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### **Published paper**

Susan Grant-Muller (ed.) with Tony Fowkes, Ann Jopson, Tony May, Peter Mackie, Brian Matthews, John Nellthorp, Matthew Page, Tom Sansom, Simon Shepherd (2000) *Assessing the Impact of Local Transport Policy Instruments*. Institute of Transport Studies, University of Leeds, Working Paper 549

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*Working Paper 549*

June 2000

## **Assessing the Impact of Local Transport Policy Instruments**

Susan Grant-Muller (Editor)

with contributions from:

Tony Fowkes, Ann Jopson, Tony May, Peter Mackie, Brian Matthews, John Nellthorp,  
Matthew Page, Tom Sansom, Simon Shepherd

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**INSTITUTE FOR TRANSPORT STUDIES  
DOCUMENT CONTROL INFORMATION**

Title	Assessing the Impact of Local Transport Policy Instruments
Author(s)	Tony Fowkes, Ann Jopson, Tony May, Peter Mackie, Brian Matthews, John Nellthorp, Matthew Page, Simon Shepherd
Editor	Susan Grant-Muller
Reference Number	WP549
Version Number	1.0
Date	June 2000
Distribution	Public
Availability	unrestricted
File	K: SG-M\reports2000\WP549.doc
Authorised	O.M.J. Carsten
Signature	
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## 1. Introduction

This working paper brings together some relevant material to assist the process of assessing local transport policy instruments. The paper was written with the support of the DETR, but is unofficial. It is intended to be a helpful resource document for local authorities who have indicated in the past a need for guidance in where to look for evidence on the diverse range of transport policy instruments referred to in the White Paper (CM3950). The authors would be grateful for feedback and comments.

This document is not intended to be a complete description of the local transport plan process (for that, see the Local Transport Plan Guidance). Nor does this note aim to give a comprehensive review of the appraisal requirements for Local Transport Plans (for that, see Annex E of the Local Transport Plan Guidance and, where relevant, the Guidance on Methodology for Multi-Modal Studies). Important elements in the LTP process including the combination of a set of individual policy elements into a strategy, and the activity of public consultation are not considered. Nor do we consider the specification of problems or the set of objectives within which local transport planning is currently taking place – for these, see for example DETR, 2000.

The focus of this piece of work is on assessment of the impact of individual instruments within an urban context. Specifically it considers their effects in terms of:-

- ❖ their impact on transport supply
- ❖ their impact on transport demand
- ❖ their final outcome in terms of their transport, environmental and other impacts

When considering policy instruments which impact on urban transport systems, there comes a point at which the impacts and interactions of policies become extremely complicated. At some point, modelling becomes an important part of the assessment process, depending on:-

- the capital and recurrent costs at stake
- the size of the impact on users and other affected parties, which can be large without the capital costs being large
- data availability and the costs of obtaining data for modelling
- the ability of a model to represent the policy tool under consideration and the cost of model development.

Policy initiatives such as major infrastructure investment, road user charging schemes, or significant roadspace reallocation schemes will require model-based approaches. This note may therefore be useful in one of two contexts firstly, where the intervention is not sufficiently large or significant to warrant a model-based approach, and secondly, to aid a rough calculation at an early stage so as to enable an initial assessment to be made which can then be investigated further.

In the next section, we provide a brief generic review of the supply and demand issues so as to give some background to the general analysis and show how second round effects (supply/demand interactions) can be significant in determining the final equilibrium. We also comment on generic appraisal issues. In section three we provide a short review of eleven of the most important policy investments and their supply and/or demand effects. Where possible we have provided approximate indications of their impact, but these should not be interpreted as accurate and applicable to all situations. Finally, in Appendices we provide a reference list of some sixty policy

instruments which we have identified in literature and other surveys, a note on elasticity methods for demand estimation, and a note on appraisal practice.

## 2. Framework of Analysis

Fundamentally, the prediction of the level of use of an urban network, and of the costs of using it, depends on an understanding of two relationships. The first is the demand curve which specifies the demand for use of a network as a function of the cost of using it. The cost should ideally be measured as the generalised cost of all the elements entering the perception of the individual – time, money, discomfort, safety risk etc. In practice, this is then simplified to a time only or time plus money measure of travel cost.

The second relationship is the supply curve which specifies the cost of using the network (again in terms of time or time plus money costs) as a function of travel volume.

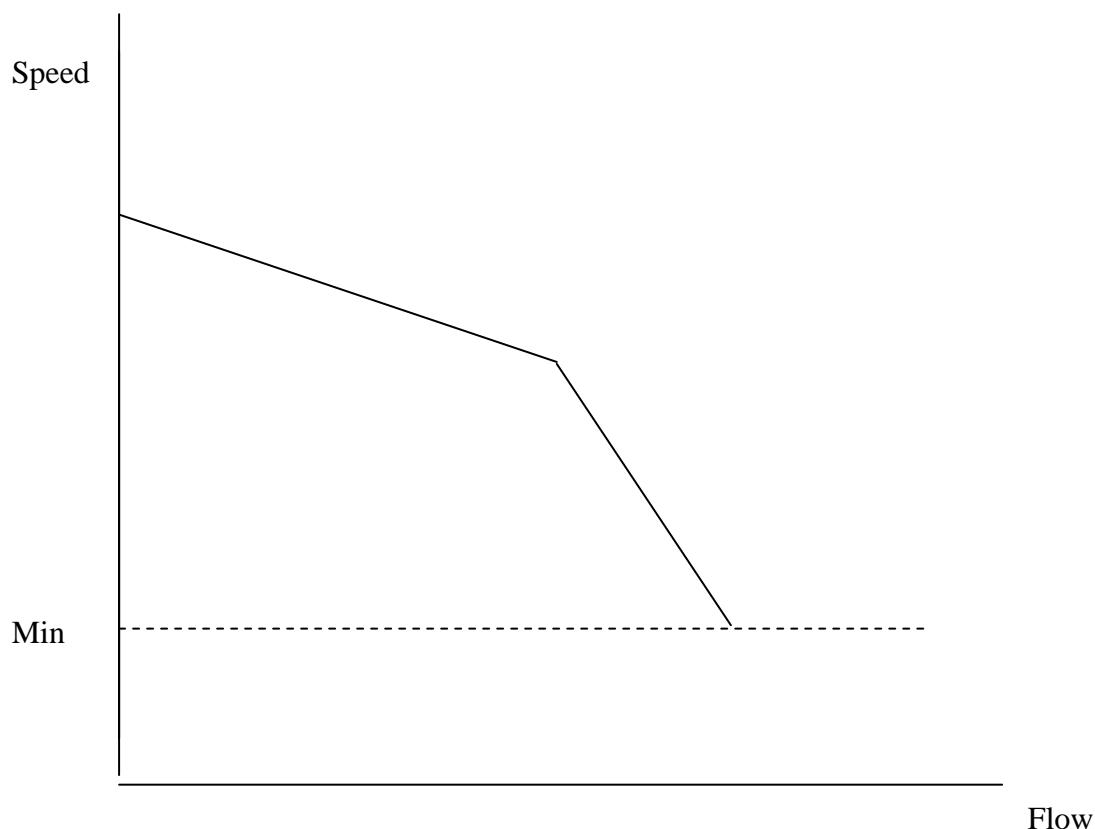
The demand and supply sides have to be brought together to determine the estimated outcome position for any particular pair of demand and supply relationships. Travellers base their travel decisions on expected costs; the market is closed or equilibrated where expected costs are equal to actual costs. In the context of goods in the shops, the price system fulfils the function of signalling to the consumer what the exact costs of purchase are. In the case of travel, the traveller is likely to know the destination, mode and start time for the journey and forms an expectation of the generalised time or cost (for example 20 minutes to drive to work). On average this will be correct, but on any particular occasion the expectation may not be realised. Thus the equilibrium volumes and travel times are a proxy for a system which, in congested conditions contains no automatic equilibrating mechanism. Dis-equilibrium events such as gridlock are spectacular examples of this.

### *The Supply Relationship*

In most traffic applications volume is measured in terms of flow. The supply curve is based on the inverse of the speed flow curve so that costs are considered to be travel time, multiplied by some value of time. Speed-flow relationships for individual links and junctions are well accepted and are used extensively to evaluate the benefits of investments in additional capacity. Traffic Appraisal in Urban Areas: Appendix E (DoT, 1996) gives advice on generating the relationships for a range of road types and conditions. The use of link-based relationships to analyse the performance of complex urban networks is, however, time-consuming and prone to inaccuracy, since such methods may ignore the interactions between links and junctions.

A number of non-strategic models have therefore used an area speed-flow approach which, rather than modelling individual links and junctions, seeks to represent network performance on an average or aggregate level (May et al, 2000). Though clearly not suitable for some applications such as bus priorities at specific junctions, such methods may be more suitable than link/junction modelling for assessing more generic policies such as green transport plans.

The performance of policies is likely to be particularly sensitive to the shape of the relationships at and around the lowest speeds observable in practice. Such speeds reflect the equilibrium in heavily congested conditions and misspecification of the relationships in these conditions will lead to over or under estimation of the benefit from congestion relief. In practice average network speeds below about 15 kph are rarely observed because congestion at about this speed becomes self-regulating. This suggests that, for simple applications, a minimum speed cut-off at or around this level may be appropriate so as to prevent speeds from falling to lower levels than those observed. This is particularly important if considering future years in which forecast growth is projected to push the system closer to capacity.

**Figure 1**

### **The Demand Relationship**

At the most aggregate level, we are looking for the relationship between generalised cost and demand volume. If, for example, some policy is introduced which increases the generalised cost of travelling by 10 per cent, what is the impact on travel volume? The elasticity of demand is the measure of responsiveness. For example if the outcome were to be a fall in travel volume of 5 per cent, the elasticity of travel volume to generalised cost would be  $-0.5$  ( $-5\% / +10\%$ ).

In practice, however, the demand side is much more complex than this because

- policy measures impact differently on travel modes, destinations, times of day AND
- the demand system is interdependent – for example the demand for travel from A to B at time T is interdependent with the cost of travel from A to C at time T and with the cost of travel from A to B at time T'.

So, for the purpose of estimating demand responses we could

- assume all the elasticities are zero, so that all demands are fixed at their measured levels and unresponsive to changes in supply conditions
- adopt an aggregate elasticity approach in which traffic responds to the own-price elasticity (the aggregate responsiveness of traffic to changes in generalised cost)
- adopt a disaggregate approach in which traffic responds to a series of cross-elasticities between time of day, destinations, modes etc in a way which is consistent with the aggregate elasticities and relative market shares.

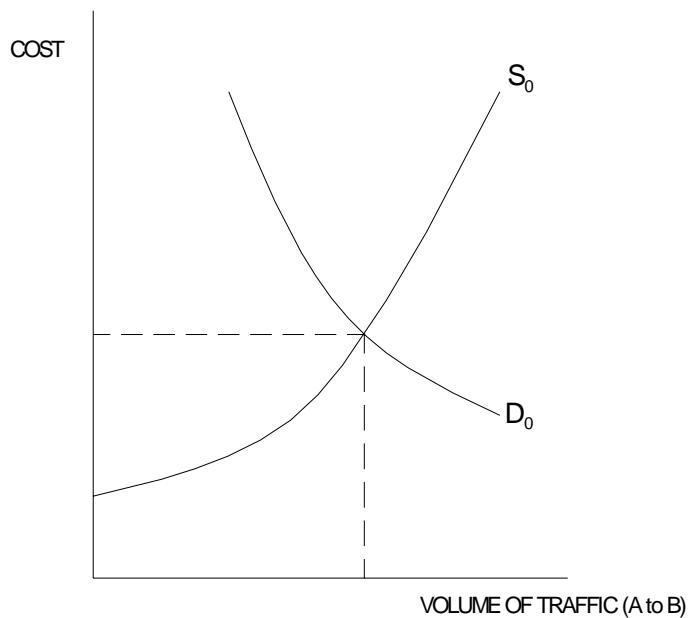
Appendix A contains a note on elasticities. In general, we recommend that demand responses should be allowed for. In general, we predict the following directions of change in traffic volumes and journey times as a result of changes to network capacity.

	<u>Volumes</u>	<u>Journey Times</u>
Capacity Enhancements	Higher	Lower
Capacity Reductions	Lower	Higher

with the demand responses partially offsetting the first round supply-only effects. For example, removing ten per cent of the capacity of a radial route into a city will, with a fixed demand, have a given effect on journey times. The increased journey times will cause some traffic to choose alternative destinations, other modes, other times of day, or to disappear altogether. But the final equilibrium journey time will be higher than in the initial position. The exception is where speeds are already at, or close to their minimum. Here, on the lower horizontal section of the speed/flow curve in Figure 1, the effect of reducing capacity will be primarily on travel volumes, with little change in journey time. Even in this case, however, if the effects are due to rerouting and retiming, there may be journey time effects elsewhere in the system.

### The Base Position

Figure 2 shows at a conceptual level the equilibrium between supply and demand for some representative traffic flow between origin A and destination B.

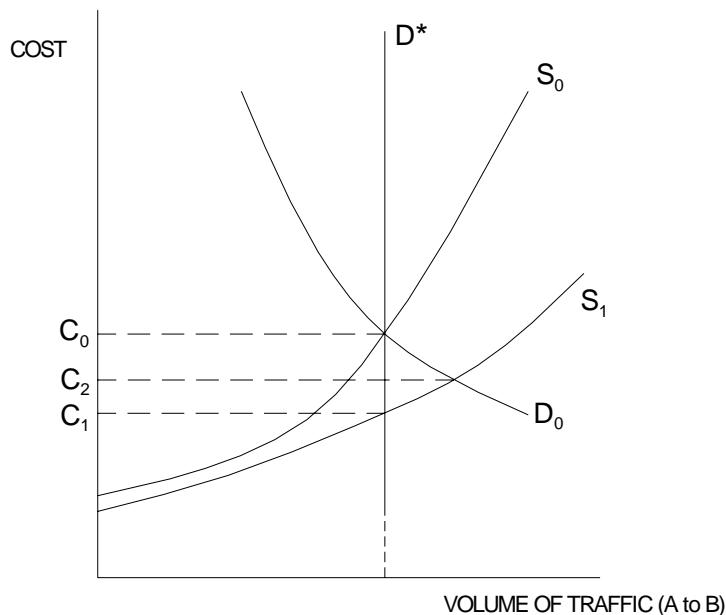
**Figure 2**

However, representing this position in practice is not straightforward since

- the road supplied caters simultaneously for many different demands and network changes may impact differentially on these demands (e.g. radial versus orbital movements)
- demand varies by time period –  $D_0$  in Figure 2 might represent average off-peak demand but peak demand would be positioned differently.

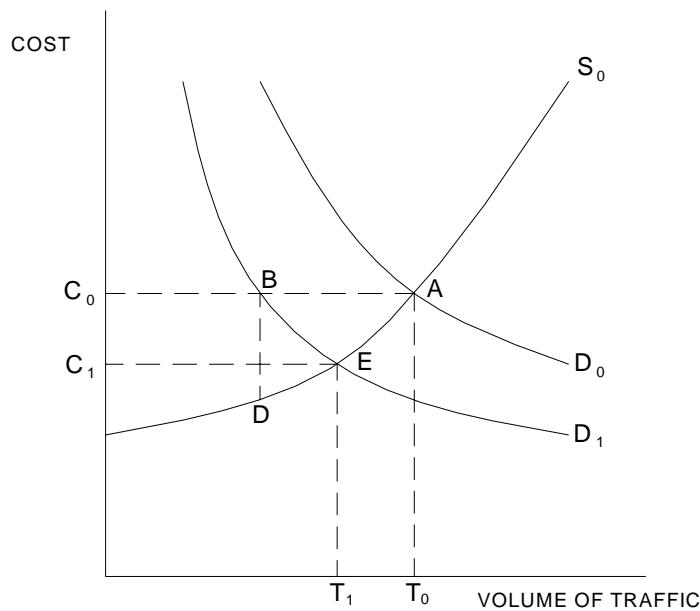
Figure 2 therefore represents one element of a complex set of demand/supply relationships which are interdependent in space and time. When measuring the impact of changes it needs to be borne in mind that traffic will re-route, re-time, change destinations etc., so that the demand pattern will adjust to supply changes. Depending on the nature of the changes made, simplifying assumptions may be acceptable.

Case 1 – an exogenous shift in supply brought about by increasing productivity/capacity of the area through a traffic management or UTC measure (Figure 3).

**Figure 3**

In the simplest cases it might be reasonable to estimate the changes in generalised cost for a fixed volume of demand  $D^*$ . A very approximate approach will be to perform calculations on journey times for the most important traffic movements (e.g. radial, orbital) in the corridor, and considering journey times for public transport and pedestrians where relevant. All demands are taken as fixed and the benefits calculated at that fixed pattern and level of demand. This is of course very crude because it ignores all demand responses. An assignment model would at least allow for rerouting, and elastic assignment would enable sensitivity to other responses to be examined. The 1994 SACTRA report demonstrated that in congested urban conditions the benefits calculated on a fixed demand basis could be significant overestimates of the benefits on the 'true' variable demand basis. Similarly, where capacity is reduced or reallocated to public transport, demand response would be expected to attenuate, though not entirely remove, the disbenefits calculated on a fixed demand basis.

Case 2 – an exogenous shift in demand due for example to a travel awareness campaign or green transport plan (Figure 4).

**Figure 4**

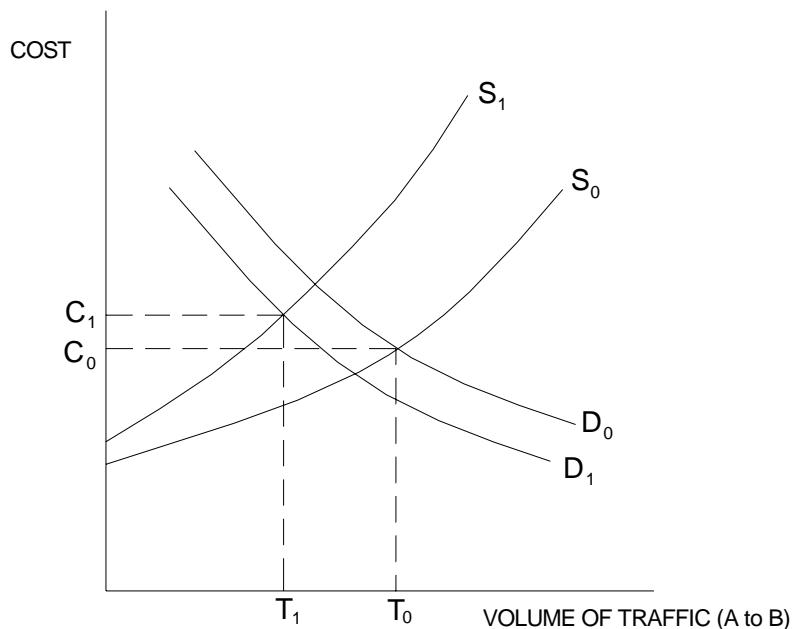
Here, the initial equilibrium is at A, and the issues to be resolved are

- how big an effect might the policy measure be expected to have on traffic volumes at a given level of cost  $C_0$ ? (A to B).
- how much do travel costs fall as a result? (B to D)
- how much general traffic might be expected to be generated as a result? (D to E).

As with Case 1, considering the first round effects only may be legitimate, given the uncertainties, but is likely to exaggerate the final outcome by ignoring the offsetting damping effects.

### Case 3

Changes in demand and supply brought about for example bus quality bus measures which improve quality of public transport by removing capacity from general road users (Figure 5).

**Figure 5**

Here the effect of the quality bus measures is to reduce demand for private travel, while the removal of road space, or signal priorities reduces supply of road space for private users. The outcome is a lower traffic volume at higher user cost. In a full assessment this will be considered alongside the benefits to bus users and operators from faster bus journey times..

The above cases are illustrations of the supply-demand framework. This framework forms the basis for estimating the impacts of supply/demand changes under simplified assumptions.

As mentioned previously, demands are interdependent in time and space, and multi-routing may be a further consideration. As a consequence calculations based on simplified assumptions may be a poor indicator of the 'true' changes. Therefore, there is a strategic choice. For low cost measures that are not judged to have significant impacts on routeing or other choices, simple calculations may be useful. Beyond a certain level, the simplifications become untenable and some form of traffic model is needed. For a discussion of models and their properties, see for example Watling (1994).

### Assessment

The subject of assessing the impacts of policy measures has been extensively covered in other documents (DETR 2000; LTP Guidance Annex E). That guidance points out that policy measures need to be considered and appraised within an overall framework, which is consistent between authorities and across policy instruments. The assessment must relate to the overriding objectives of policy as stated in the White Paper and daughter documents, and must consider relevant constraints such as finance, the legal position, acceptability and practicability. A commentary on some practical issues of applying the official advice is provided at Appendix B.

The orientation of the official advice is towards a situation in which a traffic model of a town or city exists, the output from which provide the measures of benefit, revenue, costs, environmental and other impacts to ‘enter’ into the assessment framework. Our appreciation of the situation on the ground is that there will be circumstances in which local authorities will not find themselves in a position to use a model-based approach to support their assessment. These include the following:-

- no model has ever been constructed for town A, nor is one likely ever to be cost effective;
- a model exists for town B, but the data on which it is based is old and untrustworthy;
- a model exists for town C, but it does not possess the properties (elastic assignment, modal switching etc.) required to assess the policy measures under consideration;
- the authority for town D is at the stage of sifting or screening of the policy options and wishes to use a model-based approach to consider a manageable set of options.

In some cases, the best advice may be that a model-based approach must be followed. If a town has a major strategic policy under consideration such as promoting large scale infrastructure or pricing measures, that is likely to be sound advice. But in other cases where management measures are under consideration, there may be arguments supporting more informal non-model based approaches. It is unlikely that such informal methods will enable authorities to follow the appraisal requirements in a fully quantitative way, and a more qualitative approach based on indicators may be required. Table 3.1 of the Common Appraisal Framework report (MVA et al, 1994) provides a list of indicators which it might be possible to use as an aid to assessment of policy measures.

Indicators have disadvantages however and need to be interpreted with care:-

- indicators should be related as closely as possible to the final criteria by which policy measures are to be judged. That is, they should indicate performance against one or more of environment, safety, economy, accessibility and integration;
- where possible, the indicator used should bear a close relationship to the benefit measures used in the GOMMMS/LTP Annex E table. Signposts are only useful if they point in the right direction;
- particular care needs to be taken where indicators relate to intermediate measures such as changes in vehicle kms or modal split. The fact that a particular policy measure reduces car kms or changes modal split towards public transport does not of itself demonstrate that such a policy measure is desirable. That can only be determined by considering what happens to the performance of the system in terms of journey times, reliability, safety, emissions and any wider consequences for the performance of the city as a whole.

Nevertheless, an appropriate set of indicators can be a useful adjunct to a purely qualitative approach. Judgement alone is rarely an acceptable basis for decision-making.

### 3. Advice on selected instruments

A comprehensive list of Policy Instruments with indicative references is contained in Appendix D. A small number of important selected instruments are reviewed below.

- Park and Ride
- Parking: off street
- Controlled parking zones
- Bus priority
- New bus station or other interchange facilities
- Rail stations
- Town centre pedestrianisation
- Traffic calming
- UTC systems
- Cycle facilities
- ‘Soft measures’

For each instrument we include some background and definition. The potential supply effects and demand effects are then identified in terms of their scope and, where data is available, approximate quantitative indicators given. Other impacts or effects are also outlined. Case studies or examples have been included as appropriate, as have indicative references for a further level of detail. An intrinsic difference in the nature and definition of these instruments combined with lack of published data in some cases implies that a wholly consistent treatment of all instruments may not be feasible within this document. Indeed further research may be needed for particular instruments to produce reliable quantitative measures.

### 3.1 Park and Ride

#### Introduction

The following section refers mainly to new bus-based park and ride facilities. These services provide an alternative means of city centre access, allowing transfer from existing car, while also providing a channel to accommodate future growth of travel activity.

#### Supply Effects

In relation to existing, conventional bus services, park and ride facilities may offer a number of improvements. These include:

- reduced access time to the public transport service
- reduced waiting times through higher frequencies
- an improved waiting environment (better personal security, information and buses waiting at the departure point)
- the “non-stop” nature of services and higher vehicle standards lessen the actual and perceived in-vehicle time
- the overall cost of using park and ride relative to parking in town/city centres may offer a significant cost saving.

Of course, these “waiting-related” attributes vary significantly depending on whether the inbound or outbound leg of the return journey is being made.

#### Demand Effects

Since bus-based park and ride initiatives are specifically targeted at car available individuals, the key potential source of demand is from existing car users –particularly those who pay to park, and whose existing journey naturally passes the park and ride site. In circumstances where existing parking facilities are insufficient to meet demand, suppressed demand for city centre access may provide an additional source of demand.

A further potential demand source, although undesirable, may be existing car available public transport users – particularly those whose existing bus or rail services has high fares and/or low frequency. In some circumstances, over 40% of users of park and ride facilities have been found to be former users of conventional bus or rail services.

Since park and ride generally offers an entirely new travel option, demand analysis based on elasticity-based methods applied to existing demand sources is clearly infeasible.

The preferred approach is to establish the extent of the core potential demand source, and then apply a simple logit formulation on the basis of the generalised costs of the existing and new travel modes.

The recommendation made here is that the core potential demand source focussed upon is the number of occupants travelling to the city centre, directly intercepted on the radial on which the park and ride service is located, and factored down according to the proportion that pay to park.

## Worked Example

Since we focus on the radial traffic intercepted at the park and ride site, only the journey time and cost components from that point to the town centre need be considered. Such a comparison is provided in Table 3.1.

**Table 3.1: Journey Components (from Park and Ride Site)**

	<b>By Car</b>	<b>By Park &amp; Ride Service</b>
Time to park at park & ride site	-	5 mins
Wait time	-	5 mins
In-vehicle time	10 mins	10 mins
Cost per person (one way equivalent)	£4 / 2 people / car / 2 directions = £1 one way per person	£2 / 2 / 2 = £0.50 one way per person
Walk at end	5 mins	5 mins

Factors are then applied to these time/cost components to yield an overall “utility” for each alternative mode. These factors are:

- time to park = -0.05
- wait time = -0.10
- in-vehicle time = -0.05
- cost per person, one-way = -1
- walk egress = -0.10

Applying these factors, we get:

$$\begin{aligned} \text{Utility (car)} &= (10 \times -0.05) + (1 \times -1) + (5 \times -0.10) \\ &= -2.00 \end{aligned}$$

$$\begin{aligned} \text{Utility (park and ride)} &= (5 \times -0.05) + (5 \times -0.10) + (10 \times -0.05) + (0.5 \times -1) + (5 \times -0.10) \\ &= -2.25 \end{aligned}$$

These “utilities” are then input into a simple formula to give the percentage diverting to park and ride. This formula is:

$$\text{Percentage (park and ride)} = \frac{\exp(\text{utility (P&R)}) \times 100}{\exp(\text{utility (P&R)}) + \exp(\text{utility (car)})}$$

Or, using the utilities in the example:

$$\text{Percentage (park and ride)} = \exp(-2.25)/\{\exp(-2.25)+\exp(-2)\} \times 100 = 43.8\%$$

This factor may then be applied to the number of car occupants in the existing base market to get the number of person trips.

### 3.2 Controlled parking zones

#### Introduction

Controlled Parking Zones (CPZs) impose controls on on-street parking in a defined area. Locations where parking is unsafe or disruptive have parking banned using yellow lines and, if necessary, loading bans. The remaining kerb space is designated for parking, but usually with a restriction on duration, thus prohibiting long stay parking. In some areas a permit scheme is provided to allow long stay parking for residents. Where, as is usually the case, demand exceeds supply, it is regulated by price, using parking meters or pay and display machines. CPZs are essential if off-street parking is to be controlled, and will need to be expanded when Workplace Parking Levies are introduced.

There have been few studies recently of the introduction of CPZs. Early studies compared CPZs with a base in which there was little or no regulation of on-street parking, and the benefits were substantial. Current applications would be made in a context where yellow lines are already used to limit hazardous and disruptive parking, and the effects will then be less dramatic.

#### Supply Effects

CPZs have three principal supply effects:

- they increase the capacity of the road network by reducing the disruption of parked vehicles (as noted, most of this will already have been achieved through use of yellow lines).
- they increase the costs for short stay parking. This is straightforwardly determined by the parking charge.
- they prohibit long stay parking, unless there is spare space off-street or outside the zone, in which they increase costs and/or walking time. Again, these costs can be estimated by considering the alternatives.

#### Demand Effects

By increasing the costs of parking in the zone, CPZs are likely to reduce the demand for car use for journeys to the zone, both short stay and long stay. The elasticity will depend on the availability of alternatives:

- the simplest assumption is that the cost will rise to the level of the nearest similarly priced alternative.
- if there are several alternatives, a low price elasticity for car use, of around -0.2, can be assumed (Feeney, 1989).
- with fewer alternatives a figure of -0.4 may be more appropriate.

One complicating factor is that matching demand to supply may substantially reduce traffic searching for space, and the time spent doing so. This is difficult to measure, but has been estimated on occasion to account for as much as 20% of town centre traffic.

Where, in the before conditions, long stay parking dominates, it is quite possible that short stay parking will become easier if more spaces are available and searching is reduced. In such circumstances, short stay parking costs will fall (though the size of the reduction may be difficult to estimate), and usage will increase. While this may benefit local access and trade, it is worth noting

that a space used for short stay parking will typically generate six to ten times as many vehicle movements as a long stay space.

Other traffic will benefit from the reduction in parking and, in particular, from the reduction in searching traffic. Thus travel times by bus and for goods vehicles should fall. Through traffic will also benefit, and may be attracted into the area.

### **Other Effects**

- CPZs should help improve the environment and safety.
- they will, however, increase the costs of car access and may reduce economic activity in favour of areas without such controls. This impact is difficult to assess but, if the before conditions are compared, the net effect on access may well be small, or even positive.

### 3.3 Parking: off street (Reallocation of Parking Space)

#### Introduction

As noted, CPZs reallocate on-street parking space from long stay to short stay parking, and usually regulate the latter by price. On-street space is typically only 20% of a town centre's parking supply, however, and the effects are thus likely to be limited. It is possible to extend such controls to public off street parking, which may represent a further 30% to 40% of space. In practice local authorities will find it difficult to control public car parks which are privately operated, even though powers exist to license such space. Thus the maximum proportion of space which can be controlled, without recourse to Workplace Parking Levies, is likely to be between 40% and 60% of the total.

Controls on public off-street space can largely mirror those on-street, through reductions in space, reallocation of space to short stay parking, closure at certain times of day, allocation of space to permit holders, and price. However, the pricing regimes can be more complex than on-street, and variants range from a fixed charge independent of duration, to an escalating charge which still costs less per hour for longer durations, to a fixed hourly charge.

#### Supply Effects

The supply effects will largely mirror those for CPZs with the exception that road capacity will not be increased. Control of off-street space will, however, further reduce the alternatives available, and thus increase the resulting cost to users. In particular the costs to long stay parkers may be increased substantially through escalating charges.

#### Demand Effects

Again, the demand effects will be similar to those for CPZs, but probably intensified:

- With fewer alternatives, price elasticities closer to -0.4 will be more likely (Feeney, 1989).
- there is likely to be a reduction in traffic searching for parking space, and reallocation from long stay to short stay may actually increase the traffic generated.
- Other traffic will again benefit, primarily through the reduction in searching traffic, but possibly also through a reduction in termination car traffic (for an example, see the Bristol case study (Coombe et al, 1997)).
- Bus use may be encouraged through such improvements, and through the reduction in car use. Through traffic will also be encouraged, however, and this may reduce the benefits to other users.

#### Other Effects

- Any reduction in car traffic will improve the environment and safety, although the effects are likely to be less than from the introduction of a CPZ, given the greater impact of on-street parking.

- Extension of controls off-street may begin to have adverse effects on access for long stay parkers. Town centre economics are usually less vulnerable to impacts on long stay than short stay parking
- Care is needed to avoid adverse impacts on those who have no choice of mode, such as unsocial hours commuters.

### 3.4 Bus priority

#### Introduction

Bus priority schemes are intended to enable buses to bypass congested traffic and hence to experience reduced and more reliable journey times. The most common measures are with-flow bus lanes; others include bus-gates or bus only sections, exemption from banned turns, selective detection at signals, and UTC timings weighted to favour buses. Contra-flow bus lanes and bus access to pedestrian areas are designed specifically to reduce the adverse impact on buses of certain traffic management measures.

The main practical limitations with bus lanes are the lack of sites with suitable space for the extra bus lane, storage of the longer queue of other vehicles and the need for effective enforcement. Revised traffic control measures may also be needed at junctions along the route to accommodate traffic diverting to avoid the bus lane. A combination of bus priority and traffic management measures is therefore needed in order to generate benefits for bus users and avoid severe disbenefits for other road users. In addition, schemes should be examined at an early stage after opening to observe whether any tuning or complementary traffic measures are required.

The advice note 'keeping buses moving' - A guide to traffic management to assist buses in urban areas (Local Transport Note 1/91) contains recommendations on how to monitor periodically to assess the impacts of the scheme. This includes monitoring the number of buses and bus passengers using the scheme, delays to buses and other traffic, accident rates and enforcement costs.

When assessing the impacts of a scheme, the change in travel times should be measured more widely than just along the section of the new bus lane. The delay incurred on the approach to the bus lane can sometimes eliminate the benefit accrued from the bus lane and without this it is impossible to verify that passengers along the whole route are benefiting from the scheme. An overview of the effectiveness of a number of major bus priority schemes around the UK is given in Daugherty et al (1999).

#### Supply effects

Supply effects will depend upon the design of the scheme and crucially on factors such as:

- whether there is a resulting reduction in capacity for general traffic,
- the speed of buses before the lane is introduced,
- the number of stops and junctions along the route
- whether complementary traffic control and other measures are introduced simultaneously.

Evidence from Daugherty et al (1999) suggests that there is no general correlation between the total scheme length and the bus journey-time savings in minutes. From the review of a number of schemes, most journey-time savings were observed in the range 0 to 5 minutes regardless of the length of the scheme. As may be expected, data on the relationship between the original bus speed and bus travel time savings (min/km) indicate that the greatest improvements are seen where the original speed is lowest, with relatively little improvement where original speeds are higher. Other studies have suggested that bus journey-time savings could be as high as 25% of the pre-scheme figure where there is no reduction in general road capacity. There is little evidence from studies of individual bus lanes that they have any significant effect on bus reliability and hence waiting time.

There are also many examples, however, where the introduction of a scheme either fails to generate any benefits to bus traffic or even worsens bus travel times. Potential reasons behind this effect are:

- increased delays by all vehicles on the approach to the bus lane. These delays can be caused by either queues building up alongside the bus lane to a point where they extended upstream of the bus lane, or because of the bus lane acting a bottleneck throttling the flow of all traffic.
- a failure to update traffic control at major junctions along the route, where there may be a reduced number of lanes for non-priority traffic combined with a uniform or even reduced green time for all traffic.
- traffic tending to divert away from the priority route if drivers perceive that their journey may be delayed due to the scheme. Diverted traffic may than enter the priority route in greater volumes at junctions further along the route and cause increased delays to all traffic on and off the priority route.

Bus priority schemes also generate effect for other modes. Where there is no decrease in capacity, general traffic can also benefit with savings up to 50% of travel time. Effects on general traffic are more typically as follows:

- non-priority traffic may benefit at off peak times from the associated traffic management measures, but can experience increased delays during peak times
- delays to non-priority traffic may result from reduced capacity along the route where the bus lanes have been installed but also by new traffic patterns at junctions with the priority route as a result of diverted car traffic
- where cyclists, emergency vehicles and taxis are permitted to use bus lanes they will actually experience savings similar to those for buses.

## Demand effects

Because most bus priorities only affect in-vehicle time and not walking or waiting time, they have relatively small impacts on generalised cost. These impacts will usually be sufficient to increase patronage but not to attract patronage from car users other than at the margins. Increased patronage may also result from a public perception of an improved service even if this is not in fact the case.

Where bus priorities impose no reduction in capacity, they are unlikely to directly affect car use, except marginally through the deterrent of longer queues. More continuous application of bus lanes, as practised in Paris, may be more beneficial in inducing a switch from car to bus travel (Webster et al, 1980), as may segregation within a dedicated guided-bus channel.

Whilst bus priorities which reduce capacity will typically still only affect in-vehicle time, the capacity reduction may, itself, deter car use and the combined effect could, hence, encourage a modal transfer. This effect is still very difficult to estimate. One major study suggests on average a 14% reduction in affected traffic where capacity is removed (Goodwin et al, 1998), but this is too crude a figure to be applied uniformly and reflects a reduction in car use, not necessarily a mode transfer.

## Other Effects

The segregation of traffic also appears to enhance safety. The main disadvantages are to frontage access, if parking is restricted, and to the environment, since queues will be longer, and traffic diversions may be induced. There is little experience of bus lanes being taken up to stop lines, but evidence from Nottingham suggests that the additional congestion may well have adverse impacts

on efficiency and the environment. It may be possible for traffic management systems to relocate queues to places where these disbenefits can be minimised. The evidence on effects on frontage access and trade is mixed (Wood and Smith, 1992). More research into the wider impacts of such measures is needed.

### **Examples of scheme effects:**

- Evidence from an Aberdeen bus priority scheme (Astrop et al, 1996) suggests that improvements in journey time for bus passengers may be no greater than increased delays incurred by non-priority traffic in peak periods
- A scheme in Brighton (Astrop et al, 1997) has resulted in substantial additional delays to both buses and other traffic compared to the before situation. This was of the order of between a 2.7% to 14.6% increase for buses and between 36.9% to 38.8% increase for non-priority traffic. Despite this the scheme was viewed as a success due to the overall increase in bus patronage in the area observed (around 16% over 3 years). Increased patronage may possibly be explained by the enhancement of the image of bus services resulting from the introduction of a priority scheme and a perception by the public that the service was quicker, contrary to the truth
- A scheme in Birmingham (CENTRO, 1994) also appears to have produced no net benefit for buses and may also have resulted in a disadvantage for them compared with the before situation. At best a 3-minute reduction in times was reported, but at worst a 4-minute increase was observed. The explanation in this case was that drivers were still operating to an old timetable and deliberately waiting or slowing down in order to adhere to this. In addition, long signal phases at junctions along the corridor resulted in bunching of buses with marginally greater average passenger wait times. There were no significant changes to patronage along the scheme over an above a general decline over the whole cordon.
- In Bristol (Bristol City council) a very large time saving to buses was observed as a result of one scheme. Savings were observed for all traffic and the general traffic saving was approximately 50% of travel time. This was achieved by combining the construction of a bus priority lane with the removal of on-street parking so that there was no reduction in capacity for general traffic.
- A scheme in Leicester (Leicester County council, 1996) achieved a modest 1 to 1.75 minutes reduction in bus journey times along the survey route, but this was at fairly high cost to other traffic with delays of about 4.5 minutes
- A 30% saving in injury accidents had been reported following the introduction of the Wilmslow corridor scheme in Manchester (Manchester City Council, 1995)
- The South Sheffield demonstration project (Sheffield City Council, 1993) also reported either a neutral effect or deterioration in bus travel times during the peak. Bus journey times tended to improve beyond the bus lane, but increased congestion prior to the bus lane were countering the benefits of this.

### 3.5 New Bus Stations and Interchanges

#### Introduction

New bus stations and interchanges enable enhanced facilities to be provided to existing and potential public transport passengers.

#### Supply Effects

New facilities provide a wide range of improvements. These include:

- improved information,
- a better waiting environment
- enhanced pedestrian and vehicular access.

Each of these groups of improvement can contribute to an overall reduction in perceived generalised costs of travel.

**Improved passenger information** may result from a number of supply characteristics. These include “real-time” departures information (based on manual or automated systems) for individual services, staffed information points and clearer timetables and poster information. The opportunity to group together related routes may exist, particularly for larger bus stations/interchanges. Thus, improved information may ease the penalty typically associated with waiting, and the availability of a wider range of services may reduce overall journey times.

**A better waiting environment** may result from enhanced personal security - provision of CCTV, staff visibility, and the presence of members of the general public. Comfort, protection from the weather and seating provision, and passenger facilities such as shops, cafes etc. also contribute to a more pleasant waiting environment.

Depending on their design characteristics and siting, new bus stations/interchanges may **alter access and/or egress times** for vehicles and pedestrians from the existing situation – for better or for worse. Thus, in-vehicle times and walk times may increase or reduce.

#### Demand Effects

The discussion of supply effects has highlighted a number of ways in which journey time components, or their perception of these components, may be reduced. In general, the cumulative effects of all these enhancements will be limited in relation to overall door-to-door journey times. For this reason, the core market for demand increases will be existing public transport users, as opposed to existing car users.

Therefore, a sound understanding of the composition of existing public transport user characteristics will be necessary. This will include

- the number of interchanges,
- the number of non-interchanges, and their typical generalised cost characteristics at present – including total journey times, wait times, walk times etc.

The change in perceived generalised cost brought about by the new facility may then be assessed in relative to these base generalised costs.

Ideally, this approach should be applied to a number of market segments.

### Worked Example

	<b>Existing</b>	<b>New</b>	<b>Change</b>
Wait time	10 mins	5 mins	
Weighting on wait	$x 2 = 20$ mins	$x 1.5 = 7.5$ mins	-12.5
Interchange penalty	15 mins	10 mins	-5
In-vehicle time	40	40	0
Generalised time	75	57.5	-17.5 (or -23%)

We can then apply a generalised time elasticity of -0.8 to give a demand increase of +18% ( $-0.8 \times -23\%$ ).

### 3.6 Rail stations - (Re) Opening Rail Stations or Services

#### Introduction

Around 1990, new rail stations were opening at an average rate of over 20 per year, but this figure has fallen back during rail privatisation. The most common case has been of new (or reopened) stations to improve accessibility from residential locations, sometimes involving several stations along a line of route. Other stations have sought to attract, rather than generate, travel. These may serve factories, offices, or educational establishments; the Birmingham Cross City line providing examples with Longbridge, Five Ways and University, respectively. Other stations may give better access to Central Business Districts (eg Argyle Street, Glasgow) or out of town shopping centres (eg Meadowhall).

#### Demand Estimates

ITS (1991) discusses several methods of estimating patronage. For large schemes, surveys should be carried out and models built. It will often be sensible to employ consultants in these circumstances. For smaller schemes, trip rates achieved by previous schemes may be a sufficient guide, particularly for stations serving residential locations. Data for 11 new stations opened in the 1980s gives the following median figures for daily ons and offs:

Per thousand population 0-800m	20
Per thousand population 800m-2km	3
% from beyond 2k	20 (i.e. multiply by 1.2)

Just to clarify this with a worked example, if 1000 people live within 800m of the site of a proposed new station, and 5000 people live between 800m and 2km away (not overlapping with the catchment of any other railway station) then  $[20(1)+3(5)]1.2 = 42$  ons or offs can be expected, which might arise from 21 persons making a return journey from the station.

Around three median values, lower trip rates (and proportions from beyond 2km) were found for sites close to central areas. Stations in suburbia can be expected to have higher trip rates, possibly double in 'prime' locations.

Naturally, the number of trips generated by or attracted to the new station will depend on the fare charged, and in particular the comparison to alternative modes. Where the main competition is the bus, it should be assumed that the trip rate model given above applies if the rail fare is broadly equivalent to the bus fare. Otherwise it should be assumed that the rail fare is in line with the average for such stations. Where it is required to assess patronage for fare levels different from this, an elasticity of rail patronage with respect to rail fare of -0.66 should be used. As rail fares are increased, this figure will rise, and vice versa.

The service level assumed for the trip rates given should be taken as hourly, weighted by usage. A service which was generally every hour, but had an extra train in the peak hour and became two-hourly in the evening would count as 'hourly'. For other frequencies, an elasticity of rail patronage with respect to rail frequency of 0.5 should be used initially, but large frequency increases (compared to hourly) will have diminishing elasticity, and infrequent services a higher elasticity. Even with these additions, however, the predicted patronage will only be a very rough estimate.

### Final Worked Example

A new station located in prime commuter belt, with 1500 people living within 800m and 10000 people between 800m and 2km away, with a half hourly service throughout the day and fares 30% above those of the competing bus, would be expected to have the following patronage.

Use double trip rates due to the prime location.

1500 within 800m	$\rightarrow$	60 ons and offs
10000 between 800m and 2km	$\rightarrow$	60 ons and offs
		_____
		120
Allowance for beyond 2km (20%)		24
		_____
		144
Fare effect $-0.66(+0.3)144 =$ (where -0.66 is the fares elasticity and +0.3 is the proportional fare charge)		-29
		_____
		115
Frequency effect $+0.5(+1)(115) =$ (The half hourly frequency is interpreted a 100% (ie +1) increase in frequency, yielding 50% more passengers due to +0.5 Frequency elasticity)		+58
		_____
		173

### 3.7 Town centre pedestrianisation

#### Introduction

Pedestrian streets involve the removal of traffic, typically on shopping streets, and the redesign of the street as a pedestrian environment. There are several variants of the basic concept:

- the measures can operate for 24 hours or just during the peak shopping hours.
- there can be exemptions for delivery vehicles and disabled drivers and cyclists.
- there can be exemptions for buses, although this will require a very different design.
- there are widespread variations in scale, from closure of a single, minor, street, to pedestrian treatment of a whole centre which, as in the case of Leeds for example.

Many pedestrian streets were introduced 20 to 30 years ago, and there is relatively little documented evidence on the impact on traffic.

#### Supply effects

The principal impact of pedestrian treatment is to **reduce the capacity** of the road network. Drivers will, in the main, reroute to avoid the closed roads and this will add to vehicle km and may increase congestion. This can be very minor; indeed it is possible for closure of a minor road, and removal of its turning movements, to increase capacity marginally. It can, however, be substantial, in which case there may be some reduction in car use (see below). There is no simple rule for assessing the impact on capacity, though the percentage reduction in the lane-length of distributor roads in the affected area will provide some guidance.

The other effect is on **access**, and this will vary by purpose and mode.

- Access by car will only be affected if access to car parks is reduced. Only a very small proportion of car users are currently able to park on-street in streets to be pedestrianised.
- Access by bus can be severely affected if buses are diverted from their normal routes, and stops are further from passengers' destinations.
- Access by bicycle may be adversely affected if cyclists have to walk, but the effect will typically be small.
- Access on foot will be improved, by reducing delays crossing roads.
- Access for delivery vehicles will depend on design. In the extreme where transshipment is required cost increased can be substantial.

#### Demand Effects

It is impossible to generalise the effects on demand given the range of possible design options and the lack of detailed evidence. However, car use is unlikely to be reduced unless the reduction in capacity is substantial. A threshold of 10% reduction in lane-length of distributors is tentatively suggested xxxx. Above this, the best guidance is in the study on the effects of **road capacity reduction** (Goodwin et al, 1998). As noted elsewhere, this suggests a 14% reduction in affected traffic when capacity is removed, but this figure clearly cannot be applied throughout the range of capacity reductions which are possible. Tentatively it is suggested that the following figures are applied:

- 5% reduction for a 10% capacity reduction, rising to

- 15% reduction for a 30% capacity reduction

**Effects on bus use** will depend on the effects on walking time. It should be possible to estimate the increase, if any, in walking time, estimate the impact of this on average generalised costs for bus travel (in which walking and waiting time are given twice the weight of in vehicle time) and apply an elasticity to generalised cost of -1.5 (Webster et al, 1980).

There is little basis for estimating the **effect on walking and cycling**, though walking at least can be expected to increase. Generally experience with pedestrian streets is that turnover, which will be related in part to pedestrian activity, increases rather than declining (eg Hass-Klau et al, 1993).

Effects on **goods vehicles** will be primarily to retime rather than reduce movements.

### Other Effects

The principal benefits will be to the environment and to pedestrian safety in the treated area.

- depending on the provision for access traffic, reductions in local pollutants and accidents of 80% or more on the treated streets are perfectly possible.
- Conversely, there will be some increase in pollution and accidents on the surrounding road network, unless the scheme is carefully designed to avoid these.

All the evidence suggests that trade is more likely to increase than fall as a result of treatment (Hass-Klau et al, 1993), though it should be considered that this trade will have been diverted from other locations.

### 3.8 Traffic calming

#### Introduction

Traffic calming measures are designed to reduce the adverse environmental and safety impacts of car (and commercial vehicle) use. They have traditionally focused on residential streets, for which Buchanan, in “Traffic in Towns”, proposed an environmental capacity of 300 veh/h, and have involved two types of approach:

- segregation, in which extraneous traffic is removed
- integration, in which traffic is permitted, but encouraged to respect the environment.

More recently they have also been extended to main roads, where integration is the only possible solution (Bicknell, 1993; Hass-Klau et al, 1992).

**Segregation** can be achieved by the use of one way streets, closures and banned turns, which create a ‘maze’ or ‘labyrinth’, which makes through movement difficult, and hence diverts it to surrounding streets. The extra traffic on surrounding streets can add to congestion and environmental intrusion there, and this trade-off needs to be carefully considered at the design stage. However, the maze treatment also reduces accessibility for those living in the area, and this loss of accessibility has often led to the rejection of such measures by the residents whom they are designed to benefit.

An alternative approach, more often used in city centres, is the traffic cell, in which an area is divided into cells, between which traffic movement, except perhaps for buses and emergency vehicles, is physically prohibited. This can also cause some access problems, particularly where parking supply and demand in individual cells is not in balance, but experience suggests that these are outweighed by the environmental benefits.

**Integration** measures include low speed limits, speed humps, chicanes, pinch points, resurfacing and planting, all designed to encourage the driver to drive more slowly and cautiously. It is clear that these can achieve significant reductions in speed and accidents (TRL, 1995). By making routes through residential areas slower, they can also induce re-routing to major roads, and hence a reduction in environmental impact. Such benefits may, of course, be offset by increases in congestion and environmental impact on the diversion route.

#### Supply effects

For both types of measure, the main impact on supply is to **reduce the capacity** of the road network. The scale of this will be greatest where traffic calming measures are applied to main roads, where maximum speeds may well fall from 30 mph to 20 mph. Reductions in capacity are also likely to be sizeable where segregation measures, using mazes or traffic cells, are implemented. In these cases, the **connectivity** of the minor road network is reduced, and through traffic and some local traffic is forced to use the main roads. The impact will depend on the extent of the measures, but it is possible to envisage reductions in capacity of as much as 10%.

With integration measures such as 20 mph zones or speed humps on minor roads, the impact on capacity will be much less, since the minor roads are still available as alternative routes when demand is at its highest.

## Demand effects

There is little documented evidence on the effects of this range of measures on car use. By far the greatest impact is to induce **rerouting**. For example:

- in the traffic cell scheme in Gothenburg, traffic flows fell by as much as 45% within the centre, and rose by 10% on the ring road, resulting in a net increase of 1% in vehicle-km
- in the early experiments with speed humps, up to 65% of flow on minor roads was diverted to main roads.

The additional distance travelled is likely to add only marginally to the cost of the journey, however, and hence to have little impact on the number of journeys by car. Only where the network is close to capacity is demand likely to be reduced. In these cases the guidance in the study of the effects of capacity reduction is likely to be relevant (see section 3.7: Pedestrianisation).

## Other effects

The main impacts of all of these measures are to:

- improve the environment
- to reduce accidents.

Reductions of 2 to 6 dBA in noise and up to 60% in accidents from speed humps have been reported from past research. The Urban Safety Project, which used such measures extensively, achieved a 13% reduction in accidents (IHT, 1990). It is important to note, however, that these benefits will to some extent be offset by **increases in intrusion** on the main roads to which traffic diverts.

As noted above, segregation measures can also adversely affect **accessibility** to and within the treated area. In residential areas this is likely to be a minor impact, and there is evidence from **increased property prices** that the environmental benefits outweigh any such impact. It appears that this is the case also in shopping centres, provided that access to parking facilities is maintained (Hass-Klau et al, 1993).

### 3.9 Urban Traffic Control (UTC) systems

#### Introduction

Urban traffic control (UTC) systems are a specialist form of traffic management which integrate and co-ordinate traffic signal control over a wide area (for more detail see IHT, 1997). They are typically implemented in an urban area over which traffic conditions are monitored by loop detectors and controlled by traffic signals connected to an urban traffic control (UTC) system. A traffic responsive signal control system is a means of adjusting the traffic signal settings (cycles, green splits and offsets) in real-time based upon estimates of traffic conditions.

The systems use the signal settings to optimise a given objective such as minimising travel time or stops, though increasingly more complex objectives are being introduced such as queue management strategies and public transport priorities (Fox et al, 1995). Conventionally, UK UTC systems have either been fixed time, using the program TRANSYT, or real time, based on SCOOT.

UTC systems are under constant development (Bretherton et al, 1998) and are being adapted to deal with more complex, though sometimes more operational issues, moving away from the traditional objectives to provide links with Intelligent Transport Systems (ITS). This includes developments in:

- motorway access control (ramp metering),
- automatic incident detection (AID),
- image processing of CCTV,
- selective vehicle priority,
- queue management techniques and other experimental measures.

Many of these measures can be linked in with UTC, generally termed UTMC (Urban Traffic Management and Control (Fox et al, 1995, Routledge, 1996). It also includes the extension of UTC to provide priorities for buses, and their integration with information systems such as dynamic route guidance.

#### Supply Effects

Widespread trials have demonstrated the benefits of such systems:

- an up to date TRANSYT system can achieve savings in travel time of up to 15%, although this may be degraded by as much as 3% per annum as patterns change
- the relative effectiveness of SCOOT varies by area and time of day but overall it is concluded that SCOOT achieved an average saving in delay of about 12% compared with good fixed time plans.

Since SCOOT does not “age” in the same way as fixed time plans, it follows that SCOOT should achieve savings of 20%, or more depending on the quality and age of the previous fixed time plan and on the rapidity with which flows change (Wood, 1993).

The savings need to be offset against the costs of around £10,000-£15,000 per junction for TRANSYT and £20,000-£25,000 for SCOOT. However the potential for these benefits to be eroded by induced traffic, as mentioned below, needs to be borne in mind.

Therefore when assessing the possible use of UTC systems one must bear in mind the *starting point* and the *end use* of the system:

- the implementation costs will be different if setting up completely new signals compared to upgrading fixed time signals
- linked to this, the benefits of UTC system should be measured against the current situation. The benefits achievable over non-signalised junctions compared to a good fixed signal plan should be taken into account
- the intended use should be considered. If it is to implement some form of signal priority for public transport over a few junctions then perhaps other ad hoc over-ride strategies should be considered.

### Demand Effects

Reducing travel times and increasing capacity over a significant area may cause a **shift in demand** towards car travel. As most systems also improve travel times for buses to the same degree (usually by default) or possibly further by giving priority to buses, the overall effect on demand would seem to be neutral.

Increasing the supply through reduced travel times may induce **re-routeing** within the network and so erode possible benefits in the signalised area.

### Other Effects

- Such efficiency gains may also improve the environment, since there are fewer stops and queues, and safety, with typical reductions in accidents of the order of 10%.
- Wood and Harrison (1998) give a comprehensive review of UTMC effects on emissions and suggest that good signal co-ordination can reduce fuel consumption by 20%. Introducing SCOOT provides a further 5% reduction in fuel consumption, and it is estimated that it would also reduce CO emissions by 5% and VOC by 4% compared to fixed time plans.

### 3.10 Cycle facilities

#### Introduction

This is taken to mean the provision of infrastructure on the highway or elsewhere to improve the safety and/or convenience of trips by cycle. For the purposes of considering different types of cycle provision, facilities can be divided into those which are segregated from general traffic (though not necessarily from pedestrians) and those which are not. Examples of the former are

- Toucan crossings (crossings which both pedestrians and cyclists can use at the same time)
- cycle paths which are separate from the roadway.

Examples of facilities for cyclists in the general traffic stream are

- advanced stop lines and
- cycle lanes on the road (whether mandatory or advisory).

Cycle routes can be identified and cycle facilities linked up along such routes to provide, as far as possible, a coherent journey for cyclists and maximise the effectiveness of the infrastructure. It is argued that even greater benefits can be gained by developing a comprehensive network of cycle routes across a whole urban area (Tolley, 1990). Obviously, any policy to encourage cycling (see for example the model cycling policy developed in CPAG, 1997) will be more effective in the context of a generally supportive transport strategy which uses many different policy measures to encourage modal shift away from the car (Mathew, 1995).

In line with the National Cycle Strategy (DoT, 1996) the aim of cycle facilities should be:

- to encourage more people to cycle more often
- to encourage modal shift from car to cycle.

Detailed design is difficult, partly because of the wide range of competencies and characteristics of cyclists, from differences in speeds and accelerations, through to willingness to mix in with the general traffic stream and attitudes to risk. Cyclists also vary in the values they attach to aspects such as directness, safety and convenience. Physically fitting convenient and safe facilities into the existing highway infrastructure can also be challenging and site specific considerations are paramount.

A wide range of measures is suggested Davies et al (1998) to encourage cycling. These include:

- engineering measures such as redistribution of carriageway space,
- cycle route networks
- traffic calming
- traffic management
- treatment at traffic signals
- cycle friendly roundabouts,

but also other measures such as:

- speed reduction and enforcement
- improvements in driver behaviour
- training for cyclists

- land use planning, integration with public transport
- traffic reduction and making the ordinary road network safer for cyclists.

There are now a large number of relevant guidelines for practitioners who wish to develop cycle policies (CPAG, 1997), review their current infrastructure and audit planned schemes (IHT, 1998) and design cycle friendly infrastructure (IHT et al, 1996).

### Infrastructure effects on other road users

Cycle facilities have traditionally been designed to have little effect on other road users, though shared use facilities (that is shared between cyclists and pedestrians) can adversely affect **pedestrian perception of safety and amenity**. For this reason and because such facilities are often not attractive for cyclists, shared use is now often seen as a last resort by the designers of cycle facilities (see IHT et al, 1996).

**Separation** from motor vehicles on the grounds of safety is seen as a major benefit for cyclists on segregated facilities. Unfortunately, these facilities are often less direct and therefore less convenient for some cyclists (for instance utility cyclists) who may prefer to use the roadway with the general traffic. There is also evidence that poorly designed segregated facilities can **increase the accident rate**. If road space can be taken from general traffic and used to provide more space for cycle facilities, then carefully designed and maintained segregated facilities could be attractive, but there will be an obvious effect on other road users.

Official guidance (IHT et al, 1996) now suggests that on-carriageway solutions should be sought wherever possible. Such cycle facilities can have an effect on **capacity** for other modes in certain cases (for instance where a general traffic lane is removed to make room for a cycle lane), but they can also have beneficial effects such as reducing **speeds** by reducing effective carriageway width. At the moment it is rare for on road cycle facilities to be allowed to affect capacity for general traffic, but there may be clear benefits for cyclists and this approach may become more common if capacity reallocation becomes more widely accepted.

### Demand for cycle facilities

The Cycle Route Demonstration Project was set up in consultation with seven local authorities who implemented comprehensive networks of cycle routes using local roads and segregated facilities to find out whether there was a significant effect on cycle use or safety.

- Harland and Gercans (1993) reported that there had been little or no increase in overall cyclist numbers, but cyclists had transferred from main roads to the cycle routes. They concluded that other complementary policies and measures were necessary to significantly affect the numbers cycling.
- A number of new towns have incorporated segregated cycle route networks (for instance Stevenage and the 'Redway' in Milton Keynes) but none of these towns has levels of cycle use significantly different from comparable towns without such networks.
- Where high levels of cycling exist, it seems more likely that this is as a result of other factors. These may include historically high levels of cycle use, the existence of a 'cycling culture', a compact city form, lack of hills, lack of barriers in the form of large, high speed road junctions and high levels of congestion.

Demand for cycling and cycling facilities is intrinsically difficult to predict. Attitudes to cycling are varied and complex and are affected by life stage, gender, location, image and status (Davies et al, 1997). People's reasons for not cycling are dominated by perceptions of danger but there are 'layers'

of motivation, reasoning and behaviour change involved in the decision to cycle or not. Existing utility cyclists tend to select their routes largely on the basis of convenience and directness. Models of cycle demand do exist and have been used (DoT, 1995a). Results should be treated with caution, but they can be used to assist in prioritising schemes to be progressed and to indicate possible underlying demand.

- Hopkinson and Wardman (1996) showed, with a stated preference study of cycle facility provision in Bradford, West Yorkshire, that different values were placed on different attributes of alternative cycle routes. They found that, for a commuter journey of about 5 km, a bus and cycle lane on a busy road was valued at 7 pence, a widened lane on a less busy alternative was valued at 18 pence, a segregated path alongside the less busy route was valued at 30 pence and a completely segregated cycleway was valued at 71 pence. An important conclusion from this work was that it showed that some new cycle facilities can be economically justified on the basis of benefits to current cyclists only, even in circumstances of relatively low cycle use.
- Wardman et al (1997), using a similar methodology in Leeds, managed to derive estimates of values of time for cycling in different weather conditions and using different facilities. It was found that the value of time for cycling varied from 2.87 pence per minute for a trip in fine weather on a segregated cycling facility to 21.28 p/min for cycling in rainy and windy weather where there were no facilities. Based upon fine weather conditions a fully segregated and continuous cycle path was estimated to reduce the value of cycle time by 6.7 p/min, which implied that such a facility would be worth about 201 pence for a cycle journey of 30 minutes, or the same as a 21 minute journey time reduction. In the same study the value of car/bus time was estimated to be 1.54 p/min. The value of some cycle facilities were also valued as part of this study and it was found that a considerable premium of 66 pence was attached to the provision of secure cycle parking.
- Davies et al (1998) suggest that the National Cycling Strategy short term target of doubling cycle use between 1996 and 2002 may be achieved if most of these suggestions are implemented, but that significant increases in cycling cannot be achieved by cycle routes alone. To increase cycle use, facilities for cycling need to be part of a comprehensive transport strategy that includes demand management and traffic reduction policies.

### **Mode shift effects**

Efforts to encourage cycling in this country have been unsuccessful in persuading people to cycle rather than drive. In other northern European countries, however, there is some evidence that a comprehensive network of cycle routes can affect mode split.

- In Delft, for instance, areas benefiting from a dense network of cycle routes showed a decrease in motor vehicle trips in favour of cycle trips. In these areas the share of all trips accounted for by cycle increased by six to eight per cent (Tolley, 1990). Further work on the Delft network has meant that the overall modal split of cycle has increased from 40 to 43%. Mathew (1995) includes a range of Continental case studies where beneficial mode shift has occurred and shows that cycle use is now increasing in Holland.
- In a study of 'cycling motorists' in the UK, the AA (AA Group Public Policy, 1993) suggested that about a third of motorists might be persuaded to increase their use of a bicycle in place of a car and that if each of these motorists transferred only one car journey to cycle per week, two per cent of the journeys currently made by car would be cycled.

- Wardman et al (1997) used a stated preference survey to forecast the percentages of car users and bus users who would cycle, given certain changes in cycle facilities in an area of Leeds. These percentages ranged from 4.4% of car users and 4.6% of bus users cycling (compared to a base of 3.0%) if an unsegregated cycle lane were available for their whole journey, to 12.9% of car users and 16.7% of bus users cycling if a segregated path with a 20% time saving, secure cycle parking and shower facilities were available.
- Research sponsored by the Cyclists' Touring Club showed that even relatively small modal shifts in favour of the bicycle could have relatively large effects in terms of emissions. This was because it was felt that cycle trips were most likely to be substituted for the shortest and most environmentally damaging car journeys (Rowell and Fergusson, 1991).

### **Policy Instrument: Soft Measures Company Transport Plans, Travel Awareness & Safe Routes to School**

A Company Travel Plan (CTP - also known as a Green Transport/Travel/Commuter Plan) is a package of measures aiming to cause modal shift away from car use for the journey to work. The motivation behind a CTP need not be environmental. Companies with a CTP have often implemented it for business reasons, e.g. expansion problems due to space constraints. A growing trend is to advocate CTPs through travel awareness work.

Travel awareness aims to reduce car use through information and persuasion. Local authorities, including Leeds, York, Hampshire, and Hertfordshire are advocating CTPs as part of their travel awareness work. At the same time, travel awareness projects looking at all journeys, are being implemented via the workplace, e.g. Travel Blending in Leeds which was run by Steer Davies Gleave consultancy. Travel Awareness can also help to promote School Travel Plans (STP).

STPs developed from Safe Routes to School (SRS) which were mainly concerned with walking and cycling initiatives. STPs are packages which include; walking, cycling, public transport, engineering, education, and travel awareness initiatives, as well as school policy measures, and pupil/parent involvement (Bradshaw, 1999). STPs can be seen as equivalent to CTPs for schools.

The impetus behind CTPs has increased since the Government placed them higher up the political agenda by including them in the 1998 Transport White Paper. Now Government departments, and local authorities are expected to put a CTP in place. Plus CTPs are advocated in planning guidance notes, including the public consultation draft for the revision of PPG13, and PPG12. Section 106 of The Town and Country Planning Act 1990, can also be used to require developers to provide infrastructure (e.g. improved measures for cyclists and pedestrians) that could be exploited by CTPs, "in line with PPG13 aims" (DoE, 1997). CTPs were also given a helping hand in the March 1999 budget, by the removal of tax on a number of CTP benefits to employees. Much of this legislation (although not the tax benefits) is applicable to STPs, which have also been included in sustainable regeneration bids (SRB).

#### **Supply Effects**

CTPs rarely have direct supply effects, as for example, bus priorities can.

- CTPs can involve measures which have supply effects for individual modes. A developer may include bus access to their site, altering the supply of buses.
- CTPs can affect the supply of infrastructure, and facilities for cycling and walking. This does not directly affect cycling rates, but it can generate demand. To affect cycle supply, companies need to subsidise bicycle purchase, or provide bike hire.

The effects of large scale supply measures, e.g. site access for buses, and bicycle provision are rarely quantified, and employers are reluctant to spend money on facilities that may not provide direct benefits to the company. Hence, smaller scale, demand measures, e.g. provision of showers and loans for public transport tickets are more common (Rye, 1999b). Consequently the effects of CTPs are greatest on the demand side.

Large scale supply measures are most likely where a company cannot expand without providing alternatives to the car, due to spatial constraints, or where a company has problems with staff recruitment and retention due to poor site access (Rye, 1999b).

The supply effects of STPs are broadly the same as those described above. As with CTPs, the focus behind STPs is not solely environmental. Common reasons for implementing a STP are:

- road safety,
- decreasing congestion, and then
- sustainability (Bradshaw, 1999).

The most common measures are:

- engineering,
- walking,
- education,
- cycling, and
- public transport (Bradshaw, 1999).

It should be noted that supply effects of STPs are complicated by the fact that the consumer is the school child, whilst in many cases the purse strings are held by the parent.

The supply effects of travel awareness programmes can be harder to identify.

- Where travel awareness is based on provision of information, and education about alternatives to cars, supply effects for individual modes, and their infrastructure are minimal.
- Where travel awareness promotes a scheme aimed at increasing the mode share of a particular alternative, supply effects can be equivalent to those generated by a CTP or STP.

## Demand Effects

As CTPs offer a package of incentives to use alternatives to the car, their greatest impacts are on the demand for

- public transport,
- walking and
- cycling.

Measures with demand effects include:

- Subsidy of public transport, which can increase the demand on routes serving a company site.
- Provision of incentives to walk or cycle, e.g. lockable cycle storage.
- Financial disincentives to use the car also have impacts on the demand for other modes.
- Changes to parking facilities, e.g. restricting parking space nearest the office can make car use unattractive relative to alternatives, and therefore increase demand for alternatives.

For STPs the greatest effects are again on the demand side. However, behaviour now is likely to have substantial effects on future demand for alternatives to the car. Financial incentives or disincentives are less likely to feature in STPs, due to the separation of the consumer and the purchaser. Having said this, public transport could be subsidised, or made more attractive by re-routing it past schools.

For travel awareness work, demand effects again depend on the nature of the work.

- Basic campaigns with no interaction with travellers to provide individual guidance, are likely to have minimal impacts on demand, although they can raise awareness.

- Projects providing individual guidance, at the same time as promoting shift to a particular mode, e.g Bike Busters in Denmark (University of Westminster, 1998), can significantly reduce car use, and therefore effect demand.

Quantifying the demand effects of CTPs, STPs and travel awareness projects is complex, due to the difficulty separating project effects from external factors. In terms of percentage changes in car use and cost, little has been written about the effects of CTPs. Some companies will give one or the other, but rarely both. The situation is very similar for travel awareness projects, although those promoting a specific mode have fewer problems separating project effects from external effects, and have therefore published more results than general information projects. However, for STPs published demand effects are hard to come by.

In view of the available data being very general, examples of successful CTP measures, STPs and travel awareness programmes are given below. Further examples of success, and useful world wide web addresses can be found in Appendix C.

#### Examples of Success - CTPs:

The recently published DETR guide to CTPs, “*Green Transport Plans. The Benefits of Green Transport Plans: The Guide*” (Taylor et al, for DETR, 1999) includes examples of CTPs - a number of which are included below - and extensive examples of measures that can be included in CTPs. A list of useful guides to implementing CTPs is also included in Annex A of “*The Guide*”. Good examples are:

- “The Royal Bank of Scotland estimates that it saves more than £70,000 a month on corporate travel through video and audio conferencing” (Taylor et al, for DETR, 1999).
- “Property developers Argent encourage rail travel wherever possible. The company saves between 30-60,000 miles of company car travel each year” (Taylor et al, for DETR, 1999). As staff can also work on the train, rail travel can also increase productivity.
- “Midland Bank Call Centre, Edinburgh Park, is looking into securing its own bus service from Livingston. This would improve accessibility for existing employees and widen the call centre’s potential labour market” (Taylor et al, for DETR, 1999). Strengthening it’s labour market was a key motivation behind the CTP implemented by Boots in Nottingham (Rye, 1999a).

There is a wide variety of measures that can be taken as part of a CTP, and the benefits accruing are not just reductions in car use. Direct benefits to the company, such as financial savings, and less sick leave (due to increased fitness) are experienced. Additionally, measures can be aimed at customer access, business travel and fleet management, instead of or as well as commute journeys.

Local authority CTPs can be used as a means to promote other policy instruments contributing to reducing car use. The instruments could also feature in employers’ CTPs. These instruments include:

- (re) opening rail stations or services,
- bus priorities,
- cycle facilities,
- town centre pedestrianisation, and
- controlled parking zones.

All of these instruments are outlined in this working paper, and help to provide a high quality alternative to the car, and/or control car use. Additionally, holistic, area wide approaches can contribute to CTPs, STPs, travel awareness, SRB and health objectives simultaneously.

The success of measures that make up a CTP is influenced by the way the plan is implemented. Key factors include:

- implementing useful measures, rather than just the cheapest (Transport 2000, 1997), and
- appointing a CTP co-ordinator within the company (Rye, 1999a).

#### Examples of Success - STPs:

Examples of STPs are currently hard to come by. Some examples of STP work are:

- St Albans in Hertfordshire: Sandringham Secondary, and Wheatfields Junior schools are working together on a STP including modal shift targets, a new bus service (used by 30 pupils, who would otherwise travel by car), training junior pupils to cycle (25% of final year pupils cycle to school), 2 new puffin crossings, and 50 local volunteers to escort children (DETR, 1998a).
- Wigan and Thetford in Norfolk: Safe routes to school contributed to SRB programmes – the “*Safe Routes, Wigan City Challenge*” and “*Thetford Walking and Cycling Initiative*” respectively. In Wigan, local schools were involved in “determining routes and designing way markers.” There are also links between the “*Wigan Healthy Heart project*” and the “*Sports Outreach project*” (DETR, 1998b).
- SUSTRANS is working on demonstration SRS projects in Leeds, York, Colchester, Hampshire, and Cumbria, (DETR, 1998a, DETR, 1998b).

#### Examples of Success – travel awareness:

The best travel awareness programmes combine education, detailed information on alternatives, individual guidance, and practical help. Some good examples include:

- HeadStart in Hampshire: a community outreach programme providing interactive education about transport and the environment, as well as promoting alternatives to the car, CTPs and STPs.
- TravelWise, promotes initiatives such as “*Car Free Day*” and “*Green Transport Week*” run by the Environmental Transport Association (ETA), and “*Don’t Choke Britain*”.
- Global Action Plan (GAP), Going for Green and Are You Doing Your Bit? all promote environmentally friendly behaviour, including the use of alternatives to the car.

Various campaign groups are involved in travel awareness work, especially advising local authorities, companies and schools on the promotion of particular modes. A list of organisations can be found in Appendix C. Information on car sharing/pooling, and alternatives to travel, such as telecommuting, which can be promoted through travel awareness can also be found in Appendix C.

## 6. References

- AA Group Public Policy (1993). *Cycling Motorists – How to encourage them*. Automobile Association, Basingstoke.
- Allsop R E (1993). London fares and road casualties. *Traffic Engineering and Control* 34(12).
- AMA (Association of Metropolitan Authorities) (1990). *Bus deregulation: the metropolitan experience*. London, AMA.
- Astrop A J, Balcombe R J and Daugherty G G (1996). The performance of bus priority measures in Aberdeen. Project Report PR/TT/003/96. Transport Research Laboratory, Crowthorne.
- Astrop A J, Balcombe R J and Daugherty G G (1997). The performance of bus priority measures in Brighton. Project Report PR/TT/027/97. Transport Research Laboratory, Crowthorne.
- Audit Commission (1999). All aboard; A review of local transport and travel in urban areas outside London.
- Bicknell D (1993). Traffic calming. *Municipal Engineer* 98(1).
- Biezus L and Rocha A J O (1998). Does congestion management improve public transit? (Logos Engenharia working paper).
- Bixby R W (1988). Park and ride schemes. *Highways and Transportation* 35(4).
- Bonsall P W (1992). The influence of route guidance advice on route choice in urban networks. *Transportation* 19(1).
- Bonsall P W and Palmer I (1997). Do time based road-user charges induce risk taking? – results from a driving simulator, *Traffic Engineering and Control* 38 (4).
- Bonsall P W, Spencer A H and Tang W (1981). ITS YORKSHARE: car sharing schemes in West Yorkshire. *Traffic Engineering and Control* 22(1).
- Bowtell P (2000). Private communication.
- Bradshaw R (1999). Research into Levels of Activity Relating to School Travel Initiatives. Final Report – Executive Summary. Transport Studies Group, University of Westminster.
- Bretherton R D, Wood K and Bowen G T (1998). "SCOOT Version 4", *Traffic Engineering and Control*, 39(7) pp425-7.
- Bristol City council (undated). Bus priority measures in Bristol. Director of Planning, Transport and development services, Bristol City Council.
- Brown M, Evans R and Black I (1991). The evaluation of traffic management and parking schemes: whither now? *Traffic Engineering and Control* 32(3).

Brown R J and Mackenzie N (1994). FEDICS: The Forth Estuary Driver Information and Control System. *Traffic Engineering and Control* 35(9).

Carden P (1999). The Midlands Driver Information System: Influencing Route Choice, paper presented at the Driver Information Systems Conference, Institution for Electrical Engineers, Savoy Place, London.

CENTRO (1994). Bus priority monitoring report. Appraisal Section, CENTRO, Birmingham.

Ciaburro T, Jones P and Haigh D (1994). Raising public awareness as a means of influencing travel choices. *Transportation Planning Systems* 2(2).

CIT (The Chartered Institute of Transport in the UK) (1998). Passenger Interchanges.

Colin Buchanan and Partners (1998). Transport Interchange: Best Practice. Report to the DETR.

Collis H (1988). The lorry management study. *Traffic Engineering and Control* 29(11).

Coombe D, Guest P, Bates J, Le Masurier P and MacLennan C (1997). Study of parking and traffic demand: 1. The Research Programme. *Traffic Engineering and Control* 38(2).

Coombe D, Guest P, Scholfield and Skinner A (1997). Study of parking and traffic demand: 3. The effects of parking control strategies in Bristol. *Traffic Engineering and Control*, 38(4).

Coombe D and Simmonds D (1997). Transport effects of land use change. *Traffic Engineering and Control* 38(12).

Cyclists' Public Affairs Group (CPAG) (1997). Bikeframe – A Model Cycling Policy, Published by the Cyclists' Touring Club. Godalming.

Daniels P W (1981). Flexible hours and journey to work in office establishments. *Transportation Planning and Technology* 6(1).

Daugherty G G, Balcombe R J and Astrop A J (1999). A comparative assessment of major bus priority schemes in Great Britain. TRL Report 409. Transport Research Laboratory, Crowthorne.

Davies D G, Emmerson P and Gardner G (1998). Achieving the aims of the National Cycling Strategy: Summary of TRL research, TRL Report 365, Transport Research Laboratory, Crowthorne.

Davies D G, Halliday M E, Mayes M and Pocock R L (1997). Attitudes to cycling: a qualitative study and conceptual framework, TRL Report 266, Transport Research Laboratory, Crowthorne.

de Jong M A (1995). National transport policy in the Netherlands. Proc. Institution of Civil Engineers. *Transport* 111(3).

DoE (Department of Environment ) (1997). Circular 1/97 – Planning Obligations. DoE, London.

DoE/DoT (Department of the Environment and Department of Transport) (1993). Reducing transport emissions through Planning. London. HMSO.

DoE/DoT (Department of the Environment/ Department of Transport) (1994). Planning Policy Guidance 13: Transport. London.

DoE/DoT (Department of the Environment / Department of Transport) (1995). PPG13: A Guide to Better Practice. HMSO.

DETR (Department of the Environment, Transport and the Regions) (1998). Breaking the Logjam: The Government's consultation paper on fighting traffic congestion and pollution through road user and workplace parking charges.

DETR (Department of the Environment, Transport and Regions) (1998a). White Paper on Transport. DETR, London.

DETR (Department of the Environment, Transport and Regions) (1998b). Sustainable Regeneration Good Practice Guide.

<http://www.detr.gov.uk/regeneration/sustainable/guide/14.htm>

DETR (Department of the Environment, Transport and the Regions) (1999). From Workhorse to Thoroughbred: a better role for bus travel.

DETR (Department of the Environment, Transport and Regions) (1999a). Revision of Planning Policy Guidance Note 13: Transport, Public Consultation Draft. <http://www.detr.gov.uk> (2/2/00).

DETR (Department of the Environment, Transport and Regions) (1999b). School Travel Strategies and Plans: A Best Practice Guide for Local Authorities.

<http://www.local-transport.detr.gov.uk/schooltravel/bppla/index.htm>

DETR (Department of the Environment, Transport and Regions) (2000). Guidance on the methodology for multi-modal Studies (GOMMS). DETR, London.

DETR (Department of the Environment, Transport and Regions) (2000a). Planning Policy Guidance Note 12: Development Plans.

<http://planning.detr.gov.uk/ppg12/5.htm> (2/2/00).

DETR (Department of the Environment Transport And Regions), Department For Education And Employment, Department Of Health (2000b). School Travel.

<http://www.local-transport.detr.gov.uk/schooltravel/index.htm>

DoT (Department of Transport) (1995). Better places through bypasses - the report of the bypass demonstration project. London, HMSO.

DoT (Department of Transport) (1995a). Traffic Models for Cycling, Traffic Advisory Leaflet 8/95, Traffic Advisory Unit, November.

DoT (Department of Transport) (1996). The National Cycling Strategy, Department of Transport, London.

Dodgson J, Sandbach J, Shurmer, Lane B and McKinnon A (1997). Motors or Modems? NERA, London, Report for the RAC.

Dundon-Smith D and Law C (1994a). Metrolink and retailing in Greater Manchester, Metrolink Impact Study, University of Salford.

Dundon-Smith D and Law C (1994b). Metrolink and the Greater Manchester Office Market: an appraisal, Metrolink Impact Study, University of Salford.

Ealing Borough Council (1999). Sustainable Access to Leisure Sites and Amenities.  
<http://www.ealing.gov.uk/salsa/>

Feeney BP (1989). A review of the impact of parking policy measures on travel demand. *Transport Planning and Technology* 14(2).

Flowerdew A D (1994). The effects of road pricing on land values and settlement patterns, Report for the Royal Institution of Chartered Surveyors.

Fox K, Clark S, Boddy R, Montgomery F and Bell M (1998). "Some benefits of a SCOOT Urban Traffic Control System: An independent assessment by micro-simulation", *Traff.Engng.Control*, 39(9), pp. 484-489.

Fox K, Montgomery F O and May A D (1995). Integrated ATT strategies for urban arterials: DRIVE II project. PRIMAVERA. 1 Overview. *Traffic Engineering and Control* 35(5).

Fox K, Montgomery F O, Shepherd S P, Smith C, Jones S and Biora F (1995). Integrated strategies for urban arterials : DRIVE II project PRIMAVERA 2. Bus Priority in SCOOT and SPOT using TIRIS. *Traffic Engineering and Control* Vol.36 p356-361.

Gartner N H (1989). OPAC: Strategy for demand responsive decentralised traffic signal control. *IFAC Control, Computers, Communications in Transportation*, Paris, France 1989 pp 241-244.

Gantvoort J T (1984). Effects upon modal choice of a parking restraint measure. *Traffic Engineering and Control* 25(4).

Gentleman H (1981). The Glasgow rail impact study, SR 650. Crowthorne, TRRL.

Gilbert C L and Jalilian H (1991). The demand for travel and travelcards on London Regional Transport. *Journal of Transport Economics and Policy* 25(1).

Goodwin P (1988). Bus trip generation from concessionary fares schemes: a study of six towns. RR 127. Crowthorne. TRRL.

Goodwin P (1992). A review of new demand elasticities with special reference to short and long run effects of price changes. *Journal of Transport Economics and Policy* 26(2).

Goodwin P (1996). Empirical evidence on induced traffic. *Transportation* 23.

Goodwin P, Hass-Klau C and Cairns S (1998a). Evidence on the effects of road capacity reduction on traffic levels. *Traffic Engineering and Control*, 39(6).

Goodwin P, Hass-Klau C and Cairns S (1998b). *Traffic impact of highway capacity reductions: assessment of the evidence*. Landor Publishing.

- GLC (Greater London Council) (1983). Fares and road casualties in London. London.
- HA (The Highways Agency) (1998). The Highways Agency's Toolkit; CD ROM.
- Hamer R et al (1991). Teleworking in the Netherlands: an evaluation of changes in travel behaviour. *Transportation* 19(4).
- Harland G and Gercans R (1993). Cycle routes. PR 42. Crowthorne, TRL.
- Hass-Klau C (1992). Civilised streets: a guide to traffic calming. Brighton. Environmental and Transport Planning.
- Hass-Klau C (1990). An illustrated guide to traffic calming. London. Friends of the Earth.
- Hass-Klau C (1993). Impact of pedestrianisation and traffic calming on retailing: a review of the evidence from Germany and the UK. *Transport Policy* 1(1).
- Haworth S L and Hilton I C (1982). Car parking standards and the urban economy. *Traffic Engineering and Control* 9(12).
- Henry J J and Farges J L (1989). PRODYN. CCCT'89 Control, Computers, Communications in Transportation, 6th IFAC/IFIP/IFORS Symposium on Transportation, Paris, September 19-21 1989, pp. 253-255.
- Hills and Bell (1998). IEE Conference Paper - Reference needs to be completed.
- Holland E P and Watson P L (1978). Traffic restraints in Singapore; measuring the effects of the Area Licence Scheme. *Traffic Engineering and Control* 19(2).
- Hopkinson P and Wardman M (1996). Evaluating the demand for new cycle facilities, *Transport Policy*, Volume 3, Number 4, pp241-249.
- Howard D F (1989). The characteristics of light rail. *Highways and Transportation* 36(11).
- IHT (Institution of Highways and Transportation) (1989). Pedestrianisation. IHT Guidelines. London. IHT.
- IHT (The Institution for Highways and Transportation) (1990). Guidelines for Urban Safety Management.
- IHT (The Institution of Highways and Transportation) (1996). Developing Urban Transport Strategies.
- IHT (Institution of Highways and Transportation), Department of Transport, Cyclists' Touring Club and Bicycle Association (1996). Cycle-Friendly Infrastructure – Guidelines for Planning and Design, IHT, London
- IHT (The Institution of Highways and Transportation) (1997). Transport in the Urban Environment.
- IHT (The Institution of Highways and Transportation) (1998). Guidelines for Cycle Audit and Cycle Review.

INPHORMM (1998). A review of current practice in Europe: Summary Report.

ITS (1991) Passenger Demand Forecasting for New Rail Services, Draft Manual of Advice, Institute for Transport Studies, University of Leeds.

Jeffery D J (1981). The Potential benefits of route guidance. LR997. Crowthorne. TRRL.

Jeffery D J and Russam K (1984). Information systems for drivers. Transport Planning and Technology 9(3).

Jopson A F (2000). Reducing Car Use: the role of The Theory of Planned Behaviour. PhD thesis, pending.

Kitamura R et al (1991). Telecommuting as a transportation planning measure: initial results of the California pilot project. Transportation Research Record 1285, Washington, TRB.

Larsen O I (1988). The toll ring in Bergen: the first year of operation. Traffic Engineering and Control 29(4).

Leicester County council (1996). Welford Road Bus Priority - before and after study. Dept. of Planning and Transportation. Engineering Design Services. Leicester County Council

Local Transport Today (20<sup>th</sup> January 2000) Education, Transport and Health Ministers Unite in School Travel Challenge. Landor Publishing, London.

LPAC (London Planning Advisory Committee) (1997). Revised Advice on a parking strategy for London.

Mackie A M and Davies C H (1981). Environmental effects of traffic changes. LR 1015 Crowthorne. TRRL.

Manchester Airport (C.1999) Manchester Airport Green Commuter Plan. Manchester Airport. Manchester

Manchester Airport, Association Of Greater Manchester Authorities, & Greater Manchester Passenger Transport Authority & Executive (C.1999) Green Transport Plans: A Greater Manchester Guide.

Manchester City Council (1995) Wilmslow Road corridor - Review Update. Report for the acting City Engineer and Surveyor and the Chief Executive, Policy and Resources Committee. Manchester City council.

Mauro V and Di Tarranto C (1989). UTOPIA, CCCT'89 - AFCET Proceedings, Paris.

Mathew D (1995). More Bikes – Policy into Best Practice, Cyclists' Touring Club, Godalming

May A D, Bonsall P W and Hills P J (1998). The impacts of different road user charging systems, Conference of the Institution of Electrical Engineers.

May A D, Roberts M and Mason P (1992). The development of transport strategies for Edinburgh. Proc. Institution of Civil Engineers. Transport 95(1).

May A D, Shepherd S and Bates J (2000). Supply curves for urban road networks (submitted for publication).

McDonald M and Tarrant D (1994). The ROMANSE project. Proc. Vehicle and Navigation and Information Systems Conference, Yokahama. VNIS.

McPherson R D (1992). Park and ride: progress and problems. Municipal Engineer 93(1).

MVA Consultancy Ltd (1993). Inter-urban charging; case studies. Summary report for the Department of Transport.

MVA Consultancy Ltd (1999). Options for influencing PNR usage. Final report for Department of Environment, Transport and the Regions.

MVA Consultancy Ltd, Institute for Transport Studies and Oscar Faver (1994). A Common Appraisal Framework for Urban Transport Projects. Birmingham City Council 1994.

Nash C A (1992). The age of the train? University of Leeds Review 35. Leeds. University of Leeds.

Nash C A and Mackett (1991) Commuting. In Fowkes T and Nash C A (1991) Analysing demand for rail travel, Avebury.

Nash C A and Preston J M (1991). Appraisal of rail investment projects: recent British experience. Transport Reviews 11(4).

Ogunisanya A (1984). Improving urban traffic flow by restraint of traffic: the case of Lagos. Transportation 12(2).

O'Malley B and Selinger C A (1973). Staggered work hours in Manhattan. Traffic Engineering and Control 14(1).

Oscar Faber (1996). Manchester Metrolink Study.

Ott M et al (1980). The behavioural impact of flexible working hours. Transportation Systems Centre. Washington, US. DoT.

Parkhurst G (1995). Park and ride; could it lead to an increase in car traffic? Transport Policy 2(1).

Pearce K and Stannard C (1973). Catford traffic management study. Vol. 1. Planning and Transportation Research Report 17. London, GLC.

Pickett M W (1982). Trials of computer generated public transport travel information in Wiltshire. LR 1036. Crowthorne. TRRL.

Pickett M W (1995). The effectiveness of bus-based park and ride. Proc: Parking Control: from principle to practice. PA 3056. Crowthorne: TRL.

Pilling A, Murray S and Turner J (c.1998) Catching Them Young Project – Summary Report. Greater Manchester Transport Resource Unit. Manchester.

Polak J W et al (1990). Parking guidance and information systems: performance and capability. *Traffic Engineering and Control* 31(10).

Read M J, Allport R J and Buchanan P (1990). The potential for guided busways. *Traffic Engineering and Control* 31(11).

Richards M G, Gilliam C and Larkinson J (1996). London Congestion Charging Research Programme: 6. The Findings. *Traffic Engineering and Control* 37(7/8).

Routledge I Kemp S Rada B (1996). UTMC: The way forward for Urban Traffic Control,. *Traffic Engineering and Control* 37(11).

Rowell A and Fergusson M (1991). Bikes not fumes, the emission and health benefits of a modal shift from motor vehicles to cycling, Cyclists' Touring Club, Godalming

Rye T (1999). Employer Transport Plans: A case for regulation *Transport Reviews* 19(1).

Rye T (1999a). Employer Transport Plans – A Case For Regulation? *Transport Reviews*, Vol. 19, No. 1, pp 13-31.

Rye T (1999b). Employer Attitudes to Employer Transport Plans: a comparison of UK and Dutch experience. *Transport Policy* Vol. 6, pp 183 –196.

SACTRA (The Standing Advisory Committee on Trunk Road Assessment) (1994). Trunk roads and the generation of traffic. London. HMSO.

Sanderson J (1994). A matrix approach to setting parking standards. *Transportation Planning Systems* 2(1).

Sheffield City Council (1993) South Sheffield Demonstration project ( The wedge) - Report of journey time savings. Transportation Policy Unit, Directorate of Planning and economic development.

Silcock D T and Forsyth E (1985). Real time information for passengers on the London Underground. Proc. PTRC. SAM Seminar J. London. PTRC.

Soo C (1998). ERP cuts congestion in Singapore. *Traffic Technology International*, June/July.

Steer Davies Gleave (1998). Leeds Travel Blending, Final Report. Steer Davies Gleave, London.

Still B G (1996). Transport impacts on land use: towards a practical understanding for urban policy making, University of Leeds.

SUSTRANS (1999). Safe Routes to Schools Project Guide. SUSTRANS (Publications). Bristol.

TAS (1997). Quality Partnerships in the Bus Industry: A Survey and Review (unpublished report).

Taylor A, Black C (Oscar Faber Ltd), Potter S (Open University) and Rye T (Napier University) (1999). The Benefits of A Green Transport Plan: The Guide, Department of Environment Transport and Regions,  
<http://www.local-transport.detr.gov.uk/gtp/guide/index.htm> (12/1/00).

Thompson R G and Bonsall P (1997). Drivers' response to parking guidance and information systems. *Transport Reviews*, 17(2).

Thompson R G, Firmin P E and Bonsall P W (1998). An assessment of drivers' interpretations, opinions and stated response to VMS in London. Proc of the 5th World Congress on Intelligent Transport Systems, Seoul, South Korea 12-16 October 1998.

Tolley R (Ed) (1990). The Greening of Urban Transport – Planning for Walking and Cycling in Western Cities, Belhaven Press, London

Tolley R (1993). The Greening of urban transport, London, Belhaven.

Topp H and Pharoah T (1994). Car Free City Centres. *Transportation*, 21(3).

Transport 2000 (1997). Changing Journeys To Work, An Employers' Guide To Green Commuter Plans. Transport 2000. London

TRL (Transport Research Laboratory) (1995). Report 174: The Environmental Assessment of Traffic Management Schemes: a literature review, TRL.

TRL (Transport Research Laboratory) (1996). Review of the potential benefits of Road Transport Telematics. TRL Report 220 (Perrett K E and Stevens A).

TRL (Transport Research Laboratory) (1999a). Motorway Tolling- modelling the impact of diversion, TRL 349.

TRL (Transport Research Laboratory) (1999b). The likely effects of motorway tolling on accident risks, TRL 357.

Tyne and Wear PTE (1985). The Metro Report. Newcastle, TWPT.

Valleley M (1997). Parking Perspectives. Landor Publications.

University Of Westminster (1998). A Resource Pack for Promoting Sustainable Transport. INPHORMM Project, University of Westminster.

Wachs M (1990). Regulating traffic by controlling land use. *Transportation* 16(3).

Wachs M (1993). Learning from Los Angeles: transport, urban form and air quality. *Transportation* 20(4).

Walmsley D A and Perrett K E (1992). The effects of rapid transit on public transport and urban development.

Wardman M, Hatfield R and Page M (1997). The UK national cycling strategy: can improved facilities meet the targets?, *Transport Policy*, Volume 4, Number 2, pp 123-133

Webster F V et al (1980). The demand for public transport. Crowthorne. TRRL.

White P R (1992). Cost benefit analysis of urban minibus operations. Transportation 19(1).

Wood K (1993). Urban traffic control, systems review. PR 41. Crowthorne. TRL.

Wood K and Harrison M E J (1998). Literature review of UTMC and Emissions, UTMC03 : Strategies to minimise emissions. Available on UTMC03 Website.

Wood K and Smith R (1992). Assessment of the pilot priority Red Route in London. Traffic Engineering and Control 33 (7/8).

WS Atkins (1998) The travel effects of park and ride: Final report to DETR.

## **Appendix A: Background note on Elasticities**

## ELASTICITIES

### A.1 Introduction

The most convenient summary measure for the effect of one explanatory variable (eg. price) on quantity, for all else held constant, is called elasticity. If price changes have no effect on quantity demanded then we say the price elasticity is zero. As the effect of price changes on quantity demanded increases, we say that demand is 'inelastic' until the revenue change is zero, when we say elasticity is (minus) unity. Here the price increase,  $\Delta P$ , has reduced demand by  $\Delta Q$ , but total revenue has remained the same since the higher price per unit has compensated exactly for the fall in number of units demanded. To preserve revenue we always need a larger % price rise than the % quantity fall.

Where price rises cause such large reductions in quantity demanded that revenue falls, we say that demand is elastic. Generally, we expect individual commercial companies to operate at prices where demand is elastic, as otherwise they could increase profits by raising prices and achieving higher revenue from lower sales (and hence costs). For wholly competitive industries, however, demand need not be elastic since any one firm trying to raise its prices might lose much of its sales to its (now lower priced) rivals i.e. the demand for any one firm's output is elastic whereas demand for the industry's output is inelastic. For example, the demand for urban public transport, as a whole, will almost certainly be inelastic, whilst the demand for travel by any one public transport operator may be elastic, due to the availability of close alternatives. Many industries, including transport, are anyway not fully competitive, and are restrained from raising prices by some form of government intervention.

Given a mathematical form for the demand function, calculus can be used to determine the elasticity for infinitesimally small price changes from any given starting point. These are known as point elasticities, and the elasticity of any variable  $y$  with respect to another variable  $x$  can be written as

$$EL(y; x) = \frac{x}{y} \frac{\partial y}{\partial x} \quad (1)$$

In the case of demand curves we have

$$EL(Q; P) = \frac{P \partial Q}{Q \partial P} \quad (2)$$

Since demand curves will be downward sloping,  $\partial Q / \partial P$  will be negative and so, for sensible values of  $P$  and  $Q$ , the elasticity will also be negative, although this is sometimes taken as implicit when discussing elasticity values.

### A.2 Arc Elasticities

For large changes in price, as an alternative to the point elasticity measure, we can define the arc elasticity as

$$EL(Q; P) = \frac{\frac{Q_2 - Q_1}{Q_2 + Q_1}}{\frac{P_2 - P_1}{P_2 + P_1}} \quad (3)$$

This takes two quantity price combinations  $(Q_1, P_1), (Q_2, P_2)$  and takes the ‘base’ for the elasticity at the linear midpoint

$$\left( \frac{Q_1 + Q_2}{2}, \frac{P_1 + P_2}{2} \right)$$

In Fowkes, Sherwood and Nash (1993), it was suggested, that current point price elasticities might be factored by

$$0.5 \left( \frac{P_2}{P_1} + 1 \right) \quad (4)$$

The rather weak backing for this came from the HFA/ACCENT/ITS (1993) work as part of the DoT's London ‘Congestion Charging Study’. The effect will be as follows. Firstly, greatly reducing public transport fares (possibly to zero) will not produce patronage increases anything like as large as fixed price elasticity assumptions would give. Secondly, the usual low empirical values for car use price elasticities will eventually be overcome as prices are raised - ie traffic will be priced off the roads despite the low point price elasticities currently observed. This is consistent with the HFA/ACCENT/ITS finding.

In 1994 the Department of Transport commissioned research into the likely effects of substantially increased fuel prices on future car ownership and use. The preferred form for the elasticity of private mileage with respect to fuel price was constant, whilst a “linear increase of elasticities according to price also gave a good fit” (Terzis et al., 1995, p251). In the case of car ownership, the “linear” form was preferred. It is clear from the example given (p.252) that by linear they mean proportional, i.e. a tripling of fuel prices was said to triple the elasticity. Clearly, if both a constant form and a proportional form were supported by the data then it follows logically that (4) must be supported by the data, probably to an even greater degree. This is because (4) is halfway between constant and proportional.

#### A.4 Cross Elasticities

Changing the price of one commodity affects not only the quantity demanded of that commodity but also the quantity demanded of related commodities, i.e.

$$Q_i = f(P_i, P_j, \text{other things})$$

Analogously with the definition of (own) price elasticity of demand in section 1 above, we can define the (point) cross price elasticity of demand for commodity  $i$  with respect to the price of commodity  $j$  as

$$EL(Q_i; P_j) = \frac{P_j}{Q_i} \frac{\partial Q_i}{\partial P_j} \quad (5)$$

For competing modes of transport, higher prices on one mode will increase traffic by other modes, so  $\partial Q_i / \partial P_j$  will be positive, and so for positive Ps and Qs the cross price elasticities between modes will also be positive.

For small changes in prices the point elasticity formula can be amended by substituting  $\partial Q_i = Q_{i2} - Q_{i1}$  and  $\partial P_j = P_{j2} - P_{j1}$ . For larger changes we again need to use arc elasticities.

$$EL(Q_i, P_j) = \frac{(P_{j2} + P_{j1})(Q_{i2} - Q_{i1})}{(Q_{i2} + Q_{i1})(P_{j2} - P_{j1})} \quad (6)$$

Any consequential or retaliatory reaction by the operators of mode i following the price change on mode j would have to be dealt with separately.

Once again, it is not sensible to assume that these cross elasticities will remain constant with respect to fares levels. As mode j raises its price, the cross elasticity for mode i with respect to mode j will fall.

If the market share of mode i is  $s_i$  and the market share of mode j is  $s_j$ , then the following relationship between cross and own price elasticities must hold:

$$EL(Q_i, P_j) \leq -EL(Q_j, P_j)s_j / s_i \quad (7)$$

*Worked example:* If 40% of morning peak trips are by car (mode 1) and 60% by public transport (mode 2), and if the own-price elasticity of public transport is  $-0.4$ , then the cross price elasticity of car with respect to public transport is limited as

$$EL(Q_1 ; P_2) \leq -(-0.4)(0.6)/(0.4)$$

$$EL(Q_{CAR} ; P_{PT}) \leq 0.6$$

Thus if total initial demand is taken as 100 (ie 40 car, 60 PT) and public transport raised its fares by 10%, (ie 0.1) its own demand would change by  $(-0.4)(0.1)(60)$ , ie fall by 2.4 to 57.6; while car demand would change by no more than  $(+0.6)(0.1)(40)$ , ie increase from 40 to no more than 42.4. The inequality and the ‘no more than’ leave open the possibility that some trips may be suppressed by the price rise.

## A.5 The Ratio of Elasticities Approach

The ‘Ratio of Elasticities’ Approach can be used to derive one elasticity from a related one given knowledge of the relationship and typical values for the attributes in question.

For example, if we know the elasticity of quantity demanded with respect to price,  $EL(Q;P)$ , current levels of price,  $P$ , and journey time,  $t$ , and the value of journey time savings,  $v$ , (expressed in consistent units) then

$$EL(Q; t) = \frac{vt}{P} EL(Q; P) \quad (8)$$

gives the elasticity of quantity demanded with respect to journey time. In this way elasticities of demand with respect to any desired variable can be obtained from price elasticities.

## A.6 Generalised Cost Elasticities

The concept of Generalised Cost adds together all monetary costs with all non-monetary costs appropriately weighted to convert them into money terms. The simplest case is where journey time (T) is multiplied by a ‘value of time’ (v) to get the monetary equivalent value of that time, which is then added to the monetary cost (C) of the journey to get the Generalised Cost (GC).

$$GC = C + vT \quad (11)$$

Provided that appropriate ‘values of time’ are available, this simple procedure allows (Generalised Cost) elasticities to be used to determine the changes in demand following an alteration in journey times.

## A.7 Some useful elasticity values

### A.7.1 Car own-price elasticities

There have been relatively few studies of the effects of petrol price on traffic levels. Goodwin (1992) reported 16 cases. For the elasticity of car demand to motoring costs, Fowkes, Sherwood, Nash and May (1993), using this evidence as well as Oum, Waters and Yong (1990) and Kemp (1973), suggested current cost level point elasticities of

Commuting	-0.1
Leisure	-0.3
Business	-0.1

going on to say these should be factored up by  $(0.5k + 0.5)$  where motoring costs were assumed to have risen by a factor k, such that  $k > 1.2$ . For example, if perceived user costs were to be tripled,  $k=3$  and  $(0.5k + 0.5) = 2$ , so the above elasticities would be doubled to -0.2, -0.6 and -0.2 respectively.

The recommendation of the present report is that the  $k > 1.2$  restriction be ignored, but that otherwise the above advice be followed, though only for London. Outside London, evidence from Goodwin (1992) suggests higher values. Our advice is therefore as follows:

### Base Elasticities of Car Use w.r.t. Motoring Costs

	<i>London</i>	<i>Outside London</i>
Commuting	-0.1	-0.15
Business	-0.1	-0.15
Leisure	-0.3	-0.45

These base values should then be used as E values in the following formula giving car use (demand),  $Q_2$ , following a change in motoring costs from  $P_1$  to  $P_2$ , from a starting position of demand  $Q_1$ .

$$\frac{Q_2}{Q_1} = \frac{2 + \left(\frac{P_2}{P_1} - 1\right)E}{2 - \left(\frac{P_2}{P_1} - 1\right)E} \quad (9)$$

*Worked example.* Doubling perceived motoring costs for commuters outside London gives  $P_2/P_1 = 2$  and  $E = -0.15$ , so

$$\frac{Q_2}{Q_1} = \frac{2 + (2-1)(-0.15)}{2 - (2-1)(-0.15)} = \frac{2 - 0.15}{2 + 0.15} = 0.86$$

ie car usage can be expected to fall by about 14%.

#### A.7.2 Public Transport own-price elasticities

Many studies have been carried out on the effect of fare changes on public transport usage. In London, the 1980s ‘Fares Fair’ policy gave a large scale test. Goodwin (1992) again summarises the data. Fowkes et al (1993) proposed bus and tube patronage fare elasticities of -0.6 for leisure travel and -0.3 for other purposes. Long distance rail is well known to have higher elasticities. Studies reported by Goodwin suggested that elasticities slightly higher than those quoted above would be appropriate when considering long run effects, say over at least 5 years. The recommended base far elasticity values for Public Transport are therefore as follows:

#### Bus Elasticities of Public Transport Use w.r.t. Public Transport Fares

	Short run	Long run
Commuting	-0.3	-0.4
Business	-0.3	-0.4
Leisure	-0.6	-0.8

These base values should then be used as E values in the formula (9) with  $P_1$  the old fare,  $P_2$  the new fare,  $Q_1$ , the old demand and  $Q_2$  the new demand.

#### A.7.3 Cross-Price Elasticities

Data on cross price elasticities is much less plentiful than that for own price elasticities. Goodwin (1992) reports that five results from three studies gave an average cross-elasticity of public transport demand with respect to petrol prices of +0.34, though with a range of +0.08 to +0.80.

Formula (7) gives an upper limit for cross elasticities once the appropriate own price elasticities are known. For example, suppose that for leisure purposes 90% of trips are by car and only 10% by public transport. Formula (7) now gives the upper limit of the cross elasticity of public transport demand with respect to motoring costs as

$$\text{EL}(Q_{\text{PT}}, P_{\text{CAR}}) \leq -\text{EL}(Q_{\text{CAR}}, P_{\text{CAR}})(0.9/0.1)$$

From section 6.1, a leisure own price elasticity value for car outside London might be  $-0.45$ , hence

$$\text{EL}(Q_{\text{PT}}, P_{\text{CAR}}) \leq 0.45 * 9 \quad \text{ie } \leq 4.05$$

From this, it is clear that cross-elasticities can be very high for minority modes, though the above method only gives an upper limit. The evidence from studies would suggest that most of the fall in car trips is represented by suppressed trips rather than mode switching to public transport.

In the reverse direction, cross elasticities of car use with respect to public transport fares are accepted to be generally very small. Fowkes, May, Nash, Rees and Siu (1995), after considering published evidence, used cross price elasticities of car mileage with respect to public transport fares of 0.05 outside London and 0.08 inside London. These values are recommended here.

Having obtained a cross price elasticity,  $C$ , the following formula (10), can be used to derive changes in demand.

$$\left( \frac{Q_{i2}}{Q_{il}} \right) = \frac{2 + \left( \frac{P_{j2}}{P_{jl}} - 1 \right) C}{2 - \left( \frac{P_{j2}}{P_{jl}} - 1 \right) C} \quad (10)$$

*Worked example.* If bus fares were to be halved inside London, what would be the effect on car usage? In this case bus would be  $j$ , car  $i$ , and  $C=0.08$ .  $P_{j2}/P_{jl}=0.5$ .

From (10)

$$\left( \frac{Q_{\text{CAR},2}}{Q_{\text{CAR},1}} \right) = \frac{2 + (0.5 - 1)(0.08)}{2 - (0.5 - 1)(0.08)}$$

$$= \frac{2 - 0.04}{2 + 0.04}$$

$$= 0.96$$

ie car usage would fall by 4%.

#### A.7.4 Generalised Cost Elasticities reflecting induced or suppressed traffic due to road schemes

Any recommended values need to take account of the range of appropriate values of time and the various proportions of Generalised Cost constituted by C and vT. HETA (1994) has made such recommendations and these are given in the table below.

Generalised Cost Elasticities		
Peak Period	Urban areas with high modal competition	-0.45
	Urban areas with low modal competition	-0.25
	Inter Urban low speed network	-0.2
	Inter Urban high speed network	-0.1
Off Peak	Urban Non discretionary purposes	-0.35
	Urban Discretionary purposes	-0.5
	Inter Urban low speed network	-0.45
	Inter Urban high speed network	-0.35

These values represent short term elasticities and should be used for sensitivity tests of opening year flows. Larger values of up to twice the above should be used for sensitivity tests of design year flows, to reflect higher long term fuel price elasticities.

## References

- Fowkes, A.S., Sherwood, N. and Nash, C.A. (1993). Segmentation of the travel market in London: estimates of elasticities and values of time, *University of Leeds, Institute for Transport Studies, Working Paper 345*.
- Fowkes, A.S., May, A.D., Nash, C.A., Rees, P.H. and Siu, Y.L. (1995). An investigation into the effects of various transport policies on the levels of motorised traffic in Great Britain in 2006.
- Goodwin, P.B. (1985). Evidence on car and public transport demand elasticities 1980-1988. Oxford University Transport Studies Unit, Ref: 427.
- HETA (1994). Guidance on Induced Traffic.
- HFA, ITS, ACCENT (1993). Road Pricing in London: Review and Specification of Modal Elasticities, Final Report to DoT.
- Kemp, M.A. (1973). Some evidence of transit demand elasticities. *Transportation* 2, 25-52.
- Oum, T.H. and Waters, W.G. and Yong, J.S. (1990). A survey of recent estimates of price elasticities of demand for transport. The World Banks. Ref: WPS359.
- Terzis, G., Dix, M., Bates, J. and Dawe, G. (1995). Effects and elasticities of higher fuel prices, in *Transport Policy and its Implementation*, Proceedings of Seminar C, PTRC, London, pp 247-259.

## **Appendix B: Additional advice on Appraisal**

## Additional advice on Appraisal

### Scope of this advice

The main body of this document (Section 3) has given some additional guidance on predicting the demand and supply side effects of local transport schemes. In this section we show how these predicted effects relate to the final appraisal outputs needed under the New Approach to Appraisal.

Some specific advice is also given on appraisal values of time and safety. Those are the two sets of values most commonly needed in order to convert changes in system performance into a measure of benefit to people. For example, when a scheme is predicted to reduce the average journey time for a particular public transport service by 5mins, this is useful appraisal information in itself, and in a full AST would appear in the Quantitative Measure column. But by applying values of time to the predicted time savings across all users, a measure can be obtained of the overall benefit from the scheme. That benefit can be compared with the costs (and with other effects such as any safety implications and environmental change) to gain an impression of the value for money provided by the scheme.

### Completing the appraisal

Having predicted the demand and supply side effects of a particular scheme, the principal tasks remaining will be to:

- extend the analysis to the full range of objectives in the New Approach to Appraisal (see Table B.1); and
- to summarise the analysis, **providing quantitative summary measures wherever possible**, in the form of an AST.

For major schemes only, a cost-benefit analysis will also be needed. Major schemes include road schemes costing over £5million as well as major public transport projects. The key reference on cost-benefit analysis within the New Approach to Appraisal is DETR 2000: *Guidance on Methodology for Multi-Modal Studies (GOMMMS)*, Volume 2, Chapter 6.

The full range of objectives and sub-objectives in the multi-modal version of the New Approach to Appraisal are shown in Table B.1, together with examples of quantitative measures. Appraisers should aim to provide quantitative measures in the AST wherever practically possible.

It is especially important that the objectives of the scheme itself are reflected by specific quantitative measures in the appraisal. For example, if a scheme has traffic noise reduction as one of its stated objectives, then it would be appropriate to go into greater depth in considering what the noise effects would be and it would be essential to report quantitative measures of noise change in the AST.

The final column of Table B.1 lists the main sources of advice on calculating quantitative measures for particular groups of sub-criteria. Generally these references are to the multi-modal guidance, GOMMMS. Where further advice is available for particular types of schemes, GOMMMS will give information on where to look.

**Table B.1: Quantitative Measures in Appraisal**

<b>Objective</b>	<b>Sub-Objective</b>	<b>Quantitative Measures - Examples</b>	<b>Source of Written Guidance</b>
Environment	Noise	Number of properties gaining net of number of properties losing (Gainer = reduction of 3dB or more, Loser = increase of 3dB or more)	Guidance on Methodology for Multi-Modal Studies: Volume 2, Chapter 4
	Local air quality	Change in levels of pollutants in key locations - or the area as a whole	
	Climate change	Estimated reduction in tonnes of CO <sub>2</sub> emitted	
	Landscape	Score on an 8-point scale from Very Strong Negative to Strong Positive <sup>†</sup>	
	Townscape	Score on a 7-point scale from Strong Negative to Strong Positive <sup>†</sup>	
	Heritage	Score on a 7-point scale from Strong Negative to Strong Positive <sup>†</sup>	
	Biodiversity	Score on an 8-point scale from Very Strong Negative to Strong Positive <sup>†</sup>	
	Water resources	Score on an 8-point scale from Very Strong Negative to Strong Positive <sup>†</sup>	
	Other health impacts	Eg. predicted change in numbers cycling/walking to work/school	
	Quality of journey	Change in number of stations/stops with real time information; Change in number of stations/stops with real time information. Change in proportion of high quality vehicles,; etc	

<b>Objective</b>	<b>Sub-Objective</b>	<b>Quantitative Measures - Examples</b>	<b>Source of Written Guidance</b>
Safety	Accidents	Change in the number of accidents expected over a 30 year period Change in the number of casualties expected over a 30 year period	Guidance on Methodology for Multi-Modal Studies: Volume 2, Chapter 5
	Security	Change in number of stations/stops with CCTV monitoring; etc	
Economy	Economic efficiency of the transport system	Changes in peak and off-peak journey times on stated routes	Guidance on Methodology for Multi-Modal Studies: Volume 2, Chapter 6
	Reliability	Changes in 'percentage stress' measure for roads; Changes in % reliability and punctuality measures for rail	
	Wider economic impacts	Serves regeneration area? Development depends on scheme? (Y/N)	
Accessibility	Option values	Score on a 7-point scale from Strong Negative to Strong Positive <sup>†</sup>	Guidance on Methodology for Multi-Modal Studies: Volume 2, Chapter 7
	Severance	Score on a 4-point scale from None to Severe <sup>†</sup>	
	Access to the transport system	Change in 'access to the transport system index'	
Integration	Transport interchange	Score on a 7-point scale from Strong Negative to Strong Positive <sup>†</sup>	Guidance on Methodology for Multi-Modal Studies: Volume 2, Chapter 8
	Land-use policy	Score on a 3-point scale: Beneficial/Neutral/Adverse <sup>†</sup>	
	Other Government policies	Score on a 3-point scale: Beneficial/Neutral/Adverse <sup>†</sup>	

Source: based on *Methodology for Multi-Modal Studies: Guidance Note DRAFT for Consultation*, Report to DETR by MVA et al, May 1999.

<sup>†</sup>These are strictly 'Summary Measures' in the full AST for major schemes, however for smaller Local Transport Plan schemes they give an appropriate level of detail on environmental effects which are hard to quantify.

**Relating Demand and Supply Side Effects to the Appraisal**

Having estimated the demand and supply side effects, the next task will be to consider the wider range of possible effects listed in Table B.1 and to attempt to estimate quantitative measures for all those which are felt to be significant. Others should be clearly reported as ‘Neutral’ or ‘Approximately Neutral’ in the AST.

Many of the quantitative measures rely heavily on the information gained at the previous stage. Table B.2 aims to summarise these relationships. The details of the calculations will differ from one type of scheme to the next, and in particular from one mode of transport to the next, so it is not possible to give comprehensive guidance in a short note. The following paragraph gives an example of the type of calculations needed.

**Table B.2: Using demand and supply information to calculate quantitative measures**

<b>Objective</b>	<b>Sub-Objective</b>	<b>Role of demand and supply information (in all cases see GOMMMS guidance for details/references on how to make the calculations)</b>
Environment	Noise	Noise levels are dependent upon traffic levels and speeds on various different routes. Changes in traffic on a road or rail link can be used to calculate noise changes for adjacent properties.
	Local air quality	Levels of pollutants in key locations - or the area as a whole - are strongly dependent upon traffic levels and vehicle mix. Changes in traffic can be used to estimate changes in local air quality.
	Climate change	Tonnes of CO <sub>2</sub> emitted are strongly related to the amount of fuel consumed and hence to total vehicle km and traffic conditions. Simple 'emissions factors' are available.
	Landscape	Traffic levels may play a role in determining landscape quality.
	Townscape	Traffic levels may play a role in determining townscape quality.
	Heritage	Traffic levels may influence the setting of a heritage site.
	Biodiversity	Traffic levels may influence habitat quality.
	Water resources	Traffic levels may play a role in determining water pollution levels.
	Other health impacts	Some measures will directly increase cycling and walking. Traffic levels may also influence various aspects of behaviour including decisions whether or not to cycle/walk.
	Quality of journey	Changes in service levels influence the overall quality of service; traffic levels may adversely affect the quality of service through congestion.
Safety	Accidents	Expected accident and casualty rates are a function of traffic levels - on road and rail. See example in the text below for road.
	Security	Levels of ridership influence perceived personal safety on public transport.
Economy	Economic efficiency of the transport system	Changes in peak and off-peak journey times on stated routes are relevant quantitative information in themselves. Furthermore, they are a key input to cost-benefit analysis for major schemes. See earlier Sections of this advice note for calculations.
	Reliability	Percentage stress measure for roads is a function of road traffic levels and road capacity. Rail reliability is also related to traffic levels on the network.
	Wider economic impacts	No direct role for supply/demand information, although if predicted traffic levels to/from the development area are low, this would cast doubt on the extent of any benefits.

<b>Objective</b>	<b>Sub-Objective</b>	<b>Role of demand and supply information (in all cases see GOMMMS guidance for details/references on how to make the calculations)</b>
Accessibility	Option values	Strongly related to service levels and route network of public transport.
	Severance	Severance increases as traffic levels increase.
	Access to the transport system	Strongly related to service levels and route network of public transport. See “Supply effects” in Section 3.
Integration	Transport interchange	Service levels, public transport network and interchange facilities all influence interchange quality.
	Land-use policy	Public transport service levels to new developments are of particular importance in determining the fit with land use policy. See “Other effects” headings in Section 3.
	Other Government policies	Local traffic levels are clearly related to road traffic reduction targets.

### **Example**

The following is an example of the use of demand and supply information as part of wider scheme appraisal under the New Approach.

A quality bus partnership scheme is predicted to increase peak bus service levels by 4 buses per hour.

Suppose the demand and supply analysis reveals that overall traffic levels can be expected to fall by 2% in the peak (no significant change off-peak) as a result of mode switch.

What implications does this have for the sub-objective ‘Reliability’?

Suppose that the estimated peak hour traffic flow on a particular stretch of route is:

- without Quality Bus 1500 vehicles per hour

Then with Quality Bus, given the predicted 2% fall in peak traffic, peak hour traffic flow would be  $1500 \times 0.98 = 1470$  vehicles per hour.

Suppose that this is a stretch of road whose capacity as measured by the Congestion Reference Flow (see DMRB 5.1.3) is 1400 vehicles.

According to GOMMMS Volume 2 Chapter 6, the appropriate measure of reliability for road schemes is the stress-based measure (which is actually a proxy for reliability, since other reliability measures are still under development). Using the formula given in GOMMMS:

$$\text{Peak Hour Stress without Quality Bus} = 1500/1400 = 107\%$$

$$\text{Peak Hour Stress with Quality Bus} = 1470/1400 = 105\%$$

In the AST for this scheme, having carried out these calculations it would be possible to report against reliability:

Stress on Key Route Section

Do-minimum: 107%

Do-something: 105%

### **Values of time and safety**

Values are given in Table B.3. These can be used in conjunction with estimates of time savings and numbers of accidents in order to obtain a monetary estimate of the benefits and disbenefits of a scheme.

**Table B.3: Standard appraisal values of time and safety**

<b>Categories of Travel Time</b>	<b>Value, £ per hour</b>
Working time (in vehicle)	12.78
Non-working time (in vehicle)	3.81
Walk, wait and interchange time	use a factor of 2.0 on in-vehicle time
<b>Casualty severity</b>	<b>Value, £</b>
Fatal	784,090
Serious	89,380
Slight	6,920
<b>Accident severity (road only)</b>	<b>Value, £</b>
Fatal	7,070
Serious	2,950
Slight	1,690
Damage only	1,050
All values on a 1994 price and value basis	

Source: DMRB Volume 13. Behavioural values of time are quoted, in the light of the latest GOMMMS advice recommending a change from the factor cost to the market prices unit of account.

If more specific values of time are available (eg. cyclists' values of time, see Section 3.8) then it would be appropriate to use them if the scheme benefits are largely focused on these specific categories of time. Otherwise, the standard values will serve as rules of thumb and will make it easier to compare one scheme with another.

## References

Annex E of DETR (1999), *Guidance on Provisional Local Transport Plans*. Also available at: <http://www.local-transport.detr.gov.uk/lpt99/index.htm>

DETR (2000), *Guidance on Methodology for Multi-Modal Studies (GOMMMS)*. DETR, London.

DETR (1999), *Design Manual for Roads and Bridges*, Volumes 5 and 13. The Stationery Office: London.

## **Appendix C: Further guidance on Soft measures**

### **Policy Instrument: Soft Measures**

#### **Company Transport Plans, Travel Awareness & Safe Routes to School**

A Company Travel Plan (CTP - also known as a Green Transport/Travel/Commuter Plan) is “a package of incentives and disincentives which aim to change the modal choice of employees for the trip to work” (Rye, 1999a). CTPs became increasingly important during the 1990s, and as Rye’s definition suggests, the motivation behind a CTP need not be environmental. Indeed, those companies who have a CTP in place have often implemented it for clear business reasons – Rye quotes a number of examples (1999a), including Boots PLC in Nottingham, and Nottingham local authority. A growing trend is to advocate CTPs through travel awareness work, and as such, the two are no longer separate entities.

Travel awareness work aims to reduce car use through the provision of information and persuasion. Local authorities, including Leeds, York, Hampshire, and Hertfordshire are advocating CTPs as part of their wider travel awareness work. At the same time, travel awareness projects looking at all journeys, not just the trip to work, are being implemented via the workplace, e.g. Travel Blending in Leeds (Steer Davies Gleave, 1998). Travel Awareness work can also help to promote School Travel Plans (STP).

STPs developed from Safe Routes to School (SRS) which were mainly concerned with walking and cycling initiatives. STPs are packages which include; walking, cycling, public transport, engineering, education, and travel awareness initiatives, as well as school policy measures, and pupil/parent involvement (Bradshaw, 1999). Consequently, STPs can now be seen as the equivalent of CTPs for schools.

The impetus behind CTPs has steadily increased since the Government placed them higher up the political agenda by including them in the 1998 Transport White Paper (DETR, 1998a). Now not only are Government departments and local authorities expected to put a CTP in place, but CTPs are advocated in planning guidance notes, including the public consultation draft for the revision of PPG13 (DETR, 1999a), and PPG12: Development Plans (DETR, 2000a). Additionally, Section 106 of The Town and Country Planning Act 1990, can be used to require developers to provide infrastructure (e.g. improved measures for cyclists and pedestrians) that could be exploited by CTPs, “in line with PPG13 aims” (DoE, 1997). In addition to this legislative background for CTPs, much of which is also applicable to STPs, sustainable regeneration bids (SRB) have also included STP work.

### **Supply Effects**

CTPs rarely have direct supply effects, as for example, bus priorities can. Instead CTPs can involve measures which have supply effects for individual modes. For example a developer may include bus access to their site, which could alter the supply of buses, especially if the access is negotiated in partnership with a bus company. CTPs may also affect the supply of infrastructure, and facilities for cycling and walking, e.g. provision of showers and lockable cycle storage. Although this does not directly affect cycling rates, it can generate demand. To affect the cycle supply, companies would have to subsidising bicycle purchase, or providing bike hire. The effects of large scale supply side measures, e.g. site access for buses, and bicycle provision are rarely quantified, and employers are reluctant to spend money on facilities that may not provide direct benefits to the company. Hence, smaller scale, demand side measures, e.g. provision of showers and loans for public transport tickets, are more

common (Rye, 1999b). Consequently the effects of CTPs are greatest on the demand side. Large scale supply side measures are most likely where a company cannot expand without providing alternatives to the car, due to spatial constraints, or where a company has problems with staff recruitment and retention due to poor site access (Rye, 1999b).

The supply effects of STPs can be seen as broadly the same as those described for CTPs above. As with CTPs, the focus behind STPs is often not solely environmental. Common reasons for implementing a STP at a school are, road safety, decreasing congestion, and then sustainability (Bradshaw, 1999). The most common measures are engineering, walking, education, cycling, and public transport (Bradshaw, 1999). Whilst this broadly follows in the footsteps of CTPs, it is worth noting that supply effects are complicated by the fact that the consumer is the school child, whilst in many cases the purse strings are held by the parent. Thus an STP that does not work with parents could supply alternatives to the car which children are prevented from taking up by parents, resulting in excess supply. Alternatively, the STP could generate a demand from children, which is not met by parents.

Whilst the supply effects of CTPs, and STPs are mainly indirect, they are at least identifiable. The supply effects of travel awareness programmes can be harder to identify. Where travel awareness work is based solely on the provision of information, and education about existing alternatives to the car, supply effects for individual modes, and associated infrastructure are minimal. Where travel awareness promotes a scheme aimed at increasing the mode share of a particular alternative, supply effects can be equivalent to those generated by a CTP or STP. For example, the Bike Busters scheme in Denmark provided bicycles, as well as accessories, and advise on cycling instead of driving (University of Westminster, 1998). Consequently, this travel awareness scheme had obvious and substantial (due to its success) supply effects.

## Demand Effects

As CTPs offer a package of incentives to use alternatives to the car, their greatest impacts are on the demand for public transport, walking and cycling. Subsidy of public transport can increase the demand on routes serving a company site. Similarly, provision of incentives to walk or cycle, e.g. lockable cycle storage; can increase the demand for cycling. Financial disincentives to use the car also have impacts on the demand for other modes. Changes to parking facilities, e.g. restricting car parking near to the main entrance of an office block, can make car use unattractive relative to alternatives, and therefore increase demand for alternatives, as people change mode for commuting journeys. At Asda House in Leeds, which has a large car park, parking spaces immediately in front of the entrance have been restricted to vehicles used by car sharers only, with a consequent increase in car sharing, (Bowtell, P., 2000).

For STPs the greatest effects are again on the demand side. However, behaviour now is likely to have substantial effects on future demand for alternatives to the car. "Not walking or cycling to school ... builds in car dependency at an early stage in a child's development. These children will find it harder as adults to use cars responsibly and will have fewer opportunities to develop the road sense they need as pedestrians and cyclists" (DETR, 1998a). It should also be noted that financial incentives or disincentives are less likely to feature in STPs, due to the separation of the consumer and the purchaser. Having said this, public transport could be subsidised, or made more attractive by re-routing it past schools, although to date, there is little evidence of new public transport initiatives in STPs.

For travel awareness work, demand effects again depend on the nature of the work. A sliding scale of demand effects is likely. Basic campaigns that provide information and education, but not interaction with travellers to provide individual guidance, are likely to have minimal impacts on demand. Various studies have shown that these basic schemes successfully raise awareness, but are much less effective when it comes to actually reducing car use (Jopson, A.F., pending). At the other end of the scale, projects providing individual guidance, at the same time as promoting schemes such as Bike Busters (University of Westminster, 1998), can significantly reduce car use, and therefore effect demand.

However, quantifying the demand effects of CTPs, STPs and travel awareness projects is a complex process, due to the difficulty of separating project effects from external factors. In terms of percentage changes in car use and cost, little has been written about the effects of CTPs. Some companies will give one or the other, but rarely both. Additionally, what has been written is usually in the form of generalised  $x\%$  reductions in car use, or  $x$  pounds spent, rather than specific figures attributed to a specific route, over a specific time period. Neither are the figures reported in terms of pounds or miles per member of staff. The situation is very similar for travel awareness projects, although those that promote specific schemes such as Bike Busters (University of Westminster, 1998) have fewer problems separating project effects from external effects, and have therefore published more results than general information projects. However, for STPs published demand effects are hard to come by.

In view of the fact that available data is very general, examples of successful CTP measures, STPs and travel awareness programmes are given below.

#### Examples of Success - CTPs:

The DETR have recently published a guide to CTPs, “*Green Transport Plans. The Benefits of Green Transport Plans: The Guide*” (Taylor et al, for DETR, 1999). The guide can be found at

<http://www.local-transport.detr.gov.uk/travelplans/guide/index.htm> and includes extensive examples of measures that can be included in CTPs, as well as examples of successful CTPs, a number of which are included below.

- “At Hewlett Packard South Queensferry 159 staff are eligible for perk cars or a cash alternative of the monthly lease allowance + 32%. 102 staff – including the site manager – now opt for the latter, and this is better fiscally for them and the company” (Taylor et al, for DETR, 1999).
- “ADAS Consulting have introduced IT-based working practices and reduced office sites from 90 to 25. More than 500 staff now work permanently from home and more than 1,200 use internet e-mail systems, ADAS estimate that each home-based consultant has reduced their work-related car use by 2,000 miles a year” (Taylor et al, for DETR, 1999).
- “The Royal Bank of Scotland estimates that it saves more than £70,000 a month on corporate travel through video and audio conferencing” (Taylor et al, for DETR, 1999).
- “Property developers Argent encourage rail travel wherever possible. The company saves between 30-60,000 miles of company car travel each year” (Taylor et al, for DETR, 1999). As staff can also work on the train, rail travel can also increase productivity.
- “Midland Bank Call Centre, Edinburgh Park, is looking into securing its own bus service from Livingston. This would improve accessibility for existing employees and widen the call centre’s potential labour market” (Taylor et al, for DETR, 1999). Strengthening it’s

labour market was a key motivation behind the CTP implemented by Boots in Nottingham (Rye, 1999a).

- “The City of Irvine in California introduced a compressed working week in 1991. The first nine months of 1991 showed a 16% reduction in sick leave compared with the same period in 1990. Staff overtime was 17% less in the second period compared to the first. Irvine still (1991) operates compressed working arrangements for all staff” (Taylor et al, for DETR, 1999).
- “Boots in Nottingham has estimated that if it were to cut its £250,000 a year support to the works bus service, the number of cars coming to the site would increase by over 1,000 per day” (Taylor et al, for DETR, 1999).
- CTPs have also been implemented at hospital sites as the pressure of congestion, space and accessibility grow. Plans can include measures for staff and/or patients. Hospital CTPs have been implemented at the LGI in Leeds, and are in the process of being implemented at Withington Hospital in Manchester, to name just two.

As these examples demonstrate, there is a wide variety of measures that can be taken as part of a CTP, some of which may already be in place. Additionally the benefits are not just reductions in car use. Direct benefits to the company, such as financial savings, and less sick leave (due to increased fitness) are experienced. A variety of measures were used in these and other past CTPs, not all of which relate directly to commuter travel. Several measures are concerned with customer access, business travel and fleet management. Further to this, local authority CTPs can be used as a means to promote other policy instruments, which contribute to reducing car use, and could feature in individual employers CTPs. These measures include (re) opening rail stations or services, bus priorities, cycle facilities, town centre pedestrianisation, and controlled parking zones. All of these measures are outlined in this guidance, and help to provide a high quality alternative to the car, and/or control car use. Additionally, holistic, area wide approaches can contribute to CTPs, STPs, travel awareness, SRB and health objectives simultaneously.

The success of measures that make up a CTP are influenced by the way the plan is implemented. Key factors include implementing useful measures, rather than just the cheapest (Transport 2000, 1997), and appointing a CTP co-ordinator within the company (Rye, 1999a). There are a number of useful guides on how to successfully implement a CTP, listed in Annex A of the DETR’s “*Green Transport Plans. The Benefits of Green Transport Plans: The Guide*” (Taylor et al, for DETR, 1999). Excellent examples of the promotion of travel awareness, including CTPs, come from Hampshire County Council and its HeadStart campaign, Hertfordshire who pioneered TravelWise – now a national organisation joining numerous local authorities together - Nottinghamshire local authorities and Boots PLC in Nottingham, and Edinburgh local authority. Other useful examples come from Manchester, who produced the “*Green Transport Plans: A Greater Manchester Guide*” (Manchester Airport, et al, c. 1999), and “*Manchester Airport Green Commuter Plan*” (Manchester Airport, c. 1999), as well as running the “*Catching Them Young Project*” – “*Summary Report*” (Pilling, A., et al, c. 1999). Oscar Faber, W.S Atkins, and Steer Davies Gleave consultancies also have experience with CTPs, travel awareness and STPs. Additionally charities such as Environ working in Leicester in partnership with other organisations (the Turning The Tide project), and Global Action Plan working with local authorities and businesses nationally, run projects promoting environmentally friendly behaviour, including reductions in car use. Going for Green and the Government’s “*Are You Doing Your Bit?*”

campaign are also involved in similar work. In addition to all this help and guidance, the Government gave CTPs a further helping hand in the March 1999 budget, by removing tax on a number of CTP benefits to employees. Again the DETR's CTP guide outlines the details in Annex D, (Taylor et al, for DETR, 1999).

#### Examples of Success - STPs:

Examples of STPs are currently hard to come by, although this is likely to because STPs are a relatively new development. Some examples of STP work that is in the public domain are:

- St Albans in Hertfordshire: Sandringham Secondary, and Wheatfields Junior schools (on adjacent sites) are working together on a STP. The STP includes modal shift targets, a new bus service (used by 35 to 40 pupils per day, including 30 who would otherwise travel by car), training junior pupils for on and off road cycling (25% of final year junior pupils now cycle to school), 2 new puffin crossings, and the involvement of 50 local volunteers who escort children to and from school by bus, and on foot (DETR, 1998a).
- Buckinghamshire County Council, employ a dedicated member of staff who spends 100% of their time on STP, and individual measures, such as walking to school schemes (Bradshaw, 1999).
- Wigan and Thetford in Norfolk: Safe routes to school contributed to SRB programmes – the “*Safe Routes, Wigan City Challenge*” and “*Thetford Walking and Cycling Initiative*” respectively. In Wigan, local schools were involved in “determining routes and designing way markers,” as well as maintenance of routes and waymarkers. There are also links between the “*Wigan Healthy Heart project*” and the “*Sports Outreach project*”. In Thetford, “the impetus behind the project came from a pilot study on the development of SRS which was commissioned by Norfolk County Council in 1995”. (DETR, 1998b).
- SUSTRANS is working on demonstration SRS projects in Leeds, York, Colchester in Essex, and Hampshire, as well as work to support SRS in Cumbria. (DETR, 1998a, DETR, 1998b). SUSTRANS have also produced a guide to establishing SRS: “*Safe Routes to School: Project Guide*” (SUSTRANS, 1999).
- Hampshire’s SRS work is also promoted via its HeadStart travel awareness campaign. Good examples of work in Hampshire can be found in Southampton.
- Transport 2000 have published the “*A Safer Journey to School*” guide, which is aimed at parents, as well as teachers and governors. The guide complements DETR’s own guide which is aimed at local authorities.
- The Pedestrians Association run Walk to School weeks, for more information go to <http://www.pedestrians.org.uk>.
- Information on transport and alternatives to the car can be found at Young TransNet – an interactive, web based learning environment aimed at young people, which can be found at <http://www.youngtransnet.org.uk/main/home.htm>.
- DETR supports STP work in a number of ways:
  - A) Specific projects have been funded in West Sussex, Manchester, Birmingham, Warwickshire and London.
  - B) The School Transport Advisory Group (STAG) has been established. STAG is made up of representatives from the departments of Education and Employment, Environment Transport and Regions, and Health, as well as local authority, school and support group representatives. STAG produced “*The STAG Report*” in 1998-99. The report is available at [http:// www.localtransport.detr.gov.uk/schooltravel](http://www.localtransport.detr.gov.uk/schooltravel). In

January this year, Local Transport Today (LTT) reported 11 recommendations made by STAG. These are: "improvements to school sites, better targeting of the substantial resources, affordable bus travel, training for all bus drivers, effective training to allow children to develop the skills, understanding and awareness needed, improved enforcement, raised driver awareness, joint planning, rewarding "champions", training for governors, and training and guidance for inspectors" (LTT, 20<sup>th</sup> January 2000).

- C) The Government's "*Healthy Schools*" initiative has a number of transport elements. The "*Investors in Health – Healthy Schools Award*" includes measures to encourage safe alternatives to the car for travel to school in its criteria (DETR, 1998a). The "*Safe and Sound Challenge*" was launched in January 1999 as part of the "*Healthy Schools*" initiative, to "increase the number of children and young people who walk or cycle to school safely through innovative travel schemes" (DETR et al, 2000b). More information on the initiative can be found at <http://www.safet trav.co.uk>. Further information on the "*Healthy Schools*" initiative can be found at the "*Wired for Health*" web site – <http://www.wiredforhealth.gov.uk>.
- D) DETR have also produced a guide to establishing STPs entitled "*School Travel Strategies and Plans: A Best Practice Guide for Local Authorities*" (DETR, 1999b). The guide is aimed at helping local authorities to work with individual schools, to set up STPs, and provides step-by-step guidance. Thirty case studies are listed in the appendices, covering rural, urban and inner city schools. Details of the case studies can be obtained free, by contacting DETR. The guide is available at <http://www.local-transport.detr.gov.uk/schooltravel/bpgla/index.htm>.

#### Examples of Success – travel awareness:

The best travel awareness programmes are those that combine education, detailed information on alternatives in a variety of formats, and individual guidance, as well as practical help. Some good examples include the following:

- HeadStart in Hampshire is a community outreach programme which provides interactive education about transport and the environment through CD ROMs, as well as promoting alternatives to the car, plus CTPs and STPs.
- TravelWise, promotes initiatives such as "*Car Free Day*" and "*Green Transport Week*" run by the Environmental Transport Association (ETA), and "*Don't Choke Britain*". All of these promote and publicise, local and national events; some of a one off nature, others are on going programmes. More information can be obtained from <http://www.eta.co.uk>, <http://www.dcb.org.uk> and <http://www.travelwise.org.uk>. The Don't Choke Britain web site has a number of useful links, including the British Lung Foundation who can provide information on the effects of pollution on health.
- Global Action Plan (GAP), Going for Green (<http://www.gfg.co.uk>) and Are You Doing Your Bit? (<http://www.doingyourbit.org.uk>) all promote environmentally friendly behaviour, including the use of alternatives to the car.
- Various campaign groups are involved in travel awareness work, especially advising local authorities, companies and schools on the promotion of particular modes. Such organisations include:
  - A) Sustrans (<http://www.sustrans.org.uk>) who promote cycling, and are involved in the implementation of the national cycle network,
  - B) The Cyclists Touring Club (<http://www.ctc.org.uk>),

- C) Transport 2000 who promote all alternatives to the car, and have a number of useful guides.
  - D) The Pedestrians Association (<http://www.pedestrians.org.uk>). The Pedestrians Association web site provides a number of useful links to other organisations involved in travel awareness work, including SALSA. SALSA - "*Sustainable Access to Leisure Sites and Amenities*" – is a project run by Ealing Borough Council to "provide safe bicycle and walking routes to Ealing's leisure sites. By providing these new routes ... [it is hoped that] children will be able to visit the swimming pools, youth centres, libraries, parks and other places without having to depend entirely on their parents to take them by car" (<http://www.ealing.gov.uk/salsa/>, 1999 (quoted on 18/4/2000, site last updated on 18/11/99)).
- Travel awareness work also includes the promotion of car sharing/pooling, and alternatives to travel, such as telecommuting.
    - A) *Car sharing/pooling* is more developed in the US and the rest of Europe. In the UK, most car sharing is company based, for example, ASDA House in Leeds operate a scheme for their employees, with parking spaces nearest to the front door, and a guaranteed ride home when working late, or in an emergency. Car sharing schemes are a common feature of CTPs, and the guaranteed ride home has been shown to improve employees' confidence in car sharing, and hence improve its success. In the rest of Europe and the US community car pools have been established, such that individual members can book a car as and when needed at a low cost. The following web sites provide some useful information and examples: <http://www.carsharing.org> (Europe), <http://www.carsharing.net/> (North America, plus some European examples), and <http://www.deq.state.or.us/aq/busplan.htm> (a market share and business plan for a community car share organisation in Oregon). Work in the UK is developing with the introduction of the High Occupancy Vehicle Lane, which favours car sharing in Leeds, and the development of a community car pool in North Leeds.
    - B) Like car sharing, telecommuting or teleworking as it is sometimes known, is most well developed in the US. However there are established examples in the East Midlands, Wales and Ireland. Information on these UK examples can be accessed via the LINK button on the UK Telework and Telecottage Agency (TCA) web site (<http://www.tca.org.uk>). The TCA web site is an extremely comprehensive source of information on all aspects of telecommuting.
  - The travel awareness organisation details outlined above form a brief over view of the key players in the UK. For more examples and information on projects elsewhere in Europe, the University of Westminster has produced a guide to travel awareness as part of the INPHORRM project (University of Westminster, 1998).
  - Outside Europe, the TravelSmart project implemented in Western Australia, with the help of SocialData, is a particularly good example of a travel awareness project. Details can be found at <http://www.travelsmart.transport.wa.gov.au/>. US examples include the Coalition for Alternative Transport (<http://www.car-free.org/>), and Transportation Alternatives (<http://www.transalt.org/>).

## **Appendix D: Summary of Policy Instruments**

## D.1 Introduction

The information presented in this section represents a reasonably comprehensive listing of potential policy instruments that are available to transport planners. For a more detailed summary, the reader is referred to ITS Working Paper 545. Alongside the listing of policy instruments which follows we provide references to particularly useful sources of evidence on their impacts and some of the most important of these instruments have been selected for closer scrutiny in section 3.

The instruments can be categorised in several ways. Here we consider them under the headings of land use measures; infrastructure provision; management of the infrastructure; information provision; and pricing. Where relevant it considers in order, under these headings, measures that provide for the private car; constrain car use, provide for public transport; provide for cyclists and pedestrians; and provide for freight.

The key question with each of the instruments is its ability to achieve one or more of the local transport plan objectives. Unfortunately, this is an area of transport policy in which information is often sparse. Experience with some measures, such as bus priorities and cycle lanes, has been well documented through a series of demonstration projects. In other cases, of which road construction is a notable example, there have been very few before and after studies to provide the evidence on the impact of the measure. Even where the evidence exists, it may be difficult to generalise from it, since results in one context are not necessarily transferable to another. In the absence of real life trials, the most obvious source of evidence is desk studies, typically using simulation models. Such results are, of course, only as reliable as the models that generate them.

While achievement of objectives is crucial, it is also important to avoid worsening conditions under other objectives. For example, one of the major concerns with road building has always been that, while it may achieve benefits in terms of efficiency, accessibility and economic regeneration, it may seriously compromise the environment of the area through which it passes. Any published evidence on adverse impacts of the measures considered is therefore also referenced.

Land use measures cannot in the main be focused on a particular mode, and are therefore considered together in this section. However, most of them are designed following the principles of PPG 13 (DoE and DoT, 1994: currently under revision), namely, to reduce the growth in length of motorised journeys, to encourage the use of public transport, cycling and walking, and hence also reduce future reliance on the car. Land use measures are also seen to have a role in influencing freight movements, by encouragement of development near to rail and waterborne freight facilities. The measures in PPG13 thus encourage an integrated approach to land-use and transport planning in both urban and rural areas, and stimulate local authorities to implement their own land-use priorities within this framework.

## D.2 Synthesis of potential policy instruments

### D.2.1 Land-use options

- **Flexible working hours** - Daniels, 1981; O'Malley and Selinger, 1973; Ott et al, 1980
- **Development densities** - DoE/DoT, 1995; DoE and DoT, 1993; Simmonds and Coombe, 1997
- **Transport corridor-based developments** - de Jong, 1995
- **Development mix** - DoE/DoT, 1995; Wachs, 1993
- **Developer Contributions** - DoE/DoT, 1995
- **Commuted payments** - DoE/DoT, 1995
- **Company Travel Plans** - Wachs, 1990; DoE/DoT, 1995; Transport 2000, 1997; HA, 1998; Rye, 1999
- **Parking standards** - Sanderson; 1994 Haworth and Hilton, 1982; LPAC, 1992
- **Telecommunications as an alternative to travel** - Hamer *et al*, 1991; Kitamura *et al*, 1991; Dodgson *et al*, 1997; DoE/DoT, 1995

### D.2.2 Infrastructure Measures

*Improved provision for the Car*

- **New road construction** - SACTRA, 1994; Goodwin, 1996; Mackie and Davies, 1981; DOT, 1995
- **New off-street parking** - Valleley, 1997

*Provision for Public Transport*

- **Reopening closed rail lines** - Nash and Preston, 1991; Nash, 1992
- **New rail stations** - Nash and Preston, 1991
- **New rail lines** - Nash, 1992; Tyne and Wear PTE, 1985; Gentleman *et al*, 1981; Nash and Mackett, 1991; DoE/DoT, 1995
- **Light rail** - Howard, 1989; Oscar Faber, 1996; Dundon-Smith and Law, 1994a, 1994b; Walmsley and Perrett, 1992
- **Guided bus** - Read, Allport and Buchanan, 1990
- **Park and ride** - Bixby, 1988; McPherson, 1992; Pickett, 1995; Parkhurst, 1995; WS Atkins, 1998
- **Terminals and interchanges** - Colin Buchanan and Partners, 1998; CIT, 1998

*Provision for Cyclists and Pedestrians*

- **Cycle routes** - Harland and Gercans, 1993; Tolley, 1993; IHT, 1998
- **Pedestrian areas** - Hass-Klau, 1993; IHT, 1989

*Provision for Freight*

- **Transhipment facilities** - Collis, 1988

### D.2.3 Management Measures

#### *Improved provision for the Car*

- **Conventional traffic management** - IHT 1997; Brown, Evans and Black, 1991
- **Urban traffic control (UTC) systems** - IHT, 1997; Wood, 1993; Fox *et al*, 1995
- **Intelligent Transport Systems (ITS)** - Fox *et al*, 1995; Routledge, 1996; TRL, 1996
- **Accident remedial measures** - IHT, 1990, 1997

#### *Measures to Restrain the Car*

- **Traffic calming measures** - Bicknell, 1993; Hass-Klau *et al*, 1992; TRL, 1995; IHT, 1990
- **Physical restrictions** - Goodwin *et al*, 1998a, 1998b
- **Regulatory restrictions** - Topp *et al*, 1994; Biezu and Rocha, 1999; Ogunisanya, 1984
- **Parking controls** - Coombe *et al*, 1997; Gantvoort, 1984
- **Car sharing** - Bonsall *et al*, 1981

#### *Provision for Public Transport*

- **Bus priorities** - Webster *et al*, 1980; Wood and Smith, 1992
- **High occupancy vehicle lanes** - Leeds City Council, 1999
- **Public transport service levels** - Webster *et al*, 1980; White, 1992
- **Bus service management measures** - Webster *et al*, 1980; McDonald and Tarrant, 1994
- **Quality Bus Partnerships** - TAS, 1997; DETR, 1999; Audit Commission, 1999

#### *Provision for Cyclists and Pedestrians*

- **Cycle lanes and priorities** - Tolley, 1993; Harland and Gercans, 1993; IHT, 1997

#### *Provision for Freight*

- **Lorry routes and bans** - IHT, 1997

### D.2.4 Information Provision

#### *Improved provision for the Car*

- **Conventional direction signing** - Jeffery, 1981
- **Variable message signs** - Brown and Mackenzie, 1994; Carden *et al*, 1999; Thompson *et al*, 1998
- **Real-time driver information systems and route guidance** - Bonsall, 1992; Jeffery and Russam, 1984; May *et al*, 1998
- **Parking guidance and information systems** - IHT, 1997; DoE/DoT, 1995; Polak *et al*, 1990; Thompson and Bonsall, 1997

#### *Measures to Restrain Car Use*

- **Public awareness campaigns** - DoE/DoT, 1995; Ciaburro *et al*, 1994; INPHORMM, 1998

*Provision for Public Transport*

- **Conventional timetable and other service information** - AMA, 1990; Pickett, 1982
- **Real time passenger information** - Silcock and Forsyth, 1985; HCC, 1996
- **Trip Planning Systems** - IHT, 1997
- **Operation information systems** - Finnamore and Jackson, 1978; Keen, 1992; IHT, 1997

*Provisions for Cyclists and Pedestrians*

- **Static direction signs** - see conventional direction signing above
- **Public awareness campaigns** - see above

*Provision for Freight*

- **Static direction signs** - see conventional direction signing above

### D.2.5 Pricing Measures

*Measures to Restrain the Car*

- **Parking charges** - Feeney, 1989; Coombe et al, 1997; LPAC, 1997
- **The Workplace Parking levy** - DETR, 1998; MVA, 1999
- **Urban road Charging** - ETR, 1998b; Soo, 1998; May et al, 1998; Bonsall and Palmer 1997; Holland and Watson, 1982; Larsen, 1988; Richards et al 1996; May et al, 1992; Flowerdew, 1994; Richards et al, 1996; Still, 1996
- **Inter-urban road charging** - MVA, 1993; TRL, 1999a and 1999b; Hills, 1998

*Provision for Public Transport*

- **Fare levels** - Goodwin, 1992; Webster et al, 1980; GLC, 1983; Allsop, 1993
- **Fares structures** - Gilbert and Jalilian, 1991
- **Concessionary fares** - Goodwin et al, 1988

This list is extensive but not exclusive and other policy instruments will continue to emerge over time. A small number of the above can be selected as reasonably common instruments in practice and these are treated in more detail in section 3 of this report.