SOME TRIALS OF CAR REGULATION SYSTEMS IN THE CBD OF SHANGHAI

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Abstract: Nowadays in Shanghai, more effective policies should be necessary for improving the huge delay, the chronically sluggish traffic and the serious environmental pollution caused by traffic congestion. In this paper, some new trials including both expanding capacity measure of traditional policies like one-way traffic system and new ideas as pricing system, are proposed and investigated, in order to contribute to mitigate their traffic problems in the central area in Shanghai.

Keywords: Shanghai, Transport Policy, Car Regulation, Congestion, Environmental Pollution

1. ROAD CONGESTION ACCORDING TO AUTOMOBILE TRAFFIC IN SHANGHAI

1.1 Road construction and car ownership

The growth speed of the car ownership is higher than that of road supply in Shanghai, as shown in Figure1. Therefore, even though the motorways or elevated roads as trunk roads were constructed, the great speed improvement has not been realized as shown in Figure2

In Figure2, the reason of speed-down on the roads belonging to 1), 3), 4) may be due to the increase of traffic volume according to free crossing beyond the Huangpu River. On the other hand, the speed on the roads of 5) and 6) has increased due to separation of bicycles and cars.

From these changes, the traffic operation methods must be effective to improve traffic conditions.

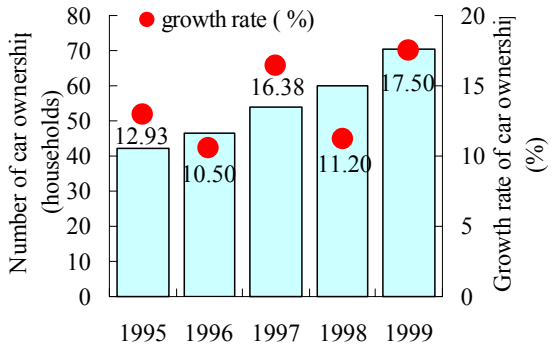

Figure1. Increase of car Ownership [1)]

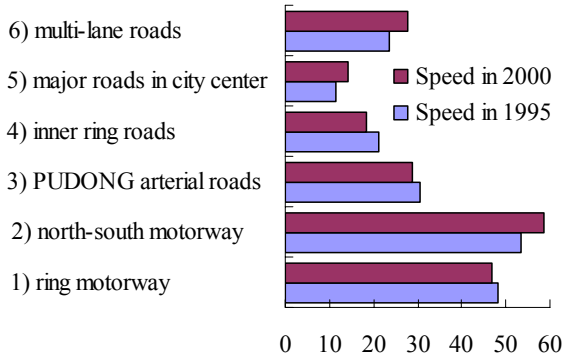

Figure2. Change of vehicle's speed according to road types [1)]

1.2 Road construction and traffic condition in the central area in shanghai

(1) Construction of motorways

When the ring motorway was opened at the end in 1995, the average traffic volume were 27,000 vehicles per day (vehs/day), and until June 1995, they increased to 43,000vehs/day. As a result, the saturation rate of rush hours on the ring motorway is within 0.8~1.2 and the speed keeps just 50 km/hour. Furthermore, the number of car ownerships was 420,000 households at the end of 1995, while it increased to 600,000 households at the end of 1998. That is, the supply of road facilities consequently brought the huge growth of traffic volume.

(2) Traffic condition crossing Suzhou River and Huangpu River

At present, there are 17 bridges on the Suzhou River, and the crossing traffic volumes become more than 500,000 vehs/day. Then, the saturation degree of more than a half bridge was over 0.9 during rush hours. At the beginning, the traffic fee on the HuangPu bridges and tunnels was 10 RMB (Ren Ming Bi; the unit of currency in China=0.118US$, 2002) for one time, while in May 1995 it was raised to 13 RMB and to 15 RMB in May 1997. And then the traffic volumes reduced by 3 % with the raise of 3 RMB at the first time. However, no further effects were obtained with the raise of 2 RMB at the second time. As a result, this pricing system was suspended in May 2000, and then, traffic volume increased up to 40% at the end of 2000. In addition, till the end of 2001, there was another increase of 22%. The saturation rate of rush hours was over 1.1 on both the YanAn Tunnel and the NanPu Bridge. Other bridges also had the saturated condition with 0.8~0.9 of the saturation degree.

(3) Traffic congestion from viewpoint of road service level (Q/C)

In Figure3, the ratio of good situation (Q/C<0.7) was 17% of road sections and only 6% of intersections. Although these congestions were mainly caused by the imbalance between road

supplies and traffic demands, there should be some additional causes as follows.

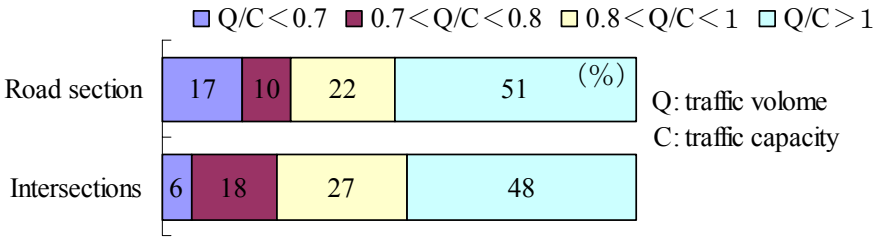

Figure3. Average Service level of roads in city center [1)]

1) decrease of road capacity caused by mixing with huge number of bicycles and rickshaws
2) unsuitable connection of road networks
3) inadequate control systems including traffic operation and information
4) unsuitable location of bus stops and parking spaces
5) lack of the law-abiding attitude or manner

2. POLICIES AGAINST TRAFFIC CONGESTION IN THE CITY CENTER

2.1 Traffic regulations

Some kinds of traffic regulations have been applied in Shanghai city until now, as follows.

- prohibit trucks from entering the central area (about 640 km^2) from 5:00 to 20:00
- restrain on possession or use of motorcycles and bicycles
- restrain on possession of cars by managing the number plates
- limit the area to use taxies and motorcycles according to the kinds of number plates
- prohibit cars from entering the city center according to the odd or even number of number plates

Although the effects of these regulations have not been evident, the worse conditions must be imagined in case of no regulations. However, nowadays, it is also true that the condition of traffic flow in the city center should not be good. Therefore, the importance of investigating some new trials such as one-way traffic system and effective operation method of bicycles must be significant.

2.2 Effects of one-way traffic system

Here, applying the one-way traffic system to some roads in the center area of Shanghai, based on the experience of Osaka City, Japan. In the case study, four streets through north and south were converted to one-way streets, as shown in Figure4.

Especially, as there is so many bicycles on the Road E, two lanes in the center were operated as one-way for north, the lane of each side was operated for bicycles. These bicycle's lanes may be expected to organically connect to the no-car zone of the Road b.

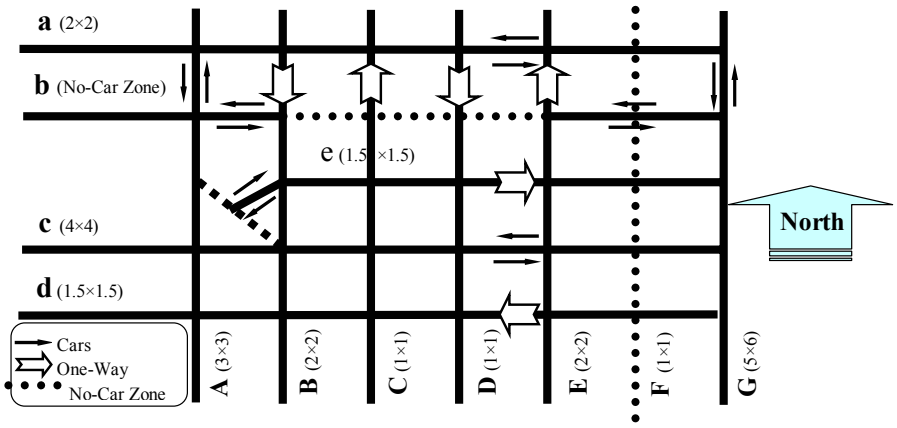

Figure4. Road network in case study [3)]

By the way, in the case of Osaka City, the traffic capacity at the intersection was reported to increase by 10% as the result of introduction of one-way traffic system as shown in Table1. In addition, the average travel speed was increased by 30%~40% with the systemized signal control. Then if these data are applied to this case study, the travel speed of the north-south direction will be expected to increase to 12~19 km/h.

Table1. Effect of One-way Traffic System in the Center of Osaka City [3)]

Evaluation Factor	Indicators
Road Traffic Capacity	Addition one lane Increase of 25%
Travel Time	Delay decreased to 1/4 Travel speed increased by 30～60%
Road Safety	Decrease of accidents such as face to face, righ turn, glare

And also according to the results of investtigation on driving mode in 1995, it is clear that the emission gas volume and the travel speed were closely correlated as shown Figure5. Based on this result, the reduction of the emission gas volume of HC and CO is estimated to reduce by 31.1% and 35.5% respectively in this case study.

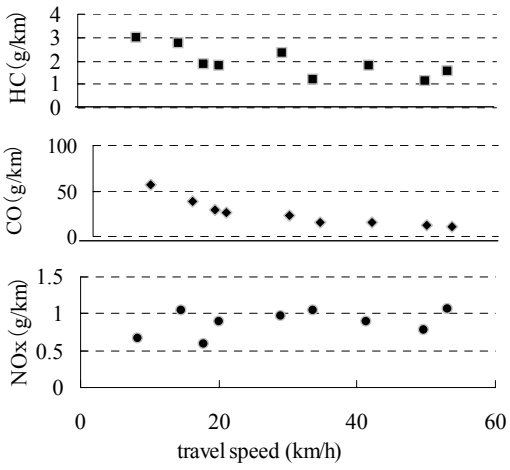

Figure5. Relation between emission gas volume and travel speed in Beijing [3)]

2.3 Idea of effective operation and evaluation method of bicycles

As mentioned above, the mixed traffic with huge volume of bicycles must be one of major causes of traffic congestion in Shanghai, as shown in Figure6.

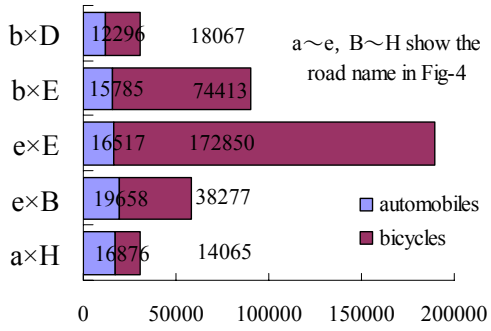

Figure6. Traffic volume consist of automobiles and bicycles in the day time [4)]

In many countries, the road capacity was generally calculated by considering the mixing rate of bicycles to the number of many bicycles, this method must be aptitude automobiles. However, in case of existing so to underestimate the influences of bicycles, that is, the value of road capacity calculated by this method should be overestimated.

Therefore in this paper, more suitable methods were investigated as follows.

1) Adjustment of signal control

In order to improve the reduction of road capacity, it should be essential to effectively operate according to demands of vehicles type and/or each direction.

2) Reallocation of road space

In case of huge demands of bicycles, it must be more effective to reallocate the road space to bicycles, because of capacity reduction caused by mixed traffic. It is also necessary to deal with the successive intersections, as well as the effective signal control systems.

3) Structural improvement of intersections

As the road capacity should be considerably reduced at the intersection as a typical bottleneck, it may be effective to construct the underpass for bicycles, after due consideration of construction cost.

3. EFFECTS OF SOME MEASURES FOR TRAFFIC DEMAND MANAGEMENT

3.1 Assumption of the regulation range

According to the simulation results based on the local OD investigation data in 1995 in Shanghai, some characteristics of traffic conditions in the city center were reported as follows.

- there were around one million trips per day.
- the ratio of trips in the day time is around 64～73%(the number of vehicles in the daytime may be around 800 thousands).
- the ratio of trips in city center is 18%, the ratio between city center and other inner city area is 35%.

And also, the return trips at the peak hour between city center and surrounding area were estimated as 28,000 trips, when the share of peak hour is 0.1 based on Figure7.

By the way, the ratio of private car, taxi and truck is reported to be 65%, 29.5% and 5.5% respectively. And also there exist another 100 thousands special vehicles consisted of the emergency and public use vehicles as estimated to correspond to 12% of all kinds of vehicles based on the past survey. Through some analyses mentioned above, the number of vehicles influenced by the regulation from 8:00～11:00 and 16:00～17:30 is estimated at 160 thousand, that is, the ratio of regulated vehicles may be calculated as 17%(=16×(0.65+0.295)/89.6).

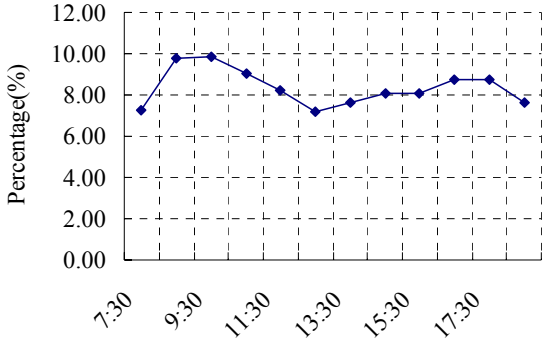

Figure7. Hourly share of traffic volume in the daytime [1)]

3.2 Road pricing policy

(1) Outline

Nowaday, a plan of road pricing policy is investigated by the authority of Shanghai City, as follows.

1)Area: the pricing area is the inner area with 21.7 km^2 including the city center consist of 17.5 km^2 in PuDong district and 4.2 km^2 in PuXi district (see Figure8).

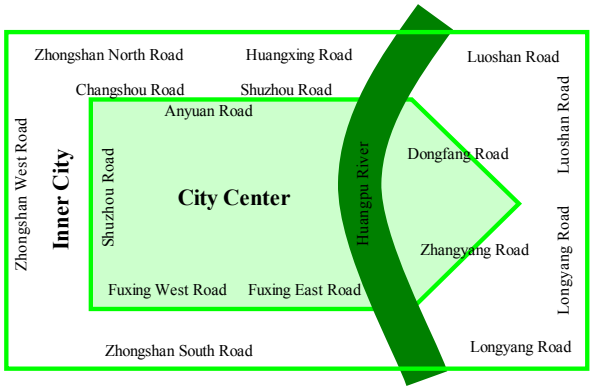

Figure8. Image of Pricing Area [1)]

2)Time period: the charging hours may be 8:00 to 11:00 am and 16:00 to 17:30 pm, Monday to Friday.

3)Charged vehicles: all private cars and taxies would be charged. Public service vehicles including emergency services would be excluded from charging.

4)Charging method: the electronic road pricing as practiced in Singapore may be recommended.

(2) Effect

The number of decreased vehicles in the central area may change according to some conditions such as charged fee, applied time period and so on. Then, the effects of pricing policy should be evaluated by the ratio of decreased vehicles (=adjustment rate in Table2). According to Table2, a reduction of 20%or more of vehicles should be necessary to achieve the suitable improvement of traffic conditions. And also in order to realize this situation, it should be necessary that the charged fee will be 7 RMB or more.

Table2. Estimated improvements according to adjustment rate [1)]

Indicator		At present	adjustment rate		
			10%	20%	40%
Saturation (Q/C)		0.89	0.83	0.77	0.66
Service level		bad	bad	just so so	just so so
Change of traffic volume	Arterial roads	-	-5.50%	-10.67%	-20.50%
	Secondary arterial roads	-	-5.83%	-10.83%	-23.30%
Change of speed	Arterial roads	-	6.50%	11.50%	27.67%
	Secondary arterial roads	-	12.01%	20.50%	39.33%

3.3 Area regulation

(1) Outline

This is more strict policy than the pricing scheme. When introducing this policy, cars and taxies must be prohibited from entering to the designated areas during the rush hours. Therefore, these trips may be compelled to be transferred to public transports. Furthermore, the pricing scheme may be executed during the daytime. Still more, trucks have been charged for a whole day.

(2) Effect

According to the same conditions in the case of pricing scheme, the ratio of regulated vehicles must be more than 17%, because the number of trucks (occupied 5.5% of all vehicles) should be also regulated. Therefore, some effects may be expected as follows.

- Regulated vehicles may be transferred to the public transports or some drivers may be abandoned the trips to the city center during the regulated hours. As a result, the services of public transport must be improved, while the congestions should be relieved.
- Around 14% of traffic volume may be expected to decrease, consequently the air environment will be greatly improved.

4. CONCLUSION AND THE PROBLEMS IN THE FUTURE

In Shanghai as one of big cities in China, more vehicles are expected to increase because of the expansion of the open-door policy like the affiliation with WTO (World Trade Organization). Therefore, more strict traffic regulations may be necessary to mitigate some problems caused by automobiles. Then, some new policies to improve these problems were investigated by using some actual data in this paper. As a result, some major findings are summarized as follows.

1) The traffic operation method including TDM (=Transport Demand Management) must be effective to improve the traffic conditions, based on the data of changes of road

facilities and traffic demands.

2) It is pointed out that the supply of road facilities may bring the growth of traffic volume based on the experience of the construction of the ring motorway.
3) As the reasons of heavy congestion in the city center, the problems of mixed traffic with huge bicycles, connection systems of road networks, traffic operation and/or control systems and so on, as well as the imbalance between road supplies and traffic demands, were assumed by some actual data.
4) It is pointed out that some existing regulations for automobiles in Shanghai must be effective to improve the traffic conditions, while the accurate effects were not evident.
5) By effectively introducing the one-way traffic system, travel speed as well as environmental pollution may be estimated to improve by around 30%, through the experience of Osaka, Japan.
6) In order to accurately investigate the congestion in the city center, the influence of bicycles should be reconsidered from the viewpoint of road capacity. In addition, some ideas to effectively deal with huge bicycles at intersections were referred.
7) The case study of introducing the road-pricing scheme applied to the central area suggested the necessity of 20% or more reduction of vehicles in order to achieve the suitable improvement of traffic conditions.
8) In another case study of area regulation, it was able to refer that the regulated vehicles may be transferred to the public transports or some drivers may be abandoned their trips to the city center.

Shanghai as well as Osaka has had some important experiences of traffic problems and countermeasures. Nowadays, both cities have tried to realize to improve the urban environmental pollutions caused by automobiles. Therefore some proposals in this paper must become not only the basic data to investigate the suitable policies but also the good opportunity to encourage the cooperative activities, in order to improve the present traffic problems caused by automobiles.

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