

**Integration of Land Use and Transportation Planning:
Singapore as a Case Study**

by

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Submitted to the Department of Urban Studies and Planning
in Partial Fulfillment of the Requirements for the Degree of
Master in City Planning

at the

Massachusetts Institute of Technology

June 1997

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ABSTRACT

Concerns with traffic growth and congestion have led to the introduction of a variety of policies and measures in Singapore. Key elements effective today include comprehensive planning of land use and controls, enhancement with expansions to the road and rail infrastructure, application of transport demand management techniques through various fiscal and regulatory measures, and improvements to service levels of transportation systems.

This case study examines and discusses some of the successful aspects and issues encountered from the current multitude of planning and transport policies in Singapore. This is done in an attempt to gain a better understanding of the potential achievements of the various policies and measures together with their inherent impacts, in view of the expected time frame from which the benefits of each policy can be realized. This assessment can also serve as a useful framework for transport planners to have a better insight of the various measures at play, and from there, make better judgments and decisions of the options to take, in achieving the desired objectives of managing traffic congestion effectively. From this, a policy package is suggested to offer as wide a range of measures that may be appropriate in Singapore's context.

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Acknowledgments

This thesis has been an interesting topic for me, partly because of my working experience with the national planning authority, but partly also because of my experience as a car user in Singapore. It has been a struggle of what I would like to see happen for the overall well-being of the country and its people, and what I would rather prefer personally, as a car user.

I am grateful to John de Monchaux and Ken Kruckemeyer for their guidance, and probing comments in helping to develop a better perspective of the issues and piece my thoughts together. I would like to thank my friends, Cindy, Melissa, Kuo-Yi, Maverick, Eng Hwee, Richard, and Mei Chee for their friendship and the enjoyable times together.

Most of all, I am indebted to my parents and family for their patience, support, encouragement and love throughout my studies at MIT. My wife, Peck Hong, who has endured my mood swings, and my children, Ronathan and Zanelle, for their love and understanding.

This is to my parents and family.

Cliff Lee
May 15, 1997

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Chapter 1 INTRODUCTION

1.1 Introduction

Transportation, in its many roles and forms, impinges upon the everyday lives of millions of people and on the environment. The motor vehicle for instance, performs a critical functional role in modern economies which cannot be easily or rapidly replaced without affecting the social and economic aspects of a country. Collectively, the resulting growth of motorized transport, which is essentially one of scale and concentration, can lead to major negative environmental impacts.

Worldwide, growth in transport demand varies from city to city but certain basic underlying factors are common to increases in demand. These include increases in: urban populations, city size, level of motorization, household incomes, and commercial and industrial activity. In effect, these demand-side factors influence the number and distribution of people and the activities they wish to undertake. Alternatively, it can also be said that demand for urban transport is affected by the efficiency of the transport system which facilitates or frustrates travel.

Like many urban cities around the world, Singapore is constantly faced with the growth in transport demand. The challenge has been to achieve what seems to be conflicting goals of sustaining or improving economic growth and meeting the aspirations of an increasingly affluent society at the same time. To this end, Singapore is one of the few countries to demonstrate that restraining motorization, restricting vehicle use and providing efficient, affordable and attractive public transport services can be combined to manage congestion. It has been viewed by some, however, that the impacts of some of the more stringent transport policies currently in force, albeit effective in achieving the objectives, may have been overly discouraging toward car ownership and use.

1.2 Objectives of Study

The main objective of this thesis is to look into Singapore's successful land use and transport planning policies as a case study in managing traffic growth and examine some of the key factors that have contributed to this achievement. In addition, the study will also assess some of the societal impacts arising from these policies and discuss possible concerns.

Lastly, it will attempt to suggest some ideas and improvements that may be suitable in Singapore's context in controlling and managing traffic growth, by drawing on some of the experiences of other cities. It should be noted that not all of the suggestions will be as effective in alleviating traffic congestion, but

more importantly, it should be borne in mind that the degree of effectiveness must also be weighed against the impact to those that will be affected by it.

1.3 Scope of Study and Organization

Although the title of this study generally covers a large range of topics that affect the mobility functions of a city, the scope of this study will be limited to urban transport - more specifically to the planning and transport policies that affect the movement of people. It will not attempt to suggest or discuss the financing aspects of the recommendations included herein. This will keep the focus of the study at a more manageable level and provide a basis for discussing the main dimensions and impacts of some of these policies.

The organization of this thesis is outlined below. Chapter 2 gives a general description of the different categories of approaches that are available in planning, controlling and managing the demand of urban traffic growth. Chapter 3 provides a brief background of Singapore, its government structure, and a general context of the urban transport problem with respect to traffic congestion and other negative impacts to the environment.

Chapter 4 outlines the key planning concepts and strategies and transport policies that are currently adopted by Singapore and discusses some of the inherent strengths and weaknesses. Chapter 5 analyzes some of the more crucial policies in Singapore including those that are viewed by some to be overly enthusiastic in managing traffic growth. It discusses the advantages and concerns, and where appropriate, possible solutions are suggested to mitigate these concerns, citing workable alternatives from foreign cities.

Chapter 6 takes a look at some general implications as a result of the policies in force, and attempts to give a broader perspective of the potential achievements set against the negative impacts for each policy. Chapter 7 summarizes by outlining the conclusions drawn, which include identifying what are some of the possible issues for Singapore to address, and some suggestions of improvements to Singapore's existing land use and transport planning practices and policies.

Chapter 2 CATEGORIES OF METHODS

2.1 Introduction

Traffic congestion is increasingly becoming a universal problem for many urbanized cities all over the world. There are, however, a wide spectrum of proposed and tried methods available, ranging from short-term effects to long-term solutions in guiding the transport system towards the desired goals of a congestion-free city. In general, these methods can be grouped under the following four broad categories described below.

2.2 Land Use Planning and Control

Land use means how the land is used and in particular what human activities are conducted and constructions allowed in what location. A land-use plan indicates what land is planned to be developed or re-developed and what is planned to be left undeveloped (e.g. green space). Additionally, it can be used to plan and safeguard the needs of the people in the long term.

Knowledge of the geographical settlement pattern of people and economic activity is crucial to the planning and development of transportation systems. It is one of the most important determinants of the demand for travel - how much travel is generated between any two points.

Transportation is but only one consideration in the development of the desired urban form. The land-use pattern is fundamental to achieving a wide range of national objectives other than transport. However, without the proper planning and control of land use, whatever transport capacity available is likely to be short-lived and eventually some compromise to the desired urban form has to be made.

2.3 Transport Capacity Expansion

The question of adding physical transport capacity inevitably remains: how much, what type and where should these be supplied? A key constraint is money, as building new capacity can be expensive, especially in a built environment. How should the plan deploy limited resources more effectively to meet the defined goals and objectives of the transportation system?

Several types of transportation technology are available. For instance, for transit there is the local bus, express bus, busway (i.e. a separate roadway or guideway), commuter rail, and several variations of rapid transit, such as conventional light rail, intermediate capacity rail, and heavy rail or subway

systems. Roads vary by width and spacing of access points, range from narrow local streets with frequent intersections to multi-lane freeways with widely spaced interchanges.

Each type of transport facility has its own cost, capacity, life-cycle, performance and other characteristics. Which type of capacity best fits for what population density and city's characteristics, and in what location? What new technologies will be available over the next 20 or 30 years, with improved characteristics? These are complex questions that depend on a variety of factors and outcomes. Many different transport networks could serve a given pattern of transport demand and, unfortunately, there is no simple mechanical, computerized method available for adding new optimal links to the existing system.

2.4 Transportation Demand Management

Transportation demand management (TDM) comprises a variety of measures and techniques to change the behavior of travelers in order to make better use of the existing transport system. It can discourage peak travel especially for trips made by single-occupant vehicles, encourage off-peak travel, and/or accord priority to public transport, by incorporating measures such as road pricing, gas taxes, parking management, and park and ride schemes. Though not the complete solution, it can postpone capital investment and shift travel demand to boost transit and carpool use. TDM can effect the following three main changes: change in amount of travel, change in mode of travel, and change in time of travel.

2.5 Transport Service Levels

Service level means the quality of the service experienced by the traveler using the particular mode of transport. Aspects of service level generally include, among other qualities, speed, convenience, frequency of service, comfort, and accessibility. The extent to which each aspect is desired, however, varies between different individuals.

Service level is a strong competitive factor among modes of transport. It influences the choice of travel mode of travelers. For instance, many commuters will choose not to travel by public transport, regardless of the fare, if it is not quick and convenient enough compared to the automobile. A proportion of car users, on the other hand, will consider changing to transit use if congested roads are being priced for their use or if parking supply becomes limited. Thus, selectively improving the relative service levels of the different modes or in different places can cause shifts in travel patterns.

Congestion is usually considered an undesirable element in any transport planning exercise. However, allowing the level of congestion to worsen for car users may sometimes be a practical method of promoting the use of rail transit. It also helps increase the effectiveness of some TDM measures such as park and ride schemes and high-occupancy vehicles (HOV) lanes.

2.6 Purpose of Categorizing

By grouping the range of methods into these four categories, a clearer distinction, and therefore better understanding, of the different functions, limitations and likely results of each method can be anticipated. Thus, for the purpose of this study, the various methods outlined in Chapters 4 and 5 are grouped into the four categories to give a broader context of the discussion of each method, as well as to provide a better sense of the overall balance adopted between the four categories for Singapore.

Chapter 3 BACKGROUND OF SINGAPORE

3.1 Background

The Republic of Singapore is a small city-state country with no natural resources. It is an equatorial country with abundant rainfall, high humidity and relatively uniform temperature averaging 80 degrees Fahrenheit (26.7 degrees Celsius) daily. At about 250 square miles (640 square kilometers) in land area, it is the smallest country in East and Southeast Asia (Figure 1). With a gross population density of about 12,000 persons per square mile (4,700 persons per square kilometer), the island state is considered to be relatively crowded for its 3 million inhabitants. The city is located at the southern part of the main island.

The British occupied the island in 1819 in order to establish a bridgehead for colonial expansion in the region. The island achieved internal self-government in 1959, and became an independent nation in 1965 after joining the Federation of Malaysia for less than two years. The present government has remained in power since 1959.

3.2 Institutional Structure

Unlike the multi-level government structure of many larger countries, Singapore has only a single level of government comprising of fourteen ministries. The ministers are appointed by the President on the advice of the Prime Minister and are selected from among the Members of Parliament. Each ministry's policies are executed by government departments and statutory boards that are under their responsibility.

The two main government agencies that play a key role in the planning of land use and transportation for Singapore are the Urban Redevelopment Authority (URA) and the Land Transport Authority (LTA). The Urban Redevelopment Authority is the national planning and conservation authority for Singapore. It is a statutory board under the Ministry of National Development which oversees the physical planning, urban redevelopment, public housing, public works, parks, and recreational facilities. As the agency responsible for the nation's physical planning and urban redevelopment, the URA is responsible for the planning and facilitating of land use and infrastructure development in Singapore, through the preparation of long-range plans and detailed local area plans to guide its physical development.

The second organization, the Land Transport Authority, is accountable for the land transportation aspects of Singapore. It was formed in September 1995 following the merger of the former Mass Rapid Transit Corporation, Roads and Transportation Division of the Public Works Department, the Registry of Vehicles and the Land Transport Division of the Ministry of Communications. Under the purview of the Ministry of Communications, the LTA is responsible for the planning, development, implementation and management of all public and private land transport infrastructure and policies. It is given the crucial task of providing an integrated and efficient land transport system to meet the needs and expectations of Singaporeans, while supporting the economic and environmental goals for the country.

A paternalistic, top-down planning approach has often been adopted by the government administration in implementing tough policies that it considers to be of national interest. Nonetheless, the government's authority over the planning process has produced the positive result that the limited land resources are put to optimal use without compromising future land requirements.

3.3 Urban Transport Problem

Singapore's gross domestic product (GDP) rose from S\$2 billion in 1960 to S\$64 billion in 1990¹ - a more than 30-fold increase over a 30-year period. And Singaporeans have shared in this rapid economic growth. As the per capita incomes grow and the population becomes more affluent, the aspirations of Singaporeans will also grow.

One of the most noticeable concerns with respect to the growing affluence of the population is the desire of each household to own a car and enjoy the benefits offered by personal mobility. Inevitably, the consequence will be the so-called 'urban transport problem' of excessive traffic congestion, casualties, air and noise pollution etc. which has plagued many urban cities around the world. This is a major concern facing Singapore. Furthermore, as a nation scarce in land resources, Singapore does not have the luxury to allow urban sprawl. Nor can it afford to increase the supply-side of private transport infrastructure to meet expanding needs.

Over the years, policy-makers have been aggressive in seeking to alleviate this overwhelming urban transport problem in Singapore. As such, Singapore is already one of the lowest car-owning societies with a significant proportion using public transport compared to many other urban cities of the developed countries

¹ Source: Department of Statistics, Singapore.

(Figures 2 and 3). However, the urban transport problem is an issue that cannot be solved once and for all but must be managed with improvements made continually to respond to changing urban conditions.

Figure 2: Transit Usage vs Car Ownership

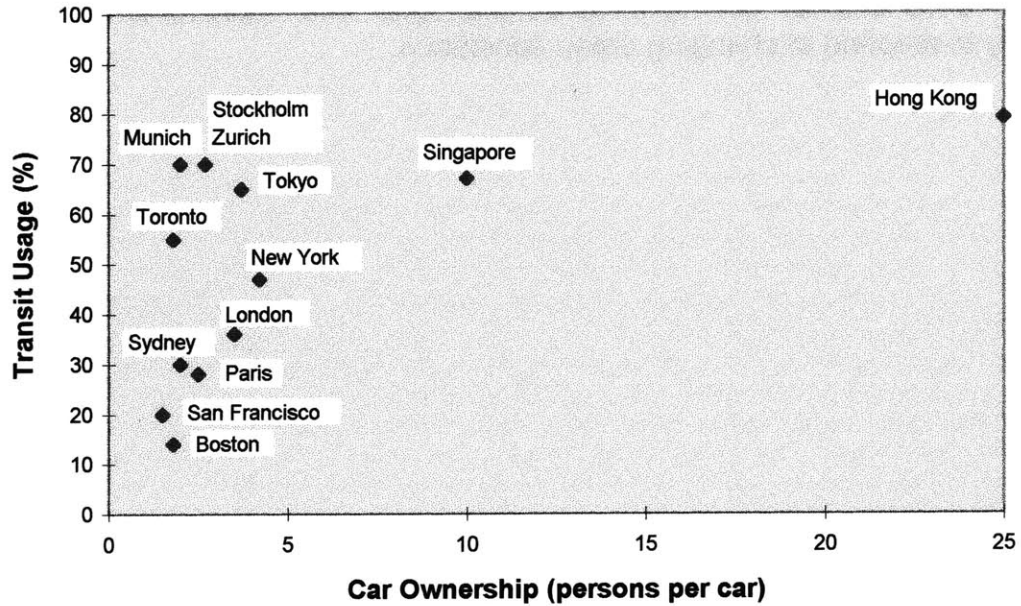
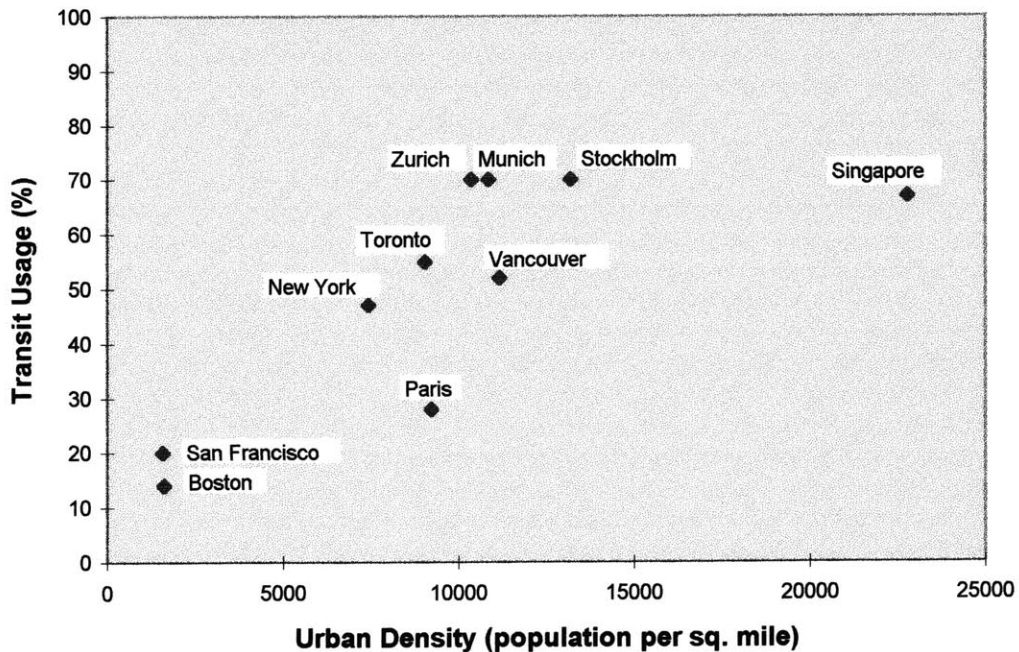


Figure 3: Transit Usage vs Urban Density



Source: Various sources including URA Study Mission Report - Development of a Strategic Transportation Plan for Singapore; Bureau of Transportation Statistics, U.S. Department of Transportation; Transport 2021 Long Range Plan for Greater Vancouver; Cities and Automobile Dependence, Newman and Kenworthy.

Note: Time period of data varies between 1985 to 1995, among various sources.

Chapter 4 PRESENT PLANNING AND TRANSPORTATION POLICIES

4.1 Introduction

A majority of the wide array of land use planning strategies and urban transport policies currently in place in Singapore have been introduced primarily to provide free-flowing traffic within the constraints of limited land. A four-pronged approach has been adopted to achieve this. Firstly, the need to travel is minimized through systematic town planning. Secondly, an extensive and comprehensive network of roads and expressways, augmented by traffic management measures, has been built to provide quick accessibility to all of parts of Singapore. Thirdly, a viable and efficient public transport system that integrates the mass transit with bus services is promoted. And finally, the growth and usage of vehicles are managed to prevent congestion on the roads.

In 1990, Singapore is one of the few urban cities in Asia where the average city travel speed of about 19 miles per hour (30 kilometers per hour) exceeds the average peak hour travel speed of 10 miles per hour (16 kilometers per hour) in most large cities around the world.² This is because a conscious decision has been taken by the government to manage congestion for both the well being of the people and the economy at large. These efforts have also contributed toward fuel conservation and protecting the environment locally as well as globally.

However, as with many other cities in the world, Singapore has yet to find the "success formula" that can efficiently manage the demand for travel in an effective and publicly acceptable way. As such, there is a continual need for Singapore to develop more innovative policies as well as participate more actively in the areas of research and development of new technologies in managing and controlling its traffic growth.

Over the years, the following key factors and policies have largely contributed toward Singapore's current traffic conditions.

4.2 Government's Role

4.2.1 Single-Level Government

Compared with many larger countries, the public administration of Singapore is greatly simplified by having only a single level of government. Thus, it escapes from many of the inherent problems arising from decentralized decision-making processes across the different levels

² Source: Midgley, 1994.

of government and institutions, as experienced by larger countries. This has fortuitously permitted a more efficient system in the implementation of national policies by the administration. At the same time, this has provided a conducive platform for close cooperation between the various government departments and agencies irrespective of ministerial jurisdiction - often the much desired working environment for the administering and regulating of centrally coordinated policies.

4.2.2 Political Commitment

One of the key elements to the successful planning of the limited land resources is attributed to the government's commitment to the long-term plan. To a large extent, this has been made possible by the political stability of the city-state - Singapore has been governed by the same political party since gaining self-government status in 1959. It has permitted the government to take a long-term position by investing in large-scale projects, as well as tough and sometimes unpopular policies that yield long-term benefits to the country.

4.3 Land Use Planning and Control

Land use planning in Singapore is necessary to ensure optimal utilization of its limited land. This task is executed at two levels, namely, strategic planning at the macro level to cater for the entire needs of the nation, and local planning at the micro level to interpret the planning guidelines at the local level. The current direction of Singapore's physical development is dictated by the revised Concept Plan completed in 1991. The Concept Plan is an integrated long-range blueprint that plans ahead for a Singapore with four million people. It is geared towards sustaining economic growth while meeting the needs and aspirations of an increasingly affluent population.

At the local planning level, the broad development strategies and policies of the Concept Plan is translated into specific planning and development guidelines for local areas known as Development Guide Plans (DGPs). Singapore is divided into a total of 55 DGPs. These DGPs set out detailed planning policies and guidelines on land use, intensity of developments, building heights, transport, environment improvements, pedestrian and open space systems, conservation and development of land.

4.3.1 Decentralization

A major planning principle in the Concept Plan is that of decentralization. The decentralization of commercial, residential and other economic activities has been one of the underlying strategies in avoiding an overloading of the city's transport infrastructure as a consequence of

over-development. This is achieved through the development of regional, sub-regional, and fringe centers away from the city center, but connecting them with an efficient system of expressways, roads and public transport.

In the medium to long term, the need for people to travel will thus be minimized. Workplaces will be brought nearer to homes by locating employment areas like commercial centers, business parks and industrial estates close to residential areas. This will also have the added benefit of better utilizing the transport network in both directions.

4.3.2 Integrated Development Planning

At the local level of planning, the conscious approach to reduce inter- and intra-center travel is to plan for integrated, mixed-use developments at and around existing and future public transport nodes such as mass transit stations and bus interchanges. A variety of integrated developments surrounding the major transport nodes will entail a proper mix of commercial, residential, and industrial developments, including the transport node itself which may be in the form of an integrated inter-modal transport facility cum-commercial and/or office complex. Through zoning regulations, development densities will be highest within proximity of the transport nodes, and less compact developments will be dispersed further away from these nodes. The adoption of this planning approach is aimed at achieving the following three intentions: (i) to minimize the distance of travel to and from work and other daily needs and services; (ii) to reduce the inconvenience of transfers; and (iii) to optimize land development around transport nodes.

4.4 Transport Capacity Expansion

The Singapore government has embarked on an ambitious plan to improve various aspects of its transportation systems, by committing some billions of dollars to build the infrastructure. Among the improvement projects and policies specific to land transport are:

4.4.1 Building More Roads

Singapore has an extensive network of expressways, arterial roads and flyovers to facilitate the transport of people and goods. There are nearly 1,900 miles (3,035 kilometers) of roads as at December 1995, the longest being the 25.6-mile long (41-kilometer) Pan-Island Expressway.³ At present, roads constitute about 12 percent of the island's area, about the same percentage as housing.⁴

³ Source: Ministry of Information and the Arts, Singapore.

⁴ Source: Urban Redevelopment Authority, Singapore.

The government's aim is to develop a comprehensive road network for the entire island. It has drawn up a major US\$0.79 billion road expansion program estimated to add another 141 lane-miles (225 lane-kilometers) to the existing road network over the next five years (Land Transport Authority, 1996). It will include new expressways, expansion of major arterial roads and upgrading of key junctions into 2- to 4-tier interchanges. In addition, the government is seriously evaluating the feasibility of building an underground ring road system that promises to add 40 percent more road capacity within the city. Approximately 9.4 miles (15 kilometers) in length, the proposed underground ring road will consist of two to four lanes wide in each direction, with 8 interchanges and 33 entrances and exits to allow for easy connection from surface roads. It is estimated to cost US\$3.4 billion in capital and US\$57 million a year in operating cost. If approved, the mega project is expected to be built in phases over a 15-year period.

The establishment of a comprehensive road network will benefit not only private transport, but also public transport such as buses and taxis. However, the expansion of the road network has to constantly take into account of other concerns such as land uptake and urban form - the provision of transport infrastructure should serve as a link for people and places and not result in severing people from places.

4.4.2 Increase Transit Density

As a compact city-state, planners envisage rail as the way ahead. It has the ability to move large numbers of people at high speeds in a comfortable environment, and can do this by taking up minimal land by being under or above ground. Thus in the Concept Plan, the present 52-mile (83-kilometer) Mass Rapid Transit (MRT) system network will be the backbone of the country's public transport to cope with the long-term transport needs. It resembles a radial network and currently has a total of 48 stations. The trains are electrically propelled and each train consists of six connected, fully air-conditioned cars. Fare structure is largely based on distanced traveled. Starting fare is US\$0.43 (S\$0.60) with a maximum of US\$1.14 (S\$1.60) for each journey. Presently, an approximately 700,000 passenger trips are made per day.⁵

With the first light rail transit (LRT) project under way, Singapore now offers three primary means of transit. The heaviest corridors will be served by MRT. LRT will be put in areas where the density may not warrant for an MRT system. For lighter corridors, buses will be used.

⁵ Source: Ministry of Information and the Arts, Singapore.

Buses are also seen to assume the vital role as feeder systems to the comparatively inflexible MRT and, to a lesser extent, LRT systems.

With this combination, the Concept Plan aims to connect every populated area with an attractive alternate mode of transport to the car. Not only must the public transport system be efficient, comfortable and affordable, but its network must also be dense enough to enhance accessibility and make transfers seamless. In working towards this objective, authorities are advocating spacings of 0.375-0.5 mile (600-800 meters) for MRT stations within city areas, based on observations from foreign cities.⁶ Maximum distance between bus stops within and outside of town areas should be 0.22 mile (350 meters) and 0.25 mile (400 meters) apart, respectively. Proximity of bus stops to MRT stations or major bus transfer stops are to be sited within 150 meters. Bus operators are required to provide a trunk service for every 3,000 dwelling units (DUs) if there is no MRT serving the town, and a trunk service provided for every 3,500 DUs if the MRT serves the town.⁷

As a benchmark, the long-range Concept Plan envisions a comprehensive rail network as accessible and extensive as those found in London, Paris or Tokyo today.

Among the major plans to increase transit density include: (i) the addition of a 12.5-mile (20-kilometer) line to the existing urban rail (MRT) network (Figure 4) with a projected cost of US\$3.6 billion and operational by year 2003; (ii) the recently awarded US\$240 million contract to build a 5-mile (8-kilometer) light rail transit system which will be operational in 1998, and (iii) establishing a comprehensive US\$0.7 billion light rail transit system to serve the public housing estates and commercial areas with high ridership.

4.4.3 Transit Subsidy

In order to permit the operating agency of the MRT (and in future the LRT as well) to set an affordable fare to the public, the government has adopted the policy of providing for the transport infrastructure, thereby removing the heavy burden of the operating agency to recover the capital costs. The operating agency only has to cover its operating, maintenance, and replacement costs for the system as the government believes that each generation should pay for their own operating assets.

⁶ Source: The Urban Redevelopment Authority, Singapore.

⁷ Source: Public Transport Council, Singapore.

4.5 Transportation Demand Management

The Government checks urban traffic congestion by regulating the ownership and use of private cars and by restricting access into the Central Business District (CBD) during certain hours. Measures adopted in pursuit of this aim include the imposition of CBD license and parking fees, the Vehicle Quota System (VQS), and high rates for annual motor vehicle licenses (road tax). As a result, there are less cars per capita of population than many other developed countries, with the exception of Hong Kong (see Table 1). These measures have kept the car population to a moderate increase in growth compared to other countries (Figure 5).

The main transportation demand management methods employed in Singapore include the following:

4.5.1 Parking Restraint Policies

The limited supply of parking spaces and high parking charges in CBDs have traditionally been the main instruments of pure restraint in discouraging car usage in many Western cities for the past two or three decades. When parking spaces on-street and off-street are insufficient or if parking charges are levied relatively high in the business area, motorists will want to seek alternative mode of transport for their work trips.⁸

Singapore adopts a relatively simple set of regulations for its parking policy. Charges for public parking spaces within the city limits is currently set at US\$1.29 (US\$1.80) per hour for daytime hours, which is double the cost for areas outside the city. Evening charges are generally lower (and free in certain areas) due to lower demand. In terms of parking supply, developers are required to provide minimum car parking space based on parking standards, to meet anticipated needs.

In an attempt to reduce employer-based auto trips, the government laid down strict controls (in 1991/1992) of not allowing public agency employees working in the city area to have free or readily available parking spaces at their place of work. This is somewhat similar to the Employer-Based Trip Reductions program found in Los Angeles where reductions appeared feasible provided that: (i) employers are willing to charge for workplace parking; (ii) alternate free parking (e.g., on-street) is not readily available; and (iii) incentives are offered to transit and ridesharing users.⁹

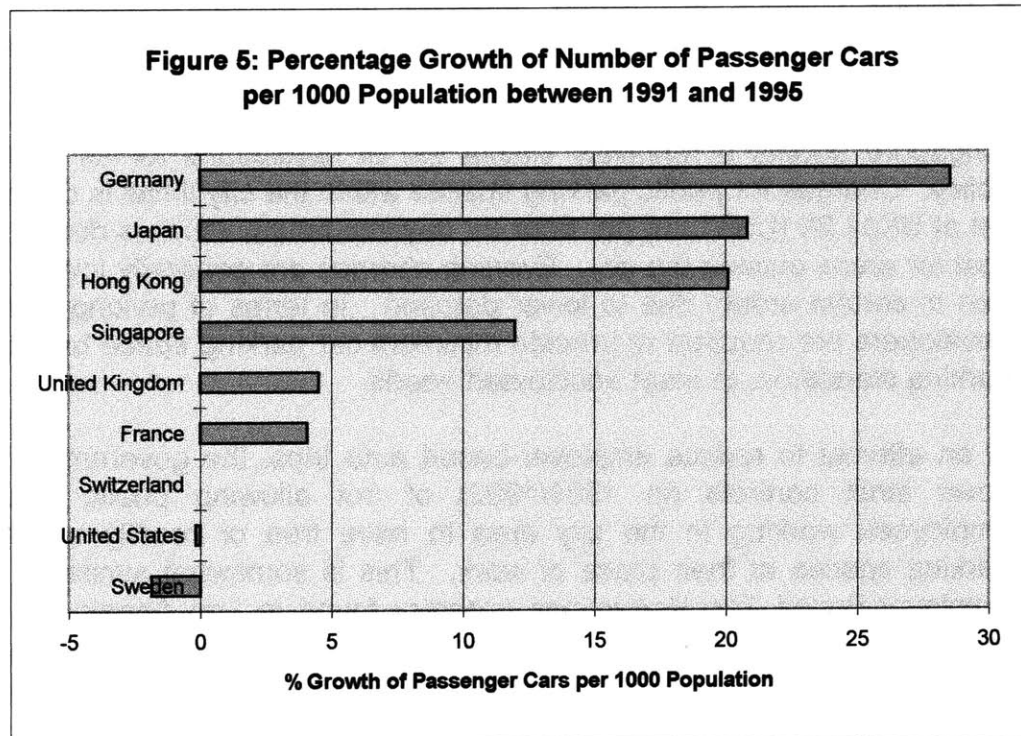
⁸ Roth and Thomson, 1963.

⁹ Harvey and Deakin, 1992.

Table 1: Number of Passenger Cars per 1000 Population for Selected Countries, in 1991 and 1995.

Country	Number of Passenger Cars per 1000 Population	
	(Year 1991)	(Year 1995)
France	416	433
Germany	384.8	494.8
Hong Kong	45.2	54.3
Japan	298.1	360.3
Singapore	103.3	115.7
Sweden	418.7	410.9
Switzerland	457	457
United Kingdom	349.9	365.8
United States	563.7	562.8

Source: International Road Federation.



Source: International Road Federation.

To be effective, such measures require vigorous employer cooperation. Thus, the Singapore government has also encouraged the private sector to impose the same, in order to gain a concerted effort in discouraging the use of private transport in city areas during peak hours. However as of date, the private sector has been slow in its efforts as these policies involve administrative burdens and are frequently unpopular with employees.

4.5.2 Congestion Pricing (present: ALS; future: ERP)

The concept of congestion pricing, proposed by the late Nobel Laureate (1996) Professor William Vickrey at Columbia University in the 1960s¹⁰, deals with the smoothing of demand peaks and troughs by linking prices to demand. Just as there is a price which acts as a mechanism to equate the supply and demand of a particular commodity and prevents queues from forming up to purchase them at artificially low prices, so it is possible to estimate a price for road space which rations it out amongst those desiring to use it.

The Singapore congestion pricing system, which was introduced in 1975 as part of a wider package of measures embracing parking controls, vehicle taxation, public transport provision and infrastructure enhancement, has attracted widespread attention. Known as the Area Licensing Scheme (ALS), it has had a number of changes since, including the fee charged, the operational hours, and the car pooling policy. The scheme, which has been upgraded to a full-day road pricing in 1995, is simple to operate: motorists must pre-purchase an entry license before making the trip into the CBD.

In addition to the cordon CBD area by the ALS, a pilot Road Pricing Scheme (RPS) was implemented along a stretch of one of the major expressways (East Coast Parkway), in June 1995. Aimed at relieving congestion along that stretch of the expressway during the morning peak hours, the pilot scheme keeps the short operation hours (between 7:30 am and 8:30 am) functional only on weekdays. Valid ALS licenses (part-day or whole-day) are also good for passing through the RPS gantries. The authorities have recently announced another two expressways (Central Expressway and Pan-Island Expressway) that will also be operated with RPS from June of 1997.

Data from the Land Transport Authority has shown that the number of cars entering the restricted zone during the morning peak period (7:30 am

¹⁰ Vickrey, 1963.

to 10:15 am) in 1989 has still been below the 50 percent figure in 1975, before the ALS was implemented. The impact of the ALS implementation in the early years of the scheme is given in Table 2 below. This is even more impressive when seen in the context of Singapore's development. In the 14 years of ALS operation from 1975 to 1989, the restricted zone has grown by a third in terms of employment, a tenth in size, and the car population in Singapore has increased by more than 80 percent.¹¹

Table 2: Impact of Singapore's Area Licensing Scheme on Congestion (1975 - 1979)

Time	Vehicle	May 1975 (Before Scheme)	May 1976	May 1977	May 1978	May 1979
7:00am-7:30am	Cars	5,384	5,675	6,488	6,723	5,723
	Car pools	176	509	636	606	497
	Total	9,800	10,332	11,489	11,692	10,596
7:30am-10:15am (Control Period)	Cars	42,790	10,754	10,350	11,350	13,181
	Car pools	2,369	4,641	5,337	5,684	5,756
	Total	74,014	37,587	44,318	47,503	49,606
10:15am-10:45am	Cars	n.a.	6,459	6,636	6,326	5,527
	Car pools	n.a.	320	280	281	232
	Total	n.a.	13,441	13,805	14,308	15,179

Source: Seah (1980)

Note: Figures denote number of vehicles.

¹¹ By 1992, the car population had more than doubled since 1975.

Experience with area licensing in Singapore has revealed, among other essential factors, the need for a competent and pragmatic management, with an organizational structure that fosters comprehensive policy-making and planning. Another factor that contributed to the successful implementation of the scheme included the relative ease of planning and decision-making in a city-state, with one geographical area. Yet other reasons cited were the cultural-social attitudes favorable to compliance with regulations - the general disposition that Singaporeans believe the government acts in the general social interest, and to accept rules and costs imposed on them.¹² Attempts in the late 1970s to institute area licensing for parts of London as well as in World Bank projects in Bangkok and Kuala Lumpur failed in part due to the resistance from the car owning lobby and central area business interests.

4.5.3 Electronic Road Pricing Scheme

Electronic Road Pricing (ERP) is a more technically sophisticated method of road congestion pricing. The system requires that each vehicle be fitted with an automatic vehicle identification (AVI) device, either in the form of a transponder mounted inside the windshield screen or underneath the vehicle¹³, the installation of roadside equipment at entry points to detect and interrogate the AVI in the passing vehicle, and a linked centralized computer. When trips are made during times of high traffic congestion, the computer records the congestion costs involved and the amount is either automatically deducted if it is a stored-value transponder or reflected in periodic bills sent to the vehicle owner giving a breakdown of the toll sites crossed, similar to a long distance telephone bill. In addition, roadside closed-circuit television cameras automatically shoot pictures of vehicles with faulty or tampered transponders.

In 1983, Hong Kong was the first city in the world to test the technical, economic and administrative viability of ERP to curtail traffic as an alternative to parking controls, area licensing and physical restraint measures. The 21-month pilot scheme, lasting from July 1983 to March 1985, was carried out using government department vehicles.¹⁴

¹² Dunkerley, H. (The World Bank), 1979.

¹³ In the case of the pilot ERP scheme in Hong Kong, the fleet of vehicles tested were fitted with Electronic Number Plates (ENPs).

¹⁴ Fong, 1985.

The proposed ERP scheme in Singapore is targeted for implementation in 1997. It will cover the same areas by replacing the current Area Licensing Scheme and Road Pricing Scheme, and will gradually be extended to other congested roads as and when deemed necessary.

The Singapore ERP system will essentially operate much the same way as that explained in the brief description above of an ERP system. It will require three main components, namely an In-vehicle Unit (IU) to be installed in the front windscreen of vehicle, the local charge-point controller and enforcement camera equipment at the entry point, and the central computer system. Upon entry into the restricted area during operational hours, an appropriate charge will be deducted from the stored value of the Smartcard. Details of the last 30 passings will be retained by the Smartcard, which can be printed out in case of disputes. Enforcement is by photographs from cameras where license plates of vehicles making illegal entries will be taken and offered as proof of violation.¹⁵

With AVI technology, the toll collection can be much more efficient, selective and flexible in achieving the objectives of limiting traffic in a specific area at a particular time. Although installation cost will be high, the system will basically remove both the physical license sales booths and the labor-intensive sales and enforcement personnel required for the manual ALS and RPS system. Operationally, it is a fairer system by charging on per entry basis instead of unlimited entry under the current manual system. In addition, it has the advantage of smoothening out peaks immediately before and after the restricted hours caused by the sudden rush of motorists entering the restricted zone just after the lifting of the restrictions. This is made possible with the electronic system, by having gradual increasing or decreasing intermediate rates over say half an hour prior and after the restricted period. By and large, the flexibility of the system imposes motorists to re-think about their travel behavior, inducing some to perhaps choose other alternatives such as combining trips, changing routes, shifting travel time, or taking public transport.

4.5.4 Vehicle Quota System

In May of 1990, the government implemented the regulation of the Vehicle Quota System (VQS) to achieve the transport objective of controlling total vehicle population in the country. Unprecedented anywhere in the world, the regulation requires that any person wishing to register a vehicle must first bid for the right or entitlement, called the Certificate of Entitlement (COE), to buy a car. Tender is conducted monthly by a closed bidding

¹⁵ Yee and Menon, 1994.

system, and each COE is valid for a period of 10 years from the date of registration of the vehicle. Upon expiry of the COE, it can be revalidated for another 5 or 10 years by paying the prevailing quota premium¹⁶, otherwise the vehicle will have to be de-registered.

To structure the system fairer to a larger population, different COE categories, differentiated by car engine capacity, are available for tender. With this direct control, the vehicle population growth has been effectively reduced from 6 percent to 3 percent per annum, with nearly 4,000 COEs being released each month. The COE price is determined based on the lowest price of the successful bids, that is, the "single strike price", for each category. The average market value of a COE is about US\$28,600¹⁷ (S\$40,000) per car.

With the vehicle population growth pegged at 3 percent, transport policy-makers in Singapore project the car to population ratio will be 1:7 by year 2010, a greater proportion from the present ratio of 1:10.

4.5.5 Off-Peak Car Scheme

Previously called the Weekend Car Scheme which was implemented in May 1991, the Off-Peak Car Scheme allows cars, that do not contribute to traffic congestion during peak hours, to be taxed at a lower rate. Off-peak cars are allowed free use of the roads from 7:00 pm to 7:00 am on weekdays, from 3:00 pm on Saturdays, and for the whole of Sunday and all public holidays. A US\$14 (S\$20) per day charge is required if the owner so decides to use the car during the non-free hours of the day, that is, from 7:00 am to 7:00 pm on weekdays and from 7:00 am to 3:00 pm on Saturdays.

Owners of cars enrolled in this scheme are entitled to many upfront and annual cost subsidies. For instance, off-peak car owners enjoy full rebate of the net Additional Registration Fee (ARF), full rebate of the Import Duty, and full-rebate of the COE, subject to a maximum of US\$10,700 (S\$15,000). They also pay only 30% of the road tax payable for the equivalent normal car.

It is expected that this scheme will remain even after the implementation of the ERP system, to progressively allow a greater number of cars to be used primarily during off-peak periods and weekends.

¹⁶ The prevailing quota premium is calculated based on the average COE price for the preceding 12 months (i.e., 12-month moving average). It is payable for old vehicles to remain on the road for another 10 years. Fee is halved for 5-year extensions.

¹⁷ Roughly the average COE value for the last quarter of 1996.

4.5.6 Car Pooling

When the ALS was introduced in Singapore in 1975, one of the requirements for an exemption from payment into the restricted area was to car pool. The regulation for car pooling necessitated that the vehicle be occupied by at least four persons.

In 1989 however, when the restricted hours for the scheme were lengthened to include the afternoon rush hours of 4:30 pm to 7:00 pm (later shortened to 6:30 pm), the car pooling policy (including certain types of vehicles) was removed from the exempt list.

The original scheme of the ALS with the inclusion of the car pooling policy revealed (see Table 2 earlier) that car pooling quickly became a popular option among those preferring automobile commuting. Although no figures were available, it could be observed that a significant proportion of the car pooling were a case of hitch-hiking of private cars at bus stops. This constituted a form of pinching of bus commuters by motorists and defeated the objective of the car pooling exemption.

4.5.7 Vehicle Registration Fee

A sizable portion of the upfront cost to own a car in Singapore is the Additional Registration Fee (ARF). Previously set at 175 percent of Open Market Value¹⁸ (OMV) of the car, the ARF was reduced to 160 percent of OMV in November 1990 to partially compensate for the COE quota premiums. It was further reduced to 150 percent in February 1991.

Past records during those two periods however, have shown that market forces will adjust and, in essence, the reduction in the ARF has only caused an equivalent increase in COE prices, without fundamentally changing the cost of owning a car.¹⁹

4.5.8 Road Tax

Traditionally, as the name suggests, road tax is used as a source of revenue for the provision and maintenance of road infrastructure. In Singapore, the hefty road tax is also being utilized as a crude tool for discouraging car ownership and controlling congestion. It is a one-off sum that is paid annually by vehicle owners, and the amount payable varies according to engine size. Currently, the road tax for a 1.6 liter (1,600 cubic centimeters) car costs approximately US\$1,020 (S\$1,440) per annum, an amount that is already at the high end compared to other countries (see Table 3).

¹⁸ Open Market Value is the listed value of the car upon entry to the country's port.

¹⁹ Past data of COE prices available from the former Registry of Vehicles in Singapore.

Table 3: Annual Road Tax for Cars in Selected Countries, 1995

Country	Annual Road Tax for Cars	Annual Road Tax for 1,600cc Car	Exch. Rate (=US\$1)
Germany	Pte. cars: DM 18.8 per 100cc Clean cars: DM 13.2 per 100cc; & DM 21.60 per 100cc after 1.1.86	US\$175	DM 1.72
G. Britain	GBP 145	US\$234	GBP 0.62
Hong Kong	From HK\$3,815 to HK\$11,215 according to vehicle horsepower	US\$492 - 1,447	HK\$7.75
Singapore	From S\$0.80 to S\$1.10 per cc	US\$1,000	S\$1.44
U.S.	All states: Varies by state from US\$8 to US\$2892 per year, depending on vehicle size/weight, private/contract carrier, farm/non-farm use, etc.	US\$8 - 2,892	n.a.

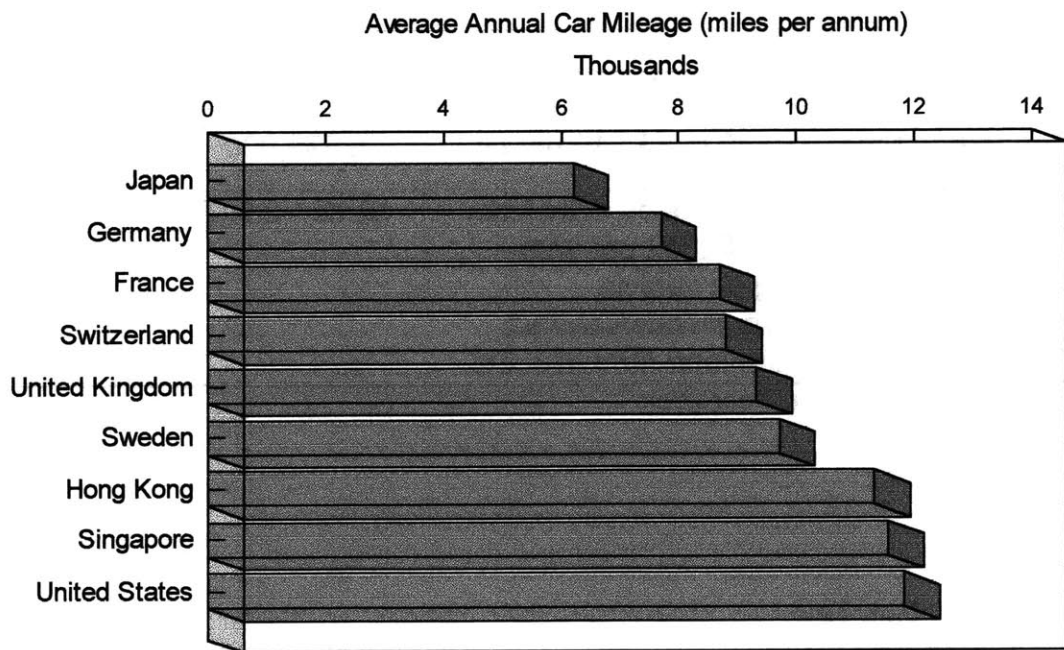
Source: International Road Federation

4.5.9 Gas Tax

Excise duty on gas is one of the oldest and most common forms of taxation imposed upon the vehicle owning population. Also traditionally used as a tool to collect revenue for road infrastructure purposes, gas tax has been increasingly exploited to satisfy a various of other objectives including penalizing road users.

In Singapore, the cost of gas, which has remained approximately the same for a while, is about US\$3.18 per gallon (S\$1.20 per liter). This is nearly two and a half times more than the gas price in the United States. Despite this high cost, the average annual mileage of cars in Singapore remains high by international standards, registering some 11,560 miles per annum (18,600 kilometers per annum), comparable to that of the U.S. (see Figure 6).

Figure 6: Average Annual Mileage of Passenger Cars for Selected Countries, 1995



Source: International Road Federation.

4.6 Transport Service Levels

Most transportation policy-makers, planners and engineers alike, share the same view: that is, the convenience and comfort offered by the automobile is unmatched by any other form of public transport currently available. The common levels of service that affect the mode choice of most, if not all, commuters include the following:

- o travel time
- o travel reliability
- o frequency
- o safety
- o waiting time
- o cost
- o comfort
- o accessibility

4.6.1 Technology

Increasingly, transport planning will involve looking to technology as one important response to the problems posed by growth and by the challenge to develop sustainable transportation systems. The potential of transportation technologies is essentially limitless, for both private and public transport. Some of the more promising technologies that have been incorporated or are being considered in Singapore are briefly mentioned below.

4.6.1.1 *Green Link Determining System*

The Green Link Determining (GLIDE) system is a computerized traffic signal control system which monitors traffic volumes at traffic junctions and coordinates the operation of traffic lights accordingly. It increases the capacity of the traffic light junctions by monitoring traffic flow in real time and optimizing the duration of red and green signals in both directions of traffic.

The GLIDE system was implemented in the city area in 1988 and is progressively being extended to control traffic signals outside the city. By the end of 1995, a total of 820 sets of traffic signals in eight regions came under the control of the GLIDE system. Works are in progress to extend the GLIDE System to the rest of Singapore.

4.6.1.2 *Automatic Network Travel Time System*

The Automatic Network Travel Time System (ANTTS), which commenced as a pilot project in 1995, is a traffic monitoring system that provides and monitors traffic conditions in real-time. It entails having devices installed at traffic light junctions and in buses and taxis to provide the communications channel for monitoring traveling speeds on roads.

The adoption of traffic monitoring systems like the Automatic Network Travel Time System (ANTTS) and close circuit televisions will progressively enable the monitoring of island-wide conditions and help set road usage charges to relieve localized traffic congestion. The authorities are further developing these systems to provide navigational and traffic information to commuters through communications systems such as the radio, telephone hotlines, variable message signs, and the internet.

4.6.1.3 *Bus-Priority Traffic Lights*

In addition to the lanes designated for buses only, Singapore is also in the process of giving greater priority to buses on the roads. More traffic light junctions will be fitted with "B" signals that will come on before the green light for other vehicles, to allow buses to filter across lanes. In addition, traffic lights with bus lanes will be fitted with sensors to detect approaching buses and turn green automatically, similar to the tram system in Zurich.

4.6.1.4 *Intelligent Transportation Systems*

Future advancements in technology will allow every commuter access to a wide variety of information before and during travel. Among possible areas for improvement by future intelligent transportation systems (ITS) technology are: (i) enhancing the capacity and safety of the transportation systems; (ii) helping to ease traffic congestion; and (iii) sensing real-time traffic more effectively to allow a greater amount of information to be communicated across.

Real-time information for public transport for instance, can serve to inform would-be commuters of delays, time of next bus or train, routes, time-tables, fares, etc., through the use of view-data systems and computer terminals in the home, stations, workplaces, and other public places including bus stop shelters. All these information will serve to better inform and allow commuters the ability to know what to do, in light of all these information.

It will be sometime before such sophisticated systems are reliable and affordable to Singapore. Thus, in the interim, the authorities are continuing their monitoring and evaluation of these new technologies as they come on-stream.

4.6.2 Virtual Slip Roads

The road authorities are currently trying out the notion of allowing motorists to turn left²⁰ even when the red traffic light is on, at selected traffic light junctions. This is similar but more restrictive than the American right-turn-on-red system in that green arrow lights will be used to signal motorists to turn, instead of the more laissez faire American style of letting motorists decide on their own. Other countries where similar virtual slip road systems are already being in use include Canada, Australia and Thailand.

4.6.3 Non-Motorized Modes Of Transport

Walking is by far the most common means of transport for short journeys in most cities. But because of the warm tropical climate all year round, Singaporeans typically tend to walk shorter distances than people living in colder climates. The provision of covered walkways and underground pedestrian links to transit stations are some of the measures taken in Singapore to improve walking conditions. Cycling, on the other hand, have the potential to play a greater role, not so much as a principal mode of transport for making trips, but to compliment transit use. Cycle and Ride schemes are becoming increasingly popular, especially at transit stations serving predominantly residential areas. Authorities can encourage greater use of cycling by way of expanding bicycle parking facilities to principle bus stops, stepping up enforcement measures against thefts, and providing cycle routes in new towns to make cycling both safer and more pleasant.

²⁰ Vehicles drive on the left side of the road in Singapore.

Chapter 5 CASE ANALYSIS AND DISCUSSION

5.1 Introduction

It is without a doubt that most, if not all, of the current policies in Singapore have been effective in controlling car growth and traffic congestion in the city area. However, there has been some criticism that some of the more stringent policies have been perceived to be overly enthusiastic in achieving the objectives and may not be the appropriate measures, in view of some of the disbeneficial impacts to certain individual groups within the society.

This section attempts to analyze and discuss, not all, but some of the more pertinent as well as radical policies. These policies are chosen predominantly from the first three categories: Land Use Planning and Control, Transport Capacity Expansion, and Transportation Demand Management. It also includes a closer examination of the main advantages, issues and concerns arising from the impacts of some of these policies. Where appropriate, possible alternatives and/or mitigation measures are suggested.

An assessment of the potential achievements and impacts of each policy and measure is given later in Chapter 6 and tabulated in Table 5, to give a broader perspective of the implications.

5.2 Land Use Planning and Control

5.2.1 Decentralization

The potential advantages of decentralization, through the creation of new towns and sub-centers that will be served by a high standard of infrastructure including good links back to the city, are clear. Such an urban structure, in which facilities are decentralized in order to be closer to the residents which they serve and to their workforce, can seek to shorten journey lengths and increase the proportion of the population which can access frequently-used facilities without resorting to car travel. If sub-centers involve a mix of uses, they also widen opportunities for people to make multi-purpose trips, as elaborated in the next section. If they are well served by public transport, and/or offer a safe and attractive environment for walking and cycling, they can be potentially helpful in reducing car dependence.

5.2.2 Integrated Development Planning: Intermixing Land Uses and Urban Intensification

In seeking to reduce travel or shorten trip lengths, it may be necessary to mix not only opportunities for living with working but also with opportunities for recreation, shopping and local services. This may be

achieved by having a good mix of land uses that brings about a local neighborhood environment which offers scope for exercise, sport, entertainment, walking, bicycling as well as opportunities for eating, drinking and meeting people.

High residential densities within the new towns also work towards reducing car travel. First, they increase the range of local shopping and other facilities which can be supported by local expenditure. And second, by concentrating travel demand at the local level, they improve the viability of public transport. Higher urban densities also have financial implications since, other things being equal, the value of property per square feet increases as the occupation of land becomes more intense.

Whether planning policies to intermix land uses and decentralize work places and other facilities to improve access from residential areas will succeed in reducing trip lengths and car travel, is likely to depend heavily on the extent to which people elect to make use of these local opportunities. The risk is that, within an environment of low travel costs, they may not. It also depends upon the quality and price of goods and services that are available locally.

5.3 Transport Capacity Expansion

The development of a comprehensive transport network is deemed necessary to provide not only good connectivity to all key activity locations within the country, but also sustain economic activities. This constitutes building up a good road and public transport infrastructure that will offer commuters a wider choice of alternatives and routes and help spread out and speed up traffic flows.

With a relatively young and simple urban rail network, clearly there is still much room for further expansion and improvement in Singapore's public transport system. The beneficiaries of improved public transport are the users themselves, other travelers, the urban environment and city-center activities. Investment in public transport helps, in particular, those who are dependent on public transport. Improvements in public transport, in terms of both level of service and accessibility, are often an essential component of any policy to restrain car use but, even if they are not, they do help to make such a restraint package more palatable - and indeed the transport authorities in Singapore are well aware of this fact. Perhaps an equally important aspect of improving public transport, especially rail systems, is that they help allow a higher proportion of new jobs and facilities to be located in the city as well as in other sub- and town centers.

5.4 Transportation Demand Management

5.4.1 Parking Policies

Singapore's present parking policies in the central area has been gradually stepping up as an effective tool against discouraging trips into the city. However, they have yet to complement well with the other car-restraint policies for a number of reasons. First, most public off-street car parking and street parking fees in the Central Business District (CBD) are considered relatively inexpensive compared to European, Japanese, and Hong Kong counterparts (where land constraint is also of concern). Thus, they do not appear to reinforce the other concurrent car-restraining measures. Second, workplace car parking is controlled only for new developments. This is perhaps a weakness in the transport policy as existing private non-residential parking is presently outside the scope of planning controls. Third, car parking standards for new developments have been demand led. Developers are required to provide car parking space based on a minimum rather than a maximum requirement, to meet anticipated needs.

Authorities may find the first and third issues to be relatively easier and straightforward to overcome than the second one. Nevertheless, possible measures to mitigate the second issue may include: (i) inducing employers to give up their existing workplace car parking to employees by way of offering an incentive, or (ii) using fiscal measures to encourage employers to charge a higher fee to reduce the attractiveness of workplace parking. Incentives can perhaps come in the form of density bonuses for employers, especially of large corporations and retailers, to allow them to convert part of their multi-story carpark structure into usable space. Fiscal measures, on the other hand, can be via taxation to employers for each parking space made available to employees, in order to gain some control over the existing private non-residential parking in Singapore.

Public parking policies for the CBD area in Singapore can also be more effective in discouraging car travel into the city by engaging in a greater variety of measures. Although there is already a doubling in the rate of parking fees between daytime and evening hours in the city, another possible measure that may complement this is the discouragement of all-day commuter parking. This can be effectively implemented through either the use of increasing parking charges after the first hour say, or having short-term (i.e., one- or two-hour) parking regulations stipulated in designated areas.

However, we must be conscious of the limitations of parking restraints. For instance, an important fact is that parking policies do not reduce through traffic. In Singapore, the through traffic has been estimated at 22% of the private car traffic in the restricted zone, and only other measures such as road pricing (or possibly just allowing high congestion to take place) are capable to dissuade this portion of road users from entering the congested area. In addition, though this is not applicable in a small city-state like Singapore, but parking fees also become relatively insensitive with increasing journey lengths and thus, may impose a relatively less financial burden to longer distance commuters.

Therefore, great care must be used in the employment of such policies and, indeed, with the actual provision of parking spaces. There is a need to redefine parking policies so that they coordinate more closely with other policies designed specifically to alleviate traffic congestion. Essentially, parking and driving are complementary and, as such, require appropriate, coordinated and consistent policies to be applied to both simultaneously.

5.4.2 Electronic Road Pricing Scheme

The 1983 Electronic Road Pricing (ERP) pilot scheme in Hong Kong was found to be effective in reducing congestion by time-of-day and location, but it was abandoned in 1985 because: (i) car drivers felt singled out and discriminated against (and taxis were seen to create more congestion but were exempted from ERP charges); (ii) ERP was considered an invasion of privacy (and the installation of closed circuit television cameras to catch defaulters did not help); (iii) the government did not succeed in effectively explaining the purpose and benefits of the system; and (iv) it was perceived by the public as yet another ploy by the government to raise revenues (as vehicle taxation had recently been increased substantially and had already resulted in reduced vehicle use and growth in the fleet).²¹

In Singapore, most people are generally aware of the proposed ERP scheme with the advent of its implementation by end 1997. The degree of acceptability in the views of the public, however, will largely depend on the regulations to be stipulated by the scheme. One obvious concern is the amount that road users will eventually have to pay, and this may very much be linked to the charging mechanism to be adopted.

²¹ Fong, 1985.

With the Area Licensing Scheme (ALS) and Road Pricing Scheme (RPS), motorists currently have a choice in selecting a fixed price based on the time of day of usage. While this approach does not offer the prospect of accurately reflecting and imposing the congestion costs to individual users, it has the virtue of ensuring road users know the financial implications of their trip-making activities in advance. With the proposed ERP system, authorities have announced that road users will be charged on a per-pass basis. On the one hand, this has the benefit of exercising a fairer treatment among motorists, however on the other, the system may have the inherent disadvantage that some road users are not made fully cognizant of the congestion costs they generate until the end of the day. And the likelihood of such occurrences will be greater for car users who make multiple entries into the restricted area each day.

As in any new traffic congestion pricing scheme, groups such as retailers and office establishments in city centers are also anxious about the impacts to their business. For instance, retailers fear that the new system will eventually drive customers to other centers while employers in the controlled area fear that the charges for road use will be pushed onto them as workers seek compensatory wage rises.

Another public concern is the potential invasion of privacy. Electronic tracking can be an emotive issue, especially as experienced by Hong Kong where the abortion of the electronic road pricing scheme there was not due to a technical problem but rather a political one. It is an issue which does not arise with the present manual system in Singapore. Hence, to circumvent this concern, one of the later requirements, as technology became available in the second round of pre-qualification to shortlist potential ERP contractors, was the specification of a Smartcard based ERP system. Smartcard technology, which offers stored-value functions, allows a two-way communication of information between the vehicle and the road side to be possible. Thus, there is no reason (or capability) of keeping track of individual movements, unless a valid card is not registered in the vehicle and only violating vehicles (not the drivers) are identified via their registration plate numbers.

A more cumbersome approach in overcoming the issue of privacy is through the provision of a semi-manual vehicle entry system as an alternative access at selected points into the restricted area. In selecting this option the driver has to, in this instance, physically stop to make the necessary payment at the toll booth. This would, however, defeat the purpose of the fully automated ERP proposal and is not likely to justify the additional costs. Besides, prospective users are likely to be deterred from using it as it would mean having to stop and pay tolls in the traditional

way and thereby adding to their trip time, instead of moving through the facility at main flow speeds.

5.4.3 Equity of the Vehicle Quota Scheme

Experiences from developed nations have clearly shown that the growing desire to own a car (and hence car growth) is closely tied to the increasing affluence of the population. According to Tanner's hypothesis²², car ownership increases over time along a S-shaped curve, tapering eventually to a "saturation level". However, the government has made a conscious decision of not allowing car ownership to even approach close to this "saturation level", on the grounds that Singapore is an island state with very limited land resources. With the implementation of the Vehicle Quota System (VQS), the authorities appear to have contained the problem at hand. An accurate charting and control of the growth in the vehicle population is now possible.

Despite its success in terms of regulating car growth, the VQS raises a number of concerns and implications since its implementation, largely because it has never been tried anywhere else in the world. The notion of having to first obtain an entitlement before a car can be registered is certainly an unique and unpopular transport policy measure by any standard. With bids stabilizing at around a high premium (approximately US\$25,000-US\$30,000 on average) and the fact that the limited number of Certificate Of Entitlements (COEs) go to the highest bidders, the question of whether this is indeed an equitable system has undoubtedly been a subject for debate. While it is clearly evident that the regulation achieves its goals efficiently, what appears to be the pertinent question to ask is: Are those who cannot pay the high premium being priced off the road as well? Lower-wage workers whose jobs necessitate the use of a car are likely to be outbid by their wealthier counterparts. Choices available to them may be stark: either not to travel and be disadvantaged in respect of job opportunities, or bear the cost at the expense of other necessities and their social, recreational or cultural lifestyles. High income families may even own two or more cars at the expense of the less well off. Increases in the bid price will only serve to further exacerbate the equity problem.

This is a similar argument to a larger debate confronting many developed cities who have, at one point or another, contemplated the idea of congestion pricing as a demand management tool for their roads. Their argument reverberates many of the social and commuter economic implications of congestion pricing that have not been adequately

²² Tanner, 1978.

addressed. While Singaporeans have generally accepted congestion pricing as a practical and necessary tool in managing the daily traffic on the roads, many are still uncertain about the appropriateness of the VQS, which is predominantly an ownership-restraint measure. This is discussed in a broader context later in Section 6.2. Moreover, with the particular price method adopted for the allocation of the entitlements, some have even expressed reservation to the design mechanism of this scheme. Some of these concerns are discussed in greater detail below.

5.4.3.1 Necessity of the Vehicle Quota Scheme after Electronic Road Pricing Implementation

Without a doubt, the impact of the Vehicle Quota System (VQS) has been significant, especially to the present and potential vehicle owning population. The fact that this measure is a direct control on ownership, and not on usage where the scale and intensity of vehicles on roads create traffic congestion, many have questioned whether the VQS will still be necessary after the widespread implementation of the Electronic Road Pricing (ERP) system. However, the government has argued for the retention of the VQS from the viewpoints that the proposed ERP may not respond quickly enough to alleviate congestion in situations when there is a sudden surge to own and use cars, and that a balance between ownership and usage measures is necessary to avoid an over reliance on any single control measure.

From the public's perspective though, there are already many other existing vehicle-restraining measures such as gas tax, city area parking rates (and limited parking spaces), annual road tax, and congestion pricing schemes that, although not precise in nailing down the vehicle population growth at 3 percent, collectively do in fact have the capability of curbing traffic growth significantly. When these measures (with some appropriate modifications²³) are coordinated in a coherent manner and charging fee levels adjusted accordingly, they can bring about a lowering in traffic congestion to an acceptable level. Nevertheless, there are bound to be some drawbacks with any approach or policy. And one of the major drawbacks for many of the conventional instruments, except for congestion pricing, is the inability to achieve immediate results. Being inherently crude instruments, the desired results are normally reached only after a few rounds of price adjustments.

²³ See Section 5.4.4

5.4.3.2 *Allocation Mechanism*

With regard to the allocation mechanism of the Vehicle Quota System (VQS), the adopted price method via a tender system for the allocation of entitlements has often been a subject for debate. Some people have suggested that the allocation mechanism should be by way of a non-price method instead, such as queuing and/or via a lottery method. However, given the strong demand and limited supply, adopting either the queuing or balloting method may entail a longer waiting time for two reasons. Firstly, the purchase cost of a car will be lower than what people are willing to pay, and so many will want a car and join the queue. Secondly, getting a car may be profitable since the car would be able to fetch a higher price from those who are unwilling to wait. This would encourage even those who have no intention of owning a car to join the queue.

Apart from the expected longer wait, the other difference, as reasoned by the government, is that in the price method the premium paid would go to the government and put to use for the benefit of the people, whereas in the non-price method, it will go to a few lucky individuals.

Another way of allocation that has been suggested is on the basis of need. The argument goes that for some people the car is not a luxury but a necessity. Logically convincing as it may seem, the greatest difficulty lies in the task of determining which individual or groups of individuals are in more need of a car than others.

Inevitably, there will be loopholes and gray areas that need to be plugged and fine-tuned for any new scheme. For instance, the stipulation that car ownership transfers is prohibited within the first six months of purchase can prevent potential opportunists from profiteering, thereby minimizing the speculative elements in the scheme. Notwithstanding this, the price method appears to be the better tool compared to the non-price method in allocating the scarce resource of a car to the person who values it most.

5.4.3.3 *Bidding System*

As mentioned briefly in Section 4.5.4, the Certificate Of Entitlement (COE) price is decided based on the lowest price of the successful bids for each category, known as the “single strike price” method. For example, if the number of bids received for a particular vehicle category is more than the 500 COEs available say, then the highest 500 bids are the successful bids. The strike price of the COE for all

500 successful bidders within that category will simply be the lowest bid price of the 500 successful bids.

The high COE prices that have prevailed over the years using the "single strike price" method has led some people to believe that the ordinary sealed-bid auction, where bidders will "pay-as-you-bid", may be a fairer method in moderating COE price levels. This may be a valid reasoning since the "single strike price" method has the shortfall of allowing each bidder know in advance that he/she will most likely not have to pay as much as he/she bids.

On the other hand, in the "pay-as-you-bid" method where bidders will essentially have to pay for the amount that they bid, prospective bidders become intuitively more aware of the price that they will submit. There is thus, a greater tendency for bid prices to be not excessively high but to better reflect the actual market demand since, in this instance, each bidder is governed by a practical limit to which he or she is willing to pay. In general, bidders will not offer more than what they think the good is worth. They may sometimes even bid less, gambling that they will be successful anyway. However, occurrences of such practices will be infrequent, especially when demand is high and bidders are genuine, since the low-bidder then faces the prospect of losing to a bid that is far below what he/she views as the true value.

5.4.3.4 *"Tough" Policy*

Lastly, the implementation of the Vehicle Quota System (VQS) has brought up an interesting point. It has indeed proven to be a difficult policy to administer, largely because it has never been tried anywhere else in the world, but partly also because of its highly restrictive regulation imposed toward car ownership. Even years after its implementation, the authorities are still occasionally fine-tuning the rules of the policy. What may perhaps be a subtle difference favoring policy-makers to advocate for the VQS is that the more conventional range of instruments currently in place, be it gas tax or road pricing, requires the continual monitoring of traffic conditions and adjustment of the rates by the government in order to achieve the desired objectives. Whenever another upward revision of the rates is necessary, it may prove to be increasingly unpopular and difficult to do so. In the case of the VQS on the other hand, once adopted as a regulation, has the inherent advantage of letting market forces determine the COE price, with little or no interference from the government. It is largely based on the number of entitlements released for tender, the degree of demand and the prevailing economic conditions.

5.4.4 Road Tax

Road tax is essentially a one-off cost paid annually and is therefore rather rigid and limited in its extent as a congestion tool. With the currently high dues imposed, it appears to be employed more as a deterrent to vehicle ownership rather than as a means of alleviating congestion. In addition, it is a transportation tool that is neither location or time specific, thus lacking the finer but necessary elements to properly manage congestion. However, in order to make the annual road tax more effective in discouraging car usage without unduly increasing the already high fixed cost of ownership, one possible method is to provide an incentive in the form of a rebate that is eligible to vehicles that do not exceed a certain amount of driven mileage by the end of each taxation year.

5.4.5 Gas Tax

The raising of gas taxes, in amounts that are politically acceptable, may have little effect on car ownership growth. It is a form of blanket measure that affects all road users, and is employed primarily to dissuade car usage. Besides being simple and flexible to execute administratively, the raising of gas tax has the added advantage of regularly reminding car owners of the price to pay for personal mobility, whenever the car is being filled up at the gas station, through their out-of-pocket costs.

It does not, however, distinguish whether the road user is driving on a free flowing road during weekends or directly contributing to the weekday congestion. Therefore, relatively speaking it fails as a management tool in effectively curbing road usage during periods and at locations of traffic congestion. Nevertheless, the raising of gas prices remains to be a good tool in bringing forth an overall reduction in car usage, which is certainly a step in the right direction towards protecting the environment. Unfortunately, past results have shown that the raising of gas prices has had only a temporary effect on road users, most likely because of rising income levels of the population - as income rises, the value of time rises, so that the monetary cost of travel becomes a smaller proportion of the generalized cost of travel (time plus money costs).

5.5 Transport Service Levels

The list of measures outlined in Section 4.6 of the previous chapter are generally aimed at improving the level of comfort and service for both car and transit travelers by way of new, advanced technology. But if the authorities are serious about shifting a greater mode split toward public transport, then public transport must ultimately become more competitive and attractive to the car. The level of accessibility and the level of service are perhaps the two vital aspects of public

transport that must go hand in hand in working towards this goal. Having outstanding accessibility but poor service frequency and vice versa can be detrimental to public transport as a serious mode of transport. Advancements in telecommunications and information technology can bring about significant improvements to public transport speed, reliability and service quality, and help accelerate this process. Overall, Singapore's public transport system can potentially do well in this respect.

5.6 Other Possible Ideas

Apart from the land use planning policies, most of the transport measures adopted in Singapore have largely been fiscal measures. As a result, most of them have been successful in achieving the objectives. In search for other possible policies then, I feel there is a need to explore "softer" approaches instead, that may also seek to improve the urban transport problem, without further burdening car owners financially. In this respect, the following are perhaps some suggestions that may be worth considering for Singapore.

5.6.1 Employer's Other Role

To a large extent, each and every employer has a key role to play in collectively improving traffic conditions during rush hours. Every employer's work place is essentially a principal trip-attracting location for work trips. Therefore, employers must be made aware of the importance that they can contribute toward mitigating traffic congestion. Employers can offer programs that effectively discourage single occupancy driving by employees. The successful implementation of the company-sponsored programs greatly depends on the commitment of the employer. If need be, incentives other than monetary terms, such as preferential parking spaces for High Occupancy Vehicles (HOVs) or even extra vacation days for instance, can be offered to employees to encourage greater participation in the programs. Below are some of the possible programs and schemes that can be initiated by employers.

5.6.1.1 *Ridesharing*

Ridesharing, which generically denotes the act of sharing vehicles for the trip the work, can involve carpooling, vanpooling, and buspooling. The main differences between the three methods are the size and ownership of the vehicle being used for ridesharing.

During the period from 1975 until its subsequent removal in 1989, carpooling became a popular mode of transport among auto commuters in Singapore. Although cases of actual sharing, in the sense of using one's own private vehicle to carry at least another three colleagues and sharing expenses, in carpooling did exist, a

significant number of the carpooling trips also came from motorists who picked up walking or waiting passengers at bus stops just outside the restricted zone to make up the necessary number of occupants for entry.

In spite of this, the idea of carpooling should be re-considered for Singapore. If the latter situation is deemed as a loophole in the system previously, then perhaps it is now possible to discourage such pooled trips with Smartcard technology where say, a monthly reimbursement can be sought (from the employer) with proper eligibility requirements.

Conceivably, what also seems promising is in the concept of vanpooling where the pooling vehicle is owned by the company. Many large companies including government departments and public agencies usually own a large fleet of cars and vans which are normally being utilized only during office hours by employees. Companies could in fact make use of these vehicles for employee vanpooling programs. Driving will be done by one of the employees, and the fixed and operating costs for the vehicle will at least be partially paid by the participants through monthly fares.

Buspooling is usually initiated by companies in the form of shuttle bus services from local transit station for employees. This service, which is already being practiced in Singapore by a few large companies despite catering primarily for their blue-collar workers only, is especially appropriate for firms with a large number of employees. Nevertheless, this scheme can also be suitable for small firms that are situated within proximity of each other, in which case the service will be operated by some private bus company.

All three methods of ridesharing have the potential of contributing to better rush hour traffic conditions, by fundamentally reducing the number of Single Occupancy Vehicle (SOV) employees. In addition, ridesharing benefits both employer and employees in terms of reduced parking space demand and commute costs, and even fixed and operating costs of the vehicle for company-owned vehicles as in the case of the type of vanpooling described above.

5.6.1.2 Provision Of Daytime And Emergency Transport

People, in general, drive their cars to work for multiple reasons. Often cited reasons include the need to have access to a car during the day. More specifically, they may need a car in their work, to run errands during the lunch break, or they drive because they do not want to be caught in case of a sudden emergency at home.

Whatever the reason, it is apparent that the provision of daytime and emergency transportation is an attractive inducement to alternative transportation. Some possible transportation services that may be beneficial in Singapore's context include: (i) shuttles or local circulators to transit stations, retail activities, key office buildings and services (e.g., post office, banks, etc.); (ii) employer-furnished fleet cars for mid-day and emergency use; and (iii) taxi vouchers for emergency trips home.

5.6.1.3 Removal Of Free Or Subsidized Parking For Employees (Part of the Employer-Based Trip Reduction method)

As earlier mentioned in Section 4.5.1, there should be a concerted effort by employers in both the private and public sectors against offering any free or subsidized parking to discourage car-driving employees. At the moment, this is difficult to achieve as there is currently no incentive for the private sector to work towards this goal.

5.6.1.4 Employer Subsidy Of Monthly Transit Pass

Rather than providing free or subsidized parking to employees, employers should encourage the use of public transport instead by offering subsidized monthly transit passes to their employees. A close-to-home example is the recent implementation of such a scheme here last year, at the Massachusetts Institute of Technology.

5.6.1.5 Alternative Work Hours

Spreading the demand for travel over a wider band of time through alternative working hours can greatly assist to moderate peak hour traffic flows in congested areas. There are three methods of spreading commuter travel demand, namely, staggered work hours, flex-time, and compressed work week. Staggered hours work well for assembly-line operations and back office operations where commencement and termination of work shifts can be easily controlled by the employer. Flex-time and compressed work week are appropriate for office workers who work independently and can exercise a certain amount of discretion over the scheduling of their work.

Currently, a few government departments and private firms already do practice a half-hour headstart from the 8:30 am norm in Singapore even though it still falls within the morning peak hour period. But in general, most employers are reluctant to consider having working hours outside of the 8:00 am to 6:00 pm period for fear of loss in business interaction hours with prospective clients and other companies.

As a form of encouragement for employers to offer these programs to their employees, the government can perhaps offer some form of incentive to them. For instance, a tax rebate can be given to companies based on the level of employee participation.

5.6.2 Residential-Based Buspooling

Although buspools have usually been initiated by employers, a potential viability of such services in Singapore is also at the residential end. This is primarily because of the high density that is characteristic of Singapore's residential developments. Private developers and condominium associations should sensibly arrange to provide shuttle bus services to and from local transit stations as part of the residents' work-trip journey. Residents will contribute to the operating and maintenance costs for the service. Not only do such services promote greater use of public transport and advocate leaving the car at home but also they serve to improve the welfare and interaction among local residents, and improve mobility of those who do not drive (e.g., children, elderly, people without cars including the poor).

5.6.3 Subsidized Off-Peak Transit Travel

Some studies (Antonioli, 1992) have indicated that transit ridership is only somewhat responsive to price changes, that is, demand for transit services is relatively inelastic. Despite this, many cities still commonly practice keeping their transit fares sufficiently low to increase (or at least maintain) transit ridership and reduce (or halt) increases in the share of urban trips taken in automobiles.

A lowering or subsidized transit fare should be considered for off-peak travel to provide an incentive to those who do not necessarily need to make the trip during rush hour periods. The Metrobus and Metrorail in Washington, D.C., is a good example of this.

5.6.4 Traffic Calming

Traffic calming is appropriate for designated areas where there is a need to regulate, control or restrict vehicular travel in some manner. Among the objectives for the implementation of traffic calming to an area are: (i) to preserve and enhance the vitality of the urban area; (ii) to improve the environmental quality of the urban area; and (iii) to encourage the utilization of non-auto modes.

A variety of techniques can be employed for the purpose of traffic calming. These include narrowing road widths by widening sidewalk pavements, introducing speed humps and suitable road surface finishes (e.g., cobblestones) to slow down vehicular traffic, effecting parking

controls to limit parking, using physical barriers (e.g., bollards) to deny auto access for certain hours of the day, and applying one-way streets, exclusive use lanes and turn prohibitions to discourage traffic. However, a great deal of attention is needed in the design, including goods delivery, access to stores, pedestrian amenities, lighting and other utility locations, landscaping, and security and safety for both automobile and pedestrian traffic. Often the success of such schemes also requires a close working relationship with the affected business community to inform and address their concerns and coordination with the public transportation network for ensuring accessibility.

5.6.5 Technology Policies

Undoubtedly, technology plays a vital role in making different transportation options convenient and in providing necessary information to users and suppliers. Promising opportunities include a wide range of applications using advance computer and information technologies for traffic management and public transportation; development of more fuel-efficient, environmentally benign automobiles; and substitution of communication for transportation through such developments as the “information superhighway”.

Its rapid advancement ultimately opens up a wide spectrum of applications. For example, the development of Intelligent Transportation Systems (ITS) technologies, may work toward: (i) an improvement in the efficiency of moving vehicles through urban traffic interchanges; (ii) providing real-time traffic information to help commuters make better informed route or mode (e.g., to choose mass transit instead of using their own vehicles) selections; (iii) making public transportation services more efficient and cost-effective, as well as more convenient, reliable and safe, to be more attractive to travelers; and (iv) developing real-time traffic control systems which combine surveillance, communications, data processing and navigation/guidance technologies to improve traffic efficiency and safety.

Chapter 6 BROADER IMPLICATIONS OF IMPACTS

6.1 Introduction

The first part of this chapter looks at some general implications arising from the multitude of transport policies in force. These implications are, by and large, a collective result of the implications of each policy. Thus, it is important to have a clear picture of the roles and implications of each policy. In this respect, the latter part of the chapter attempts to give a wider perspective of the potential achievements of the various policies and measures, together with the associated impacts inherent in some of them. A general indication of the time frame necessary for each policy to take effect is also included to give a better interpretation of the effectiveness of the policy. In this way, transport planners are then able to gain a better insight of the various measures at play, and from there, make better judgments and decisions of the options to take, in achieving the desired objectives.

6.2 Auto: Fixed Cost versus Usage Cost

Today, even with the current road pricing scheme, the out-of-pocket cost to drive a car is low in comparison to its fixed costs. Given that on average, 70 to 80 percent of the total cost to own and maintain a car is fixed²⁴ - that is, the cost of owning a car regardless of whether the car remains at home or is used to the maximum extent possible - Singaporeans are in fact acting rationally when they use their cars to provide nearly all of their transportation needs. This however, does not necessarily imply that usage cost should be increased in order to balance the situation. On the contrary, the fixed cost of owning a car in Singapore is already one of the highest in the world and it would probably make better planning sense to lower the fixed cost progressively instead while gradually increasing the usage cost (through road pricing and higher parking fees in the city area) simultaneously. This can seek to bring about a larger proportion of the population to own cars and make use of them for non-work trip purposes, since more car owners are then willing to leave their cars behind and take transit instead, provided, of course, public transport service is sufficiently attractive as an alternative mode. With the coming implementation of the Electronic Road Pricing (ERP) Scheme, a better reflection of the true cost can soon be directed more accurately to road users for the appropriate use of the road space.

²⁴ Land Transport Authority, Singapore.

6.3 Safety Concern

A seemingly valid concern with regard to vehicle safety arises as a result of the substantially high cost of owning a car in Singapore. Today, new car prices generally end up costing more than 300 percent of its Open Market Value (OMV) before it is allowed to be on the roads. Larger capacity and more luxurious cars are therefore more expensive accordingly. A relatively small, modest car for example, costs around US\$40,000. When compared with other countries it becomes increasingly obvious that for the same amount of money invested, Singaporeans are not getting the same level of safety and protection that are readily available in cars owned by their European and U.S. counterparts. Large, heavy cars are indeed safer than small, light cars, as common sense would suggest. Life-saving equipment such as air-bags and extra reinforced frames for instance, are commonly available in cars within the higher price range categories, such as the Volvos and BMWs. The key question that becomes evident then, is whether such restraints on car ownership, albeit effective in dissuading car growth to some extent, is in fact the appropriate control measure to enforce when human lives may be at stake.

6.4 Broader Impact of Congestion Pricing - A Simplified View

Looking at a broader perspective on congestion pricing, it is interesting to note that such schemes will inevitably impact a substantially large proportion of the population, in a complex and entwined manner. For instance, if we confine our discussion to work-trip commuters only, then all these commuters can fall into one or more of the following three groups, the “tolled”, the “tolled-off”, and the “untolled”, when the congestion pricing scheme is implemented. The first group, the “tolled” commuters, will be those who choose to pay and remain using the now restricted roads. The “tolled-off” group will include those that were previously using those affected roads as part of their trip but are now displaced by the scheme and has to use an alternative route or mode of travel. The last group, the “untolled” group, are those who do not previously make use of those affected roads as part of their trip and will remain to do so in terms of mode choice and route of travel.

Evidently all three groups will be affected by the introduction of the congestion pricing scheme, as illustrated in Table 4 of the before and after implications. Only a simplified scenario is considered for this case, but it does exemplify the intricacy of the impacts encountered by work-trip commuters alone. It is also interesting, and perhaps important, to point out that the most “innocent” group, in this case the “untolled”, who may have been previously assumed as the least affected party amongst the three groups in the event of a congestion pricing scheme, may actually turn out to be the one holding the short end of the stick.

Table 4: Before and After Impact of Congestion Pricing Scheme - A Simplified Scenario

	BEFORE IMPLEMENTATION OF SCHEME		AFTER IMPLEMENTATION OF SCHEME	
	Motorist	Transit user	Motorist	Transit user
THE TOLLED	Neutral to somewhat unhappy. May be frustrated with the worsening traffic conditions. The motorist does not, however, have to pay for the use of the road although he takes that for granted (or does not realize it).	Increasingly unhappy. Journey time getting longer with worsening traffic conditions.	Happy to somewhat unhappy. Enjoying improved traffic conditions but having to pay for it.	Happy. Enjoying improved traffic conditions. However, transit users may experience a lower level of service (e.g., overcrowding on the system) than previous.
THE TOLLED-OFF	Neutral to somewhat unhappy. May be frustrated with the worsening traffic conditions. The motorist does not, however, have to pay for the congestion costs of the road although he takes that for granted (or does not realize it).	n.a. n.a.	Unhappy. Has to take an alternative, and usually longer, route of travel, or change travel mode.	n.a. n.a.
THE UNTOLLED	Neutral.	Neutral.	Increasingly unhappy. Traffic conditions worsening due to additional traffic from those who chose to avoid paying by taking alternative/by-pass routes.	Increasingly unhappy. Traffic conditions worsening due to additional traffic from previous motorists who chose to change mode of travel (i.e. to transit) and avoid paying the road charge. Additionally, transit users may also experience a lower level of service (e.g. overcrowding on the system) than previous.

But this is not to say that congestion pricing schemes are inappropriate. As in most restraint measures that are seemingly harsh but effective, there are bound to be some who will benefit from it and others disadvantaged by it. It is thus the duty of policy-makers and planners alike to try, as much as possible, and seek not only the most appropriate choice of policies in achieving the primary objectives, but also to give equal consideration and take the necessary steps to improve situations for those who are negatively affected by it.

6.5 Potential Achievements and Impacts of Land Use and Transport Policies

Most of the policies discussed thus far have some merit, to a certain extent, in either reducing car travel or encouraging transit use or both. But because of other implications that some of these policies may also cause, it is important to have a wider perspective of the potential achievements and associated impacts of the policies, including an awareness of the expected time frame in which the benefits can be realized.

Thus, as a “rough cut” analysis of the policies, I have attempted to give a subjective assessment of the potential achievements of each type of policy initiative against a set of impacts. A list of the various land use and transport policies, which includes all of the measures and suggested ideas mentioned, is compiled in Figure 7, and the assessment is tabulated in Table 5 given below. This list is by no means exhaustive. In addition, these measures, which have broadly been grouped into the same four categories, are generally assessed in the context of Singapore. I have added a fifth category, Other Supporting Measures, which includes other factors that may contribute toward reducing car travel.

In assessing the potential impacts, there exists cases where a policy may exert different impacts to different groups of people, similar to what I have discussed above in Section 6.4 for congestion pricing. So, in order to have a better appreciation of the impacts, I have differentiated three groups in the table. Group A comprises of car owners who use their car for work trips and most other non-work trips. Group B also comprises of car owners, but they do not drive to work - they take the public transport instead. The last group, Group C, are basically non-car owners and rely mainly on public transport for most of their trips.

LAND USE AND TRANSPORT POLICIES

I. Land Use Planning and Control

- o Decentralization
 - designate areas for growth/control over the pattern of development (e.g. using zoning regulations)
 - use of preferred locations for travel-generating activities (e.g. town centers)
 - relocation of particular employment groups/sectors (e.g. through fiscal inducements to relocate in designated areas, density bonuses)
- o Integrated development planning
 - new developments linked to the provision of public transport
 - : higher densities in vicinity of transit stations
 - : zoning regulations - increase mixed use, encourage integrated developments, promote intermodal transport facilities, etc.
- o Other planning measures
 - regenerating of decaying areas (city centers, inner city areas)
 - improvements to housing and neighborhood quality/facilities
 - parking standards for new developments (e.g. stipulation of maximum provision)

II. Transport Capacity Expansion

- o Road expansions/improvements
 - network extensions
 - intersection/junction improvements (e.g. multi-tier interchanges)
 - provide by-passes (e.g. underground roads)
- o Rail investment/expansion
- o Park and ride facilities
- o Pedestrian linkages, cycle and walk ways

III. Transport Demand Management

- o Car-use restraint
 - congestion pricing (e.g. ERP, road tolls)
 - parking controls
 - : parking charges
 - : limiting supply
 - : short-term duration (via pricing or restriction regulations)
 - gas tax
 - off-peak car scheme
- o Car-ownership restraint
 - vehicle quota system
 - vehicle purchase tax (e.g. registration fee, import duties)
 - annual road tax
 - compulsory annual vehicle inspection
- o Employer-sponsored programs
 - include ridesharing, shuttle services, etc.
 - limited or non-free parking for employees
- o Residential programs (e.g. shuttle bus services to transit stations, local retail/community services)
- o Demand response services (e.g. dial-a-ride services, handicapped and elderly services)
- o Park and ride
- o Car pooling
- o Bus (and future LRT) priority (e.g. bus lanes, segregated rights of way, priority traffic signals)
- o Traffic calming
- o Pedestrian priority
- o Cycle and ride (e.g. bicycle parking facilities at transit stations and principle bus stops, cycle lanes in new towns)

IV. Transport Service Levels

- o Improved public transport service
 - service frequency improvements
 - coordinated scheduling between transit modes
 - integrated transit fares
 - fares and scheduling (including real-time) information
 - improved passenger accessibility and transfers
- o Transit fares
 - fare subsidy
 - discriminate peak and off-peak travel
- o Improved private transport service
 - traffic management
 - : intelligent traffic signal intersections
 - : road monitoring technology
 - real-time information to drivers (e.g. traffic situations, 'best' route selections, etc.)
- o Vehicle technology improvements
 - in-vehicle controls
 - automated vehicle highways
- o Road regulation improvements (e.g. virtual slip roads)

V. Other Supporting Measures

- o Telecommunications technology
 - tele-working (i.e. home-based working)
 - tele-shopping (e.g. shopping via commercial televisions, internet, mail-ordering)
 - tele-banking services
- o Environmental protection regulations
 - vehicle noise and emission standards/targets
 - lowered fuel consumption goals for vehicles

Figure 7: List of Land Use and Transport Policies

Table 5: Potential Achievements and Impacts of Land Use and Transport Policies

Before presenting the table in the following pages, below are the notes and footnotes with reference to the table.

Notes:

- Y Attempts to fulfil objective.
- N Does not fulfil objective.
- ? Might go either way.
- Y? Attempts to fulfil objective if implemented in the best way.
- yes? Somewhat yes, as it depends on other factors or method of implementation.
- no? Somewhat no, as it depends on other factors or method of implementation.
- A? Majority but not all of group A. (Similar for `B?', `C?', and `all?')
- S, M, L Denotes short-, medium-, and long-term duration for benefit(s) to be realized.
- A Group comprising of car owners who use their cars for work trips (and most other trips).
- B Group comprising of car owners but use transit for work trips.
- C Group comprising of non-car owners and rely mainly on transit for most trips.

Footnotes:

- a) A subjective assessment of the potential achievements and impacts, broadly judged in the context of Singapore.
- b) Includes bringing homes closer to jobs and frequently-accessed services.
- c) Includes improving road safety and making the city more environment-friendly.
- d) Includes discouraging the use of the mode of travel.
- e) User incurs a direct cost.
- f) Perception of reduced personal freedom, a hinderance, or frustration.
- g) Group(s) who benefits from the policy/measure or enjoys a less congested ride as a result.

Table 5: Potential Achievements of Land Use and Transport Policies

POLICIES AND MEASURES	POTENTIAL ACHIEVEMENTS ^a					POTENTIAL IMPACTS ^a										
	Reduce peak hour congestion	Reduce non-pk hr congestion	Increase transit use	Reduce dependence ^b	Improve city attractiveness ^c	Lower accessibility ^d			Financial burden ^e			Social inconvenience ^f			Who Benefits ^g	Time frame to take effect
						A	B	C	A	B	C	A	B	C		
I. Land Use Planning and Control																
o Decentralization																
- designate areas for growth/control over the pattern of development (e.g. using zoning regulations)	Y	?	Y	?	Y?	no	no	no	no	no	no	no	no	no	all	M-L
- use of preferred locations for travel-generating activities (e.g. town centers)	N	N	?	?	Y?	no	no	no	no	no	no	no	no	no	all	M-L
- relocation of particular employment groups/sectors (e.g. through fiscal inducements, density bonuses)	Y	?	?	?	?	no	?	?	no	?	?	no	?	?	A, B?, C?	M-L
o Integrated development planning																
- new developments linked to provision of public transport																
: higher densities in vicinity of transit stations	Y	Y?	Y	Y?	Y?	no	no	no	no	no	no	no	no	no	B, C	M
: zoning regulations - encourage mixed use, integrated developments, intermodal transport facilities, etc.	Y?	Y?	Y?	Y	Y?	no	no	no	no	no	no	no	no	no	all	M
o Other planning measures																
- regenerating of decaying areas (city centers, inner city areas)	Y?	?	Y?	Y?	Y	no	no	no	no	no	no	no	no	no	all	M-L
- improvements to housing and neighborhood quality/facilities	Y?	?	Y?	?	Y	no	no	no	no	no	no	no	no	no	all	S-M
- parking stds. for new devts. (max. reqt.)	Y	Y	Y	Y?	Y?	yes	no	no	?	no	no	yes	no	no	all	S

Table 5: Potential Achievements of Land Use and Transport Policies (cont'd)

POLICIES AND MEASURES	POTENTIAL ACHIEVEMENTS ^a					POTENTIAL IMPACTS ^a										
	Reduce peak hour congestion	Reduce non-pk hr congestion	Increase transit use	Reduce dependence ^b	Improve city attractiveness ^c	Lower accessibility ^d			Financial burden ^e			Social inconvenience ^f			Who Benefits ^g	Time frame to take effect
						A	B	C	A	B	C	A	B	C		
II. Transport Capacity Expansion																
o Road expansions/improvements																
- network extensions	?	?	N	N	Y?	no	no	no	no	no	no	no	no	no	all	M-L
- intersection/junction improvements (e.g. multi-tier interchanges)	?	N	N	N	?	no	no	no	no	no	no	no	no	no	all	M-L
- provide by-passes (e.g. underground roads)	Y?	N	N	N	Y?	no	no	no	no	no	no	?	?	A	M-L	
o Rail investment/expansion	Y	Y	Y	Y	Y	no	no	no	no	no	no	no	no	B, C	M-L	
o Park and ride facilities	Y	Y?	Y	?	Y	no	no	no	no	no	no	no	no	A, B	S	
o Pedestrian linkages, cycle and walk ways	?	?	Y?	Y?	Y	?	no	no	no	no	no	?	no	B, C	S	
III. Transportation Demand Management																
o Car-use restraint																
- congestion pricing (e.g. ERP, road tolls)	Y	Y?	Y	Y?	Y	yes	no	no	yes	no	no	yes	no	no	all	S
- parking controls																
: parking charges	Y	Y	Y	Y	Y?	yes	no	no	yes	no	no	yes	no	no	all	S
: limiting supply	Y	Y	Y	Y	Y?	yes	no	no	no	no	no	yes	no	no	all	S
: short-term parking (via pricing, restriction regulations)	Y	Y?	Y?	Y?	Y?	yes	no	no	?	no	no	yes	no	no	all	S
- gas tax	Y?	Y?	Y	Y	Y	yes	no	no	yes	no	no	yes	no	no	all	S
- off-peak car scheme	?	N	?	N	?	yes	no	no	no	no	no	yes	no	no	B	S

Table 5: Potential Achievements of Land Use and Transport Policies (cont'd)

POLICIES AND MEASURES	POTENTIAL ACHIEVEMENTS ^a					POTENTIAL IMPACTS ^a										
	Reduce peak hour congestion	Reduce non-pk hr congestion	Increase transit use	Reduce dependence ^b	Improve city attractiveness ^c	Lower accessibility ^d			Financial burden ^e			Social inconvenience ^f			Who Benefits ^g	Time frame to take effect
						A	B	C	A	B	C	A	B	C		
III. Transportation Demand Management (cont'd)																
o Car-ownership restraint																
- vehicle quota system	Y	Y	Y	Y	Y	no?	no	no	yes	yes	no	yes	yes	no	all	S
- vehicle purchase tax (e.g. registration fee, import duties)	Y?	Y?	Y?	Y?	?	no?	no	no	yes	yes	no	?	?	no	all?	S
- annual road tax	?	?	N	N	N	no?	no	no	yes	yes	no	?	yes	no	all?	S
- compulsory annual vehicle inspection	N	N	N	N	Y	no	no	no	yes	yes	no	yes?	yes	no	-	-
o Employer programs																
- include ridesharing, shuttle services, etc.	Y?	Y?	Y	Y	Y	no	no	no	no	no	no	no	no	no	all	S
- limited or non-free parking for employees	Y	Y	Y	Y	Y?	yes	no	no	yes	no	no	yes	no	no	all	S
o Residential programs (e.g. shuttle bus services to transit stations, local retail/community services)	Y	Y	Y	Y	Y	no	no	no	no	yes	yes	no	no	no	B, C	S
o Demand response services (e.g. dial-a-ride services, handicapped and elderly services)	?	Y?	N	Y	Y?	no	no	no	no	yes	yes	no	no	no	B, C	S-M
o Park and ride	Y	Y	Y	Y?	Y?	no	no	no	no	no	no	no	no	no	all	S
o Car pooling	Y	N	N	Y	Y?	no	no	no	no	no	no	no	no?	no?	all	S
o Bus (and future LRT) priority (e.g. bus lanes, segregated rights of way, priority traffic signals)	Y?	Y?	Y	Y	Y?	yes	no	no	no	no	no	yes	no	no	B, C	S

Table 5: Potential Achievements of Land Use and Transport Policies (cont'd)

POLICIES AND MEASURES	POTENTIAL ACHIEVEMENTS ^a					POTENTIAL IMPACTS ^a										
	Reduce peak hour congestion	Reduce non-pk hr congestion	Increase transit use	Reduce dependence ^b	Improve city attractiveness ^c	Lower accessibility ^d			Financial burden ^e			Social inconvenience ^f			Who Benefits ^g	Time frame to take effect
						A	B	C	A	B	C	A	B	C		
III. Transportation Demand Management (cont'd)																
o Traffic calming	Y?	Y?	Y?	Y?	Y	no?	no	no	no	no	no	yes	no	no	B, C	M-L
o Pedestrian priority	N	?	N	N	Y	?	no	no	no	no	no	yes	no	no	B, C	S
o Cycle and ride (e.g. bicycle parking facilities at transit stations and principle bus stops, cycle lanes in new towns)	Y	Y?	Y	Y	Y	?	no	no	no	no	no	yes	no	no	B, C	S-M
IV. Transport Service Levels																
o Improved public transport service - service freq. improvements, coordinated scheduling betw. transit modes, integrated transit fares, real-time scheduling info., improved pass. accessibility & transfers	Y	Y	Y	Y	Y	no	no	no	no	no	no	no	no	no	all	
o Transit fares - fare subsidy	Y	Y	Y	Y	N	no	no	no	no	no	no	no	no	no	B, C	S
- discriminate peak and off-peak travel	N	Y	Y?	Y?	Y?	no	no	no	no	?	?	no	?	?	all	S
o Improved private transport service - Traffic management : intelligent traffic signal intersections : road monitoring technology	Y	Y	N	N	Y	no	no	no	no	no	no	no	no	no	A, B?, C?	S-L
- real-time info. to drivers (e.g. traffic situations, 'best' route selections, etc.)	Y	Y	?	N	Y											

Table 5: Potential Achievements of Land Use and Transport Policies (cont'd)

POLICIES AND MEASURES	POTENTIAL ACHIEVEMENTS ^a					POTENTIAL IMPACTS ^a										
	Reduce peak hour congestion	Reduce non-pk hr congestion	Increase transit use	Reduce dependence ^b	Improve city attractiveness ^c	Lower accessibility ^d			Financial burden ^e			Social inconvenience ^f			Who Benefits ^g	Time frame to take effect
						A	B	C	A	B	C	A	B	C		
IV. Transport Service Levels (cont'd)																
o vehicle technology improvements																
- in-vehicle controls	?	?	N	N	N	no	no	no	no	no	no	no	no	no	all	S-L
- automated vehicle highways	Y	Y	N	N	Y?	no	no	no	?	?	?	?	?	?	all?	L
o road regulation improvements (e.g. virtual slip roads)	Y	Y	N	N	Y	no	no	no	no	no	no	no	no	no	A, B?, C?	S-M
V. Other Supporting Measures																
o telecommunications technology	Y	Y	N	Y	Y	no	no	no	no	no	no	no	no	no	all	S-L
- tele-working (i.e. home-based working);																
- tele-shopping; tele-banking services, etc.																
o environmental protection regulations (e.g. vehicle noise and emission stds, etc.)	?	?	?	?	Y	yes?	no	no	yes?	yes?	no	no	no	no	all?	S-L

As a whole, this assessment is greatly simplified for convenience's sake, but it does illustrate a good approach to enable transport planners to gain a better comparison and thus better understanding of the different instruments available. More importantly, the table provides a good starting framework from which transport planners are then able to select one or a combination of appropriate policies necessary to achieve the desired objectives, in view of the likely impacts. It should be cautioned, however, that the degree of impacts resulting from the same policy may vary greatly between different societies and cultures, and perhaps even between different communities within the same metropolitan area. It is thus vital to also take this into account in the assessment.

From Table 5, it is interesting to note that in the first category, Land Use Planning and Control, the policy of decentralization alone may not achieve the goals of a congestion-free city. On the contrary, it may also promote greater travel as in the case for urban-suburban planning. Decentralization planning must be carefully followed with, among other ingredients, urban intensification and higher residential density planning in the vicinity of transit stations, and good intermix of uses. Land use planning policies play a key role in this respect, with little or no negative impact to society. However, most of these policies require a medium- to long-term wait before the benefits materialize, and sometimes it is difficult to sort out the genuine benefits and impacts of the long-term policies from background effects which may have nothing to do with the policy.

In the second category, Transport Capacity Expansion, it is clear that rail investment and expansion is critical to reducing traffic congestion, with or without any car-restraint policies. In general, it has the added benefit of not causing any undesirable impacts to society, except in situations when rights-of-ways are sometimes necessary within a built environment. Nonetheless, it has the potential of adding to the attractiveness of the city, if careful planning and design are carried out, together with proper land use planning.

Transportation Demand Management has played a substantial role in Singapore's transport system. The majority of these measures have been fiscal measures and pricing instruments. These measures have largely been effective, but they come with a price. It is worth noting that the negative impacts arising from car-ownership restraint policies appear to be far worse than for car-use restraint policies, especially for group B where the population do own cars but do not wish to use them for work-trips. In addition, most of the car-ownership restraint measures tend to be rigid and do not have the capability to respond quickly enough to contain rising traffic congestion, with perhaps the exception of the Vehicle Quota System (VQS) policy. If Singapore is to look for more ways to minimize the impacts of affected parties, it should perhaps lean more towards non-fiscal measures such as encouraging employers to play a greater role in

helping to ease the impacts. Employees constitute some 88 percent of the working force in Singapore.²⁵ Benefits may, however, be slower in this instance, but they can be substantial, depending on the level of commitment from employers in encouraging their staff.

Almost all the measures grouped in the Transport Service Levels category seek to reduce traffic levels in general, not just during rush hour congestion. Ways to improve more efficient driving and comfort for car users will, however, make it more difficult for public transport to compare favorably against the car. In addition, these improvement measures will likely increase rather than reduce car dependence. Thus, it is important that transport authorities are aware of the possible conflict of interest that may arise from an “over-investment” in private transport if public transport is acknowledged as the key mode of travel for the majority of the population. An appropriate apportionment of the funds can reduce the likelihood of such occurrences.

In the last, additional category, Other Supporting Measures, advancements in telecommunications technology may also serve to improve road conditions in the future. However, there are different viewpoints on this issue but it is not my intention to discuss this subject here. In any case, the home-based tele-working population in Singapore is expected to be insignificant in the near future, despite reports from Singapore’s latest household survey (1995) which indicated that some 13 percent of the working population did not require any form of transport to travel to work.²⁶ The bulk of them were likely to be domestic maids instead. Overall, it is crucial to note that the government can play an instrumental role in the decision-making process as well as in the implementation of transport policies. In this respect, the government’s single-level organizational structure which has facilitated the close working relationship and coordination among public agencies, and the long-term commitment of government have largely contributed toward the successful implementation of the policies in Singapore.

²⁵ Source: 1995 General Household Survey, Singapore.

²⁶ Source: 1995 General Household Survey, Singapore.

Chapter 7 CONCLUSIONS

7.1 Introduction

With the implementation of the Area Licensing Scheme (ALS) in 1975, Singapore has shown that effective transport demand management techniques can be a major contributing factor in managing congestion. Over the years, Singapore's transport system has also seen a gradual shift in emphasis from measures geared to increasing road capacity (in an attempt to reduce congestion) towards improving its public transport accessibility. But the long-term solution, nevertheless, requires a well balanced package to effectively manage and contain congestion to an acceptable level.

7.2 Necessity Of A Well-Balanced Package

All policy instruments listed in Table 5 are potentially helpful, but no single one of them has the power to achieve the objectives of alleviating traffic congestion to a manageable level. It can be seen, as in Singapore's case, that there is a need to introduce packages of policies that are mutually reinforcing. Packages embracing land use policies and pricing instruments aimed at discouraging car use are particularly appropriate, since they have the capability of reducing car travel and improving accessibility for those without cars. In addition, the package should encompass a greater responsibility of measures to include an extensive road and rail infrastructure to be put in place, and a high standard of service level to be entrenched in the private and public transport systems. Thus, a well-rounded package may require a combination of policies and measures from each of the four categories discussed.

In the category of Land Use Planning and Control , planning and control of land use policies can be employed to:

- (1) decentralize through urban intensification of existing and new towns by steering major employment, commercial and residential activities including public facilities to locations that are well served by the public transport network;
- (2) concentrate high-density residential development in vicinity of stations along public corridors;
- (3) intermix uses and integrate developments and intermodal facilities to widen the scope of opportunity for living with working, shopping, recreation and local services as well as to achieve a sustainable urban intensification to support public transport (i.e. urban rail);
- (4) limiting the amount of car commuting to new office developments by imposing low maxima on the number of car parking spaces that can be provided;

- (5) shifting the supply of parking from central area to fringe center park-and-ride interchanges; and
- (6) planning in new towns to include improved facilities and linkages for cyclists and pedestrians.

In the category of Transport Capacity Expansion, the development of a comprehensive transport network includes:

- (1) developing a comprehensive road network to ensure good connectivity to all key activity locations;
- (2) providing or improving bypasses (including the possibility of tunnels) around the restricted zones of congestion pricing;
- (3) expanding the urban rail network to strengthen the backbone of Singapore's main transport system and reach a network density that chiefly boosts passenger accessibility and convenience in transfers;
- (4) providing improved intermodal facilities of rail with bus, rail and/or bus with cycling (for cycle-and-ride schemes), and rail and/or bus with auto (for park-and-ride schemes); and
- (5) increasing the coverage of feeder systems to improve accessibility to transit systems and help reduce reliance on the car.

In the category of Transportation Demand Management, a balance of fiscal and regulatory measures with non-fiscal measures are necessary. These may involve:

- (1) enhancing pricing mechanisms that are directed at discouraging car use, especially during peak periods of travel. These may include a combination of congestion pricing, gas taxes, and parking management (e.g. pricing, short duration parking, limiting supply, etc.);
- (2) continuing the present car-ownership restraints (e.g. vehicle quota system (VQS), vehicle purchase taxes, annual road taxes), but with the intention of gradually down playing the pricing of these instruments in an effort to allow a greater level of car ownership but primarily for non-peak travel;
- (3) promoting park-and-ride, cycle-and-ride, and off-peak car (OPC) schemes that serve to advance transit use;
- (4) encouraging employers to assume greater programs (discussed in Section 5.6.1) by way of allowing a tax rebate to companies based on the level of employee participation; and
- (5) employing traffic calming measures and other improvements to sensitive areas to limit car use.

In the category of Transport Service Levels, measures that are needed include:

- (1) providing and maintaining a high level of service in public transport to make it an attractive alternative to the car. This entails enhancing, among other

- qualities, service frequency, passenger accessibility, convenience and comfort of travel;
- (2) using reserved lanes and intelligent traffic signals to give widespread priorities over other traffic to buses; and
 - (3) utilizing advanced information technology to provide auto drivers with real-time information about park-and-ride and off-street parking availability, and bus and rail riders with real-time information about services at all stops.

Last but not least, having an effective, competent decision-making management, with an organizational structure that fosters comprehensive policy-making and planning for all aspects of transport, can be instrumental to the successful implementation of the policies, as can be seen in Singapore's achievement with the Area Licensing Scheme (ALS).²⁷ This has been further reinforced with the progressive vision, willingness and commitment of the Singapore Government for long-term planning. The single-level government structure has facilitated easier and closer working relationship as well as greater coordination among government departments and public agencies. Over the years, the 'top-down' planning approach has illustrated the possibility of making significant improvements to traffic conditions, but not without instilling a sense of anxiety from the public. The alternative of a 'bottom-up' approach may reduce some of the anxiety and concerns, but improvements tend to be incremental and slower. In this time and age where public awareness and feedback is becoming increasingly important in advocating any public policy, it may perhaps be prudent to adopt an approach that still maintains overall control but with greater interaction and feedback from principal interest groups likely to be affected. To this end, I believe Singapore is slowly moving towards this approach. In recent years, the private sector has been encouraged to participate more actively in the planning process. The Urban Redevelopment Authority (URA), for instance, holds regular dialogue sessions with professional bodies and private developers to facilitate feedback and comments. Public exhibitions of land use master plans and large projects have become part and parcel of the development process.

7.3 Conclusion

All the planning and transport policies discussed in this study can not be mutually exclusive. The success in containing congestion will largely depend on the choice of measures brought together within an integrated, overall package designed to limit car travel and dependency.

In setting the policy objectives, there is an increasing need to better understand and tackle the underlying causes rather than the symptoms of the problem of too

²⁷ Dunkerley, 1979.

much traffic in our cities. In this respect, greater emphasis should be placed on policies that are geared toward improving accessibility rather than mobility. Policies that work to reduce the need to travel, in ways that ensure reasonable proximity between places of residence, employment and other facilities, minimize the length and duration of trip necessary to access particular opportunities, and create mixes of facilities which increase the scope for multipurpose trips, are effective measures that can yield long-term benefits. These efforts can be further enhanced with an extensive, attractive public transport system to reduce car dependence. Short to medium term results will, on the hand, have to rely more on transport demand management techniques and public transport measures. Fiscal and regulatory measures should seek to discourage car use, especially during peak travel, rather than depending heavily on car-ownership restraints. Incentives and attractive alternatives will serve to increase the effectiveness of the car restraint policies. Schemes such as park-and-ride and cycle-and-ride have the potential to play a more prominent role in connection with transit. Service levels of public transport, particularly in the area of accessibility, service frequency, and real-time information, must improve to gain its competitive edge against the private car.

There is no easy way to achieve a safe, visually-attractive urban environment with efficient access to all destinations. Policies can be made to improve the accessibility, especially for those without cars, but the benefits will not be without costs, in particular to people living mobile lives and dependent on cars for practically all travel. Institutional and social mindset and behavior, however, may sometimes pose the greatest obstacles toward a collective effort in improving accessibility and the environment for the people.

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