Environmental Problems and Importance of Transportation Demand Management Policy*

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1. Introduction

As the 21st century approaches, traffic congestion and car pollution are becoming more and more severe in big cities of the world. This is especially true in countries such as Japan, and its solution is badly needed. Many measures have been taken to solve these problems, but the most remarkable of these is the Transportation Demand Management policy (TDM policy). This paper explains why this policy is strongly needed, and examines its components. It also discusses the effectiveness and difficulties in implementing the TDM policy by referring to some cases in several countries. Then it will focus on use of road pricing which uses a function of price mechanism.

2. The Present Condition of Traffic Congestion and Pollution in Big Cities in Japan

The increase in traffic flow and volume does not only cause traffic congestion but also car pollution and noise. All of these problems are intensifying in big cities of Japan.

First, let's survey the present condition of traffic congestion in Tokyo. The volume of vehicles has been increasing at an alarming rate. Between 1975 and 1992 the number of vehicles increased 67%, with a total number of 4.61 million vehicles within the city in 1992. The Tokyo metropolitan areas have experienced similar increases, and the number of vehicles is near 13 million. Especially, the volume of private cars has been increasing at the highest rate of other vehicles. Thus these statistics mainly reflect motorization in private cars.

According to the Tokyo Metropolitan Police Department, the volume of traffic in the city increased some 14% between 1987 to 1992. Although the amount of time spent waiting in traffic jams has increased along with this, it has decreased slightly in 1991 and 1992. But, what should be noted is that the higher congestion degrees are the higher its rate of increase is in view of the duration of congestion. For example, its rates in the highest level

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of congestion degree (congestion is often more than 1000 meters in length) has increased 11%. On the Metropolitan Expressway duration of congestion has risen a surprising 26%. Also, inbound and outbound traffic volumes have increased 13% in total. In addition, over 50% of the space on trunks in the Tokyo area is covered with traffic jams between 300 and 500 meters.

Thus road congestion in the Tokyo area is going from bad to worse not only in quantity of the duration of congestion but also in the quality of the congestion degree because car ownership and traffic volumes have increased.

Needless to say,in Japan, air pollution also is going from bad to worse. Though emissions regulations introduced in 1973 have reduced the density of hydrocarbons and carbon monoxide, the density of nitrogen oxides (NO_x) has risen continually since 1985. Furthermore, only half of the cities officially surveyed in the Tokyo, Osaka, and Yokohama areas meet the government standards for NO_2 limits. This low rate of success has hardly changed in the last 5 years, and this is especially due to the increase in the number of diesel vehicles as well as the number of vehicles in general. Since traffic produces about 53% of all NO_x pollutants in Tokyo and Osaka, it is obvious that a policy is needed to control the amount of traffic in order to effectively reduce pollution. Unfortunately, in spite of government efforts to solve it, the situation is getting worse.

3. Why is the Transportation Demand Management Policy Needed Now ?

In tackling the problem of traffic congestion, the traditional approach has been to focus on the supply side rather than reducing traffic demand. However, there has been a paradigmatic shift toward policies attempting to restrain traffic demand. Such a shift has occurred since the latter half of the 1980's in both the United States of America and Europe notably in Holland, though the importance of demand side approach was long ago recognized in the Smeed Report in 1964.

The Japanese government has lagged behind, showing little interest in controlling traffic demand until very recently. In 1992, however, a demand side approach called the TDM policy was adopted, and in the autumn of 1993 the Ministry of Construction, the Ministry of Transport and the Police Agency joined together in order to investigate demand side policy and to establish a more unified road transportation policy.

TDM policy is road transportation policy from the demand side that seeks to optimise road transport by reducing directly and indirectly car traffic demand. It is the policy that aims at road congestion and environmental problems through guiding reductions in generations of traffic demand, averaging of their time, and modal shift. There are some reasons why this TDM policy is badly needed now. The TDM policy has been created due to the fact that supply side policies have not solved the basic problems caused by increasing

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Yoichi Obuchi (1999) Transportation Demand Management Policy and How It Should Be, Seikei Ronso, Meiji University, Vol. 67. 243-257.

Yoichi Obuchi (1999) The Introduction of Road Pricing and Formation of Social Consensus. Selected proceedings of the 8th World Conference on Transport Research, vollume 2.

motorization.

First, the greatest reason is that the restriction in building new roads becomes bigger recently from environmental problems due to air pollution. For example, though the construction of a loop road has been noted as the most effective measure to reduce road congestion and to raise efficiency of road transport, even such a road is restricted due to environmental problems now. Consequently, the limitation of supply side approach has been recognized and the shift to demand side approach has occurred. The main factor is that the local, regional and global environmental problem is going from bad to worse as traffic volumes increase.

The second reason is that road construction in response to the increase of transport demand is financially difficult in many cities of the world. To reduce the road congestion that many cities are facing currently, the existing road capacity must be continually increased, and the financing is difficult. This is especially true in the big cities in Japan, where the cost of land for roads is astronomical even in spite of the fact that the price of land has fallen due to collapse of the bubble economy.

The third reason is that in congested cities reducing pollution can be overcome only by restricting the amount of traffic entering the city. In such cities, traffic control system has been to control traffic by optimising the timing of traffic signals. This has had the same effect as the increasing of road capacity because of improving delay to road users (Martin, D. and Michaelis, L. 1992). But the extra traffic has only increased the pollution. Thus, while they serve to increase traffic flow, they do nothing to solve the problem of pollution or to slow down the increase in the number of cars.

The fourth reason is that the benefit of using cars is becoming more and more oligarchic goods (Hirsh, F. 1976). This is especially true in the central area of cities like Tokyo and London. It is impossible to increase road capacity to meet user demand easily, however many those who want to use roads in the central urban area increase. Generally, this reason isn't brought up, but it is the most fundamental reason to be considered in examining road congestion and pollution problems. When road congestion occurs due to social scarcities, road capacity cannot be easily increased. Therefore, demand side policies should be made to restrict the excess demand against the oligarchic benefit in using roads.

Finally, the advance towards an information-oriented society has caused many companies along with the general population to move towards the centers in Tokyo, bringing thousands of commuting workers with them. It has been widely believed that the ease in transport of information would allow business to establish themselves in less populated areas, but the amount of information has rather served to beckon business to the most information- concentrated areas, namely the central areas of large cities. Consequently, in fact, information concentrates more and more to Tokyo, and agglomeration of population and firms to Tokyo goes on.

Yoichi Obuchi (2001) Gaining Social Consensus for Road Pricing through a Policy Mix Approach. The presentation given at the 9th World Conference on Transport Research in Seoul, Korea.

4. Road Congestion, Environmental Problems and Transportation Demand Management Policy

4.1 TDM Policy and Road Pricing

Now I'd like to explain the measures specified in the TDM policy, its kinds of measures, and examine the efficiency of TDM policy in reducing road congestion and pollution, especially focusing on road pricing by referring to some cases in the world.

The TDM policy attempts to reduce traffic demand through both direct and indirect measures. The direct measures consists of:

(1) Economic measures: road pricing, high toll at peak periods, fuel taxes, and so on.
(2) Legal measures: entrance ban, zone regulation, regulating types of cars, HOV lanes, obligating HOV use.
(3) Non-economic measures: staggered commuting, ridesharing (car pool, ban pool), shift to public transport.

Next, there are indirect measures.

(1) Urban planning: elimination of concentration, dispersion to local areas, city formation with home close to office, land use to transport infrastructure.
(2) Industry policy: reduction of working hours, flextime, telecommuting, satellite offices, efficient logistics, holiday dispersion.
(3) modal shift policy: park and ride system, bus location system, formation of low public transport fares, parking management, increasing taxation for car registration and ownership.

The measure of road pricing is a central key in promoting the rest of the TDM policy. This is because it is the most effective measure in discouraging liberal road use and it encourages road users to seek other modes of transportation. Thus, it is a driving force behind the successful promotion of measures such as ridesharing, staggered commuting and shift to public transport as well as being the most direct measure to reduce pollution. Pollution taxes can also form a component of road pricing charges. To explain, the charges should add up road use charges and the car's pollution charges according to mileage, and time on the particular road.

4.2 The Area License Scheme in Singapore and TDM policy

In Singapore the term "TDM policy" hasn't expressly been used, but it is suggested that the concepts of TDM policy have substantially been implemented. The measure which has had the biggest effect reducing road congestion is the Aera License Scheme (ALS). Here's how the operation of ALS works.

In Singapore, ALS is a cordon road pricing system which was introduced in 1975 as the main part of an overall transportation strategy to restraint road traffic (Menon, A.P.G. and Hoi, L. S. 1992). Its initial introduction was so successful that it produced effects beyond the government's expectations. And, in spite of decreased effectiveness in following years, it is still remarkably effective. For example, the average journey speed in the CBD during

the morning ALS time was about 25 km/h in 1992. Moreover, the introduction of an ALS evening time in 1989 has also resulted in a big decrease of inbound traffic and outbound traffic and average journey speeds of about 30 km/h during the evening peak period. It is apparent that ALS is the most effective introducing traffic demand. Also, since nitrogen oxides and carbon monoxide are reduced due to relieve road congestion, the ALS improves pollution.

It should be noted that ALS was significantly modified in June 1989 (Turner, D. J. and Olszewski, P. 1993). This was in response to the gradual increase each year in traffic volumes especially of commercial vehicles. In 1989, the private car and taxi fees were reduced to S$ 3 per day and company car fees were also reduced to S$6 per day. Commercial vehicles and motorcycles, which had been formerly exempted from license fees, were also assessed fees for the first time. Unfortunately, this new policy has had a reverse effect. Traffic volumes during the morning ALS have shown the tendency to increase since 1989 because of reduced fees, while commercial vehicles and motorcycles have decreased only slightly (being charged S$ 3 per day and S$ 1 per day, respectively). Thus the overall effect is an increase in traffic. This case shows how large the effect of reducing fees on traffic demand can be.

Next, let's discuss some things which have been learned from experience in the ALS in Singapore. This is important in examining what TDM policy should be. First of all, although the ALS has been effective in reducing road congestion during the morning and evening peak periods in the restricted area, it has caused congestion in the adjoining areas and during pre- and post-restricted hours. In addition, traffic volumes entering the restricted area during off peak hours have increased in recent years. Thus, in view of the worldwide pollution problem, it is necessary to charge during all hours except during the night.

Second, to reduce traffic demand, road pricing which uses a function of price mechanism has proved to be the most effective measure in Singapore. The park and ride system was exempted in 1977 and carpooling in 1989. It is learned that road users are responsive to direct fees, and measures depending on their function is effective in reducing traffic demand.

Third, without road pricing, getting car users to shift to public transport is still a big problem even when new public transport is made available. The introduction of the ALS had big effects on making car users shift to buses for commuting purposes, but starting operation of the MRT in 1987 didn't have such effects. This is because bus users shifted to the MRT for commuting purposes, but car users largely did not.

Finally, the biggest problem in introducing the TDM policy, especially road pricing is to gain social consensus, but this has been successful in Singapore.

4.3 Features and Problems of TDM policy in the United States of America

The objective of the TDM policy in the United States is to reduce single occupancy vehicles (SOV) for commuting purposes during peak hours, and its main measure is "rid esharing" by car pool and van pool. To promote this ridesharing, something to motivate

the commuter is needed. There are many concrete ways of doing this, including parking lot charges for workers, the lane and entrance rump giving priority to HOVs, and a parking space for HOVs.

Two acts passed to promote this TDM policy (Ohta, K. 1994). One is the 1990 Clean Air Amendment Act (CAAA), and the other is the Integration Surface Transport Efficiency Act (ISTEA), which has been promoted in conjunction with the CAAA since 1991. These acts specified the traffic control measures to be regulated. Traffic control measures under the CAAA include many measures related to the TDM policy, including ridesharing, HOV lanes, parking management, restriction of car use, changes in commuting time, and so on. The ISTEA took up "congestion reduction/pollution improvement undertaking" as one of its main measures, and stated that the government would no longer subsidize for the road construction undertaking to increase single occupancy vehicles, and that many areas in the United States had not achieved environmental standards and called for improvements. Consequently, most big cities have been obliged to tackle the introduction of the TDM policy not only on the measure of road congestion but also on environmental measures.

Along with this, local governments have been substantially obliged to tackle the TDM policy in order to comply with these new federal legal measures and find ways to solve new problems of road congestion and air pollution in the suburbs. Most local governments have established the "traffic reduction ordinances" to restrain the occurrence of SOV commuter traffic. Also, in response to such legal legal ordinances, the Transportation Management Association (TMD) has been organized by land developers. The TMD is also active in supporting ridesharing and promoting the use of public transport services.

Now let's examine the effect of the TDM policy in connection with the promotion of ridesharing. Ridesharing has been promoted through the "Transportation System Mana gement" since 1973, but its effect has hardly been seen. In the 1980's, rates of ridesharing for commuting purposes decreased not only in the big cities of the USA, but also in the rest of the country. Conversely, rates of single occupancy vehicle commuting to work decreased greatly. In the 1990's, the promotion of ridesharing has been implemented under TDM policy by Traffic Control Measures due to the CAAA and ISTEA, and also by the establishment of traffic reduction ordinances and the organization of Transportation Management Association, but their effect has yet to be seen.

With the promotion of ridesharing, traffic volume has decreased on particular roads, but pollution hasn't remarkably improved. In many big city areas, such as Los Angeles, environmental standards concerning carbon monoxide and ozone, particles have not been achieved on the whole. Thus, the TDM policy strongly depending on ridesharing should be promoted not only on road congestion measures but also on environmental measures. But the difficulty is how to motivate it. For example, charging SOV's for use of turnpikes going into the center of a big city during only the morning peak hours, and not charging ridesharing vehicles, even if it isn't comprehensive road pricing, is a more efficient motivation to increase ridesharing commuting. If this is done, the activity of the Transportation Management Association providing the matching service for ridesharing could be more effective. But it is difficult to charge fees in the USA because public transportation is very

limited.

One feature in the American society is the cultural value that the mobility of cars is to be free. In such a society, in any case, the fact that TDM policy may have to impose a certain social limitation on using cars is greatly noted as showing what kinds of problems need to be faced in implementing transportation policy.

4.4 The Transportation Demand Management Policy in Europe and Japan

In Europe, the term of the TDM policy hasn't been expressly used, but the importance of the demand side approach has been recognized for more than thirty years, and various policies to restrain the transportation demand have been implemented so far. In Europe there have not explicitly been proposals for the TDM policy. Holland is the only country in Europe to have publicly recognized and positively promoted such a policy. In Holland, the TDM policy seeking to restrain car mobility has been promoted, because road congestion, pollution, and traffic accidents have increased in recent years. This policy adopts much from TDM policy experience in the USA. But it is quite different from that of the USA and consists of more comprehensive measures, including all sorts of pricing policies, location policies, and parking policies to name a few. Pricing policy the most effective of these policies was introduced in 1992, in order to reduce the number of expressway users entering the cities during morning peak hours.

In the UK, Urban Traffic Control Systems (UTC) has been promoted through road traffic management. The most recent system, which seeks to raise average journey speeds, is called Scoot (Middelham, F., Dibbits, J. and Fransen, W. 1994), (Martin, D. and Michaelis, L. 1992). Scoot, which is now being introduced in many cities, is a dynamic UTC system. It has the effect of lowering energy consumption and reducing pollution emissions because average journey speeds have been increased. But, in the congested cities, Scoot has had the same effect as increasing road capacity. Therefore, road congestion is temporarily relieved, thus encouraging more traffic. Pollution is continuing to worsen. To overcome this UTC drawback, traffic volume entering the city needs to be restricted. In the UK there have been proposals to employ road pricing. It hasn't been introduced yet but soon it is likely to be implemented in several towns such as Cambridge and the London Borough of Richmond.

In Japan, TDM has been recognized since the Ministry of Construction publicly stated in 1992 that it would be part of a new long range project. The TDM policy is in the same position as the supply side solutions in the road transportation policy. It seeks to reduce road congestion through raising transport efficiency, reducing traffic demand generations and averaging its time, and guiding due to costs. Though how to implement TDM has not been yet worked out, the fact that the TDM policy has been recognized by the government is a great change in policy, and its implications will be enormous.

5. Problems of the Transportation Demand Management Policy

To solve road congestion and air pollution problems, as stated above, a TDM policy

strongly depending on road pricing is badly needed. But there are some difficulties in implementing it. First, the TDM policy is to encourage modal shift, changes of times and routes, efficient car use, and regulations of transport demand occurrence, but the biggest difficulty is whether the TDM policy can include direct pricing for road use or not. It goes without saying that the TDM policy should be part of an overall transportation policy, and should work along with other policies including policies from the supply side. But TDM policy that does not include road pricing, can't be expected to produce big effect in terms of modal shift, changes of times and routes, and the promotion of ridesharing. In particular, promotion of ridesharing won't be effective if something isn't done to motivate the commuters, especially motivation due to pricing.

Second, it will be difficult to gain social consensus concerning who can and can't use roads where and when they want to and consensus on how much to charge. It is more difficult to do in comparison with supply side approach, as changes of mode, times and routes are needed in the TDM policy. Moreover in the TDM policy that includes road pricing it is more difficult to gain social consensus because the income distribution effect is inevitable. But road pricing is still fairer than other measures, because road tolls are the only restriction imposed and anybody can use the road if they pay the tolls.

Third, there are difficulties in gaining and improving the substitutional mode. The improvement of public transportation services is especially needed to shift from car usage, but the biggest difficulty is how to finance it. According to the Oxford work (Martin, D. and Michaelis, L. 1992), it is suggested that the policy which would have the biggest positive effect on the financing of public transport would be urban road pricing. This is the policy that intends to charge road vehicles for their use of the road in the correct proportion to the congestion, pollution, and road wear that they cause. If the revenues were returned into the transport system, they would finance public transportation and improve its services. In addition, by lowering the fees of public transport services, it is possible to promote a modal shift to public transportation.

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