

Systems for Controlling the Total Number of Vehicles for a Clean Jeju Island¹⁾

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Abstract

The purpose of this study is to present many polices of transportation demand management and ways to institutionalize them in order to actively introduce the total number of vehicles system as a strategy to solve the traffic problems in the Jeju area and protect the environment on Jeju Island.

Various measures and polices of transportation demand management as well as the total number of vehicle system are presented. These are considered as long-term policies which need to be applied to the Jeju area. Implementing these policies will need some time to attract the public's policy compliance and they need to be institutionalized through a variety of ways. Below are the ways to achieve this goal: (1) Introduction of the total number of vehicles system, (2) introducing motor fuel tax on energy consumption, (3) differentiation of parking fees based on types of vehicles, (4) charging for mileage, (5) collecting congestion fees and levying garage option, and (6) managing license plates through auction.

Key words:

transportation demand management, the traffic problems, vehicle system, the environment on Jeju Island.

I. Introduction

The aim of this study is to introduce several measures for transportation demand management as a strategy for introducing systems for controlling the total number of vehicles in order to protect the environment on Jeju Island.

Recently, transportation demand management not only focuses on relieving traffic congestion (Ryu & Oh, 2004) but also protecting environment in the era of 'low carbon, green growth' (Yoon & Park, 2009).

In Jeju Island, in 2012, the number of vehicles increased by more than 100 on a daily basis, by 3,111 on a monthly basis and by 37,334 on a yearly basis, showing the increase by 14.5% from the year before.

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<Table 1> Trends of the increase in the number of vehicles on Jeju

Division	2007	2008	2009	2010	2011	2012
No. of vehicles increased in a year	6,833 (3.0%)	4,660 (2.0%)	8,133 (3.5%)	9,143 (3.8%)	6,360 (2.5%)	37,334 (14.5%)
No. of vehicles increased in a month	570	388	677	762	530	3,111
No. of vehicles increased in a day	18	13	22	25	18	102

Source: summarizing and rearranging the data from the Statistics Korea Jeju Office (as of the end of June, 2013)

As the number of registered vehicles increases in the Jeju area, environmental problems such as carbon dioxide emission as well as parking problems at the side streets and serious traffic congestion on Yeon-sam Street, Yeon-buk Street and Nohyeong Traffic Circle emerge rapidly (the Jeju Ilbo, Tae-hyeong Kim, 2013.09.25). Carbon dioxide emission from vehicles is the main cause in the increase of CO₂ emission on Jeju where the manufacturing industry has a very weak presence. Therefore, decreasing the number of vehicles on Jeju comes to the forefront as an important task.

This study seeks appropriate measures to manage transportation demand and establish basic objectives, referring to cases in Singapore and Beijing.

II. Concept and Necessity of Transportation Demand Management

1. Concept of Transportation Demand

Management

Transportation Demand Management refers to all policies which aim to control transportation demand to appropriate levels by changing drivers' behavior (Yoon & Park, 2009). The TDM strategy aims to control the situations of the ownership of vehicles and vehicle demand. In other words, it is to control the desire of owning vehicles by putting economic burden of owning vehicles and increase the efficiency of transportation as a whole by managing traffic demand by the hour, area and route. The TDM strategy does not include policies such as constructing new roads which inevitably entail environmental damage but attempts to solve traffic problems by controlling the desire of owning vehicles or transportation demand.

Geon-yeong Lee and Je-mu Won (1997) identify the objectives of the TDM plans as lowering the volume of traffic by inducing drivers' behavioral change. This, also leads to the decrease in social costs such as increase in passing speed and volume of traffic per unit time, and reductions in air pollution and fuel consumption.

2. Traffic Condition on Jeju and Necessity of Introducing Transportation Demand Management

As of June 30th, 2013, the total number of registered vehicles on Jeju is 316,441. Analyzed by use, the number of owner-driven cars is 275,668, and that of commercial vehicles is 39,078. In terms of car models, the number of passenger cars is 230,751, that of vans is 19,486, the number of freight cars is 65,524, and that of special automobiles is 680.

The rates of registered vehicles and car ownership on Jeju are much higher than those in other regions. The car ownership rate on Jeju is the highest in the nation (0.53 per capita),

followed by Gyeongnam Province (0.45 per capita) and Gyeongbuk Province (0.44 per capita). Also, Jeju is ranked at the first place in terms of car ownership by household (1.35 per household), followed by Gyeongnam Province (1.13 per household) and Ulsan (1.12 per household). In this light, it is enough to say that the ratio between the number of registered cars and population in the Jeju area is the highest in the nation and, given that there are many unregistered rented vehicles on the road on Jeju, the car ownership rate in Jeju is the highest in Korea.

It is not desirable for Jeju Island, which is an island and a tourist attraction at the same time, to build expressways focusing only on increasing vehicle speed. Rather, Jeju needs systems which systematically control and limit the number of vehicles on the island. In this light, plans for transportation demand management

<Table 2> Car Ownership Rates

Division	Jeju (‘13.6.30)	Nation (‘12.12.31)
No. of owner-driven cars per capita	0.47 / person	0.35 / person
No. of vehicles per household	1.35 / household	0.94 / household
No. of persons per vehicle	1.90 / vehicle	2.66 / vehicle
No. of vehicles per capita	0.53 / person	0.38 / person
Total No. of vehicles (1.62%)	316,441 (1.62%)	19,160,337
No. of owner-driven cars per household	1.17 / household	0.89 / household

nt are strongly recommended.

Source: summarizing and rearranging the data from the Statistics Korea Jeju Office (as of the end of June, 2013)

III. Case Study for Transportation Demand Management in Foreign Countries

1. Transportation Demand Management in Singapore

As of 2012, the land area of Singapore is about 714km² and its population is 5.3 million. Ever since its foundation in 1965, the population of Singapore has increased continuously into overpopulation. According to the statistics bureau in Singapore (2012), even though the land area has increased by 23% through reclamation projects since its foundation, the population has also increased by 43%. The population growth has inevitably led to the short supply of transportation. Management and control of transportation demand through transportation strategies such as fully utilizing potential transportation resources has become a major issue of the government. The followings are major policies of transportation demand management in Singapore which has world-class transportation demand management.

(1) Controlling Transportation Demand

Singapore has controlled the public's desire of owning vehicles by increasing costs of owning vehicles through imposing taxes and other fees on its people. For this purpose, there are dozens of taxes levied on the people in Singapore. Major taxes are import duties on vehicles, fees on vehicle purchase, registration fees, and tolls, etc.

In terms of vehicle use management, Singapore has also introduced strong measures. Firstly, the area licensing scheme system has

been adopted since 1975. Under the system, if a vehicle enters the downtown commercial areas, the driver should pay congestion fees for that. This system has evolved into the electronic road pricing system since 1998. Secondly, Singapore has implemented “the total number of vehicle system” since May 1990. If a person wants to purchase a vehicle, he or she must possess “car ownership certificates” and these car ownership certificates are sold by auction. In 1999, the Parliament of Singapore evaluated the total number of vehicles system as very effective and necessary means of transportation demand management. The car ownership certificates have played an important role in reasonably curbing vehicle increase and avoiding traffic congestion (Pung Sun Wei, 2013.1.8.).

There are three distinct characteristics in the total number of vehicles system. First, license plates are categorized based on types of vehicles and sold by auction. Vehicles in Singapore are classified as five types such as class A (engine displacement is below 1600cc), class B (engine displacement is more than 1600cc), class C (motorcycles), class D (general vehicles and buses), and class E (vehicles can change their license plates into from class A to class D), according to engine displacements and their uses. License plates are sold by auction according to the vehicle classification based on the engine displacement. Vehicles which can switch their license plates into class A to class D fall under class E (Loh Chow Kuang, 2009). This way, Singapore has widened the range of vehicle selection and increased the efficiency of the auction market by classifying vehicles into various types and introducing the flexible system.

Second, Singapore has allocated supply of vehicles based on scientific demand predictions. The number of license plates which will be put up for the auction market is

determined considering the number of vehicles whose registration was canceled six months ago and the annual growth rates of vehicles. The Singapore government announces the number of vehicles which will increase each year considering the traffic situations and the road traffic capacity.

Third, there are expiration dates for the license plates. One distinct feature of the license plate auction market in Singapore is that the expiration dates for license plates is a 10-year period. In 10 years, drivers should scrape his or her car. Then the driver should pay the half of the assignment amount for another 10-year period calculated from the average prices for the last three months and renew the right to use vehicles for another five-year period. However, in 5 years from the renewal, he or she cannot extend the period anymore (Loh Chow Kuang, 2009; Pung Sun Wei, 2013; Lu Yan Qiu, 2013).

(2) Before 1988: Area Licensing Scheme (ALS)

Singapore implemented the area licensing scheme in 1975. This system stipulated that any driver who enters the downtown areas should possess permission. The sign posts, which show the time period during which drivers could enter the areas, were installed at the entrances of the downtown areas. The traffic police monitored and managed the system. This system was very successful (Luo Ming, 2007).

The major effects of the ALS on the traffic in Singapore were as follows. First, the traffic volume decreased while the vehicle speed increased during the rush hour. Second, the people mainly chose to take buses when they went out. Third, there were remarkable economic benefits from the system. Except for the spending in operating and maintaining the ALS system, most of the tax revenues were reinvested in managing and constructing roads

(3) After 1998: Electronic Road Pricing (ERP)

As time went by, the drawbacks of the ALS system began to emerge. In response to this, the Singapore government introduced a new system. They changed the ALS system into the Electronic Road Pricing (ERP) system.

The ERP system is the most advanced area pricing system in the world. It is a kind of congestion fee system adopted for managing traffic in congested areas. The main features of the system are identifying vehicles and automatizing fee collecting. The system is connected to the sensors and makes it possible to collect the congestion fees on the busiest streets. The ERP system is a pay system related to the road congestion. Therefore, this system is very effective in controlling the traffic congestion and the public tends to accept the system easily (Luo Ming, 2007; Loh Chow Kuang, 2009).

(4) Management of License Plates of Owner-driven Vehicles

There are still many problems in managing the license plates of owner-driven cars in Singapore. The biggest problem is that the demand for license plates for individual drivers has kept growing. The public has appealed for increasing the number of the license plates for individual drivers. In May 2012, the Traffic Bureau of Singapore reviewed the formulas of determining the number of the license plates and estimated the maximum supply of them between 2014 and 2018.

At the auction for the license plates in December 2012, the price for them reached to S\$97,000(82,547,000 Korean won). Considering that the expiration dates of the license plates are 10 years, the daily fixed costs are about S\$72(22,970 Korean won), which is higher than London's daily congestion fees (10 pounds or

17,090 Korean won) (Loh Chow Kuang, 2009; Pung Sun Wei, 2013; Lu Yan Qiu, 2013).

(5) Management of Vehicles from Other Countries or with Foreign License Plates

In Singapore, it is not allowed for its people to drive vehicles with foreign license plates. In case that vehicles with foreign license plates (especially Malaysian license plates) enter Singapore, tolls which are equivalent to the daily converted amount of the prices of the domestic license plates at the auction market are levied on drivers (Loh Chow Kuang, 2009).

2. Transportation Demand Management in Beijing

The traffic in Beijing is highly congested because of the increasing transportation demand coming from the rapid economic development and population explosion.

The number of vehicles in the city in 2008 was 3,504,000 but it increased to 5,200,000 in 2012.

<Table 3> The number of vehicles in Beijing over the past 5 years

Year	No. of vehicles
2012	5,200,000
2011	4,984,000
2010	4,809,000
2009	4,019,000
2008	3,504,000

Source : Beijing Business Paper, 2013.1.

As of 2012, the number of the people whose family registers belong to Beijing was 12,460,000, the floating population was 7,638,000 and the number of vehicles was about 5,200,000. The rail transportation burden ratio in Paris was 70% and both of the ratios in Moscow, Hong Kong were 50%. Tokyo's rail transportation burden ratio was 80%. However, in Beijing, the figure fell to below 10% (Wang

Wen Jie, 2005). Because of the scarcity of parking space, many drivers illegally parked their cars on the streets. Consequently, this led to the increase in the traffic volume in which drivers were looking for parking spaces (Wang Wen Jie, 2005; Luo Ming, 2007).

In order to solve its unbalanced transportation problems, Beijing introduced transportation demand management.

(1) Management of Bus Exclusive Lane

Bus exclusive lane not only guarantee the efficiency of bus operation but also are used in emergency or for transporting distinguished guests. As of today, the total length of the roads in the urban areas of Beijing is 6,247km and that of the bus exclusive lanes is 303km.

After the bus exclusive lines were open, an average driving time of a certain bus route reduced from 26 minutes to 12 minutes and in case of the most reduced driving time, a bus driver can drive the route in 9 minutes. From these cases, it can be learned that the strong management of the bus exclusive routes in Beijing has resulted in a considerable effect for improving the traffic situations in the city (New Beijing Newspaper, 2012.4.11, China News, 2010.5.2).

(2) Increasing Parking Fees in Downtown Areas

Since April 1st, 2011, Beijing has implemented a new standard system for imposing parking fees on drivers. The parking fees are differentiated from area to area and those in the downtown areas has increased substantially. The parking fees in some districts has increased two to three times and this discouraged many people from purchasing vehicles. According to a survey, 51.1% of the car owners in Beijing look for parking lots with lower fees and 50% of those

who don't own vehicles say that they are holding off their plans to purchase vehicles. Judging from this survey, increasing parking fees have a serious effect on using and purchasing vehicles.

(3) Slowing the Number of Vehicles controlling and Introducing the Total Number of Vehicles System

On December 23rd, 2010, the provisional rules of the license plate lottering system to control the total number of vehicles system in Beijing were formulated. Owner-driven cars were distributed to individuals by the drawing of a lottering. In 2011, 240,000 license plates were allocated, about 20,000 plates per month. After adopting the lottering method, the ratio of winning has dropped continuously as more people apply for the license plates and it is now about 3%. For Beijing, there were few options for limiting vehicle purchase but this policy has produced desirable results (Sina news, 2010.12).

(4) Alternate-day Driving System for Odd-Even Car License Plates and Differentiation of Office Attendance Hours

From July 20th, 2008 to September 20th 2008, during the Beijing Olympics, Beijing implemented active transportation demand management plans such as an alternate-day driving system for odd-even car licence plates, differentiation of office attendance hours, and limitation of vehicles on official duty. Among them, the differentiation of office attendance hours had the most positive effect during that period. According to some source, the traffic volume in Beijing reduced by 22.5% during the Olympic Games compared to the figure before the Olympics.

IV. Policy Suggestion

Measures for transportation demand

management which are relevant to the Jeju traffic situation are suggested here in reference to the cases in Singapore and Beijing. The most important and the most difficult policy to implement is the total number of vehicles system. This system is meaningful because it is an ideal type for the TDM and has the highest priority. A variety of measures for transportation demand management are as follows.

(1) Introduction of the Total number of Vehicles System

In order to discourage drivers from owning vehicles, this system increase taxes on owning vehicles. The limitation can be set as two vehicles per household. Within the limitation, car owners pay described taxes and if they purchase more vehicles than the limitation, they must pay additional described taxes for owning more vehicles than the limit. The limitation is set for two vehicles per household because the number of vehicles per household on Jeju has already exceeded 1.35.

(2) Introducing Motor Fuel Tax on Energy Consumption

This system is to levy taxes on energy consumption. This kind of policy can change drivers' behavior because it is like imposing taxes on driving vehicles. Under this system, if drivers use his/her vehicles much, they have to pay higher taxes and if they don't, they should pay lower taxes. If Jeju introduces a tax system which levies taxes on energy consumption such as motor fuel tax, the transportation demand in the Jeju area can decrease. This system is fair both to drivers and non-drivers and also accords with market economy principles so it can be said that the motor fuel tax system can easily secure policy compliance from the public.

(3) Differentiation of Parking Fees Based on Types of Vehicles

Parking is stationary traffic. Managing parking demand is also one of useful measures of transportation demand management. It is possible to control transportation demand efficiently through parking fees. Transportation demand management through parking fees enables the authorities to control and limit use of vehicles effectively. Implementing differentiation of parking fees based on congested time and area will double the effectiveness of the policy.

(4) Charging for Mileage

This is a system that local governments charge for mileage based on reports from drivers. In other words, automobile tax will be differentiated according to vehicles' mileage. Drivers who use roads will bear the beneficiary charge. Under this system, local governments will receive mileage reports for the past year from drivers and impose taxes on them once a year. In case that drivers scrap their vehicles, the taxes can be levied on the mileage from the time of the last report to the time of the scrappage and this will encourage drivers report their mileage voluntarily. This policy can change people's driving patterns dramatically. If local governments carry forward this policy strongly, use of public transportation may increase.

(5) Collecting Congestion Fees and Levying Garage Option

This policy is to collect congestion fees on vehicles if they enter designated congestion areas. This can induce drivers to avoid rush hours or congestion areas. The USA, Singapore and some parts of Hong Kong have already implemented this system and had some positive effects. If this policy is adopted and reasonable fees are levied, flexible transportation demand management can be possible. If the EPR system is incorporated with the congestion fee collection system, success rates will increase.

The levying garage option in “dong” areas in Jeju City has been challenged. There is a burden on securing garages for both house owners and tenants but no incentives for their effort. The policy, under which the congestion fees are levied on vehicles entering the dong areas in Jeju City and the fees can be lowered in the form of incentives for those who secure garages in the dong areas, is worth considering. It can be said that this policy can both improve the efficiency of the levying garage option and secure policy compliancy of the congestion fee collection system.

(6) Managing License Plates through Auction

This policy is to put license plates up at auction for controlling the vehicle registration in the Jeju area. In other words, this is to make drivers bear the costs of purchasing the license plates and preferred plate numbers. The total number of vehicle system and the license plate auction system are in the same vein. For the success of these policies, an exact estimate of the number of vehicles approved is needed in order to set the appropriate standards.

V. Conclusion

The purpose of this study is to present many policies of transportation demand management and ways to institutionalize them in order to actively introduce the total number of vehicles system as a strategy to solve the traffic problems in the Jeju area and protect the environment on Jeju Island.

The number of vehicles per capita on Jeju reaches to the highest level in the nation and the rate of the increase of the number is still high, so it is time to take special measures to solve the problems. Therefore, in this situation, this study tries to present some effective policies as means to manage transportation demand. Among them, it is important for this

study to propose the total number of vehicle system as the most important way of solving the traffic problems on Jeju Island.

Transportation Demand Management refers to all the policies which aim to control transportation demand to appropriate levels by changing drivers' behavior.

Singapore is the representative nation which has successfully adopted and implemented the total number of vehicle system. Beijing is also introducing measures and policies to manage transportation demand actively. This study briefly analyzes and summarizes these two cases. Jeju Island needs to study these kinds of foreign cases thoroughly and introduce transportation demand management systems which can serve as a model for solving the existing traffic problems.

In this study, various measures and policies of transportation demand management as well as the total number of vehicle system are presented. These are considered as long-term policies which need to be applied to the Jeju area. Implementing these policies will need some time to attract the public's policy compliance and they need to be institutionalized through a variety of ways. Below are the ways to achieve this goal: (1) Introduction of the total number of vehicles system, (2) introducing motor fuel tax on energy consumption, (3) differentiation of parking fees based on types of vehicles, (4) charging for mileage, (5) collecting congestion fees and levying garage option, and (6) managing license plates through auction.

It is not easy to introduce and institutionalize these transportation demand management measures. However, these measures should be implemented over time through study and research, publicity activities and education. Jeju Special Self-Governing Province and experts in related fields should devote effort to

successfully adopt these policies for a clean Jeju Island.

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