

## Research on Solutions for Urban Traffic Congestion

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**Abstract:** in recent years, the conflicts between urban traffic supply and demands have been getting more and more serious. It is known that today, urban traffic congestion is getting more and more severe, which has greatly affected residents' regular travel and made the environment pollution worse. So far, urban traffic congestion has become a key factor adversely affecting the social development and economic development in cities. In this thesis, it analyzes traffic congestion in cities and the current situation of traffic congestion, as well as the reasons, influences and roots. Then on the basis of the analysis (about the situation in China) and the successful experience of easing traffic congestion in foreign countries, the thesis proposes some measures which are proper for China to solve the problems related to traffic congestion.

### Introduction

We all know that the invention of autos has greatly changed peoples' life, which provide us with convenience and enjoyment. However, since more and more people are widely using autos, traffic congestion has been resulted in, which is a bottleneck difficult to be overcome during the urban modernization. This is the situation being suffered by China. Nowadays, more and more cities are stepping into a stage of auto society, lots of big and medium sized cities are facing an era of traffic congestion. In fact, traffic congestion has become a hot topic and challenge being faced by governments and functional departments. Under this background, it is important and emergent to study traffic congestion and to find out proper measures to solve the problems related to traffic congestion. In order to ease the traffic congestion and improve people's life, some measures have been taken to solve the traffic congestion in different countries and regions, which have made some achievements. However, there is still a long way to go. Therefore, it is not only needed to analyze the reasons resulting in traffic congestion and learn experience in easing traffic congestion from foreign countries, but also to find out a way which is suitable for China to solve problems related to traffic congestion.

Taylor, in the view of economics, tried to find out the reasons of traffic congestion. McKnight thinks that limiting the procurement and use of private cars are the only two ways used to ease traffic congestion. Up to now, regarding the theoretical development linking with easing traffic congestion, there has been three stages: (1) strength the construction of infrastructure for urban traffic, which is able to satisfy the continuously-increased travel demands; (2) traffic system management; (3) management on travel demands. Actually, all the measures taken in the three stages were fully based on the urban traffic system, by which it analyzed that how to ease traffic congestion by improving urban traffic system. We can see that these measures have made some achievements but failed to essentially solve the problems. Now, there are three modes to ease traffic congestion: increase the supply, manage demands and improve systems. In the view of advanced experience in foreign countries, there are only a few proposals which are able to ease the traffic congestion in China.

### 1.Current Situation of Traffic Congestion

In most cities in China, there are some common issues like that population density is too large, the road density is too low and the mixed traffic is serious, which make the traffic congestion in these cities

rather fierce. Here below are the features of urban traffic congestion:

### **1.1 more and more places suffering traffic congestion**

#### **(1) The number of crossing with traffic congestion is being increased.**

For example, in Beijing, the first serious traffic congestion was occurred on around National Day in 1984. At that time, there were 42 crossings suffering traffic congestion where there were more than 10 times (average) to wait for the traffic lights. In 2014, there were 393 crossings where there were more than 10 times (average) to wait for the traffic lights.

#### **(2) The cars are speeding down on arterial roads.**

At present, in most cities in China, the traffic flow of the urban arterial roads is saturated or over saturated. With the continuous increase of traffic flow, some roads have been in saturation for a long time, which makes the traffic congestion more serious. For example, in Three Ring of Beijing, there are 110 arterial roads, of which over 80 roads are suffering saturation or over saturation. Even some roads encounter a situation that there is no traffic jam but a congestion all day long.

**1.2 The time of congestion is getting longer and longer.** In most cities in China, there is a common situation that traffic jam always occurs in the morning and in the afternoon. For most roads, traffic jam in the morning is normally from 7:00 to 9:00; the traffic jam in the afternoon is from 17:00 to 19:00. It can be seen that traffic congestion is getting worse and worse. According to statistics, it is said that the time of traffic jam in the morning is getting earlier and earlier. Now, the traffic jam in the morning is started at 6:00, which will not be ended until 9:30 while the traffic jam in the afternoon is started from 17:00, which will not be ended until 21:30. <sup>1</sup>

## **2.Reasons of Traffic Congestion**

### **2.1 The number of motor vehicles is being increased**

In 2015, the production and procurement of autos in China were both increased. Through the whole year, 24,503,300 vehicles were produced while 24,597,600 were sold, which ranked number one in the world in seven consecutive years and achieved a new record in the history. <sup>2</sup>The rapid growth of vehicles has brought great pressure to the traffic infrastructure and the traffic management. In order to release this kind of pressure, many cities are investing large amounts of funds in improving traffic infrastructure like newly construct viaducts and prolong the subways. However, what the cities were trying hard is not able to keep the pace with the growth of autos' inventory.

### **2.2 Urban planning is flawed**

Actually, urban expansion is suffering a problem that how to well handle the relationship between old city redevelopment and new city construction. When engaging in new city construction, many large cities are constructed into a "dormitory town" where there are lots of residents gathered together. Most residents are far away from the places where they work, in this way, quite lots of residents need to rush to the old city in the morning or backed to their "dormitory town" in the afternoon from the downtown. Besides, some city only attach importance to the arterial roads but the branch roads. In this way, the road network is not so rational because the branch roads are not so smooth and the arterial roads are difficult to be made full use of. Thus, the efforts on easing traffic congestion is not efficient.

## **3.Advanced Modes in Easing Traffic Congestion in the world**

No matter what kind of cities, like the cities (London, Paris and New York etc.) early developed in Europe and America, and cities (Tokyo, Singapore and Hong Kong) later developed in Asia, there was a common problem-- traffic congestion resulted in by economic development and wide use of autos. In

<sup>1</sup> Data source: Beijing Traffic Committee

<sup>2</sup> Data source: China Automotive Industry Association

the process of easing traffic congestion, these cities have got rich experience in easing traffic congestion. After making a conclusion on the modes used by foreign countries to ease traffic congestion, there are three modes listed here below:

**3.1 Increase Supply.** At the early time of stepping into auto society, European countries and American countries emphasized to strengthen the construction of traffic facilities and to increase the traffic capacity of the road network. However, there lands in cities are in bad short, the road supply is not able to satisfy the demands. Under this background, Anthony Downs proposed a scientific law that “travel demands always excess the capacity of traffic supply” in 1962. That is even though new roads lower the time spent on traveling, there is also a new travel demand therefrom. We can see that newly constructed roads will result in new traffic capacity, making the travel demand is more than traffic supply. Then with time goes by, the traffic congestion will be back again.

According to Downs’ law, compared with the congestion before the improvement and the congestion after the improvement, we can see that the newly increased traffic capacity is mainly from: (a) although the service of this road is not obviously enhanced, the other roads become more crowded than before. So the travelers will choose the road where the service is better. That is this road has to share the traffic jam of other places. If there is no such road, the service of road network in this city will become worse. (b) in fact, the increase of traffic flow is led to by the development of social economy. If there is no improvement of this road, the traffic flow passing by will also increase, which will make the traffic congestion worse. After improvement, although it is still crowded, it does not get worse. For the mode “Increase Supply”, it does not mean that the traffic congestion shall be solved only by increasing the number of roads. Thus, this mode is focusing on the rational plan of urban traffic, and the efficient use and provision of traffic management and smart traffic. The core ideology of this mode is to rationally use the roads and land resources.

**3.2 Demand Management.** Since the travel demand always excesses the traffic supply, so how to well control the travel demands is quite important for easing the traffic congestion in cities. Travel Demand Management (hereafter refer to as TDM) is a kind of solution to focus on the management, control and guidance related to occurring source, by which the total travel demand in the city will be lowered down. Therefore, travel demand which is relatively centralized will be decomposed and the travel structure will be adjusted. In this case, the urban traffic system will be operated efficiently and the traffic congestion will be eased. Anyway, the core ideology of this mode is to change the travel method to ease the traffic congestion in the cities. Change of travel methods include advocating public transport, controlling and guiding the use of cars. It is advocated that traffic tools which are able to save the road areas should be used, traffic tools which are not economical shall be restrained. Normally, there are two kinds of measures: first, manage the ownership of vehicles; second, manage the use of vehicles (that is control the traffic flow).

For management on vehicle ownership, there are several ways including quota system, garage licensing system, limit of vehicle standards and economic adjustment etc. For management on vehicle use, there are several ways including (a) limit of traffic management. That is control the traffic flow by planning the use of roads. For example, streets are planned into walk street, or set up some accommodation roads etc. (b) limit of vehicle travel. For example, all roads and time for vehicles shall be restricted; the vehicles are restricted according to their license plates; for roads which are quite crowded, special permits will be given. (c) parking restriction. For example, the public parking lot is set up at a place which is far from the crowded area, so that the vehicles accessing to this area will be lowered down; the time for vehicles parking on the side of roads will be restricted etc.

In America, the policy traffic demand management is being implemented, even though it is a small automobile kingdom, it well controls the traffic flow in the urban area, which greatly eases the traffic congestion. In 1975 and 1998, Singapore introduced artificial road toll system and electronic road toll system, which helps to control the traffic flow via congestion charge. In Hong Kong, a series of measures like high gasoline tax, toll charge, congestion charge and electronic road toll to lower the use

of vehicles. What's more, many measures are used to improve the efficiency of vehicle use, for example, encourage people to share their cars and restrict to take a car by only one. In this way, the number of vehicles running on the roads is decreased.

**3.3 System Standardization Mode.** Systems are the rules used to regulate peoples' behaviors, which targets to lower the transaction expenses. For such systems, on one hand, it is able to reduce the conflicts and frictions in the society, which is able to avoid the efficiency loss; on the other hand, get people have a rational expectation to the future, which is able to lower the uncertainty. System improved mode is a concept based on what is mentioned above, it thinks that the government shall provide policies and rules which can make the roads used the most efficiently; besides, the sense of residents' in strictly following traffic rules shall be strengthened, so that traffic congestion and traffic incidents can be reduced. In developed countries, there are strict rules which will seriously punish the people who violates relevant laws and rules, which can also help people to follow these laws and rules. For example, in Germany, if there is any behavior violating traffic rules, the driver will be seriously punished, which will also adversely affect the individual's credit. People who frequently break the laws and lead to traffic accidents are difficult to find a job or even their insurance rate will be much higher than others. In this way, the drivers gradually form a sense that it is mandatory to follow traffic rules.

#### **4.Social Solution for Solving Urban Traffic Congestion**

With the fast development of cities and the rapid growth of population in cities, the number of private cars is being increased, travel congestion is getting more and more serious. Under this background, in order to solve traffic congestion, it is required not only focus on traffic but also other fields. According to the experience in easing traffic congestion in developed countries, we can see that focusing on techniques is not able to essentially solve traffic congestion, that is we need to focus on more, for example, we can ease traffic congestion in three aspects --- policy, ideology and technique.

**4.1 Policy.** China, depending on the experience learned from developed countries, is working on rationally guiding the traffic demand by considering the actual situation in China. That is the government guides residents to select the traffic tools by issuing policies and measures, so that rational traffic structure can be formed. In this way, harmonious development among different traffic tools can be better pushed forward.

##### **(1) Ensure that public traffic can be developed in priority**

Public traffic includes buses, taxis, rail transits etc, which are able to carry a lot of people by providing less resources, so that the possibility of traffic congestion can be greatly reduced. Meanwhile, public traffic is much safer than private traffic tools. So in the future, public traffic shall play a leading role. First, well implement the the measures regulating to develop city bus in priority. When defining urban traffic rules, it is required to set the sequence of public traffic, for example, make sure that the establishment of bus transit lane and bus stops is fully available; the investment and financial tax shall give privileges to public traffic, such as financial allowance, low interest, interest-free and tax preference etc. Second, enhance the service of public traffic, trying to satisfy personal requirements in traffic. Enhance the on-schedule rate and operation efficiency by improving the operation routes and transfer hub of public traffic; rationally distribute the operation ability of public traffic, enhance the use and satisfaction of bus; provide prompt information for passengers so that different demands in traffic of different people can be satisfied.

##### **(2) Advocate the travel mode "bike+ public traffic"**

It is known that bikes are economical, convenient, pollution-free and energy saving, as well as that riding a bike is good for our health, it is an ideal traffic tool which is quite suitable for China. In the view of transportation management, cities in China shall study how to well combine these two tools in order to get a highest efficiency. First, bike tribes and walkers shall have a deep sense in following

traffic rules; encourage people to travel by healthy and environment-friendly tools, like bikes; second, set up more bike lanes and strengthen the construction of stores for renting out bikes and support facilities for bikes.

### **(3) Utilize policies “cars’ supply in short”**

Owning a car is an individual behavior, which shall be satisfied in the modern society but not robbed away from human beings; meanwhile, using a car is a social behavior because the use of cars will occupy public spaces and result in traffic congestion, which will make the social cost increased. As a result, the government is able to guide the ownership of a car and to restrict the use of a car, requiring customers to additionally pay for the use of a car.

In China, it is mandatory to guide and adjust the development of private vehicles, while policy of “cars’ supply in short” shall be utilized. For example, in some special areas, they can be defined as areas for walk only or areas for single-way drive only, parking lots can be limited or speed limit is required etc., so that the urban residents will become less dependent on the private cars. At the same time, financial tax policies shall be reformed and perfected, such as tax can be charged based on the use of private cars, making residents form such a concept that “buying a car is not only about using a car but also renting urban road system”; increase the road use fee or use tax by charging gasoline tax and tire tax; adjust the demand of private cars by economic leverage, trying to make the means of transportation comply with the transport facilities in the city.

## **4.2 Ideology**

### **(1) Build the ideology of “Green Transport”**

In order to change people’ attitude in cars, it is required to make people build the ideology of “green transport” and “sustainable transportation”. Green transport, with the purpose to ease traffic congestion and lower the energy consumption, is to push forward the development of sustainable development of urban traffic, including bus development shall be in priority, ride a bike when traveling, walk more etc., so that energy can be saved and environment can be protected. By understanding the ideology aforementioned, people will gradually give up or reduce their dependence on private cars but use green transport more.

### **(2) Execute the ideology “Green Transport”**

We all know that urban traffic is quite huge and complicated, which is strong in fundamentality and sociality. Therefore, the implementation of green transport shall be pushed forward by the government, which needs to be coordinated and adjusted in terms of policies, rules, traffic rules, technical standards, operation rules and management systems. So that different means of transportation will not only self-concentrated, self-planned and self-constructed, if so, the efficiency will be lowered while the cost will be increased and the resources will be wasted. The promotion of green transport can be carried out via: (a) promotion and education in the society, which is an important way to spread the ideology of green transport, for example affect the people by setting up models and social opinions, administrative officers can play a leading role in guiding people to concentrate on green transport; (b) make public service advertising via media, for example, enhance the guidance and supervision on green transport via televisions, broadcasts, newspapers and internet etc, criticize the behaviors and phenomenon of breaking green transport.

## **4.3 Technique**

Guiding traffic demand management by economic measures and technical measures is a positive way to do the management. Currently, the economic measures are being used to affect the travelers’ when selecting the means of transport, the routes and the time of travel, which is able to well adjust the traffic demand in terms of time and space. Economic measures include congestion toll, parking charge etc.

### **(1) Congestion toll.**

It is a measure to charge from the vehicles which are running on the roads which are crowded or at the time when it is rush hour, whose target is to guide the travel demand by pricing system, so that the travel route can be adjusted, the traffic flow at the rush hour or busy road will be lowered. By

congestion toll, a transfer from private cars to public traffic can be realized, which will speed down the increase of cars. Singapore is the first country engaging in congestion toll. In order to ease traffic congestion, vehicles will be charged at some certain areas, which greatly lowered the traffic flow during the rush hour and the average speed of cars was obviously increased. At the same time, travel by bus was more than before. Within the inner ring in London, private cars and trucks are all charged 21 km around the place, the charge time is from 7:00 to 18:30, while no charge is required on weekends and legal holidays. After this rule was put into practice, the congestion was reduced by 40%, traffic flow was reduced by 16%, the lining was reduced by 20%-30%, the speed was increased by 37%, travelers taking buses were greatly increased, and even buses become more attractive. All these cases tell us that congestion tool is an efficient way. However, in China, congestion toll shall be well combined with the real situation in China, that is it is not allowed to totally follow what others did.

## **(2) Bus in priority shall be guaranteed by engineering measures and management measures**

Draw up the measures that bus shall be in priority, which shall be reflected in two aspects -- in the view of engineering and in the view of management. From the view of engineering, right of way shall be in priority in terms of hardware environment. That is according to the rules of road use, buses shall have the priority in using roads and infrastructure, which should be the base of the policy "bus shall be in priority". From the view of management, draw up traffic management measures, make sure the bus can run smoothly by guaranteeing software environment.

First, the lanes for bus shall be planned rationally and scientifically in a comprehensive and systematic way. Spaces for bus in priority like bus lanes, priority lanes, single-way lanes and contra-flow lane for buses shall be provided by setting signs on the roads or controlling the accommodation roads; according to the road conditions and environment around, select proper technical indexes of bus in priority; lane network for bus in priority can be integrated planned and periodically established, so that hardware facilities for the development of bus in priority can be provided. Second, signal system for bus in priority shall be rationally set, making sure that public traffic has the priority in passing the crossings; by rationally set the signals for buses when passing by the crossings, phase positions or bus signals dedicated for bus can be set. Anyway, in order to enhance the on-time performance of public traffic, public traffic shall be given priority and the delay at the crossings shall be reduced.

## **5. Conclusion**

At present, China is at the stage that social transformation is speeding up and social stratification is being enlarged, which there is a social problem that urban traffic environment is getting worse and worse day after day. Under this background, in order to solve this kind of problem, the whole society needs to do efforts together. We think that the key to be successful is that a correct value is widely known and accepted, which shall not be only focused on road extension and technique reform. Anyway, we need to get more people feel the traffic congestion, as well as the consequences resulted in by environment pollution and ecological damage, trying to let people change their lifestyle -- "large amounts of production --- large amounts of consumption --- large amounts of waste". Thus, irrational value in auto consumption can be abandoned. New value will not emerge in a general way but in a specific way, that is once there is a new value, there will be actual situations and new realities, as well as a new world.

Today, China is facing a reality that traffic congestion is a problem difficult to be solved, it is emergent for Chinese people to set up a philosophy which is healthy and humanized. Such a philosophy put emphasis to that urban traffic shall be low-carbon, that is it is mandatory to ease traffic congestion and environment pollution, enhance the social fairness and rationally use resources. This kind of philosophy shall not only be involved into the draw-up of transport policies but also involved into people's daily life.

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