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An Examination of Beijing Urban Transportation Development Under National Land Use Planning

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Abstract: In order to ensure the implementation of urban general planning, a city examination mechanism arises at this historic moment. In the new situation of national land-use planning, Beijing urban transportation examination is facing new requirements. This paper discusses the challenges and opportunities of transportation examination in three aspects: control of the planning implementation process, implementation of the city wide planning, and implementation of the overall cycle of the transportation system. According to the practice of urban transportation examination in Beijing, the paper summarizes the organization mode and the main contents of transportation examination. Finally, the paper provides suggestions on future transportation examination in several aspects: continuous monitoring transportation system using multi-dimensional data, combination of fixed mode and optional mode, integration of objective evaluation, and subjective perception. **DOI:** 10.13813/j.cn11-5141/u.2021.0103-en

Keywords: national land use planning; city examination; transportation evaluation; Beijing

0 Introduction

In 2017, the Master Plan of Beijing (2016–2035) (hereinafter referred to as the Master Plan) was approved by the State Council of China, which took the lead in the country in establishing a routine mechanism of annual examination and quinquennial assessment. This mechanism is expected to ensure the implementation of the urban master plan contents and provide feedback and revisions.

In April 2019, the Ministry of Natural Resources held a deployment meeting for the implementation evaluation of national land use planning and selected four provinces (including Zhejiang and Jiangxi) and 10 cities (including Beijing, Shanghai, and Qingdao) to perform pilot implementation evaluation. The evaluation work is expected to improve the working methods and conduct evaluation work in accordance with new development concepts. The current status of urban development with scientific solutions and the importance of the master plan in guiding urban development are required to be fully reflected. In May 2019, the Chinese Communist Party Central Committee and the State Council issued the Guidelines on Establishing and Supervising the Implementation of a National Land Use Planning System (hereinafter referred to as the Guidelines), starting a new era for the country's land use development and governance system. The five-level, three-category, and four-system national land use planning system was established. The planning implementation supervision becomes one of the four components in the system.

Literature [1-5] presented studies of Beijing, Guangzhou, Shanghai, and other cities with respect to accelerating the implementation of general regulations, the transformation of implementation evaluation mechanism, and the construction of examination system. With the continued improvement in the planning implementation mechanism, the transportation system serves as skeleton of the city and is critical to evaluate. It is necessary to use innovative indexes and technology to promote an institutional reform and achieve a fine control of the planning implementation process. This paper focuses on the basic situation of urban transportation development in Beijing, the challenges and opportunities of urban traffic examination, and the best practices of urban traffic examination; suggestions for the development of future urban traffic examination are also provided.

1 Basic situation of urban transportation development in Beijing

1.1 Construction of major transportation infrastructure has solid progress.

On the basis of performing key tasks, such as the

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Beijing-Tianjin-Hebei integration, the Winter Olympic Games, the Global Horticultural Expo, the Beijing Municipal Administrative Center, and the Daxing International Airport, the construction of major transportation infrastructure has been steadily progressing in Beijing. The Daxing International Airport, the Beijing-Zhangjiakou high-speed rail, the Daxing Airport Expressway, the Daxing Airport North Line Expressway, and the Beijing-Chongli Expressway have all been completed and open to traffic since 2019.

The length of urban rail transit increased from 631 km in 2015 to 940 km in 2019, including 241 km of suburban railway. The service levels of rail transit become increasingly diversified and have transformed from the traditional subway routes to the regional express line-metro express line-metro general line mode.

1.2 Traffic congestion has improved

In 2019, the annual average road traffic index in Beijing's central urban area during peak hours was 5.48, which was classified in the "moderately congested" category and decreased by 3.5% from the 2015 index of 5.7 (see Fig. 1). The daily congestion time dropped from 3 h to 2 h 50 min.

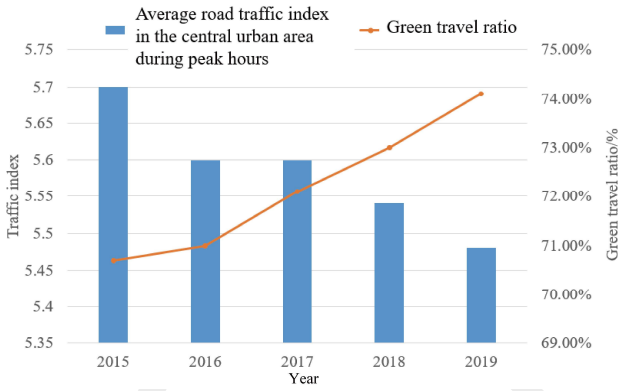

Fig. 1 Change of traffic index and green travel mode share

Source: Annual reports of transportation development in Beijing.

The proportion of green travel in Beijing's central urban area increased from 70.7% in 2015 to 74.1% in 2019. The average speed of 2019 commute traffic was 14.8 km·h^{-1}, which was 2.1 km·h^{-1} higher than the 2014 level (see Fig. 2). The travel efficiency has also increased with substantial improvements in the development and management of transportation infrastructure.

1.3 The transportation-land coordination needs to be strengthened.

In 2015, the urban road implementation rate in Beijing's central urban area was 62%. The total mileage of new urban roads open to traffic was approximately 50 km each year, which reflected a growth of less than 1%. The implementation rates of bus stations and public parking lots in the central urban area were only 20% and 25%. However, the total amount of construction land in the central urban area was 910

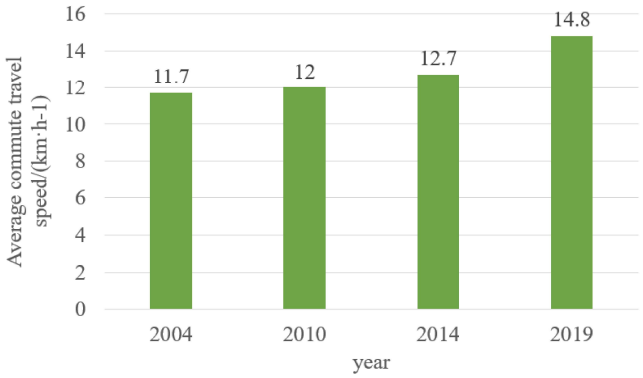

Fig. 2 Change of average commuting speed

Source: Estimates based on 2004, 2010, and 2014 survey data and 2019 data obtained from Baidu Eyes Data.

km^2, which will be reduced to 860 km^2 by 2020 and 818 km^2 by 2035. The planning dynamic target for construction of new buildings is set to zero growth, but the current total amount of construction land and building scale has already exceeded the planning target. Despite the establishment of the highway network and railway network, the development of local collectors and traffic station facilities is not meeting the expected goal and reflects a lag in improvements of Beijing's transportation system.

In 2017, the coverage rate of residents and jobs near rail transit stations in the central urban area was 55% (see Fig. 3), which failed to reach the planning target of 70%. From 2015 to 2019, only 34% of the newly launched residential and industrial land was located within 800 m of the existing and constructed rail transit stations. The Greater London Plan 2008 proposed that areas with high public transit accessibility should preserve more than 50% of the new land development, which should be used as one of the urban development annual evaluation indicators. The new residential and industrial land has not been coordinated with the rail transit station development; as a result, induced travel demand for passenger cars may increase and contribute to worsen traffic congestion in the urban roadway network.

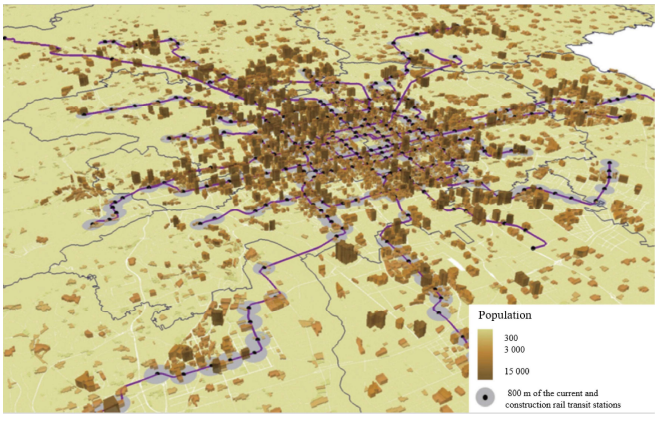

Fig. 3 Distribution of permanent residents around subway stations

Source: 2018 Beijing City Examination Report.

According to the "2020 Annual Report on Commuting in Major Cities in China", the average commute distance in Beijing is 2–3 km longer than that in Shanghai, Shenzhen, and Guangzhou. The proportion of satisfied commute trips (≤ 5 km) is only 38%, which was much lower than the proportion of 57% in Shenzhen (see Table 1). Residents who chose public transit and had a commute time less than 45 minutes accounted for only 32% of the population in Beijing, which was much lower than Shenzhen and Guangzhou (both above 50%). The capacity of Beijing's public transportation services needs improvements to adapt to the city's employment and housing distribution.

Table1 Comparison of travel characteristics in megacities

City	Average commute distance /km	Commuter proportion (≤5 km)/%	45 min public transportation services capacity/%
Beijing	11. 1	38	32
Shanghai	9. 1	48	39
Guangzhou	8. 7	51	50
Shenzhen	8. 1	57	57
Average	9. 3	49	45

Source: 2020 National Assessment Report of Commute in Major Cities.

1.4 The proportion of bus transit trips continues to decline.

The preliminary results of Beijing's 2020 urban examination have suggested that urban transit passengers volume in 2019 was 7.13 billion and 1.3% higher than the 2018 level. The rail transit passengers volume was 3.96 billion and the bus passengers volume was 3.17 billion. The share of public transportation in commute trips increased from 40.2% in 2015 to 41.7% in 2019 (see Fig. 4). However, bus transit trips and passengers volume decreased over years and the proportion of bus commute trips decreased from 18.7% in 2015 to 16.8% in 2019.

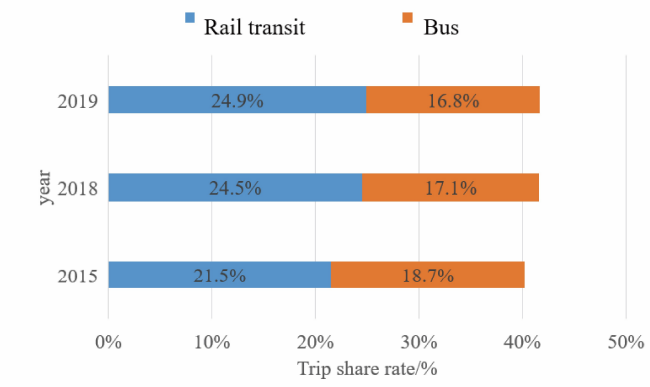

Fig. 4 Changes of public transportation mode share

With respect to the population served by public transit, about 6.1 million people use the services on weekdays; 4.28 million people (70% of the population) travel by bus, including 1.25 million people making bus-rail transit trips (see Fig. 5). Therefore, bus transit still serves the majority of travelers.

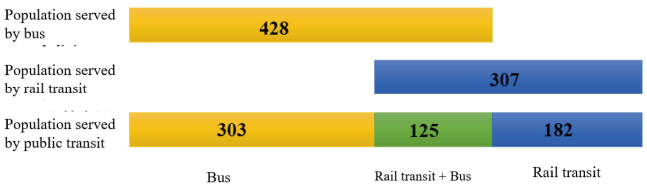

Fig. 5 Population served by public transportation

Source: Estimates based on 2018 IC card data.

1.5 Improving the traffic environment is a long-term task

Beijing has the world's longest non-motorized lanes, but the non-motorized vehicle travel environment is poor. According to the 2015 Beijing Walking and Biking System Plan survey, 56% of the non-motorized lanes within the Fifth Ring Road are occupied by motor vehicles parking (1,375 km); the effective widths of 75% and 50% of the non-motorized lanes are less than 2.5 m and 1.5 m, respectively (see Fig. 6). The 2020 Annual Report of Beijing's Transportation Development also indicated that the proportion of non-motorized vehicle trips dropped by 0.4% from 2017 to 2018, but rebounded in 2019.

In Beijing's 13th Five-Year Plan Outline for National Economic and Social Development, released in 2016, a non-motorized lane system with a complete network of 3,200 km was proposed to be developed in the area within the Fifth Ring Road; this system was expected to promote the connection of non-motorized traffic, pedestrian traffic, and public transportation. From 2016 to 2019, a total of 2,836 km of pedestrian and non-motorized lanes completed substantial maintenance (see Fig. 7). The pedestrian and non-motor vehicle traffic environment continues to improve with effective management of on-road parking, but addressing further improvement needs remains a challenging task.

2.1 New requirements of land use planning

1) Changes in the planning scope

The original urban planning focuses on the planning of construction land within the urban development boundary, with a lack of overall planning for non-construction space. In contrast, the new type of land space planning concentrates on the overall planning scope with the whole area and all spatial elements. The land space planning system consolidates urban areas, agricultural land use, and ecological environment as a whole; the system also coordinates the ecological red line, the permanent protection of basic farmland red line, and the urban development boundary to support the adjustment of economic structure, planning of urban development, and promotion of urbanization. The planning scope is expected to highlight the ecological and agricultural space outside of the development boundary and balance the requirements of ecological protection and urban development.

a. Non-motorized roadways used by motor vehicles

b. Lane width of non-motorized roadways

Fig. 6 Construction and management of non-motorized lanes

Source: Beijing Walking and Biking System Plan.

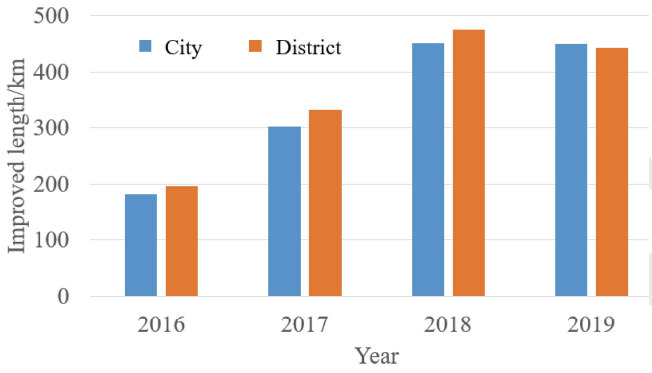

Fig. 7 Non-motorized traffic environmental management length

Source: Preliminary results from the 2019 Beijing City Examination Report.

2 Challenges and opportunities of urban transportation examination under the new situation

2) The new planning system is conducive to the consolidated master plan

The overlapping and conflicting contents of land use planning and urban space planning, as well as the complicated approval process, are critical factors that restrict the planning implementation. In different locations, the original planning at various levels involves many issues, such as inconsistent database standards, changing data structures, and unbalanced data quality levels; with these issues, spatial contradictions and problems of various types of planning are not easily discovered. Land space planning integrates the planning of major functional zones, land use planning, urban planning, and other spatial plans to achieve the consolidation in one master plan. Through the establishment of a basic information platform, various spatial data are consolidated to form the "One Map" for national land space planning. Such consolidation enforces the consistency of planning, strengthens the role of land spatial planning on guiding and constraining various special plans, solves the spatial governance and development issues, promotes scientific planning mechanism, and ensures effective supervision and implementation of the planning process.

3) Improve approval process and strengthen supervision in planning.

The Guidelines divides the system of land space planning into four sub-systems: the system of planning compilation and approval, the system of planning implementation supervision, the system of regulations and policies, and the system of technical standards. The classification of the four sub-systems aims at improving the procedure of planning approval; in addition, it is helpful to enhance the supervision of the planning implementation and improve the planning efficiency.

2.2 New requirements for urban transportation examination in Beijing

1) Focus on the control of the whole implementation process.

The mid-term and final implementation evaluations of Beijing City Master Plan (2004–2020) were carried out in 2010 and 2014, respectively. The mid-term evaluation report supported the compilation of Beijing's "13th Five-Year Plan" [6]; the final evaluation set a foundation for the compilation of the new master plan. In general, previous evaluations focused

on the outcomes of the planning implementation. As a new approach for the master planning implementation evaluation, the city's examination concentrate on the control of the planning implementation process. Government decision-making can be performed on the basis of refined control of the implementation process and dynamic adjustment of construction plans and objectives, so as to meet the planning goals and implement the contents in the Master Plan.

2) Focus on the implementation of the entire city area.

One of the most important characteristics of land space planning is the transition of planning scope from the planning of construction land within the urban development boundary to the planning of the entire area with all spatial elements. The corresponding city examination also needs to assess and justify the implementation of the planning in non-centralized construction areas. Analysis and assessment of the planning implementation are much needed in towns, villages, and arranged ecological spaces, as well as city core areas, central urban areas, and new development areas. The scope of the assessment should be consistent with the scope of the national land space planning.

3) Focus on the complete cycle of transportation system.

The Master Plan in the new development era serves as a statutory blueprint and a policy program; as a result, its evaluation must be designed as an overall "city examination" instead of a simple "planning examination"[7]. The establishment of a "five levels, three types, and four systems" structure for land space planning also requires solid management of the complete cycle of the transportation system, addressing the effectiveness and issues of policies, planning, construction, operation, management, and other system components.

3 Best Practices of Beijing's transportation examination

3.1 Organizational mode of city examination

Beijing's city examination includes a self-assessment and a third-party assessment (see Fig. 8) to ensure the transparency and fairness of evaluation results. The self-assessment is jointly led by Beijing Municipal Bureau of Statistics and Beijing Municipal Commission of Urban Planning and Natural Resources. All departments and district governments perform self-assessment following specific requirements. The results of city examination are also used as important basis for performance evaluation of all departments, district governments and leading teams [7]. The third-party assessment is initiated by relevant functional departments, who need to select and delegate a third-party technical team to carry out thematic evaluation work and enhance public participation. Through the citywide residents' satisfaction survey and investigation in certain streets and communities, public comments are collected and consensus from all parties are reflected in the city examination report [8].

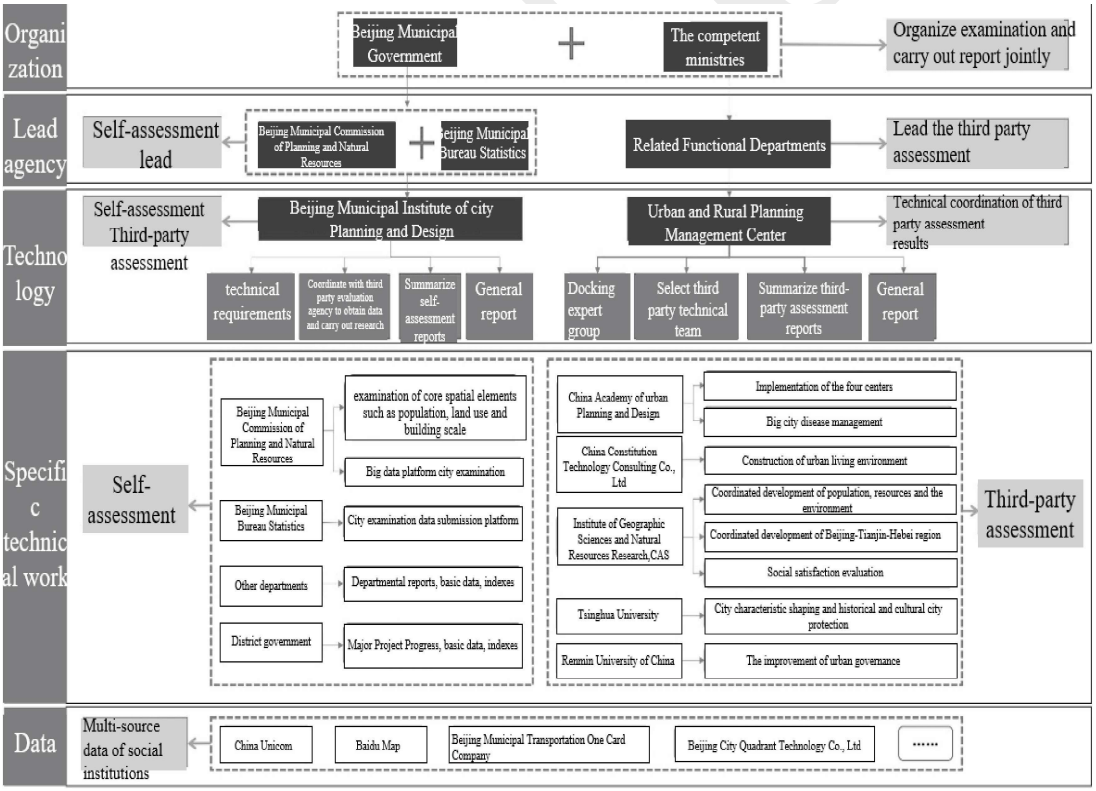

Fig. 8 Organization structure of examination in Beijing in 2017

Source: Literature [8].

From 2017 to 2019, Beijing's city examination had been implemented and enhanced with the mode of a combined self-assessment and third-party assessment. The scope and contents of the self-assessment were consistently adjusted according to the examination results from the previous year; the third-party assessment team and the assessment contents were also improved. The two types of assessments were complementary to each other and promoted the multiple-level city governance.

3.2 Exploration of transportation examination contents

Beijing's city examination has been developed as a framework with core contents monitoring, specially focused assessment, and annual conclusive suggestions. The core contents include a table, a figure, a list, a survey, and a platform, which reflect a table of comprehensive quantitative indices, a figure of complete spatial development review, a list of implementation tasks, a survey of residents' satisfaction, and a platform of data correction from multiple sources [8].

Urban transportation examination needs to continuously monitor the core index of traffic system, including rail travel mileage, road network mileage, railway operation mileage, land use for transportation infrastructure, roadway network density, roadway planning and implementation proportion, central city bus-lane mileage, passenger cars travel proportion and reduction of average travel strength, proportion of green travel, and proportion of non-motorized travel, etc. In addition to the assessment indices of traffic facilities construction, other indices are also used to expand the assessment to the system operation and transportation-city coordination, including population and employment coverage within 800 m of rail transit stations, proportion of new projects near rail transit stations, 500 m coverage of bus stops, average speed of buses and cars, proportion of non-motorized vehicle lanes meeting width standard, congestion index, commute distance, and proportion of population commuting within 45 minutes, etc. Through multiple indices cross-analysis, an in-depth assessment of the changing trends can be performed in traffic congestion, transportation-city coordination, public transportation development, and the quality of travel. Such assessment can be used to summarize the current development achievements and issues, and support proposal of a list of priority tasks for the coming year.

Based on the combination of self-assessment and third-party assessment, the contents of urban transportation examination are reflected in the core contents of city examination (see Fig. 9) as a complete cycle of the transportation system. Outcomes of the transportation policies implementation are evaluated for some measures, such as the regulation of non-local passenger cars and the construction of suburban railways. A range of transportation infrastructure construction is also assessed from the perspective of transportation planning and implementation. With respect to transportation system operation, passenger volumes and travel speed of various transportation modes are evaluated; non-motorized traffic environment management and on-road parking management are also assessed. The proportion of green travel, the relationship between land release and traffic corridors, and the characteristics of commuting travel are examined to reflect multi-system coordination. Through the big data platform of city examination and the thematic evaluation of transportation, a comprehensive and clear understanding of the relationship between transportation and cities can be achieved.

3.3 Suggestions on future work

1) Continuous monitoring of the transportation system with multi-source data

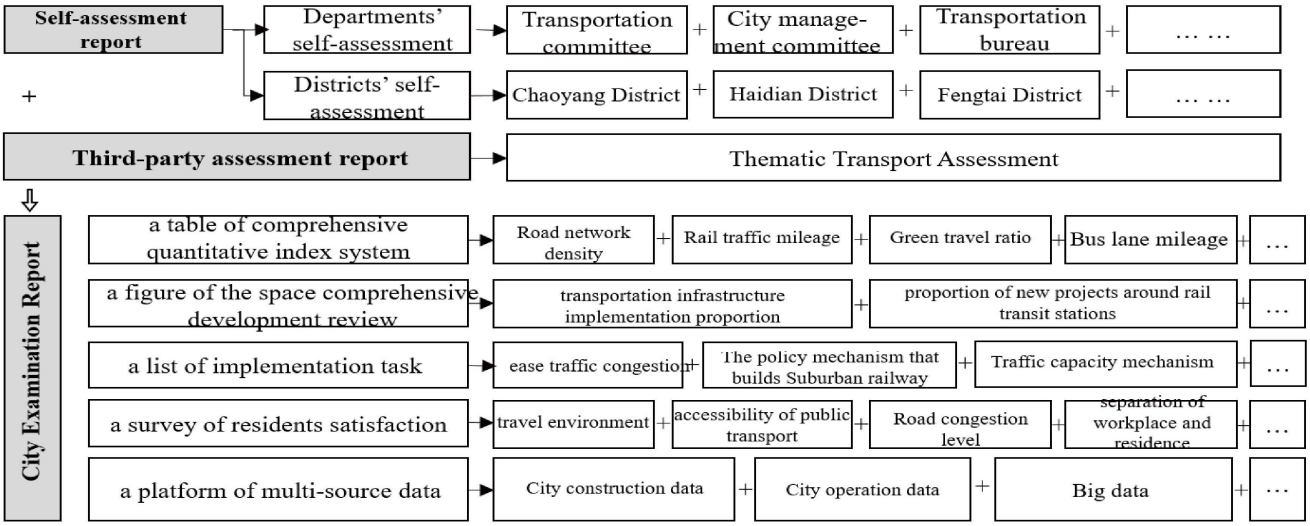

Fig. 9 Examination of urban transportation development in Beijing

Most of the core indices for the annual examination of the transportation system are provided by relevant departments and districts; these indices typically include roadway operation status, improvements of pedestrian and non-motorized lanes, the travel intensity of passenger cars, and the proportion of green travel, etc. Multi-source data, such as IC card data, online car-hailing data, shared bike data, mobile phone signaling data, navigation map data, and urban construction data should be used for cross-analysis. Subjective and objective analyses should be conducted to check against each other, so as to achieve fairness in urban traffic examination results. At the same time, the annual multi-source data acquisition channels and calculation methods should be stabilized to achieve the data continuity and improve the reliability of results.

2) Combination of fixed mode and optional mode

The contents of urban transportation examination should be organized into a combination of fixed mode and optional mode. In the fixed mode, the examination contents, data sources, and evaluation criteria should closely follow procedure, remain easy to operate, and reflect a clear evaluation direction. The optional mode is an important way to promote index innovation and technology innovation. Through the accumulative annual examination experience and the change of urban construction focus, the transportation system itself and the characteristics of transportation-city interaction can be assessed in detail. Each year certain problems can be effectively reflected after specially focused examination. Some well-developed analysis contents in the optional mode can be gradually incorporated into the fixed mode.

3) Combination of objective evaluation and subjective perception

Transportation system is one that involves all participants in the city. Therefore, urban examination should not be limited to the evaluation of city managers' work. It's necessary to investigate and analyze the experience of urban participants. The 2017 Social Satisfaction Survey is a good example. In addition to using various data to assess the construction and operation effects of the transportation system, the satisfaction of using the transportation system is evaluated based on the perception of participants themselves. For example, despite mitigated traffic congestion as shown in data, further control work is still required if participants' satisfaction did not have improvements. Any analyses and the associated transportation strategies should be developed based on a combination of the objective evaluation and the users' subjective perception.

4 Conclusion

The establishment of a national land space planning system involves a range of new requirements in transportation planning and introduces an opportunity for technology upgrade as well as planning system assessment. The proactive examination of transportation planning can effectively support evaluation of construction, operation and management of the current traffic system, and further ensure a long-term systematic monitoring of urban transportation. Through the examination, we can fully understand the current problems of urban traffic system and the planning implementation status. Such examination can help build a foundation for the government to make reasonable and precise policies, making contribution to a high-quality and sustainable city development.

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