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Mass Transit Development Strategy of Chinese Satellite Cities

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Abstract: Because of the expansion of satellite cities in China along with rapid urbanization, various urban problems occur especially when it comes to transportation. Transit priority is the only way to relieve urban transportation problems in China and achieve the sustainable development of urban transportation as well as "the first working procedure of the social production". However, the construction of urban transit system in China has now been lagged behind which is significantly disadvantaged compared to private cars and electrical bicycles. Both hardware and software of mass transit are in need of improvement. This study analyzes the status and priority of mass transit to solve urban traffic congestion and thus provides a valuable reference and a new way for the renewal of satellite cities in China, especially for developing cities in the transition period.

Key words: Mass transit, urban transportation, priority of mass transit, satellite cities

INTRODUCTION

Car sales in China have surpassed those of the United States which can be called a nation on wheels. However, the rapid growth of cars is not supported by land in China and global oil resources. So, it has been a common sense that we should develop mass transit system and control irrational growth of private cars. In our work of ensuring and improving people's well-being, it is the top priority to develop mass transit. From the view of historical development, all nations around the world make mass transit as an important support of urban management, urban image and sustainable development. This study aims at studying the need of priority of mass transit after analyzing its status. In China, the rapid development of urbanization, the increasing number of urban people, inadequate expansion of major cities, overdevelopment of urban land and fast addition of cars have brought out some new problems and challenges, such as traffic jams, environment weakening, shortage of urban land and social security etc. (Xu, 1992).

To solve these problems, it is necessary to take measures like preventing the inadequate expansion of megacities and improving urban function system and actively develop satellite cities to optimize urban deployment of land use and achieve harmonious development of the regional economy. To some extent, satellite cities absorb the population and industries from megacities and outer regions and alleviate residential and employment pressure in megacities which is an effective way to use urban land reasonably.

STATUS

While developing satellite cities of megacities in China, such as Shanghai, Beijing, Guangzhou and Wuhan etc, problems of satellite cities are increasingly apparent. The status of mass transit is particularly serious between satellite towns and the central city, affecting the integrated development of cities and towns seriously.

General characteristics: From Fig. 1 and 2, travel time distribution curve shows that daily traveling time has three peaks: Morning, noon and afternoon. The morning rush hour is approximately between 7:00 am and 8:00 am and the afternoon rush hour is approximately between 17:00 pm and 18:00 pm and there are two peaks of noon rush hour which is approximately between 11:00 am and 12:00 am and between 13:00 pm and 14:00 pm on going home for lunch and going to work after lunch break (Li and Yang, 1990). The modal split rate of mass transit is more than 20% in morning and afternoon rush hours. In specific, mass transit has several general characteristics as follows.

Firstly, the one-trip direction is from satellite cities to the central city in the morning peak and from the central city to satellite cities in the afternoon peak. Secondly, modal split only rely on bus and vehicles. For example, urban rail transit is the main way to solve mass transit problems in some cities. Thirdly, traveling time is often very long, because satellite cities are far away from the central city and it would take more than one hour.

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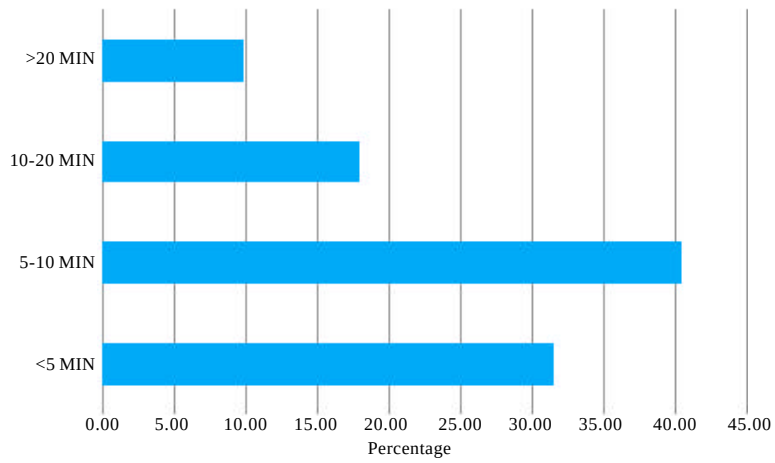

Fig. 1: Traveling time from home or work units to bus stops

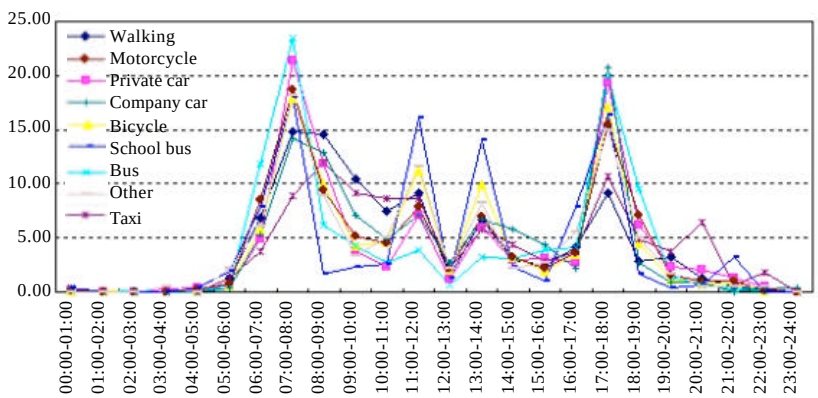

Fig. 2: Trip time distribution of inhabitants

Problems: Mass transit is the main travel mode between satellite cities and the central city but still has some problems.

Firstly, mass transit lacks fundamental facilities. Satellite cities are planned without the consideration of mass transit, for the fact that there is a serious lack of fundamental facilities and multifunction of satellite cities is restricted by the single function of land.

Secondly, mass transit lacks attractivity. The attractivity of mass transit is getting worse because of few bus lines, the long trip time, uncertain timetable and the increasingly serious traffic congestion.

Thirdly, road resources are distributed unevenly. With the aggravation of urban transportation problems, many cities in China make efforts to build exclusive mass transit lanes (Xu, 2006). However, exclusive mass transit lanes have not been widely popularized in satellite cities and can't be the main mode of urban transportation due to the limited road resources.

Fourthly, there is a lack of government support which mainly refers to buildings and subsidies for the public. As of now, no special laws have been issued to establish mass transit facilities during the course of land development. As a result, it is inconvenient for the public to use mass transit for their future trips. Also, the government hasn't adopted a series of favorable policies to encourage the public to use mass transit (Allsop, 2001).

Finally, mass transit lacks of carrying capacity. Because of the incomplete administrative system and legal system, lack of intensified construction and severe traffic jams, buses in satellite cities have several vivid characteristics, including poor punctuality, low reliability, low speed and discomfort etc. As a result, it will fall into the kind of vicious circle where the lack of attractivity of bus, low bus occupancy and bad service quality start to deteriorate. Bus companies in fiscal crisis deteriorate conditions of transit operation.

GOALES AND RECOMMENDATIONS

In the context of urbanized and mechanized high-speed development, mass transit should provide excellent services in terms of speed, punctuality, convenience, comfort and affordability (Henderson, 2003).

Goals: With the rapid development of urbanization and motorization, satellite cities are trying to achieve the goal of rapid and sustained development of economy by developing the mass transit system.

Soon, we will demand to set up an integrated mass transit system which will take bus rapid transit as the backbone, supplemented by minibuses and taxies, information system as the means and take the transfer hub of urban transportation as the connection to compete with private cars (Boarnet, 2011). In the long term, we need to set up an integrated mass transit system which will take the high-speed rail, the metro rail transportation and the bus rapid transit as the backbone, take buses as the main part, take minibuses, taxies and other transportation as a supplement, to guide private cars to transfer to mass transit and put the concept of "neo-city of mass transit and low carbon" into reality in satellite cities.

Recommendations: Firstly, coordinate relations with city layouts, land use and mass transit. It is very important to research on city master layout and characteristics of land use which will be closely integrated with mass transit planning and city master plan and will make the mass transit planning adapt to and promote to develop satellite cities for travel demands of city dwellers. In terms of the needs of mass transit, top consideration should be given to urban road planning and buildings which support the development of mass transit from two aspects, namely compiling and implementing planning. Building plan of bus parking lot, bus origin stations and terminals and bus stops shall be integrated into the planning of roads and urban rail transit. Urban planning department should make advanced planning and detailed arrangement to provide a reliable guarantee for transit stations and hubs and insist on the high-density planning mode to save land. Along with urban road planning and construction, priority should be given to the demand for mass transit development (Penalosa, 2011). For instance, building projects of bus parking lot, bus origin stations and terminals as well as bus stops can be integrated into the planning of city roads and rail transportation for economic restructuring. In addition, we can also lay out a bus bay on the conditional road in both old road rebuilding and new road building. Furthermore, urban planning administration should give a reliable guarantee for the land of transit station infrastructure which is important for insisting on the high-density land development mode and the establishing mode of mass transit.

Fig. 3: Combination of Singapore's transportation hubs as metro and bus

Fig. 4: Combination of Singapore's transportation hubs as bus and walk

Secondly, improve urban transportation structure and prioritize mass transit. With the rapid process of motorization and higher requirements for commuters' travel quality, we must stick to prioritizing mass transit from policies, institutional framework, funds, construction projects, management, services and other aspects in the development of satellite cities. We should use the land for railway construction and integrate passenger transportation hubs and transit stations and hubs into the land transfer without costs list, in order to remit fees for land (Gordon, 2011). It is very important to optimize the percentage of urban passenger transportation and insist that mass transit is the mainstay of passenger traffic structure in our city in the future, such as Singapore as shown in Fig. 3 and 4.

Thirdly, it is necessary to set up a foundation to commence the introductory investment of regional transit hub and metro rail transportation for prior mass transit, to transfer surcharges of municipal public utilities and other infrastructures to mass transit. The land for metro rail transportation, integrated transportation hubs and mass transit stations should include processes for land transfer without costs and reduce land grant fee (Tica *et al*., 2011). Satellite cities should insist on guiding people to travel reasonably by mass transit and forming an urban passenger traffic structure with the main body of public traffic.

Fourthly, reform the operation management of mass transit. At present, satellite cities don't have their own bus operating companies and have to carry out operation management of mass transit by bus operating companies in the central city or other places. By this way, these cities implement appropriate-scale and intensive operation to some extent but still result in wasted resources and decreased service level of mass transit due to excessive unordered competition among enterprises. Therefore, it is necessary to develop mass transit business for public welfare as the premise and adjust existing operation mechanism of bus operating companies for a more open and market-oriented approach.

Fifthly, integrate market-oriented reform of mass transit service with trade management. International experience shows that it is common to have a low availability rate of less than 80%, a low operating kilometer a day by bus and a low ratio of operating revenue total costs, especially for some new lines in order to solve the travel demand of city dwellers. An important part of mass transit planning to compile and implement is to add bus lines according to travel demands of city dwellers which causes rising losses of mass transit over a period of time. To implement mass transit planning and normal operation of bus operating companies, we have to establish a development foundation which has to depend on the whole society and develop mass transit energetically as a strong economic background through various channels.

Finally, improve information management measures of mass transit. The implementation of mass transit planning depends on the operation of bus companies. The management quality is directly related to social and economic benefits for planning implementation (Department of Statistics, 2011). In mass transit planning, the level of mass transit dispatching management shall be enhanced by various advanced technologies, such as building a mass transit operation management information system and the mass transit line network integrating cross-regional dispatching with cross-line passenger flow shall be achieved, in order to increase the overall efficiency of transportation network, emergency capacity and the corridor resource allocation.

CASE STUDY (SHANGHAI JIAO TONG UNIVERSITY, 2011)

As is shown in Fig. 5, Yanjiao, located in the east of Tongzhou District in Beijing, belongs to Langfang City in Hebei Province with superior geographical positions, flourishing economy and convenient transportation. According to Fig. 6 and Table 1, in Yanjiao, every one thousand people own 193 cars in 2009, saying that averagely 100 families own 42 cars. With the sustained development of economy and improvement of urban public infrastructure, the number of private motor vehicles especially cars will increase much more rapidly without various macro-control policies. Through a model of population forecasting, population control at less than 1

Fig. 5: Location of Yanjiao

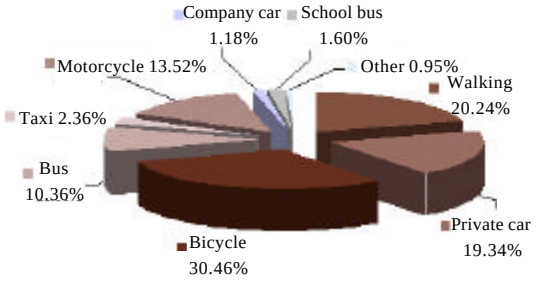

Fig. 6: Modal split of Yanjiao

Table 1: Status of public transport in Yanjiao

Bus Route	Vehicle model	No. of vehicles	Fleets of buses	Frequency interval (min)
No. 930 Bus	Large Bus	49	316	Peak Time: 3, Other Time: 8-10
No. 930 Branch Bus	Large Bus	53	320	Peak Time: 6, Other Time: 10
No. 930 ShuttleBus	Large Bus	23	198	Peak Time: 6, Other Time: 10
No. 930 Special Bus	Large Bus	30	220	Peak Time: 4, Other Time: 10
Yanjiao Bus Line No.1	Midi-Bus	10	65	10-14
Yanjiao Bus Line No.2	Midi-Bus	10	65	10-14
Sanhe Bus Line No.1	Midi-Bus	22	88	10-14
Sanhe Bus Line No.3	Midi-Bus	20	100	8-10
Sum		217		

Table 2: Four levels of public transport line network planning

	Level	Characteristics	Ratio (%)	Passenger carrying capacity per day (Million connts per day)
Backbone public transport	High-Speed Rail and Metro Rail Transport	Great capacity, high speed and pnnctuality	30	24.30
	No. 930 Bus	Long-distance stop spacing, high speed, the departure multi-frequency	25	20.25
Surface Public Transport	Arterial Lines	Use in connecting to rail transportation and rapid bus.	30	24.30
	Branch Lines	Service incorridors of passenger volume, short travelling distance	15	12.15

Fig. 7: Crowded passenger at the No. 930 bus station

million people, Yanjiao construction land control at less than 100 km, mass transit will become an important factor to drive the development by 2030. Meanwhile, due to dramatically increased amount of cars and the retarded construction of urban transit facilities, traffic jams have already taken place in Yanjiao's downtown.

As is shown in Fig. 7, although there are a lot of sound strategies in hand for transit priority, Yanjiao is in urgent need of priority to develop urban transit and form transit cultures.

Planning targets: We will set up a multimodal and integrated mass transit system which will take the high-speed rail, the metro rail transportation and the No. 930 bus as the backbone and guide private cars to transfer to mass transit and keep the mass transit in a dominant position in comprehensive passenger transportation system. According to development goals of mass transit, over 50 percent of daily travels will rely on mass transit in Yanjiao by 2030.

Planning principles: According to the principle of sustainable development, the planning should control urban construction, limit wasteful sprawl, gradually change the individual-oriented transportation development mode, ensure the land for stations and transit hubs, improve line network density and stop service ratio and expand mass transit services.

Public transport line network planning: According to integrated mass transit mode of Yanjiao, the mass transit line network can be divided into four levels: The high-speed rail and metro rail transportation, No. 930 bus, arterial lines and branch lines, as shown in Table 2 and Fig. 8.

Compared with road traffic, high-speed rail and metro rail transportation have many advantages, such as great capacity, high speed, punctuality, security and comfort. Rail transportation is the major traffic corridor covering the city with the main objective of leading directly to Beijing and Sanhe which is the core of mass transit network.

Number 930 Bus is a means of transportation between rail transportation and bus to expand the coverage of mass transit backbone network and improve service quality of mass transit which can take Bus Rapid Transit (BRT) into consideration.

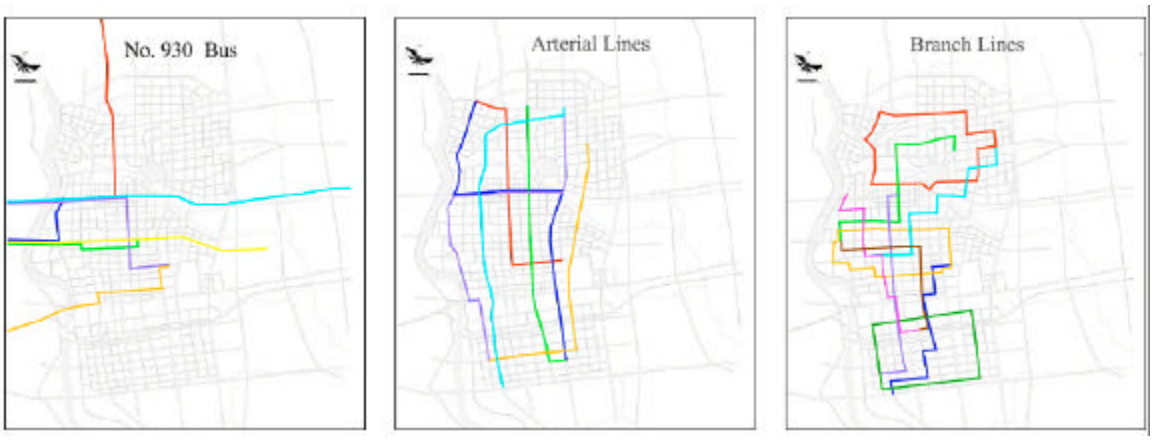

Fig. 8: Public transport line network planning in Yanjiao

As a major mass transit in Yanjiao, Arterial Lines serve for areas which can't be covered by rail transportation or No. 930 bus and connect all kinds of convenient transportation in the meantime including rail transportation and the No. 930 bus.

Branch Lines mainly provide services for internal districts in some low-demand areas for the secondary corridors of passenger volume based on secondary roads and slip roads.

CONCLUSION

This study studies the necessity of mass transit and puts forward the construction of mass transit in satellite cities when facing a huge number of cars and increasingly serious traffic jams. According to actual conditions of satellite cities, measures should be taken to enhance the competitiveness of mass transit, such as optimizing mass transit network, upgrading the level of public services, limiting the development of motorcycles and private cars to make mass transit a leading factor in city development. According to analysis, a conclusion could be reached that China's small and medium-sized cities should break the old way of thinking according to their actual conditions, improve the competitiveness of urban transit in terms of the level of service and details of the construction area, in order to limit the number of motorcycles, private cars and other kinds of private traffic and to reduce illegal taxies for development, so that urban transit could be the dominant factor in urban development to ensure the implementation of short-term urban transit planning.

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