ROLE OF TRANSIT PRIORITY IN CITY DEVELOPMENT

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abstract: Chinese city development has made outstanding achievements in the past twenty years. Yet many big cities have met serious traffic congestion. How to profoundly realise the varying trend of urban transport to correctly establish policies has become heat topics in China. In the paper based on the hundred year evolution of transport in would main cities, existing characteristics of transport in Chinese cities are analysed and the viewpoint transit priority is main melody of rational development of a city is put forward and discussed in depth for promoting the healthy development of Chinese cities.

1. INTRODUCTION

In the course of entering urbanization for twenty years, Chinese cities have been developing rapidly. Population grew dramatically and areas doubly expanded, which pushes forward the modernization of society and economy.

Yet, transportation problems have always been pestering large and medium size cities. On the one hand, roads and bridges have been constructed more and more. Motorized vehicles increase greatly. On the other hand, traffic congestion and pollution of emission get more and more serious. So how to solve transport problems has been heat topics of the society.

"Chinese National Code for Urban Transport Planning" was promulgated under such conditions in 1995. The purpose is to guide transport development in Chinese cities by means of legal documents. The contents cover each aspect of public transport, bicycles, walking, highways and parking lots.

Having participated in working out "The Code", the author of the paper has the responsibility to introduce its key theory and viewpoint: "Transit priority is the main melody of city development".

Hoping to promote the healthy development of Chinese cities, the paper first discusses several theoretical matters of transit priority based on the hundred year evolution of transport in world cities and then proves the important leading role of transit priority in city development by using some cities especially Shanghai as cases .

2. TRANSIT PRIORITY AHEAD OF CITY DEVELOPMENT

2.1 Objective Regularity of Urban Transport Evolution

The evolution of urban transport, just like any other things, follows certain objective regularity. To expose the regularity hidden behind the complicated phenomena is of great importance for making urban transport planning and countermeasures.

(1) Urban Space and Transport System Depend upon Each Other

The size of urban space, layout of urban structure and style of urban life all depend on the nature and service quality of urban transport system. Because transport itself is a part of the city and transport facility occupies as high as 20-40% urban areas. Transportation link with all urban activity palces. For example: The life style of Los Angelos is decided by its express highway; The life style of London is decided by its 19th century railway; In Manhattan there is a forest of skyscrapers facilitated by the dense metro of New York; And the modern industrial region around Boston is produced by its express ring road.

Surely certain transport system can only form its own characteristics in a specific urban space. For instance: Without Los Angelos' 20 thousand km2 there is no possibility for building express highway; The high dense empolyment distribution of Manhattan only allows multi-transferring metro system to build underground, so 85% traffic flow into and out of Manhattan uses metro system.

(2) Environmental Quality and Transport System Condition Each Other

The concept of modern urban environment was originated from urban transport. Later it broadly indicated other affairs in urban and rural areas. Yet, environment and transport have most close relationship. The control of the overuse of automobiles is mainly due to environment. By the 1960's, the abrupt growth of automobiles seriously affected environment and arose world wide protest, for automobiles brought about 2/3 of air pollution. Severe air pollution is harmful to human beings both physiologically and psychologically. Many doctors in America explain that the fog made by emission of automobiles induce dying young and also a lot of of disease. It is estimated that the economic costs of air pollution in America exceeds 10 billion U.S. dollars anually. Hence, the government of all levels works out laws to strictly control automobiles and the construction of express highways. This is the main reason that the automobiles in developed countries have increased slowly in recent 20 years.

(3) Mutual Promotion of Economic Level and Transport System

The economic level of a city has close relationship with the quality of transport system. It is not only the origion of the generation of transport demand, but also the motive power pushing forward transport supply. Economic prosperity promotes transport development and

in turn advanced transport system accelerates the great jump of urban economy. The former Japanese prime minister once said:" The growth of GNP is in proportion to the growth of traffic volume and trip disdance.".

The technique of transport system that matches economic level is a whole part of indicators composed of vehicle speed, punctuality, safty, comfort, environmental quality and so on. Hence, the viewpoint that economic flourishing should be automobile popularity is quite mistaken. France once made a policy that in Paris everything should give priority to automobiles. This policy came to a failure in two years, then Paris had to give priority to the development of rail system.

A citizen with certain amount of income may purchase an automobile. But his driving times may be reduced due to a lot of restriction. Many car owners may turn to public transit when it is more convenient. The choice of transport means all depend on the quality of transport system. Yet, the quality of transport supply is wholly decided by the urban economic level. This is the essential reason that several hundred metro systems in the world mostly distribute in the cities of a few developed countries. No doubt, the economic benefit produced by so developed metro system has far surpassed the original investment. Since 1950's, Toranto of Canada that has depended on metro to recover economy is a typical example.

(4) Resource Consumption and Transport System Transform Mutually

To form a transport system needs a lots of resource, including the occupation of land, construction material, energy consumption and financial capacity and man power, etc. Yet the formed transport system itself may reproduce resources for the utility of a city. The circle gradually rises to a higher level and thus reach an appropriate extent. Any over consumption of resources might encounter the penalty of the reality.

The automobile transport system needs building express highway and parking lots, and consuming gasoline. It also pollutes air and worsens living environment. For instance: Los Angelos uses 2/3 land constructing roads and parking lots. The population of America accounts for 1/30 of the world, but its gasoline consuming of automobiles takes up 1/3 of the world. Every year more than 300 thousand people die of traffic accident over the world. In the 1990's, the resources consumed by automobiles in the world excedes normality.

So America has to change its policy to prop up and develop public transport system first, for it consumes less resources but possesses greater benefit. Comparing public transport with automobile in terms of same quality carrying same amount of passergers, the former saves 3/4 land resource, 4/5 construction material, 6/5 investment and reduce 9/10 air pollution and 99/100 traffic accidents. Being an automobile kingdom, America has been successively building metro and light rail in the cities ever since the 1960's in order to reverse the overuse of automobiles. This is really a wise action, for it observes the objective regularity.

2.2 Practical Countermeasures for Development of Urban Transport

Based on the understanding of urban transport regularity, combined with practical conditions, each country works out many transport countermeasures. They may be classified into three categaries:

(1) Consistently Giving Priority to Development of Public Transport

Almost all countries firmly choose the policy of giving priority to the development of public transportation after undergoing pains and tortuosity. So they have accumulated a wealth of experience. The main points are as follows:

- First investing transit facility projects. Most rail systems in America have been built since "Transit Law" was promulgated in 1962. The countries in Europe were also lifted out of congestion of automobiles in the 1960's and turned to reform and build rail system.

- Transit vehicles passing through first. On urban network, exclusive roads are built and special purpose signal lights are set up for transit vehicles passing through first. The developed countries have accumulated experience in transit priority to use roads for over 30 years.

- Defining land for public transport. Since on average transit passengers occupy land for roads and parking lots most economically, many countries plan land for transit in priority. Transit stops and buldings are usually built into one so that they might provide great convenience for passengers.

- Giving Priority to the development of new transit technique. Developed countires pay attention to absorbing high and new technology into transit system. Fully automatic express rail system have all brought forth in these 10 to 20 years.

(2) Properly Developing Automobile Transportation

Private cars become more and more popular due to its advantages of fast speed, comfort and convenience. Most metropolitan cities might result from traffic motorization. So the historical contribution of automobiles should not be neglected. Yet going too far is as bad as not going far enough. The excessive growth of automobiles has resulted in serious consequences. The wise countermeasure is to develop automobiles appropriately and at the right moment.

- Automobiles should be developed appropriately under the condition that the original superiority of public transportation has been preserved. The city of London, in which powerful transit system (mainly rail) was built defore the automobile era, only allows automobiles to be popularly used in suburban areas. In the city proper, only 15% workers are permitted to drive private cars to go to work. In the 27 km2 city core of London,

there are 1.2 million employees, 130 thousand parking berths and 200 thouand residents. The car ownership totals 650 thousand. But the employees driving cars to go for work only amounts to 130 thousand. If 1.2 million employees all go to work by private cars, then the area of the parking lots is equal to the whole area of the city proper itself. If 1/3, i.e. 400 thousand employees go to work by private cars, then there need 40 highways with 8 lanes. Of cources all the above are impractical. Several decades experience of London shows that its policy of developing automobiles properly is quite successful and has instructive meaning.

- Automobile transportation increases properly under the condition that its development keeps balance with public transportation. Many big cities that came into being with traffic motorization need both public transportation and private cars to develop simultaneously and to supplement each other. Chicago adopted this policy and has won success. In the suburban areas, automoiles drive freely just like Los Angelos and Detroit. Yet in the urban area, i.e. within the inner ring road, the speed of buses and automobiles are nearly the same. And in the city proper, 85% employees go to work by bus.

- Automobiles are fully developed under the condition that the developing potentiality of public transportation is retained. A few cities in the world have a brilliant history of expanding automobiles fully for 30 to 40 years. But the margin for developing public transport has been left. The typical automobile kingdom, Los Angelos recovered transit after 1960's by building rail systems, for developing automobiles unrestrainedly on the earth which has limited resources and space is irrational.

(3) Focusing on Construction of Comprehensive Transferring Hubs

To let public transportation and private automobiles give full play to thier own advantages respectively and form join forces producing much more benefit, the crux is building transport hubs for mutual transferring. When public transportation rivived after 1960's, its friendly competition and mutual compensation and benefit with automobiles were noticed. So many hubs for transferring transit and automobiles appeared. High-level hubs include finane, commerce, consulting and transportation. While transferring, passengers might go shopping, have entertainment and do business. So traffic volume is greatly reduced. Meanwhile, land development and economy prosperity surrounding the hubs are pushed forward. The comprehensive transferring system of New York works like this.

3. TRANSIT IS MAIN TASK OF TRANSPORT PIANNING

3.1 Public Transportation Should Be in Dominant Position

Public Transportation planning must determine the position of public transportation in the whole transport system and its relationship with other traffic modes. Whether public transport is developed in priority and whether its development level reaches planning objective, these

questions must be answered by the varying proportion of public transport. The change of the urban transport in China in recent 20 years shows that the situation is rather grim. For example: The proportion of transit and bicycle was 2:8 in Tianjin in early 1980's, but reduced to 1:9 in the 1990's. The proportion of transit and bicycle was 5:5 in Beijing in the 1980's, but in the 1990's, the transit volume droppd, so the proportion came down. The proportion of Shanghai was 7:3 in early 1980's, 6:4 in late 1980's, and decline to 4:6 in the 1990's. The conditions of other big cities are similar.

Table 1. Percentage (%) of Urban Area Person Trip Modes for Shanghai

Year	Walking	Transit	Passenger Vehicle	Taxi	Motorcycle	Bike	Others	Total
1986	36.6	35.2	2.41	0.2	0.08	24.9	0.6	100
1995	36.5	22.9*	3.1	1.5	1.4	34.4**	0.2	100

* Including metro.
** Including moped.

The protruding contradiction is that the construction of roads is quickened while the level of transit service goes down. So the market of private transport is even more expanded. This practical contradiction faced by public transportation planning can only depend on the policy of giving priorty to the development of public transportation and a series of corresponding measures.

Table 2. Road Transport Facilities in Shanghai

Year	1985	1990	1995
Road Length (km)	3300	4700	5400
Road Area Per Capita (m2/person)	-	4.5	5.7
Road Capacity (10,000 vehicle km/h)	200	-	400
Vehicle Flow (10,000 vehicle km/day)	1400	-	2000
Motorized Vehicle (10,000)	14	21	42
Bicycle (10,000)	370	545	750

3.2 Selection of Transit Modes Should Base on Time Reduction

It is stipulated in "The Code" that during peak hours when 95% residents adopt transit, maximun one-way trip time in the city with a population of over 2 million people should not exceed 60 minutes; In medium size cities should not exceed 35 minutes; In small size cities should not exceed 25 minutes.

According to this goal, transit means need to be appropriately chosen. Transit means based on the characteristics of speed and capacity are divided into slow speed buses and trolley buses with small capacity, moderate speed light rail or busway transit system with medium

capacity and mass rapid metro system with high capacity. Since mass rapid rail system is high in investment, long in construction and the shrinkage of public passenger transport market exacerbates, public transportation planning is forced to search for new practical strategy. In recent 20 to 30 years, busway transit system, which is compatible with rail and buses, has suddenly come to the fore and deserves to be seriously studied in the field of Chinese urban transport planning.

Table 3. Passenger Trips Undertaken by Different Transit Modes in Shanghai

Year / Mode	1986	1992	1995
	Daily Transport Volume	Daily Transport Volume	Daily Transport Volume
	(10,000 Person times)		
Urban Area Bus &trolley-bus	1223	1015	696
Shuttle Bus	-	14	104
Metro	-	-	23
Long Distance Suburban Bus	-	84	66

3.3 Priority of Public Transportation Projects

From buses to modern metro and light rail, piblic transport has evolved into an independant existing and exclusive system and has become large family in transport facilities. How to quickly start making the priority of modern transit projects has become the substantive task of urban transport planning. The priority of transport projects should base on detail quantitative calculation and evaluation. The object of traffic demand forecast and analysis is person flow rather than vehicle flow. Public transport is superior to any other private transport means due to its high capacity and saving of road space. Hence, a transport planning whose principle is "carrying people" may easily be listed in projects.

4. COMPREHENSIVELY FOSTERING TRANSIT DEVELOPMENT

4.1 Optimizing Transit Network

Once transit model is decided, route network is the indicate to measure service level. It is the important prerequisite and decisive factor for passengers to turn to transit. By making network analysis and calculation of 15 million ridership daily on average in Shanghai, 40 km mass rapid metro can only carry 20%, i.e. 3 million ridership; 200 km semi-rapid peak hour routes operating all day may carry 50%, i.e. 7.5 million ridership; And 1000 km regular transit routes may carry 100%, i.e. 15 million ridership. The result output by tested and verified

computer model vividly shows that only when the network reaches certain scale can transport modes gain maximum benefit.

The key points of optimizing transit network are as follows:

- When the density of route network is 3~4km/km2, the sum total of both passengers' walking and dwelling time is the shortest. So the operating cost of transit enterprise is lower.

- Arterial and sub-arterial routes should be distinguished by passenger flow. The space of arterial transit routes should be intensified. The maximum operating space of sub-arterial routes should be restrained. So transit enterprise may provide high capacity with minimum cost.

- The distribution of transfer station in the network should ensure that all private and public transportation can transfer in 3 mimutes or in a range of 100 metres.

- The nonlinear factor should be controlled within 1.4 so as to save time for most passengers and meanwhile the operation cost of transit enterprise is reduced.

- In one trip the transit transfer factor of most passengers less than 1.5 is assured. This is the final result of the four above-mentioned measures. If this result cannot be reached, then more improvement should be done.

4.2 Optimum Seeking of Transit Stations

(1) Scale of Station Should Be Rational

The station levels depending on passenger flow should be appropriately decided. Generally they might be divided into mono-route stations, multi-routes stations, terminals and multi-modes transferring hubs. The land use of stations should be both economical and effective.

(2) Station Space Should be Moderate

Transit station space is mainly determined by the nature of the surrounding land use. It is stipulated in "The Code" that the region with a station service radius of 300 metres should reach 50%, and the region with that of 500 metres reach 90%. This means that most people may arrive at transit station within 10 minutes. Most service radius of transit stations in Hong Kong are with 300 metres. Hence, the powerful attraction rate of public transportation is maintained.

(3) Station Locations Should Be Appropriate

Whether transit stations lacate on both sides when two directions meet, or in the opposite direction when approaching to intersections, or in alternation when multi-routes with same direction, or in the buildings being close to activity area, all should be based on the principle of being convenient to passengers and favourable to vehicle driving. And also the relative stable garages should be built. According to this principle it is meaningful to select proper criteria to adjust the existing location of stations. The passengers in Zhuhai city have increased several times in 3 to 5 years due to the appropriate selection of station location, which makes the transit company become a profit enterprise and takes lead in China.

4.3 Rationally Building Transit Depots

(1) Land Use for Depots Should Be Reserved to Full

Cities with favourable conditions should strive for maximum land use target. Metropolitan cities with great difficulties should also strive to expand land use in suburban areas so as to supplement the insufficience in the city proper.

(2) Depots Utmostly Close to Collecting and Distributing Places

Except that workshops be appropriately arranged in suburban areas, most parking lots, especially small and moderate size parking lots should utmostly close to collecting and distributing places of passanger transport. In the downtown of Hong Kong Island, it is easy to find terminal depots for buses. Some depots may contain 100 or so buses. The lay out of some parking lots in Beijing and Tianjin is fairly good, but still need to be adjusted on the whole.

5. Conclusion

Public transport, which takes a dominant and leading position in city development, should be given priority to be developed. Many corresponding countermeasures for its implementation in the field of urban planning have been guaranteed in the newly released "Chinese National Code for Urban Transport Planning". So we believe so long as transport planners seriously and flexibly observe the planning regulations urban public transport in China will surely have a bright future.