain. Therefore, there is an urgent need to track, monitor and evaluate the trend between transportation and urban development and the changes of various factors determining the trend, based on modern information and communication technologies. Continuous tracking and monitoring of uncertain environment should be used to evaluate the coordination and adaptation between transportation and urban development, and to assess the reasonableness of the adjustments in the planning and implementation process. The planning implementation effects and success experience or causes for deviations should be analyzed. The revision of the plan, the policy and the planning operating system should be proposed based on the prediction of multiple trends of the future uncertainty environments. Uncertainty-oriented planning is a dynamic, progressive, open and strategic regulating process, where the key to strategic regulation lies in the allocation of resources and the mode of transportation supplies.

2 Redefinition of transportation service attribute and reform of its supply mode

2.1 Socioeconomic attributes of the urban transportation service

A correct definition of the socioeconomic attributes of the transportation infrastructure and the transportation service products is the key to determining the allocation mode of urban transportation resources. The purpose of this definition is to clarify the provider and producer of transportation services. Reference [6] presented the details about the socioeconomic attributes of urban transportation infrastructure and services. According to the definition of social product attributes by the theory of public economics, the urban transportation infrastructure and the services it provides are basically quasi-public products and private products that are obviously competitive and exclusive and should be provided by the market or shared by the government and the market [6].

2.2 Reflections on the current transportation supply mode

The transportation supply mode in which the government undertakes everything was originated from the socioeconomic system in China since 1950s, and its theoretical basis is the *Science of Finance* deeply imprinted with the planned economy rather than the modern *Public Economics*. Unsustainability of the existing transportation supply mode lies in the following aspects: 1) the market-orientated urban land development is not related with the government-dominated transportation infrastructure construction, which is the root cause for the failure in the implementation of the TOD model. It is difficult to establish and maintain the coordinated relationship between transportation and urban development. 2) It cannot get out of the dilemmas such as low efficiency and effectiveness in resource allocation (even mismatch in some cases), distorted market prices, inadequate public service supply and heavy burdens on public finances. 3) According to the law of diminishing marginal utility of capital (resource) inputs, the development mode driven by the input of public resources inevitably leads to unsustainable growth.

2.3 The goal, direction and difficulties of the reform of the supply mode

The strategic goal of the structural reform of the urban transportation supply is to promote marketization in depth and breadth, innovate methods for resource allocation, and relax government regulation. It will also establish a competition mechanism for transportation supply services, build a diversified and moderately scaled transportation supply service system, improve resource allocation efficiency and effectiveness, and provide consumers with more opportunities to choose transportation services.

On the basis of satisfying the public service demand, increasing the effective supply, and improving the service quality, the direction of the reform of the transportation supply mode is to adhere to the two major standards of fair and efficient transportation supply, so as to give full play to the decisive role of the market in transportation resource allocation and the functions of the government in planning guidance, macro regulation and market supervision. Its difficulty lies in the risk of coexistence of government failure and market failure, as the government supply and the market supply represent the game and balance between fairness and efficiency. In this light, the core of the supply mode reform is the construction of a legal environment and a social credit system to properly address the relationship between the government and the market to avoid the failure of both.

3 Restructuring of comprehensive urban transportation system

3.1 Reflections on the existing binary structure system

The current regional comprehensive transportation system has ambiguous boundaries, while the urban comprehensive transportation system lies within the urban administrative areas. These two systems bear different service tenets, different planning–construction–operation– service participants, independent system formats and technical standards, and incompatible operation and service modes. The current pattern of binary partition between the regional and the urban comprehensive transportation systems is intrinsic with multiple problems.

1) All modes of transportation only achieve "superficial connections" in urban areas (at transfer hubs) without "cross-boundary fusions"

Taking rail transit as an example, because of the incompatibility of system standards and the inconsistency of management and planning entities, urban rail transit and regional railway are not integrated effectively. Various rail transit systems are not complemented and connected to each other, and it is difficult to fully integrate the network channel resources. The multiple entities of the connection interfaces demonstrate their territory awareness and implement separatism, disregarding the interests of passengers. Taking Beijing West Railway Station as an example, the above-ground parts like the railway depot and the inbound system belong to the Beijing Railway Bureau, but the entire West Railway Station area with the outbound system as its main body belongs to the Beijing Municipal People's Government. Both administrative authorities basically maintain independent operations, and they lack effective integrations in transfer connection, capacity allocation and release of service information to passengers.

2) The spatial circles between the urban and region systems (30 km–70 km–120 km) become a service blank area

From the perspective of the metropolitan area, urban (city center) rail transit system is dominated by subway. However, with the expansion of urban built-up areas, the commuting distance of residents continues to increase. For example, the towns around Beijing represented by Yanjiao have been integrated into the Beijing metropolitan area. However, the 30 km–70 km circles are still in short of the support of the corresponding rapid rail transit network. From the perspective of urban agglomeration, the connections among cities in the Beijing-Tianjin-Hebei urban agglomeration are mainly undertaken by the existing national railway trunks (ordinary rails and high-speed rails, etc.). Their station arrangement, departure frequency and service level cannot satisfy the needs for frequent exchanges and efficient travels among cities. The construction of intercity railways needs to be accelerated. In addition, problems including the arbitrary selection of rail transit system formats, the deviation of service orientation from the market demand and the mismatch of channel resources also emerge. Apparently, this separated and imbalanced structural system not only fails to provide efficient transportation services for the metropolitan area, but also makes it difficult for resource integration and sharing and system interconnectivity, which is unable to satisfy the development needs of urban agglomeration.

3.2 Reconstructing the "regional–urban" comprehensive transportation system

The development of urban agglomeration and the tendency of urban integration make the boundary between regional transportation and urban transportation more and more blurred. It is imperative to reconstruct the "regional–urban" comprehensive transportation system, namely, breaking the barriers of institution and ownership relations to satisfy the needs for regional integrated development and resource integration.

On the one hand, the new comprehensive urban transportation system after reconstruction should achieve a high degree of integration of multiple transportation modes in different spatial circles so that they are compatible to and complement each other and share service demands, rather than connected only at the interfaces. On the other hand, the transportation demand in different spatial circles should be the only factor that determines the functional structure of the future system. Different passenger flow features determine the service standards and requirements, thus further determining the operating modes and system formats that they are suitable for. To this end, the selection of system formats and operating modes for rail transportation should never be arbitrary considering the limitation of channel resources. Routes and stations should be reasonably allocated, and the operation organization and planning should be refined so as to satisfy different travel demands with limited channel resources [7].

4 Reflections on the goal and control index of urban transportation planning

4.1 Erroneous tendency in the formulation of transportation planning goals

While preparing transportation planning, major cities of China show erroneous tendencies to a certain degree when setting planning goals and defining planning indexes, which are summarized as follows:

1) Neglecting the strategic concepts and the connotations of transportation development goals, and resulting in the generalization of planning goals and indexes.

On the one hand, some words are abused, such as efficient, convenient, economical and green. Different understandings of the connotation of planning goals by different planners and implementers (executors) inevitably lead to the changes in the strategic directions. On the other hand, transportation development goals and indexes are imitated blindly, which ignores the significant differences in transportation development stages and basic conditions for cities with different sizes (large, medium and small) and cities in different regions (in the east, central and west). This results in the homogeneity of Chinese cities. In fact, from the perspective of the planning indexes of transportation structure, even one city should apply different transportation structure standards for different space-time areas (administrative

region, urban center and core area, etc.).

2) Lack of scientific justifications for planning goals and control indexes

Due to administrative interventions for quick successes and instant benefits, most planning goals and control indexes fail to be justified for their necessity and feasibility, and they are usually irrelevant to planning countermeasures. Taking transportation structure (shares of different transportation modes) as an example, when this planning index is determined, the interdependence between travel modes and demand features and the balances among different travel modes have not been studied in earnest. The necessary and sufficient conditions for optimizing the transportation structure and the possibility of having these conditions within the planning period have not been conscientiously analyzed, neither. Moreover, in many cities' comprehensive transportation planning, planners fail to take this index as the basis for the justifications of infrastructure supply size, layout plans and operation mode selections, so it has no binding effects on planning.

3) Ineradicable car-oriented concept falling into a paradox of strategic goals and tactics

Most cities include both public transit mode share and traffic efficiency (or speed) in rush hours as planning indexes. The objective of the public transit priority strategy is to improve the competitiveness of public transit against individual motorized transportation (cars) and minimize the use space and costs of cars, through reasonable resource allocations. However, many cities, while mitigating traffic congestions, focus on the improvement of cars' speeds and use conditions.

On the one hand, the infrastructure supply for motorized vehicles is continuously increasing in the name of congestion governance, which even squeezes the travel space for pedestrians and bicycles. On the other hand, massive technological and financial resources have been concentrated on the research and commercialization of the cooperative vehicle infrastructure system. This paper has no intention to completely deny its academic value and social realistic significance. However, this system focuses on the improvement of the level of services for cars. From this point of view, there is indeed a need for reviewing this system.

4) Mistakes in the definition of "congestion" and the focus of "congestion reduction"

In the congestion reduction process of many cities, the governments pay far more attention to the traffic efficiency (speed) than to the public transit mode share. The average speed during rush hours in road networks of megacities represented by Beijing, Shanghai and Guangzhou ranges between 20 km h^{-1}–30 km h^{-1}, obviously higher than that of many European and American cities (16 km h^{-1}–20 km h^{-1}), and the trip speed of cars has been far higher than that of public transit. However, what's ironic is that currently European and American cities are greatly promoting "road diet" to constantly reduce the use space of cars, while decision-makers of Chinese cities, strongly stimulated and tempted by the road congestion ranking, are taking irrational measures to reduce car congestion. The outcome is that the misallocation of urban public resources and malformation of transportation structure are becoming increasingly severe, and the expansion of car trip demands is uncontrolled. However, aren't the prevailing congestion reduction measures and public transit priority bear contradictory goals and constraining conducts in essence? So what day is the end of such an awkward competition?

4.2 The main goal and focus of transportation planning

The goals of urban transportation planning should be consistent with the goals of urban environment, and social and economic development. The sustainable growth vitality featuring urban mobility should gradually become the direction and strategic focus of transportation planning.

1) Adhering to the people-oriented service tenet

On the one hand, the fairness and equity in travel modes options for different travel groups should be respected. The allocation of transportation resources and service modes should satisfy citizens' daily travel needs at the lowest cost (frequency, distance, time and service fee). On the other hand, an index system for planning control should be established based on human demands. For example, compared with public transit mode share and traffic efficiency (speed), the average daily travel time of all modes or the generalized accessibility may bear more strategic significance as the major planning control index.

2) Promoting the restructuring of urban transportation space

On the premise of satisfying the diversity and comprehensiveness of urban public space functions, it is proposed to promote the design concept and method of complete street [8], turn back from road design to street design, and adhere to the transportation concepts of safe, green, low-carbon and sustainable development, thus ensuring the right of way for all travelers and providing them with fair road space. Moreover, as the urban transportation space is a part of urban public space, the restructuring of urban transportation space should fully consider the diversified functional demands of urban public space, and properly deal with primary and secondary functional goals and collaboration between the two in different occasions.

3) Realizing integrated and coordinated development between multiple transportation modes

Objective resources and environmental capacity should serve as the constraints for the construction and expansion

of transportation system. The advantages of different transportation modes in serving residents' different travel purposes, distances and requirements (comfortableness, timeliness, etc.) should be fully utilized. The integration of multiple transportation modes and the integral synergistic effect of the system should be maximized.

5 Public transit priority and transit metropolis

5.1 Bottleneck of the public transit development

The development of urban public transit in China has reached an insurmountable bottleneck. From the perspective of travel modes in megacities like Beijing, Shanghai and Guangzhou, the increase in public transit mode share is in a difficult situation. Beijing is the only city in China whose public transit mode share (in city center area, excluding pedestrians) grows by 2 percentage points annually for several years. However, the cost is also enormous (annually add 40 km of rail transit routes, with the construction cost of 30–40 billion Yuan if calculated at the price of 0.8–1 billion Yuan ·km^{-1}, and every year, the government has to spend a lot of operating subsidies). Public transit mode share in Shanghai rose from 18.5% in 2009 to 20.7% in 2014, which increased by 2.2 percentage points in five years. Guangzhou shows almost no change from 2010 to 2015 (only shows an increase of 0.3 percentage point). Despite the huge investment on public transit, the mode share of cars remains at a high level while the mode share of bicycles, an important green travel mode, declines year by year. In the meantime, the public transit is facing another awkward situation, namely that at the same time, when China greatly promotes the development of rail transit, the bus resources are not fully utilized, and bus passenger volume is declining in spite of the increasing capacity.

The reason for the abovementioned bottleneck in China's urban public transit development lies in the deviations of its service tenet and service attribute orientation, which are mainly reflected as:

1) Deviations of the service tenet

For a long time, the characteristics of public transit which is the social public welfare and an approach to provide basic travel guarantee services have been unilaterally emphasized. The due attention has not been paid to the growing demands for services not serving the public benefits.

2) Contradictions of the monotony of the operation and service model with the diversity of travel needs

The traditional operational service model, which operates on fixed routes and schedules based on the route network and capacity allocation, was initiated in the planned economy era and it kept running since then. Travel demands now become more and more diversified and complicated, but the existing public transit operation and service have not been rationally configured according to the objective market requirements (for example, serving different user groups traveling in different time and space and for different purposes). The asymmetric information service model of "passively waiting for customers" fails to provide diversified services to the travelers. All of these make it increasingly difficult for public transit to compete with cars and its service attractiveness is deteriorating.

3) Contradiction between the government monopoly in the operating system and the multi-level diversified market demands

The majority of state-owned public transit agencies have long been constrained by the traditional business concepts and systems. In addition, the absence of competitions in the service market has caused public transit agencies to rely on the government subsidy over time and gradually lost their enthusiasm to actively expand the passenger market. As a result, the imbalance between the ability of government departments to provide public services and the actual social requirements has become increasingly acute.

5.2 Market-oriented reform of public transit services

China's urban public transportation system faces a strategic crossroad and must undergo strategic changes. First of all, the tenet and orientation of public transit services shall be redefined. The service orientation of the public transit shall be adjusted from providing residents with basic travel guarantee services to providing comprehensive and alternative services (including personalized value-added services) for all trips that are suitable for public transit and for all social classes. Second, the traditional pattern of monopolized operation should be broken. The market competition mechanism should be introduced, and the system allocation as well as the operation and service model should be comprehensively reformed. In addition, the modern information and communication technologies should be applied to comprehensively improve the capacity and reliability of the real-time response service in the network operation. The diversified models of personalized, customized and one-stop coordinated sharing services should also be supported.

5.3 Reflections on the construction of the transit metropolis

Chinese government and transportation planners have some misunderstandings on the nature and the connotation of transit metropolis, which are summarized as follows:

1) Transit metropolis is not equivalent to metropolis public transit

According to the definition by Robert Cervero, "transit metropolis" [9] in essence is the integration of the urban development model and the transportation development model.

In this sense, the construction of the transit metropolis is absolutely not equivalent to the construction of the urban public transit system or the public transportation industry. It is required to look outside the transportation industry and pay more attention to the coordination between transportation and urban development at a strategic level.

2) The responsibility entities for the construction of the transit metropolis are not public transit agencies but local governments

The transit metropolis is actually a development model of a city, so efforts in public transit alone cannot lead to the real establishment of a transit metropolis, for which the responsibility entities should not be public transit agencies but local governments. The focus of transit metropolis construction should be how to promote the integration of public transit and urban development, instead of the assessment of the public transit system itself. The current version of *Assessment Index System for the Transit Metropolis* issued by the Ministry of Transport and the associated assessment methods must be changed.

3) There are no universal development models or undifferentiated assessment indexes

The development model of the transit metropolis is closely related to the urban morphology. The applicable public transit systems to fit cities with different morphologies and features are different, and there are no universal development models or undifferentiated assessment indexes. Cities with different sizes, morphologies and development stages should be encouraged to explore the development paths that are suitable for their developments.

6 Rational attitude toward new transportation services in the context of big data and Internet Plus

6.1 About shared mobility

In recent years, under the banner of sharing economy, numerous types of shared mobility emerge. Sharing economy (also referred to as collaborative consumption) has no unified definition by far. Some think that sharing economy refers to the integration and sharing of idle resources using modern information technologies such as the Internet, and the goal is to maximize the efficiency of resource utilization [10]. Others, however, have different opinions. They believe that the nature of sharing economy is not the sharing of idle resources, but the separation of ownership and the right to use, and the pursuit of service rather than ownership. It is undeniable that at present, the connotation of sharing economy is controversial, and that all kinds of shared mobility services are still in trial, resulting in a mixture of the good and the bad. It requires more rational independent thinking, instead of blind following, to properly face the misleading more or less caused by the good packaging of the business idea.

First of all, not all forms of shared mobility, such as the popular APP-based ride-hailing, car-sharing and bike-sharing, are utilizing idle resources. Instead, some are inputting more incremental assets. For example, the APP-based ride-hailing induces private cars into operation, which is actually releasing potential demands through incremental services. Some demands are irrational and are contrary to the rational positioning of taxis in the urban travel service system.

Second, it is impossible to achieve a real sharing if the sharing of space resources is ignored. In addition to transportation tools, the shared mobility also occupies other resources including the limited urban public space (parking and road space). All forms of shared mobility service involve the allocation efficiency of public resources and social equity. The market regulation and the social governance system are not yet available.

6.2 Issues worthy of attention

Any new business models should not be rejected with a rigid attitude, but their subsequent chain effects on the entire urban transportation system should be evaluated before accepting it. It is necessary to carefully examine whether the efficiency and equity of various transportation (travel) service groups are truly protected based on the basic strategic values of urban transportation. The following issues deserve serious considerations:

1) Different shared mobility models should be treated reasonably and differently

The basic strategic principles of urban transportation should be adhered to, and different shared mobility models should be treated differently to keep what is good and abandon what is not. It is proposed to properly handle the relationship between the sharing of idle resources and incremental resources, and the sharing of idle resources should be promoted and encouraged with a higher priority. It is proposed to focus on the resource and environment benefits, adhere to the principle of sustainable development, and rank transportation modes by their publicity and degree of intensification. Moreover, we should encourage green travel, and properly handle the relationship between personalized shared mobility service and aggregated travel service (public transit).

2) Fully evaluating the negative externalities of various shared mobility modes

It is proposed to fully take into account the constraints of urban resources and environment and the actual social governance abilities, avoid the problems caused by the transfer of negative benefits, and prevent market failures, and at the same time deal with the integration and co-existence of new

and traditional business types.

3) Establishing a new social governance pattern featured with co-building, co-governance and sharing

All urban transportation service patterns should be established in a market environment with strict regulations. The government must integrate various social resources and encourage multiple social entities to participate in the joint management of the transportation service market, establish a coordination mechanism and platform for stakeholders, and maintain and manage positive lists and negative lists. Moreover, it should actively use Internet technology to realize the innovation of government measures based on the rule of law and reduce administrative costs.

4) Paying attention to the true and most needed sharing patterns

The sharing truly needed by urban transportation is a reasonable sharing of urban public spatial resources that are people oriented and can manifest social fairness and justice. It is a reasonable allocation and sharing of the idle transportation infrastructure resources of different levels and ownerships, and the sharing of the natural resources, economic resources and social resources for the development of regional transportation integration. It is also the opening-up, fusion and sharing of the governmental and social information resources.

7 The goal and main direction of the development of urban intelligent transportation system

7.1 Deviations in the development of intelligent transportation system

The current studies and applications of urban intelligent transportation system in China are deviated from the urban transportation development models and the sustainable development strategy. The issues are summarized as follows:

1) Expanding the application field and clarifying the relationship between information service and intelligent decision-making

Currently, two different "ITS" concepts including Intelligent Transportation System and the Information Technology System are often confused for each other. Due to this confusion, the research and application of intelligent transportation system still focus more on the informatization of highway and urban road traffic management services, and the informatization of public transportation. Little progress has been made on the strategic and planning decision-making level. In addition, the research and development of new technologies have been overemphasized, and the innovations on transportation strategy, planning and decision-making theory have been neglected. In particular, there is almost no research on the theories of the interactions between transportation and urban development.

2) Focusing more on palliatives than permanent cure

Both the cooperative vehicle infrastructure system and the autonomous technology can certainly improve the driving safety and can increase road capacity conditionally in a certain time-space range, but they are only palliative measures to the entire urban transportation system. It is unlikely to solve the traffic congestion issue by improving the road capacity and efficiency through the application of the cooperative vehicle infrastructure system. The reason is that it is contrary to the strategic principles and basic laws of urban transportation development. It also neglects the relevancy of mutual constraints between transportation supply and demand, in particular the guiding and regulating effect of supply on demand. The modern urban transportation strategy advocates to expand the supply of intensive and green travel services, rather than to improve road capacity simply by increasing supply. In addition, even if only the vehicle infrastructure relationship is concerned, the dynamic change of the road function structure and the topological structure and their influence on the behaviors of the vehicle drivers (namely the actual demands) cannot be ignored. The supply and layout of non-roadway infrastructure can also subtly change the behaviors of road users.

3) Ignoring the differences in the demand for intelligent transportation in different spatial categories and the collaborative relevance of subsystems

The demands for intelligent transportation in different spatial categories differ apparently. Different spatial levels such as inter-city, region (urban agglomeration) and city (metropolitan area, city administrative region and urban center) have different characteristics in intelligent transportation demands, development goals and system components. However, the studies and applications of intelligent transportation system in China have not been considered carefully. In addition, the subsystems of intelligent transportation are currently developed separately. The intrinsic relations and functional cooperation between the intelligent transportation system and the urban function system, and between the subsystems of the integrated transportation system have not yet been fully considered. Examples include the interaction, coordination and reciprocity between transportation and urban development, and the interdependence of all subsystems that are based on the transportation system and the integrated synergistic effect of the system, etc.

7.2 The goal and direction of the development of intelligent transportation system

The correct goal of intelligent transportation system in China is to achieve collaboration between transportation and urban development, respond intelligently to various

personalized human activities and logistics demands, realize intelligent urban management and operation, and ensure sustainable urban development. To achieve this goal, the new generation of information technologies should be fully utilized, such as mobile internet, internet of things and cloud computation. This goal should also be supported by the application of comprehensive sensing, ubiquitous connectivity, pervasive computing, integrated application and artificial intelligence.

The strategic direction of intelligent transportation system should be guided by that of urban transportation development. They have the same basic point of view, but the intelligent transportation system needs to focus on the following topics: 1) the urban transportation development model, such as the coordination relationship between urban transportation and land use, socioeconomic development, environment and resources; 2) the intelligent analysis of the evolution of travel modes and associated factors; 3) the tracking, monitoring and evaluation of urban space expansion, functional layout evolution, and its relevance to transportation supply and demand; 4) the people-oriented transportation service tenet, the constraints of objective resources and environmental capacity applied on system expansion, the integration and synergy of multiple transportation modes, and solving the system stability problem under the condition of information asymmetry.

The specific development directions include the following: 1) based on the interaction between transportation and urban development, realizing intelligent decision-making of transportation strategy, planning and policy through human-machine interaction; 2) providing one-stop intelligent services on the urban travel and the logistics distribution based on the real-time response to demands; 3) monitoring urban transportation operation risks, avoiding these risks intelligently and handling the emergencies; 4) realizing intelligent and dynamic demand management based on the allocation of urban transportation service resources; 5) ensuring transportation safety actively and intelligently.

8 Conclusion

This paper proposes several strategic direction-related issues that need to be reviewed closely, including the establishment of uncertainty planning models, the reform of the transportation service supply model, the restructuring of comprehensive transportation systems, the innovations in transportation planning goals and indexes, the public transit priority and transit metropolis, the rational attitude toward new transportation services and the development of intelligent transportation system. With regard to the realistic issues and future demands of urban transportation planning, this paper suggests that more theoretical and technological innovations and explorations should be conducted on the following topics: 1) the law of interaction between the evolution of the functional structure of urban space and transportation development; 2) the law of travel mode evolution and the optimized pathway; 3) the integration of the city and regional comprehensive transportation systems, and the reshaping of the structure system in the context of new urbanization; 4) the adaptive and counteracting interaction theory between service demand and supply; 5) the planning model system based on the mapping relationship between travel behaviors and spatial features; 6) the research and development of uncertainty models focusing on scenario planning; 7) the theory of the operational relevance of transportation subsystems, and the quantitative evaluation technology for the degree of relevance between internal and external factors.

References

[1] Central Committee of the Communist Party of China and State Council. National Plan on New Urbanization (2014–2020)[EB/OL]. 2014[2017-10-05]. http://www.gov.cn/zhengce/2014- 03/16/content_2640075.htm (in Chinese).

[2] Central People's Government of the People's Republic of China. 中共中央办公厅 国务院办公厅印发《关于创新政府配置资源方式的指导意见 [EB/OL]. 2017[2017-10-05]. http://www.gov.cn/zhengce/2017-01/11/content_5159007.htm (in Chinese).

[3] Quan Yongshen, Pan Zhaoyu. Supply-Side Structural Reform for Urban Transportation [J]. Urban Transport of China, 2017, 15 (5): 1–7 (in Chinese).

[4] Wang Rui. 基于情景规划的城市总体规划编制方法研究 [D]. Wuhan: Huazhong University of Science and Technology, 2007 (in Chinese).

[5] He Lei, Song Yan, Dai Shenzhi. Research on the Paradigm of Urban Planning Responding to Uncertainty [J]. City Planning Review, 2012, 36 (7): 15–22 (in Chinese).

[6] Quan Yongshen, Pan Zhaoyu. 中国大城市交通市场化发展战略研究 [C]//Academic Committee of Urban Transport Planning of Urban Planning Society of China, China Academy of Urban Planning & Design. 交叉创新与转型重构: 2017 年中国城市交通规划年会论文集. Beijing: China Architecture & Building Press, 2017 (in Chinese).

[7] Quan Yongshen, Liu Jianfeng. Issues and Thoughts on Regional Rail Transit Planning [J]. Urban Transport of China, 2017, 15 (1): 12–19 (in Chinese).

[8] Ye Zhen, Li Ruimin. A Historical Review of Complete Streets Policy Development [J]. Urban Transport of China, 2015, 13 (1): 17–24 (in Chinese).

[9] Robert Cervero. The Transit Metropolis [M]. China Sustainable Transportation Center, translated. Beijing: China Architecture & Building Press, 2007 (in Chinese).

[10] Informationalization Research Department of State Information Center, Sharing Economy Working Committee of Internet Society of China. 中国分享经济发展报告 2016 [R]. Beijing: Informationalization Research Department of State Information Center, 2016 (in Chinese).

