

Traffic Limitation Techniques

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ABSTRACT

Urban transportation plans based on demand forecasting techniques that assume continuation of present-day modal choice characteristics are not being implemented in their originally conceived form. Firstly, the financial resources are not available to transport authorities to fulfill the plans, and secondly, the community is concerned about the impact of major facilities that in many cases must be superimposed on existing urban fabrics. This paper reviews methods of limiting traffic in certain key areas, or of bringing about changes in choice of travel mode so that the best possible use can be made of existing transport systems, and critical environments preserved. Studies cited demonstrate that considerable benefits can result from approaches of this kind, and it is suggested that some of the techniques reviewed may have application in Australia.

INTRODUCTION

In the narrow sense traffic limitation might be construed as relating only to vehicular traffic using the street systems. However, in the context of this paper, traffic limitation embraces the road vehicle, the road systems, the urban dweller, the networks of public transport facilities and the vehicles that operate on them.

While emphasis is directed principally at private vehicles that use congested portions of urban road systems, it is held that traffic limitation should not be seen as implying a ban on them as some would seem to desire, but rather as aimed at maximizing the operational advantages and efficiencies of the public and private modes of travel for the purposes to which they are best suited. Thus, traffic limitation is seen as having application in the most congested parts of our cities where transport efficiency is low and environmental impact and loss of amenity are prime factors. The technique is intended to enhance the use of the private vehicle for trips of the most essential kinds to these areas, and is directed at increasing overall transport efficiency, facilitating and promoting the use of public transport, and improving critical environments.

TRAFFIC LIMITATION RATIONALE

In the largest cities most of us are confronted daily with the problems that stem from imbalance between transport capacities and peak periods of demand. While the levels of service provided by urban road systems in off-peak periods might be adequate, or nearly so, congestion which delays not only motorists but also street public transport, exists for four or more hours daily in many places. Although much thought has been given to ways of spreading peak traffic demands over longer periods of the day, for example by staggering working hours, little has been accomplished.

Traffic limitation techniques offer the means to more nearly equate peak transport demands with available or realistic capacities. They can be designed to influence choice of travel mode for particular trips, and can be aimed at achieving a variety of objectives appropriate to specific situations.

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THE AUSTRALIAN CONTEXT

Positive efforts have been made in all of Australia's principal cities to plan adequate public and private transport systems to meet projected needs for two decades or more. The plans developed involve the need for very substantial capital investment, and entail varying degrees of social and environmental impact for the communities through which the planned facilities would pass. It now seems clear that the community is reluctant to accept many of these provisions at this time, and the financial resources are not likely to be available at a rate sufficient to keep pace with growth in demand.

There is strong evidence of renewed interest in urban public transport as a possible means of reducing the impact of ever-increasing road traffic, and there is undoubtedly merit in this. Real efforts are being made to upgrade urban public transport systems.

Recognizing that a comparatively small proportion of all daily vehicle trips in large urban areas are destined to the centre, the most complex transport problems are still identified with central areas and their vicinities because of the generally radial configuration of existing road networks. Although the skills of the traffic engineer have been used to the fullest to maximize the peak period capacity of urban streets, insufficient attention has been given to ways of influencing modal choice, reducing non-essential traffic, or to improving the environmental quality of the central areas and congested sections of the larger cities.

It should perhaps be acknowledged that a satisfactory balance between the traffic generating capacity of urban land

uses and the facilities that can be provided may never be achieved, and steps taken to get the best from the facilities that are available right now. Although the road facilities envisaged by existing plans may be abandoned or delayed, the upgrading of public transport could complement sound traffic limitation programmes designed for early implementation. While it could be argued that public transport systems in some places might not be able to cater for a large diversion from private vehicles during peak periods, there are sufficient grounds to warrant more in-depth investigations of the possibilities.

DEFINITION

The term "traffic limitation" implies some change in freedoms now enjoyed, and decisions that impinge upon freedom to travel in urban areas must ultimately be the responsibility of those elected for the purpose. By comparison with many other cities throughout the world, urban residents in Australian cities still enjoy a high degree of mobility and convenience through the use of their private motor cars. Suffice it to say here that those with a planning role should acquaint the community and the leaders of government of the alternatives for improving our cities. If the benefits of such schemes are clearly related to the costs, then decisions in the best interests of the majority can be made by those responsible.

Traffic limitation techniques may be considered as falling into three categories:

- a) Traffic Restriction - Aimed at regulating vehicular access through physical or other obstructions, or by regulation.
- b) Traffic Restraint - Aimed at influencing people's desires, but not denying them the right to travel where and when they wish to for whatever purpose.

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- c) Traffic Avoidance - Directed at minimizing or designing the need for travel.

To a degree we are accustomed to traffic restrictions, and in some respects have experienced a level of traffic restraint. However, the advanced state of development of the larger cities has resulted in little attention or success in the field of traffic avoidance. This aspect will no doubt be an essential input to the planning of our designated growth centres and new towns.

THE OBJECTIVES OF TRAFFIC LIMITATION

Before designing a programme for implementation or testing, it is essential to have a clear understanding of the objectives that are to be achieved. For example, in a large city in a developing country, a principal objective might be to reduce the need for use of private vehicles to gain access to employment in central and other areas, so reducing the demand for new road facilities. In parallel would be the upgrading of public transport to serve the needs of the less privileged.

A similar objective for an Australian city might be to encourage private car commuters to central business districts or regional centres to utilize existing public transport, and so reduce road congestion.

Thompson (1972) has defined five possible functions for a traffic limitation policy as follows:

1. To limit the stream of traffic in particular streets, either permanently or at certain times. The objectives could include facilitating pedestrian movement, improvement of amenity, or reduction of noise and fumes.

- 2.. To limit the volume of traffic in particular areas of the town, e.g. environmental areas or the town centre. The aim might be to create residential precincts or to stimulate the competitiveness of the town centre.
- 3.. To limit the volume of traffic in the urban area as a whole. Objectives could include reduction in air pollution, conservation of natural resources, reduced demands for roads or better balance between public and private transport.
4. To limit the use of certain types of vehicles.
- 5.. To limit the use of vehicles for certain purposes. The objective might be to reduce peak hour congestion and lessen demand for parking.

LIMITATION STRATEGY

A great number of individual techniques are available, some of which could be used in conjunction with others, and some which have not been tested on a sufficiently wide scale to demonstrate their suitability. Although many of the techniques described later may have little application in the Australian context, they are given brief treatment because of the increased interest in new towns and in growth centres. While not appropriate today, some techniques may become more relevant with the passage of time.

The 30 techniques described can be categorized into four broad strategies:

- 1.. Restraint of vehicle ownership.
2. Regulation of vehicle use.
- 3.. Improved competitiveness of other modes.
4. By planning, reduce the need to travel.

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With car ownership levels amongst the highest in the world, there would appear to be little short-term prospect of limiting vehicle ownership. However, recent events show that national economic policy, fuel prices, taxes and other factors undoubtedly have at least a short-term impact upon the numbers and types of private motor cars purchased. It would therefore seem premature to dismiss this strategy without at least casual examination. Regulation of vehicle use can be accomplished using pricing techniques or through physical restrictions. A wide range of applications is possible in the short term.

The relevance of the third strategy is already apparent through state and national policies to upgrade public transport. The fourth strategy of necessity relates to techniques that could only be effective in the longer term. Strategies 2 and 3 - regulation of vehicle use and the improved competitiveness of other modes - are possibly those in which the greatest potential benefits lie.

RESTRAINT OF MOTOR VEHICLE OWNERSHIP

Although current levels of private car ownership are high, there is reason to expect that they will increase further if overseas experience can be accepted as a guide. The six pricing and regulatory techniques to restrain vehicle ownership described in following sections could be framed to have some impact on the rate of increase. However, ownership restraints could have national implications of greater significance than the problems they would be designed to alleviate.

Registration Fees - Differential registration fees applying to country and urban areas are already in force in Australia. While these were not devised originally to restrict

ownership but to raise revenue, there is no doubt that application of this system could be extended and the differential increased in areas where particular objectives were defined.

Import or Purchase Taxes - Import taxes would tend to be selective because of varying local content in motor vehicles sold in Australia. Purchase taxes would be difficult to apply on a local area basis, and so would impinge on the ownership of vehicles in areas where traffic limitation might not be desirable, nor necessary.

Driver's Licence Tax - This would involve the taxing of the driver rather than the vehicle, and has inherent problems as a restraint mechanism in an urban area. This is basically because of the likelihood that such a method would have to be applied at least at the State level, rather than that of the urban area. Enforcement would also be difficult.

Numerical Ceilings - This implies placing a limit upon the number of vehicles that can be registered or driven in a given area. The method suffers from the disadvantage that allocation of ownership privileges would be arbitrary and an equitable procedure difficult to establish.

Vehicle Road Worthiness - By setting sufficiently high standards, and enforcing them, some marginally roadworthy vehicles could be removed from use. Standards might relate to noise, safety or air pollution.

Vehicle Financing - More stringent conditions, determined by Government and applied to motor vehicle financing, could be used as a means of limiting motor vehicle purchase.

REGULATION OF VEHICLE USE

Pricing techniques for regulating vehicle use

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include strategies that relate to the direct cost of running the vehicle, or which impose a charge for entering a defined area, for using a specific road facility or group of facilities, and parking charges in areas where development is intense. Other techniques rely on physical controls to deny access to all or some vehicles, control congestion, or limit the supply of fuel.

Fuel Taxes - Taxes on motor fuels have long been a substantial source of revenue to Governments, and there is some justification for believing that choice of travel mode and the need or desire to travel could be influenced by increasing taxation on motor fuel. Indeed, current trends towards the purchase of smaller cars with lower fuel consumption are evidence of this. However, such a tax would inevitably be applied in areas where traffic congestion would not warrant such action.

Mileage Taxes - Mileage related taxes are already applied to commercial vehicles, and differentiate between the relative uses of different vehicles. However, application of such taxes to private motor vehicles would be difficult, as would distinction between use in urban and non-urban areas.

Tolls - The use of tolls is widespread, the most common purpose being to recoup the cost of an expressway or bridge. They can be applied to specific roadway segments and at various times of the day, if desired. While application of tolls on an areawide basis would be complex, their use in specific corridors served by a limited number of facilities might be appropriate. For example, a corridor served by high capacity public transport and heavily utilized, parallel arterial roads.

Zone or Area Permits - With this concept, specified vehicles only would be allowed into a restricted area. This

practice is sometimes applied on a limited scale for sporting events, parades or other occasions when restricted access to small areas is required. It is difficult to foresee wide-spread application of such a method because of the need to allocate preference to a limited number of vehicles.

Vehicle Metering - The purpose of this technique is to charge users of motor vehicles a fee that is directly related to their use of specified streets or areas within a city. Meters would be placed either on or off vehicles to record the use of the specified streets or areas. For instance, meters would be switched on when a vehicle crossed an electrical loop buried in the road surface, or could register a fee every time a loop detector was crossed. The loops might be embedded in streets around a cordon defining a critical area of congestion, and where traffic limitation was desirable. They could be activated constantly, or only during peak or other periods as desired. The vehicle owner would be billed in a manner similar to that for telephone accounting.

While vehicle metering appears to offer a highly flexible means of charging vehicles for the congestion to which they contribute, there remain technical difficulties associated with its application, and the technique has not been implemented anywhere on a wide scale. It is therefore unproven. Nevertheless, there is likelihood of a satisfactory system evolving in the future. The method does have the advantage that it would apply to all vehicles and not merely to those which had origins or destinations within the limitation area. That is, vehicles passing through could also be metered and charged.

Zone or Area Licences - This is a pricing technique that can be aimed at reducing the use of private vehicles for travel to or from key congested areas, for instance city centres.

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It may be applied at peak periods or for other periods of the day as desired. Only vehicles which have purchased a daily, monthly or annual licence would be permitted to enter the defined area during the specified times. The areas could be any size and could incorporate differential area licencing whereby costs differed between areas. Further, licences could apply to specific vehicle types only and for certain hours of the day.

A major task associated with this technique is enforcement, and there is some reason to believe that satisfactory levels would be achieved. The area to be licenced would need to be surrounded by a ring or by-pass road system to allow vehicles not desiring to enter the chance to deviate. It is usually considered in association with peripheral parking lots and shuttle bus service, so as to provide an alternative to the possibly high cost of the licence.

Parking Charges - Perhaps the most common pricing technique used to influence vehicular use in core areas, this method usually implies a rate structure designed to minimize parking duration. It would be aimed at long-term or all-day parkers, and would be intended to promote greater turnover and use of spaces by short-term parkers. Thus, rates would increase rapidly with duration of parking.

Alternatively, parking rates could be structured so that a premium was associated with parking during congested peak hours. In Australian cities where substantial numbers of parking spaces are provided by private enterprise, such a technique would require public regulation of privately owned facilities. While undoubtedly a complex issue, this aspect of central city parking regulation and provision could benefit from further study.

Parking Control - By restricting the numbers of parking spaces provided in a given area, particularly those that would normally be used for long-term parking, it is possible to restrict vehicular use. As already indicated, the central cores of our cities include substantial numbers of privately owned and controlled spaces. There is no doubt that strict regulation concerning the provision of new spaces in re-development is relevant to the reduction of central city traffic congestion. In particular, such strategies are of great relevance to growth centres or new towns where the opportunity exists to implement limitation policies at an early stage.

Road Closure - This concept is already receiving consideration in Australian cities. Closures for the purposes of creating shopping malls or prohibiting through traffic from using residential streets as detours, are currently being implemented. Road closures can be used to improve the environment where traffic congestion and conflicts between pedestrians and motor vehicles are frequent. Closures could be implemented for peak periods only, or for the whole day, depending upon the objectives of a limitation strategy.

Vehicle Prohibition - The total prohibition of all vehicles over extensive areas of cities is rare. Few cities are prepared to experiment with such a radical step and some vehicular access to most areas is considered to be necessary. However, the creation of traffic-free zones in core areas could well be studied for limited applications in our cities. Special consideration would have to be given to the needs of goods and emergency vehicles.

Route Restriction - This technique is already commonly used in Australia. It usually involves definition of specific routes to be used by certain types of vehicles. For

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example, buses and trucks exceeding prescribed dimensions are often required to follow specified routes where environmental objectives, bridge clearances or road standards dictate. To limit traffic, specified streets might be set aside solely for use by public transport vehicles, taxis and pedestrians. However, it is difficult to envisage application over a wide area.

Planned Congestion - This technique is currently used at freeway access points in order to maintain continuous flow and high capacity on freeway systems. The traffic congestion is forced to take place on the surface street system through metering of access ramps. It is also possible to use traffic control devices to restrict vehicular access to particular areas, by controlling congestion at the access points. Most congestion that we see on the street system today is unplanned.

Rationing of Fuel - Vehicular usage could be modified drastically by the introduction of fuel rationing. However, the application of this approach purely on traffic limitation grounds would be unrealistic because of the impact it would have on rural and other areas where traffic congestion is not a problem.

IMPROVED COMPETITIVENESS OF OTHER MODES

Substantial effort is currently being devoted to changing the image of public transport and to improving service levels. Policies are emerging at the state and national level and there is some evidence to indicate that past patronage trends are already changing favourably. By making public transport more attractive, particularly for the kind of travel that it is best able to serve, i.e. the mass movement of people to and from major areas of attraction, it is possible to make a contribution to the

reduction of demand for road space. However, the problem of low density development and widely dispersed travel patterns remains through most of the urban areas in Australia.

Low Public Transport Fares - As a means of diverting trips from private cars to public transport, low or reduced fares are a means of influencing choice of mode, particularly for work trips. This technique can be readily applied and requires positive policies regarding community priorities. Although fares could be modified independently, the method might be best introduced as part of a package in which traffic limitation techniques are applied. For example, low or reduced peak period public transport fares might be offered in parallel with limitation to traffic in a particular corridor.

Improved Public Transport Service - Increases in service frequencies, route coverage and hours of operation could be part of an overall limitation program in key areas. Adequate levels of public transport service cannot be provided through fare-box revenues, and clear policies with respect to public and private transport priorities are needed. Improved service for street public transport might also include allocation of priorities through traffic control techniques where congestion causes excessive delays.

Improved Public Transport Amenities - Although hard to assess, passengers might be attracted to public transport through improvements in the design and comfort of vehicles, the facilities provided at stops, stations and transfer points, and through improved access to bus stops and stations. This technique is seen as part of the action necessary to upgrade urban public transport, and not as an end in itself.

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Improved Pedestrian Facilities - Transportation studies have shown that a substantial proportion of private car trips are comparatively short, particularly in central areas where frequent parking and unparking has been recorded. Improved pedestrian facilities and segregation of pedestrians from traffic would play some part in reducing the use of vehicles in congested areas.

Improved Bicycle Facilities - There has been renewed interest in the bicycle, possibly as a result of concern for the environment. In some places, limited access roads are being planned so as to incorporate special grade-separated facilities for cyclists and low powered motor cycles. Where topography permits, the development of segregated cycle tracks through parks and reserves could contribute to a reduction in the use of motor vehicles.

BY PLANNING, REDUCE THE NEED TO TRAVEL

Long established travel patterns and traditions in existing cities restrict opportunities for spectacular results in the short term. Some of the methods described in this section could be implemented in a relatively short time, but others would take years to become effective. Some methods are more applicable to the planning and development of new cities, whereas others have more immediate application to transport in existing cities.

Car Pooling - High occupancy motor vehicles make more efficient use of road space, and efforts have been made in some countries to reduce the number of motor vehicle trips, especially during peak periods, by promoting car pools in which those who would normally drive are encouraged to ride as passengers. This is accomplished either voluntarily or through mechanisms designed to give preferential treatment to vehicles

carrying more than a specified number of occupants. The technique is usually applied to transport facilities in heavy corridors of demand. If applied on a wide scale, it is conceivable that overall reductions in traffic might be achieved.

Staggered Work Hours - By the wide-scale staggering of the hours of commencing and terminating work on weekdays, it is possible to spread peak periods of traffic demand, and at the same time reduce the magnitude of the peak, thereby reducing traffic congestion. Implementation of this technique would require substantial changes in established community living patterns, but could work to the benefit not only of traffic using the street system, but also to those using public transport where demand might be more uniformly spread. In particular, operators of public transport might benefit by being able to use equipment more productively for extended periods.

Proximity of Like Functions - This is a planning technique in which businesses or facilities that have similar characteristics or bear some relationship to one another, are located in proximity. This technique would be but an element in a broader, all encompassing planning and traffic limitation concept. Obviously, its application would be most appropriate where new cities are being designed, or when major re-development projects are implemented in existing cities.

Land Use Densities - The density of land use largely determines the intensity, orientation and magnitude of travel within a city. Compact, high density cities will result in shorter trips and greater dependence upon public transport than will low density, dispersed cities. In addition, public transport is more viable in areas where development is intense. The continued outward growth of our cities following existing patterns of density and development, tends to increase dependence on private motor vehicles and reduces the viability of public

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transport service. Opportunities exist not only in planning of new communities and in guiding the outward growth of existing centres, but also in the redevelopment of inner areas.

Land Use Patterns - Most daily trips in an urban area are made to or from home and involve destinations such as work places, schools, and shops. By relating employment opportunities to residential locations there is some scope for minimizing the need of residents to travel widely to work places. However, it does not seem feasible to regulate the activities of residents in this regard, and there will inevitably be greater dispersal in search of wider job opportunities with time. However, more conscious efforts to relate places of residence to shopping facilities, work places and schools might produce some reduction in the need to travel.

RESEARCH OPPORTUNITIES IN AUSTRALIA

As already indicated, some of the techniques outlined appear to have little prospect of achieving a better balance between transport demands and capacities in Australian cities in the short-term, or even at all. Others provide definite scope for further research and possible implementation.

The following table presents a summary of the strategies and techniques described, and indicates those that seem to hold the most potential at the present time. The regulation of vehicle ownership through pricing techniques or numerical ceilings is not likely to gain community acceptance at the present time. While short-term economic influences may affect growth in private motor vehicle ownership, it seems likely that the availability of cars to households will increase.

It is believed that significant early benefits could be achieved through techniques designed to regulate motor vehicle use. Again, it is stressed that the concept is seen as applying to core areas of cities and other major centres where excessive transport demands impeach upon the environment, reduce amenity and create transport inefficiency. Indiscriminate application of restraint techniques outside these areas would not be justified, nor in accord with the interests of the community. The most immediate results could be achieved through manipulation of parking provision, rate structures and controls. Modifications to street patterns through road deviations and closures also hold potential for reducing traffic impact in critical areas. While vehicle metering possibly is a long-term prospect, consideration should be given to area licencing schemes that incorporate pricing strategies to reduce peak period demands on the roads.

Strategies to restrain motor vehicle usage should be accompanied by positive action programmes to improve and extend public transport. While it may be argued that public transport might not be able to cope with increasing peak period traffic demands, further investigation is needed to establish guidelines. The essential aim is to provide a feasible alternative where restrictions are being imposed. Research into many of the techniques described in this paper can be facilitated by the use of systems analysis. In most of Australia's larger cities, transportation planning programmes are already installed and the interaction between transport networks and land-use distributions can be examined in detail.

Finally, future planning efforts to guide growth and development should include conscious attempts to minimize the need for travel. There is substantial scope for research in this field, particularly related to current policies for national population distribution.

TRAFFIC LIMITATION STRATEGIES AND TECHNIQUES

<u>STRATEGY AND TECHNIQUE</u>	<u>APPLICABILITY IN AUSTRALIA</u>		
	<u>Definite Potential</u>	<u>Possible</u>	<u>Unlikely</u>
<u>Restrain Motor Vehicle Ownership</u>			
Registration Fees		X	
Import or Purchase Taxes			X
Drivers Licence Tax			X
Numerical Ceilings		X	
Vehicle Road Worthiness			X
Vehicle Financing			
<u>Regulation of Vehicle Use</u>			
Fuel Taxes			X
Mileage Taxes			X
Tolls			X
Zone or Area Permits		X	
Vehicle Metering		X	
Zone or Area Licences	X		
Parking Charges	X		
Parking Control	X		
Road Closure	X		
Vehicle Prohibition		X	
Route Restriction	X		
Planned Congestion		X	
Rationing of Fuel		X	
<u>Improve Other Modes</u>			
Low Public Transport Fares	X		
Improved Public Transport Service	X		
Improved Pedestrian Facilities	X		
Improved Bicycle Facilities	X		
<u>By Planning, Reduce Need to Travel</u>			
Car Pooling	X		
Staggered Work Hours	X		
Proximity of Like Functions		X	
Land Use Densities	X		
Land Use Patterns	X		

RECENT APPLICATIONS

Recent studies in which Wilbur Smith and Associates have been involved included evaluation of traffic limitation strategies for the cities of Singapore and Kuala Lumpur, Malaysia.

The Singapore study included positive recommendations to achieve more efficient use of the road system by bringing travel demands into closer balance with capacity. The recommendations flowed from a detailed evaluation of alternative public transport systems to serve the needs of the area up to 1992. The limitation measures selected were designed to make the costs of car use less attractive than at present, and thereby divert travellers from the private to the public modes for certain trips. The techniques recommended included restraint of car ownership by a higher annual registration tax, and increased parking charges in the central area to reduce private travel to that part of the city.

The ownership restraint was calculated to reduce the number of cars in the area in 1992, by nearly 20 per cent below the unrestrained level. When combined with increased central area parking charges (\$2.00 per hour compared with the present rate of 50¢), the restraint package produced substantial reductions in projected private vehicle trips. Projected daily person trips in 1992 were estimated to reduce by 4 per cent with the introduction of restraints, and the proportion of all trips made by public transport was expected to increase from 43 to 48 per cent. With restraints, 13 per cent fewer trips by private vehicle and 9 per cent more public transport trips, would be made.

The Singapore Government is now in the process of implementing these broad recommendations. Registration taxes

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have already been increased and the core area will soon only be accessible by private vehicles between the hours of 7.30 A.M. and 9.30 A.M. through the possession of a supplementary licence costing S.\$60.00 per month. No restrictions on access will be placed outside these two hours. Peripheral car parks will be provided and shuttle bus service at frequent intervals operated to the core area. Two levels of charge have been established for parking within the restricted zone. In the core, the charge will be 50¢ for the first hour, S.\$1.00 for the second hour and S.\$1.00 for each subsequent half hour. For the balance for the restricted zones the charge will be 50¢ for the first hour and 50¢ for each subsequent half hour. The aim is to discourage long-term parking by the maintenance of reasonably low rates for short-term parkers.

In the fringe car parks the charge would be a nominal S.\$10.00 per month, except for a few multi-storey car parks located adjacent to the restricted zone where the charge will be S.\$30.00 per month. Initially, about 10,000 car parking spaces will be provided. A flat fare of 50¢ a trip will be charged on the bus. Alternatively, seasonal tickets costing S.\$20.00 per month will be available for commuters.

The Kuala Lumpur study showed that limitation of traffic in the central area would produce a demand for circumferential road capacity to allow by-passing. This study considered a wide range of restraint alternatives and finally recommended a package that limited parking provision, allowed for high parking charges, placed physical restrictions upon circulation and movement through the central area, and provided substantial public transport improvements while maintaining a stable fare. In addition, guidelines regarding central area employment policies were established to ensure that demand for peak period travel to the city centre could be balanced to the available supply of private and public transport facilities. In particular, critical examination of bus needs and street capacities for public transport

were dealt with.

Evaluation of the combined techniques comprising the strategy indicated that restraint measures would increase 1990 public transport patronage by about 9 per cent, while reducing vehicle miles of travel by about 3 per cent. Car driver trip destinations to the restraint area were reduced by approximately 10 per cent and the number of parking spaces by nearly 40 per cent. This was because car driver work trips were the most likely ones to be impacted by the pricing policy and limitation strategies envisaged. Thus, emphasis was placed upon the use of parking spaces for short-term needs and the encouragement of public transport use by workers.

While it is not suggested that the approaches described for these two cities are directly applicable in Australia, it is contended that substantial benefits to the community might flow from scientific application of traffic limitation methods. There is certainly scope for further research by those responsible for guiding the development of our cities and shaping the environments in which we live.

REFERENCE

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