Contents

1 Introduction

The material in this Working Paper was generated as input to DETR's Guidance on the Methodology for Multi Modal Studies (GOMMMS). DETR subsequently decided only to provide summary information on transport policy measures, and to leave the consultants involved in individual multi modal studies to make their own assessment of individual policy measures in the context of specific study areas. It has been decided to make this fuller document available as a reference source.

The purpose of the review of policy measures was to provide summary information on the range of policy measures available, experience of their use and, based on past studies, their potential contribution to the range of policy objectives specified for GOMMMS.

The review was based on an earlier one included in the Institution of Highways and Transportation's Guidelines on Developing Urban Transport Strategies (1996). This material was updated using references published since 1996 and expanded to cover policy measures relevant in inter-urban areas. It had been intended to circulate it for comment before publishing a revised version. However, DETR decided to use an abridged version before this consultation was complete. It should be borne in mind that this document has not, therefore, undergone the peer assessment which had been intended.

To avoid unnecessary further work, the material is presented as it had been drafted for the GOMMMS Guidance document. The only modifications have been to change the chapter and paragraph numbers, and to remove the cross references to other parts of the Guidance document.

2 Policy Instruments

2.1 Introduction

2.1.1 Transport planners have available to them, at least in principle, a wide range of instruments of transport policy. These are the means by which the policy objectives can be achieved, and the problems identified overcome.

2.1.2 The first main section of the chapter (2.2) presents, in outline form, the main policy instruments likely to be of primary focus in the Studies. This section therefore focuses on those instruments of most relevance in an interurban context. However, some of the study areas include urban areas and, for measures of more relevance to these areas, reference should be made to the sections which follow.

2.1.3 Much of the evidence relates to urban areas, and some of the measures discussed are more relevant to urban areas than an inter-urban context. While this Guidance will be used more frequently for inter-urban schemes, measures appropriate to urban areas will still be relevant where schemes being assessed bypass, or provide immediate access to, urban areas. All measures have therefore been included, but those which are considered more appropriate for inter-urban application have been identified in bold in the tables. These exclude instruments specifically relating to trip-ends or short journeys, which are likely to be less important unless applied consistently over a study area. Section 2.2 discusses this issue further.

2.1.4 The instruments can be categorised in several ways. After the overview in Section 2.2, the chapter considers them under the headings of land use measures (Section 2.3); infrastructure provision (Section 2.4); management of the infrastructure (Section 2.5); information provision (Section 2.6) and pricing (Section 2.7). Where relevant it considers in order, under these headings, measures which provide for the private car; constrain car use, provide for public transport; provide for cyclists and pedestrians; and provide for freight.

2.1.5 The key question with each of the measures is its ability to achieve one or more of the policy 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 the most glaring 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 computer models. This is, for example, still the only source of guidance on the impact of road pricing in the UK. Such results are, of course, only as reliable as the models which generate them. This chapter provides a brief summary of the evidence on each of the main types of measure available, and provides references to particularly useful sources of such evidence.

2.1.6 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 evidence on adverse impacts of the measures considered is also summarised below.

2.1.7 Inevitably, when dealing with almost 60 separate policy instruments in one short chapter, much of this information has to be presented in note form. The reference

texts should provide further information where necessary. A series of tables are presented in Section 2.8 which summarise in 'headline' form the impact of each measure on each objective on a common basis. These tables are provided for guidance only; it is essential to assess the impact of each measure in the context of the area for which it is being considered.

2.1.8 The chapter is based directly on an earlier assessment of policy measures, included in the Institution of Highways and Transportation's Guidelines for Developing Urban Transport Strategies (IHT, 1996). The review differs from that in the IHT Guidelines in three important ways. Firstly, it extends the measures to include those such as motorway tolls, which are relevant in an inter-urban context, and those, such as workplace parking levies and quality bus partnerships, which have emerged since. For completeness, it includes three pricing measures which can only be applied at a national level. Secondly, it updates the assessments based on the considerable work which has been carried out on some policy measures since 1996. Thirdly it revises the seven objectives used in the IHT Guidelines to reflect the requirements of the New Approach to Transport Appraisal. It considers first four of the five objectives identified in the 1998 White Paper :- Environment, Safety, Economy and Accessibility. It then considers the four supporting issues of Equity, Affordability, Practicality and Acceptability. These are defined briefly as follows.

Government's Objectives for Transport	**Summary of Sub-objectives defined in NATA**
Environment	Noise, local air quality, climate change landscape, townscape, heritage, biodiversity, water resources, other health impacts, quality of journey.
Safety	Accidents and security.
Economy	Economic efficiency of the transport system, reliability, wider economic impacts.
Accessibility	Access to the transport system, option values, severance.
Supporting Issues	**defined from IHT, 1996**
Equity	The impacts on different groups in society of the transport system.
Affordability	Financial considerations, typically acting as a constraint, can be offset by ability to raise revenue.
Practicality	Includes political/public ability to implement, availability of legislation, feasibility of new technology or designs.
Acceptability	Political and public acceptability.

2.1.9 The main differences from IHT, 1996 are:

- economic efficiency and economic regeneration are considered together under economy;
- sustainability is considered under environment;
- accessibility is limited to those changes, for public transport users, pedestrians and cyclists, which are not included in a conventional cost-benefit analysis; and
- practicability has been split into the separate constraints of legislation and technology on the one hand, and acceptability on the other.

2.1.10 Finally, the chapter considers Central Government's fifth objective of integration of policy measures into a coherent strategy, in which the individual measures complement one another, and potentially help to redress any adverse impacts of measures chosen on their own. It is in these ways that synergy can be obtained: in other words that the performance of the overall strategy becomes greater than that of the sum of its parts. Section 2.9 considers the ways in which synergy can be obtained between measures and the types of combination which might most effectively form the basis of an integrated strategy.

2.2 Policy Instruments of Most Relevance to the Multi-Modal Studies

2.2.1 The 60 or so instruments outlined in the following sections cover the full range of urban and inter-urban policy instruments. However, the Multi-Modal Studies are likely to have more of an inter-urban emphasis, given their genesis in the Review of the Roads Programme. A good example of this is the South and West Yorkshire motorway box study, focusing upon congestion issues on motorway routes. Here, one can conclude that certain instruments are clearly not appropriate, for example cycle lanes, or LRT. However, even in this instance, the framework for assessment means that consideration of issues such as pedestrian severance, or alternative modes for large point to point demands, means that a wide range of instruments for impact amelioration should be considered. Moreover, where inter-urban schemes bypass, or provide access into urban areas, then the urban instruments will be very relevant.

2.2.2 Given this wide range of potential studies, clearly it is the task of the Steering Groups and consultants to determine what is appropriate in a given situation.

2.2.3 However, certain policy instruments can be highlighted as being of particular relevance to the inter-urban situation. In particular, instruments which focus upon trip ends (eg, land use and parking measures), or short journeys (eg, cycling measures) are less likely to be relevant unless applied consistently over the area of study.

Land Use Measures

2.2.4 Land use measures are important for consideration in all transport studies, and will be most effective as part of solutions with long term timescales. The effectiveness of all of these instruments at an inter urban level can be improved by wide scale application and a strict enforcement policy.

Infrastructure Measures

2.2.5 Infrastructure measures clearly are relevant, although the cost of many of these measures may make them less acceptable solutions. The most obvious measures are new and expanded road provision, upgrading of inter-urban rail services, and pipeline and water-based freight. Other measures such as light rail and guided bus, and improved parking and terminal provision are more appropriate for urban applications.

Management Measures

2.2.6 Management measures using conventional, ITS and accident remedial instruments should always be considered. Public transport priorities, service levels, and HOV lanes are all relevant where they can improve provision for inter-urban public transport. Lorry restrictions are also important for channelling freight movements onto appropriate roads. Other measures are more appropriate to urban areas.

Information Provision

2.2.7 The majority of these measures are likely to be relevant to the inter-urban context, particularly signing, variable message signing, real-time information and fleet management systems. However, information on the effectiveness of these measures is particularly limited at present. Parking and timetable information are more appropriate to urban areas , as are, at present, awareness campaigns.

Pricing Measures

2.2.8 Of the pricing measures discussed in Section 2.7, road tolling may seem the most relevant to an inter-urban context. However, given that many studies will have trips with at least one end at a city centre or workplace destination, the issue of workplace parking levies, congestion charging and parking charges are all potentially relevant. Fare levels and structures provide a means of encouraging the use of inter-urban public transport.

Summary

2.2.9 In summary, inter-urban travel is a complex phenomenon, which includes urban travel elements, particularly if schemes being assessed bypass, or provides access into, urban areas. Therefore, the distinction between what instruments are irrelevant to inter-urban studies will be almost entirely study area specific, and the priorities listed here should be interpreted with caution.

2.3 Land-Use Measures

Application to Different Modes

2.3.1 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.

Types of Measure

2.3.2 **Flexible working hours** are designed to reduce demand for peak travel and the resulting congestion. True flexible hours working provides the employee with flexibility in hours of arrival and departure, while specifying a required core time and number of hours per week or month. In many cases they were introduced by employers to retain employees rather than for transport policy purposes, and the scale of their operation, and impact, is thus not well understood. However, there have been some detailed studies of such operations (Daniels, 1981). Staggered hours, in which employers are encouraged to change the fixed working hours of all or a proportion of their employees, were popular in the US in the 1970s, and were designed specifically to reduce peak loadings on the transport system (O'Malley and Selinger, 1973). Another variant which has been discussed, but rarely tested, is the four day week in which employees work the same hours per week, but travel on one fewer day.

2.3.3 Studies of flexible working hours and staggered hours suggest that the overall economic benefits have been small, but they can have significant benefits for participants. In some cases they have enabled peak public transport services to be withdrawn, thus saving operating costs (DoT, 1977), but in the main they have simply transferred travel to slightly less congested times. It had been feared that flexible working hours would discourage car sharing and public transport use. In practice, US experience suggests the reverse; some car users switch either to car sharing or to public transport because they can adjust their working hours to match the schedules imposed (Ott et al, 1980).

2.3.4 However, all such measures are the direct responsibility of the employer, and can be changed without consultation with transport providers. Local authorities therefore have no real power to influence them, but there are now a few examples of local authorities working with selected employers to develop more sustainable transport policies (see Green Transport Plans, below). Local authorities can, of course, set an example by implementing flexible working hours themselves.

2.3.5 **Development densities** can be specified in Unitary Development Plans, and will apply to new development. Higher densities enable more opportunities to be reached within a given distance, and hence may encourage shorter journeys and use of cycling and walking. By increasing population and employment densities, they may also make public transport more viable. Some examples of schemes attempting to encourage centralisation in London and Watford are given in

DoE/DoT (1995). However, there is very little evidence of the scale of these effects, except for cross-sectional comparisons which demonstrate that residents in lower density areas are more likely to use the car and to travel longer distances (DoE and DoT, 1993). A modelling study for Bristol found that car trips to the centre could be reduced by over 10% if population could be centralised within Bristol (Simmonds and Coombe, 1997).

2.3.6 **Developments within transport corridors and near to transport nodes** provide a way of concentrating denser development, and that which can more readily use public transport, in those areas where public transport is readily available. This can lead to a corridor-style development, and has been used to considerable effect in cities such as Toronto (Knight and Trygg, 1977). The Dutch ABC policy is an extension of this concept. Developments are categorised in terms of their ability to use public transport and their need for road-based freight transport, and allocated to different zones in an urban area (de Jong, 1995). A recent Dutch Government report on the ABC policy, summarised in DoE/DoT (1995), concluded that while new developments were being concentrated near public transport nodes, there was still resistance to development at sites with limited car parking provision. Such strategies are intuitively sensible and should reduce journey lengths, improve accessibility and have some efficiency and environmental benefits. However, there is little evidence concerning their impact on overall travel levels.

2.3.7 **Development mix** is strongly advocated in PPG13, and can be specified in Unitary Development Plans in such a way that houses are closer to places of work and to other attractions such as schools, shops and leisure facilities. The key objective is to reduce car use and travel distances. The PPG13 Guidance on Good Practice (DoE/DoT, 1995), cites Almere in the Netherlands, parts of Edinburgh, Richmond and Crawley as good practice in mixing land-uses as part of re-development or new developments. Several US states have introduced a 'jobs-housing balance' into their planning controls for the same purpose (Wachs, 1993). However, while such policies should improve accessibility, there is little evidence that users do in practice travel to the jobs and leisure facilities which are nearer to their homes. Generally there is insufficient understanding at present of the impact on travel of different policies for development density and mix.

2.3.8 **Contributions to transport infrastructure** can be required from developers as part of the process of obtaining planning gain. This approach has been applied successfully to secure finance for new roads and also for the provision of park and ride sites. More recent examples are for developers to contribute to public transport serving new developments (e.g. at the Leith dockside in Edinburgh, or Hounslow (DoE/DoT, 1995)). The main risk is that the developer will go elsewhere if too many contributions are demanded.

2.3.9 **Commuted payments** are a special case in which the normal requirements for private parking provision at new developments are waived in return for payment to the local authority of a charge per space so that the local authority can make provision in public car parks. This has the twin advantages of permitting denser development and increasing the proportion of parking stock which is within public control. However, PPG13 suggests that Local Authorities should consider whether it would be more appropriate to meet requirements for access to sites by seeking contributions to measures to assist public transport or walking and cycling instead of funding parking. Hamburg has combined park-and-ride with commuted payments, although the success of these policies is largely unknown (DoE/DoT, 1995).

2.3.10 Another variant on commuted payments is the Californian 'cashing-out' policy, where employers are required to offer their employees cash in lieu of a parking space. Initial results have shown that solo drivers fell by 17% while car-poolers and public transport patronage increased (Shoup, 1997).

2.3.11 **Company Travel Plans** are a form of developer contribution, initially introduced in the US (as Travel Reduction Ordinances) and the Netherlands, in which developers are given permission to develop on the condition that they, or their tenants, produce a plan specifying ways in which they will reduce car use to a level below that which would normally be expected from such a development (Wachs, 1990). There is now evidence that such plans are being implemented by employers (DoE/DoT, 1995). In the UK, the emphasis has been on 'Green Travel Plans[1]', voluntary schemes whereby companies at existing sites encourage employees to use alternatives rather than driving alone (Transport 2000, 1997). Recent tax changes also encourage employer funding of public transport. There are several examples of Company Travel Plans in action, for example the HA Toolkit has an example of the Highway Agency's own travel plan (HA, 1998). A review of studies into their impacts has concluded that while there may be clear reductions at individual workplaces, there appears to be less impact at a wider spatial scale (Rye, 1999). Of course larger overall benefits may result if the majority of companies implement such schemes.

2.3.12 **Parking standards** probably offer the single most direct impact on levels of car use among land use measures. Conventionally these have required developers to provide at least a minimum number of parking spaces per unit floor area to ensure that all parking generated takes place off street. The resulting parking adds to the stock of private non residential space, and further reduces the ability of local authorities to use parking controls as a restraint tool (see paragraphs 2.5.14 and 2.7.1). PPG13 now requires local authorities to set much more restrictive 'maximum' standards and several authorities have already followed this approach (Sanderson, 1994). Such measures can limit the growth in parking space and aim to invoke mode switching (although it is possible that workers simply park elsewhere). Reducing parking can increase the gross floorspace, and hence site profitability. Changes in mode use can lead to efficiency and environmental benefits. However, there is always the danger that, under pressure from developers, local authorities will relax these new standards to attract valuable development, or that developers will find ways around the standards. There is evidence of this in the early years of implementing maximum standards (Haworth and Hilton, 1982). This is particularly the case in areas with competing centres with different parking standards. More recently, some authorities are now linking the level of parking standard applied to the level of public transport accessibility. The higher the latter, the fewer non-operational spaces permitted (LPAC, 1992). DETR will be issuing further guidance on the delivery of parking measures set out in A New Deal for Transport.

2.3.13 **Telecommunications** provide an alternative to travel for all, but studies have focused particularly on their use as an alternative to car travel. Teleworking, through which employees can work at home, has been more extensively studied, but there is interest also in teleshopping and teleconferencing. The former is now growing in popularity and practicality through the internet as products can be bought in 'virtual stores' and delivered to the consumer's home. However, such schemes are relatively new, and there is little indication yet as to whether they are

[1] Technically this is not a land-use measure, but it fits well here due to its similarity with Travel Reduction Ordinances.

replacing or complementing retail trips. There is a similar lack of information regarding the extent to which teleconferencing is replacing face-to-face meetings.

2.3.14 Studies in the US and Holland suggest that teleworking can reduce car use; typical teleworkers work from home two days a week, and their cars are used much less on the days when they are at home (Hamer *et al*, 1991; Kitamura *et al*, 1991). Such reductions may have economic benefits via reduced peak period car use. This has been strongly argued by Dodgson *et al* (1997). It may also therefore, contribute to environmental objectives. It will not however, have any influence on accessibility as defined in this guidance, as it provides an alternative to travel. Their impact is limited by employees' and employers' willingness to permit working from home, and its practicality. It is not yet clear how popular teleworking may become in the UK, although attitudinal surveys suggest that up to 40% of commuters would prefer to work at home (Dodgson, 1997). Teleworking is seen as particularly attractive for long distance (inter-urban) commuters. A variant is 'Telecottages' (common remote offices for use by tele-workers) where the aim is to encourage local economic development. There are over 100 telecottages already operational in the UK (DoE/DoT, 1995).

2.4 Infrastructure Measures

Improved provision for the Car

2.4.1 **New road construction** has, until the recent past, been the traditional response to relieving congestion. However, its success in reducing congestion has come under increasing criticism. The road user time-saving benefits of road construction (typically accounting for around 80% of the predicted economic benefits), have been called into question by the 1994 SACTRA Report which indicates that they can be eroded by the induction of additional traffic under some circumstances (see also Goodwin, 1996). Indeed, it is entirely possible that the overall scheme benefits may be so small that they are outweighed by the capital costs.

2.4.2 New roads can, however, by bypassing particularly sensitive urban areas, achieve environmental improvements there, as evidenced by a series of TRRL studies (Mackie and Davies, 1981). In this way, orbital roads can have a different impact from radial ones. However, these are only likely to be sustained if steps are taken to redesign the roads which are relieved of traffic; this has been the main focus of the bypass demonstration project (DOT, 1995). At the urban scale, while much has been written on good practice in this area (DoT, 1992), fitting a new road into an existing urban area is a major design challenge.

2.4.3 There are particular direct environmental concerns associated with new roads, such as land-take, habitat destruction or loss of landscape quality. There are also indirect impacts. New roads focus particularly on the car, and are likely to encourage its use for faster and longer journeys. This in turn will make public transport, cycling and walking relatively less attractive, and increase fuel consumption and carbon dioxide emissions. Moreover, new roads may well, if not carefully designed, worsen accessibility across the alignment, particularly for pedestrians and cyclists.

2.4.4 New roads should almost certainly contribute to a reduction in accidents, by transferring traffic to purpose built roads whose accident rates should be much lower than those of typical urban streets. To some extent this effect, too, will be eroded by the induction of new traffic.

2.4.5 New roads are extremely expensive; costs of £20m per kilometre are not uncommon in urban areas, and provision for environmental protection may result in figures substantially above this. Even significant time and accident savings may be difficult to justify when set against such costs.

2.4.6 The impact of new roads on economic regeneration is far from clear. The 1997 Interim SACTRA report found that under certain circumstances transport investment may have economic impacts additional to those measured in a conventional cost/benefit analysis, but that these could be positive or negative. They found no clear unambiguous link between road provision and local regeneration. This means that particularly close scrutiny should be paid to road schemes which are developed for economic regeneration objectives.

2.4.7 New roads clearly fail to contribute to an equity objective, since they provide in the main for those who already have the greatest advantages in terms of transport. The main practical constraints on road building are the time taken between design and implementation, which is often made more protracted by the strength of public opposition; and the restrictions imposed by existing built form and services.

2.4.8 **New off street car parks** are the other main way in which infrastructure can be provided for cars. There is even less evidence of their impact, but much will depend on the measures which complement such provision. Additional parking provision can contribute to user travel time savings by reducing the need to search for parking space. Although there is little hard evidence, it does appear that a significant part of town centre traffic is made up of cars searching for available parking space. However, lack of parking also acts as a control on car use, and expansion may simply encourage additional car use. New off street parking is probably therefore best combined with a reduction in on street parking. This should reduce searching traffic (since parking locations are clearer), improve the environment and increase safety. It may, however, aggravate accessibility problems, particularly for those who need to park close to their destination. More seriously, car crime is on the whole higher in poorly designed car parks, and there may be personal security concerns (Valleley, 1997).

2.4.9 As with new roads, the cost of parking provision, which may well exceed £10,000 per space, time scale and land availability are likely to be significant constraints.

Provision for Public Transport

2.4.10 **Conventional rail provision** now includes significant upgrades to existing infrastructure, as well as the reopening of closed rail lines and provision of new stations. There are several well documented studies of the impact of such measures, and procedures for predicting their effects (Nash and Preston, 1991). There are, in addition, a few examples of more expensive urban projects, in which wholly new lines are constructed (as in the London Underground or Heathrow Express) or existing rail lines linked under a city centre (as with the Loop and Link in Liverpool).

2.4.11 Such schemes can reduce travel time for existing users and attract users from other modes. Several studies have shown that, while around 60% of new usage comes from bus, around 20% is transferred from car use, and 20% newly generated (Nash, 1992).

2.4.12 The transfer from car will also contribute positively to the environment, while the reopening of closed lines and stations, if carefully designed, should have little

negative environmental impact. It will also contribute positively to safety. So, potentially, can the reduction in bus use. The Tyne and Wear Metro generated a 17% reduction in accidents in the city centre, largely through reductions in bus movements, but unfortunately this was lost once deregulated buses were able to compete with the Metro (Tyne and Wear PTE, 1985).

2.4.13 The impact of rail infrastructure projects on wider environmental sustainability is uncertain. By reducing levels of car use they reduce energy consumption and hence CO_2 emissions; however, they may encourage longer distance travel and more decentralised patterns of land use.

2.4.14 The effect of rail on economic regeneration is, as with roads, uncertain, but it is highly likely that there are impacts under some circumstances, which may be positive or negative. The short to medium term impacts from new urban schemes in Glasgow and Newcastle have been well documented (Gentleman *et al*, 1981, Tyne and Wear PTE, 1985), and generally have only minor impacts on development or employment. That said, the studies did find that that rail infrastructure presents a positive image and enhanced environment for an area, which can be important in marketing and attracting employment. Under some circumstances there also appears to be impacts on residential location choice (Nash and Mackett, 1991).

2.4.15 Rail infrastructure measures contribute positively to accessibility, by reducing access distances to public transport, by reducing waiting times and, particularly, by increasing in-vehicle speeds, since the trains are protected from road congestion. Those schemes which increase penetration of a city centre are particularly effective in reducing walking distances. The impact can be substantial; for example the Tyne and Wear Metro increased by 35% the population within 30 minutes of the city centre. However, these benefits are specific to the areas immediately around the new facilities.

2.4.16 Rail infrastructure projects are likely to have positive equity implications, since they offer a service which can be used by all. However, these benefits are limited to the corridors directly served, and any resulting reduction in bus services may disadvantage certain groups of travellers.

2.4.17 Rail infrastructure projects vary substantially in cost. A single new station may be able to be constructed for under £0.2m, and a line reopened for as little as £3m per kilometre (exclusive of rolling stock). At the other end of the spectrum, the Jubilee Line Extension in London will cost over £172m per kilometre. Cost may therefore be a substantial barrier to implementation. However, rail schemes have the advantage of producing a revenue stream which may attract private finance.

2.4.18 The main practical constraints, as for other infrastructure projects, are timescale for implementation and availability of land; although the latter may be eased by existence of earlier rights of way. In addition, the new distribution of responsibilities following rail privatisation may make it more difficult for local authorities to reach agreement with rail operators on the design, financing and operation of such schemes.

2.4.19 Schemes of this kind will only be of relevance in urban areas where rail services already exist and are in use for local commuting. Even in such circumstances, new provision is probably only justified where journeys in excess of 5km can be made by rail (DoE/DoT, 1995). Below this, bus services, with their more frequent

stops and better town centre penetration, will provide shorter access times. This in turn limits rail application to urban areas with a population of over 150,000.

2.4.20 **Light rail** has become a widely proposed alternative to conventional rail provision in recent years. New schemes have been implemented in London Docklands, Manchester and Sheffield. In many ways it can be expected to have a similar impact to conventional rail. Its main differences are that it can operate on street, have more frequent stops, and achieve better penetration of town centres (Howard, 1989).

2.4.21 Its impacts on the economy, the environment, safety, accessibility, and equity are thus likely to be similar to those of conventional rail, with a few exceptions. Light rail may potentially have adverse impacts on travel times for other modes if capacity for other traffic has to be reduced. Light rail schemes have been targeted at producing a mode shift from car use. To some extent this has been successful (Oscar Faber, 1996), with 12-15% of Manchester Metrolink patronage coming from car users, but the majority of patronage has some from other public transport modes (particularly bus). There may also be issues of suppressed car traffic re-entering the network.

2.4.22 Its impact on the urban economy has been the subject of considerable monitoring (e.g. Dundon-Smith and Law, 1994a, 1994b*).* Generally these studies have found few impacts, although there is a strong perception that urban vitality has been enhanced. Some clear impacts have been found from schemes implemented in other cities in Europe (Walmsley and Perrett, 1992). Light rapid transit can also have an adverse impact on the visual environment, and this has been a significant barrier to implementation in some cases. Conversely, it is likely to provide greater accessibility than conventional rail, by having more frequent stops.

2.4.23 Finance is again a major barrier. Light rail schemes are expensive, not least because of the requirements of street running, and typically exceed £5m per km. One constraint which may not arise is the need to negotiate with existing rail operators; indeed, one attraction of light rail to PTEs is the ability to establish a fixed track system under the authority's direct control. The guidance on Local Transport Plans (DETR, 1999) has stated that due to their expense, funding for light rail is not a priority, unless the objectives it meets cannot be met in other ways, and some funding can be found from other sources.

2.4.24 **Guided bus** provides a lower cost alternative to light rail while having the advantages of dedicated rights of way. While totally separate rights of way can be provided, as in Adelaide, most UK proposals envisage providing guideways solely where buses need to bypass congestion, as in the UK test case in Leeds. This can be achieved with minimal space requirements; the guideway need only be 3m wide, and is only needed in the direction in which congestion is experienced. Specially equipped buses can then operate normally on the rest of their routes, hence providing much more extensive suburban coverage than light rail (Read, Allport and Buchanan, 1990).

2.4.25 The impact of guided bus is uncertain, as few schemes have been implemented. It should have less adverse impact on congestion than light rail, by requiring less space, but its positive impacts depend critically on its ability to attract patronage. If it is perceived by car users as a slightly improved bus it will be unlikely to contribute significantly to the reduction of congestion, environmental impact and accidents, and will perform much as bus priority measures do (see paragraph 4.5.17 below). If it is seen as a higher quality service approaching that of rail, its

impact will be much greater. The trial in Leeds will provide important evidence on this issue. While its impacts are uncertain, the costs of provision are clearly much lower than those of light rail. The Leeds pilot cost £600,000 per km, limited to the sections which need treatment, and £3000 per equipped bus, which is then able to operate on other guideways in the city.

2.4.26 **Park and ride** extends the catchment of fixed track public transport into lower density areas, by enabling car drivers to drive to stations on the main line. It has also been used successfully in smaller cities such as Oxford and York in conjunction with dedicated bus services (Bixby, 1988; McPherson, 1992). The parking facility itself provides a low cost way of extending the benefits of public transport, by increasing the numbers able to use public transport, and hence reducing congestion, environmental intrusion and accidents in inner urban areas. It does not, however, offer significant improvements in accessibility and equity since, by definition, only car users can use the facility. Some doubt has been cast, recently, on the true benefits of park and ride; a survey has suggested that it may in practice generate longer journeys by rural residents, and hence increase car use (Pickett, 1995). There is also the danger that park and ride may take part of its demand from those who previously used public transport for their whole journey (Parkhurst, 1995). However, the beneficial impact on inner urban areas is not in dispute. A recent survey of eight towns with park and ride concluded that park-and-ride does reduce private car mileage, but is only effective when combined with other measures such as high city parking charges. However, its benefits are severely eroded by PNR, and park and ride itself will attract patronage from bus (WS Atkins, 1998).

2.4.27 The net effect will depend on where the facility is located. Land availability and cost are likely to be the main practical barriers although several recent schemes have been financed as part of new retail developments, or as part of commuted payments in lieu of parking provision (see paragraph 2.3.9).

2.4.28 **Terminals and interchanges** provide a means of extending the coverage of public transport services, by reducing the time taken to interchange between bus services or between bus and rail. They also provide a focus for city centre bus services, and reduce the congestion of on-street stops and terminals. It has been argued that their impacts on travel time and accessibility are likely to be significant if the public transport system is designed to use interchanges and high frequency feeder services, rather than the more traditional solution of longer, less frequent through services (Colin Buchanan and Partners, 1998). In other words, there is an argument that public transport networks should be designed around interchanges, rather than trying to avoid them. However, the recent CIT guidelines recommend a different emphasis; that the basic network structure should aim to meet the highest point to point demand without the need to interchange (CIT, 1998). Both arguments may be correct according to circumstances. However, time saving is not the only issue in interchange design and use. Information provision (preferably real-time) at interchanges is critical, for the entire route network being served, and should also offer information about alternative route options. Good design of the interchange is very important to maximise comfort and quality, and ensure security. For ease of travel, through ticketing, travelcards, and simple timetables should be used. The CIT also recommend that informal interchanges are identified and improved, making the best use of existing facilities. This relates to the importance of siting interchanges at appropriate nodes, and ideally, at key destinations

2.4.29 It may well be that the greatest benefits in travel time, environment and safety arise through removal of on-street bus stops, and any encouragement to switch modes from car to public transport. There is no study known of the impacts of interchanges on economic regeneration. Costs will depend greatly on the opportunities for development, which may well be enhanced by the provision of a terminal. A significant barrier may well be the effects of deregulation, which makes it difficult to require bus operators to use a given facility.

Provision for Cyclists and Pedestrians

2.4.30 **Cycle routes** provide dedicated infrastructure for cyclists, and hence extend the range of cycle priorities (paragraph 2.5.27). As well as making cycling safer, they have been designed to attract more people to cycle in preference to driving, hence achieving the benefits of reduced car use. In this, in the UK at least, they have so far proved unsuccessful (Harland and Gercans, 1993). It appears that cycle routes can achieve significant savings in cycling accidents, and potentially travel time benefits for existing cyclists, but will not attract more people to cycle in the absence of other measures. Tolley (1993) argues that a comprehensive network solution is required, as in several continental cities, rather than piecemeal measures. In Delft (Holland) for example, the development of a network of 25 km of dedicated cycle routes, led to a 7% increase in cycle use and a 7% fall in car use.

2.4.31 The costs of cycle provision will depend very much on the availability of suitable corridors and land availability, but as part of the National Cycling Strategy, provision for cycling is to be built into new traffic infrastructure and management schemes (IHT, 1998). This is a clear example of an integrated policy approach (see Section 2.9).

2.4.32 **Pedestrian areas** provide a dramatic improvement in the environment for pedestrians, in increasing safety, and have proved very successful in enhancing retail vitality in many town and city centres. There is little evidence to support traders' claims that pedestrian streets cause a loss in overall trade (Hass-Klau, 1993), although what changes may arise in the composition of shops is less well understood.

2.4.33 However, they present some accessibility problems for car and bus users and, particularly, for goods deliveries and for disabled people. Exemptions for some of these, whether permanently or, as with deliveries, at certain times of day, inevitably reduce the environmental benefits somewhat.. They also potentially cause disbenefits in the surrounding area, both by loss of roadspace, diversion of traffic and by attracting trade to the protected area. These potential adverse impacts can be reduced by careful design. Aesthetic design is of crucial importance in maintaining trade and will in turn inevitably add to the costs of the measure (IHT, 1989). PPG13 Guide to Good Practice gives examples of York and Birmingham where such schemes have been well implemented. Pedestrianisation also only can reach environmental objectives if integrated with parking and other policy measures (see Section 2.9).

Provision for Freight

2.4.34 Several of the above policies have implications for freight. **Roads and railways** are particularly important for the efficient movement of freight, with road taking by far the greatest share (82% of tonnes lifted). However, pedestrianisation schemes also have implications for freight access for certain times of day.

2.4.35 **Lorry parks** provide a means of reducing the environmental impact of on-street overnight parking of lorries. In practice this has become a less serious problem except in close proximity to industrial areas. However, where it does arise, dedicated provision in a well designed and secure parking area, together with on-street restrictions, may well be beneficial.

2.4.36 **Transhipment facilities** aim to provide a means of transferring goods from the larger vehicles needed for efficient line haul to smaller, less environmentally intrusive vehicles for distribution in town centres. Some proposals have also envisaged trolleying of goods over short distances and, at the other extreme, underground freight distribution. Experience to date in the UK suggests that such facilities are unlikely to be attractive to freight operators, and hence to be cost effective, at least until much greater restrictions on existing practices can be justified (Collis, 1988).

2.4.37 **Encouragement of other modes** is likely to focus primarily on rail-borne freight, but in appropriate cases could extend to water and pipeline. There is potential in the 'hydraulic capsule piping' approach (Howgego and Roe, 1998), but such schemes are still largely unimplemented, especially in the UK. Such modes are only competitive over longer distances (c.250 miles) and for bulk freight, given the additional costs for handling and road-based distribution for other goods.

2.5 Management Measures

Improved provision for the Car

2.5.1 **Conventional traffic management** includes a wide range of largely urban measures, and the reader is referred to other texts, especially IHT 1997, for more detail. In general, measures such as one way streets, redesign of junctions, banned turns and controls on on-street parking have been shown to have beneficial impacts on travel time and on accidents, and typically to repay the costs of implementation within a matter of months (Duff, 1963). It is, however, necessary to bear in mind their possible adverse impacts. If such measures cause some traffic to reroute, journey lengths may increase and, in the extreme, this could more than offset the benefits of any increase in speed. The economic user-benefits are particularly sensitive to this process. Such re-routing may also introduce environmental intrusion into previously quiet streets. Accessibility may also be reduced; for example one way streets can pose problems for bus services and deliveries; parking restrictions affect local frontages; and, in the extreme, a gyratory system can make access to the "island" caused very unattractive (Pearce and Stannard, 1973).

2.5.2 Finally, any measure which reduces the cost of car use may encourage usage to increase. There is as yet little evidence of this effect, which will be smaller in scale than that now attributed to new roads (SACTRA, 1994), but it could potentially offset many of the resulting benefits. A major practical consideration with all traffic management is that of enforcement. Unless measures are self-enforcing, the costs of enforcement action need to be included in any appraisal (Brown, Evans and Black, 1991).

2.5.3 **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). It uses the signal settings to optimise a given objective function such as minimising travel time or stops. Conventionally, UK UTC systems have either been fixed time, using the program TRANSYT, or real time, based on

SCOOT. The former costs less to implement, but settings are related to past traffic data, and become outdated as patterns change; the latter uses extensive detectors to measure current traffic patterns, and adjusts signal settings accordingly (Wood, 1993). With the expansion of European research in this area, other systems, such as the Italian SPOT system, which is also real time, but uses distributed computing to give greater flexibility, have been tested (Fox *et al*, 1995).

2.5.4 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. A SCOOT system may achieve as much as a 20% saving, which should not then be degraded (Wood, 1993). Such efficiency gains also improve the environment, since there are fewer stops and queues, and safety, with typical reductions in accidents of the order of 10%. 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 above, needs to be borne in mind.

2.5.5 **Intelligent Transport Systems (ITS)** is the current title for the range of applications of information technology for transport. This includes developments in motorway access control (ramp metering), automatic incident detection (AID), image processing of CCTV, selective vehicle priority, queue management techniques and many 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, which are covered in more detail in paragraphs 2.6.3 and 2.6.9([2]).

2.5.6 Although there is considerable research into these measures, most is concerned with operational issues, rather than assessment against the kinds of objectives considered here, and for many measures it is still too early to judge their effectiveness in widespread application. UTMC measures are aimed at network efficiency, and therefore should have economic benefits, possible safety benefits, and potentially accessibility benefits for pedestrians and cyclists who can also benefit from UTMC high signal cycle times. Some hypothetical CBA of measures has been undertaken by TRL, which found most measures returning a positive cost/benefit ratio, and in general the urban measures out-performed the inter-urban measures (TRL, 1996). Ramp metering on the M6 has been assessed, and showed benefits of 20% in motorway in-vehicle time saved, by preventing congestion on the main carriageway (IHT, 1997).

2.5.7 **Accident remedial measures** also cover a wide range of possibilities, and are much more fully documented elsewhere (IHT, 1990, 1997). Most blackspot treatment and mass action measures (such as skid-resistant surfacing) will have few impacts other than a reduction in accidents; their effects on other objectives can therefore be considered minimal. Area-wide measures are likely to have other impacts, and are considered below under the general heading of traffic calming.

[2] Guidelines on the implementation of ITS is discussed in the ITS City Pioneers Planning Handbook; some details are available at www.ertico.com.

Measures to Restrain the Car

2.5.8 **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 (Buchanan, 1963), and have involved two types of approach: segregation, in which extraneous traffic is removed; and 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).

2.5.9 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 (McKee and Mattingley, 1978). 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 (Elmberg, 1972).

2.5.10 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 (Sumner and Baguley, 1979). Such benefits may, of course, be offset by increases in congestion and environmental impact on the diversion route. Despite this, re-routeing strategies were the key policy in the Urban Safety Project, which did report a reduction in accidents of 13% after implementing policies of this type (IHT, 1990). Such measures are likely to generate significant environmental, safety and equity benefits, without adversely affecting accessibility. The key issue currently is that of balancing cost of provision with effectiveness and visual quality (Hass-Klau, 1990).

2.5.11 **Physical restrictions on car use** have been proposed more generally as ways of reducing car use in urban areas. Possibilities include extensive pedestrian areas and traffic calming, and also the use of bus lanes (see paragraph 2.5.17) to reduce capacity at junctions and give clear priority to buses. More radical elements include closing roads or restrictions such as the City of London "ring of steel" scheme. Until recently the most well-known scheme was the Nottingham 'Zone and collar' scheme, which aimed to use signal control to increase car travel time by 10 minutes, and reduce car travel by 10% (Vincent and Layfield, 1978). The scheme failed to produce these benefits however, primarily due to a lack of queuing space, and signal violation. There has recently been an extensive study of the effects of road capacity reduction on traffic levels using over 60 case studies (Goodwin *et al*, 1998a, 1998b). This concluded that if the road network is at capacity, capacity reduction measures can reduce car traffic due to a wide set of behavioural responses. This fall in traffic can offset some of the potential disbenefits such as increased travel time, and greater congestion. The authors

conclude that physical restrictions should be used as part of an integrated package, and that analysis of the impacts is very complex.

2.5.12 **Regulatory restrictions on car use** have been used in several cities as an alternative way of reducing car use. Two main methods are in use; permits and number plate restrictions. In several Italian cities, permits are allocated to those who can justify needing their cars in the centre, and others are banned. A similar system is operated in Bologna, where 50,000 permits were issued restricting access to the centre. Although initial benefits were high (traffic levels were halved), these were eroded over time (Topp *et al*, 1994). Feasibility studies have suggested that permit systems could prove expensive in terms of the resources required to issue and check the validity of applications (GLC, 1979), and there will inevitably be an element of rough justice in the way that they are allocated.

2.5.13 Number plate restrictions are in operation in Athens and Lagos, where an "odds and evens" system operates, in which cars with odd number plates can enter on alternate days, and those with even numbers on the other days. São Paulo has a similar scheme where two digits are not allowed on each day. Early indications are that vehicle km have been reduced by 7-10%, with a much higher reduction in congestion (Biezus and Rocha, 1999). Those without permits, or with an excluded registration plate may in some cases experience a serious reduction in accessibility. That apart, such systems should in practice be able to achieve any required reduction in car use. Experience with the Lagos system suggests that, while it is easier to operate, it is less effective, since drivers can respond by owning two cars, and some who would not otherwise have chosen to drive may elect to do so (Ogunisanya, 1984). Once again, careful testing would be needed before a scheme of this kind were to be proposed.

2.5.14 **Parking controls** potentially provide a more effective way of controlling car use. Controls can be by reducing the supply of spaces, restricting duration or opening hours, regulating use through permits or charging. The last of these is considered in paragraph 2.7.1. Local authorities are able to impose any of these controls on on-street space and in publicly operated car parks. Powers also exist to enable controls to be extended to privately operated public car parks, but have been rarely used because of the compensation implications. The main problems, however, are that controls cannot readily be imposed on private non-residential parking, which typically accounts for 40% to 80% of all town centre space, or on through traffic. As a result, even the harshest controls on public parking may simply result in an increase in traffic parking privately or driving through the area (May, 1975). Recent studies have identified that controlling PNR parking, within a complementary package of public on-street and off-street controls, can reduce traffic levels substantially (Coombe *et al*, 1997). Where private non-residential space is small, or already fully used, and through traffic can be controlled, parking controls can be effective in reducing car use. This in turn should reduce congestion, environmental impact and accidents. However, performance will depend very much on the way in which controls are applied. Simply reducing space is likely to increase the amount of time spent searching for parking space, which may have adverse impacts on congestion. This was found in a study at Delft, which also reported a 20% reduction in car use (Gantvoort, 1984).

2.5.15 Targeted restrictions on duration or on categories of parker could avoid congestion problems, but will introduce inequities similar to those from other regulatory restrictions. Inevitably accessibility will be reduced for some categories of parker with all types of parking control. Controls are generally inexpensive to implement, but may require continuing expenditure on enforcement if they are to be effective.

2.5.16 **Car sharing** offers a means of reducing car traffic while retaining many of the advantages of private car travel. Several experiments have aimed to encourage drivers to share their cars with others or to 'car pool' by taking it in turns to drive. Unfortunately, experience suggests that the numbers sharing voluntarily, even with incentives, are unlikely to exceed 5% of car users, and that their passengers are as likely to transfer from bus use as from other cars (Bonsall *et al*, 1981). Such schemes are thus likely to have a minimal impact in urban areas although, at the margin, they may offer some reduction in congestion. Such schemes are highly likely to be more successful when linked to other policies such as green travel plans (see paragraph 4.3.11).

Provision for Public Transport

2.5.17 **Bus priorities** 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. Conventionally bus priorities in the UK are designed to keep loss of capacity to other traffic to a minimum. With with-flow bus lanes this is done by providing a setback at the stop line. Provided that this is done, efficiency is usually improved; travel time savings to buses can exceed 25% while there are few losses to other traffic. 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 (NATO, 1976), although it may be possible for traffic management systems to relocate queues to places where these disbenefits can be minimised. Unfortunately there is little evidence from the UK that bus travel time savings are sufficient to induce a switch from car to bus travel; thus the potential wider economic and environmental benefits are not achieved. It appears that more continuous application of bus lanes, as practised in Paris, may be more beneficial in this regard (Webster et al, 1980), as may segregation within a dedicated guided-bus channel (see paragraph 2.4.24). The main practical limitations with bus lanes are the lack of sites with suitable space for the extra lane and storage of the longer queue of other vehicles, and the need for effective enforcement.

2.5.18 It is occasionally suggested that bus lanes be taken up to stop lines, thus reducing capacity and imposing physical restraint on other traffic. As noted in paragraph 2.5.11, there is little experience of such practice, but the evidence from Nottingham suggests that the additional congestion may well have adverse impacts on efficiency and the environment (Vincent and Layfield, 1978).

2.5.19 A more recent development in bus priorities has been the use of Red Routes in London (called Greenways in Edinburgh), in which bus lanes are combined with intensive and well enforced, parking restrictions. Travel time savings on the pilot Red Route were dramatic, while the evidence on effects on frontage access and trade is mixed (Wood and Smith, 1992, Knowles, 1998). More research into the wider impacts of such measures is needed.

2.5.20 **High occupancy vehicle lanes** extend the use of with-flow (and potentially contra-flow) bus lanes to other vehicles which make more effective use of scarce road space. These can include car sharers, taxis and commercial vehicles. Trials of this in an arterial corridor in Leeds since 1998 suggest traffic flows had fallen by around 14%. Average car occupancy in the AM peak has risen from 1.35 to 1.41

for the road as a whole, and 2.19 for the HOV lane (Leeds City Council, 1999). Experience elsewhere has suggested that HOV lanes can provide greater benefits than conventional bus lanes, provided that the delays to buses are not great. The bus operators in the Leeds scheme, have reported time savings of 3-6 minutes along the 1.5km HOV lane section.

2.5.21 **Public transport service levels** can be modified to increase patronage, and hence to attract diversion from car use. For bus services the main options are to increase route density or to increase frequency on existing routes. The first of these reduces walking time, while the second affects waiting time. Since both of these have a greater impact on passengers than does a similar change in time on the bus, they can be expected to be more effective in increasing patronage (Webster *et al*, 1980). The most appropriate allocation of a given fleet of buses between denser and more frequent routes will depend on local circumstances. Other bus service measures include the use of minibuses, which are more expensive per seat-km to operate, but can achieve greater penetration and may be more attractive (White, 1992); and demand-responsive bus services, such as dial-a-bus, although for these the operating costs have tended to exceed benefits. There is also a wide spectrum of paratransit measures involving unconventional bus and taxi services; their impacts are too varied to summarise here. With rail services, the only option available is usually to increase service frequency.

2.5.22 The short run elasticity of demand with respect to bus-km run is typically around +0.6, suggesting a 6% increase in patronage for a 10% increase in service level. Unfortunately cross-elasticities for car use are typically an order of magnitude lower, at around -0.08, suggesting less than a 1% reduction in car use for a similar service improvement (Webster *et al*, 1980). Cross-elasticities are typically somewhat higher for rail service improvements. These elasticities will apply, of course, only to the corridor in which the improvements are introduced. Thus service improvements have, as their primary impacts, improvements in accessibility and equity; they are unlikely on their own to achieve significant efficiency or environmental benefits except, to a limited extent, within the specific corridor.

2.5.23 The main practical barriers to such measures are costs of operation and the fact that responsibility lies in the main with private operators. Local authorities can provide financial support for those bus services which are not commercially viable, but cannot, outside London, influence the nature of commercial service operation.

2.5.24 In theory, at least, the cost of service increases can be met from increased fares revenue. Indeed, it has been suggested that an optimal operating strategy within given financial constraints may be to increase both service levels and fares (Webster *et al*, 1980). Unfortunately deregulation makes it difficult to influence both fares and service levels in a consistent way.

2.5.25 **Bus service management measures** can be designed to improve the reliability of bus services and reduce operating costs, using fleet management procedures, and enhance their quality of service using real-time information. These measures are likely to be particularly beneficial in reducing uncertainty in travel time, and the extra waiting time resulting from irregular services, which are major disincentives to travel (Finnamore and Jackson, 1978; Webster *et al*, 1980). Such measures should generate significant efficiency benefits, and can potentially contribute to reduced car use. While they are largely the preserve of private operators, there are some recent examples of collaboration between local authorities and operators to achieve such benefits (McDonald and Tarrant, 1994).

2.5.26 **Quality Bus Partnerships** are agreements between local authorities and bus operators to enhance bus services (TAS, 1997). The aim is to achieve faster services that will attract more passengers. The local authority role is to enhance the infrastructure and bus priority measures, while the bus operator should provide high quality buses, information, integrated services and integrated ticketing. In other words such Partnerships are a means of obtaining synergy between a range of bus policy instruments. At the time of writing a Quality Partnership had no statutory basis, although statutory powers may be introduced following a recent Government consultation paper (DETR, 1999). There is strong evidence that such partnerships can increase public transport patronage, and figures for trial corridors are between 5 %-42% (TAS, 1997). Quality Bus Partnerships therefore offer accessibility and equity benefits, via improved public transport services and quality. Economic impacts may be more mixed, for the reasons discussed above regarding bus priorities. However, a recent report has cast some doubts over the benefits of the schemes (Audit Commission, 1999).

Provision for Cyclists and Pedestrians

2.5.27 **Cycle lanes and priorities** serve the same function as cycle routes (paragraph 2.4.30) and experience with them is similar (Tolley, 1993). They reduce accidents for cyclists, and may encourage some increase in cycle use, but have yet, in the UK, to achieve a transfer to cycling from other modes (Harland and Gercans, 1993). They are easier to implement than bus lanes, because they require less road spaces, but still pose problems of frontage access (IHT, 1997). Cycling measures are a key element of the 'Safe Routes to School' programme, and the forthcoming DETR document on good practice for travel to school (Sustrans, 1998).

2.5.28 **Cycle parking** provision, to increase availability and security, may also be beneficial, but its impacts have rarely been studied. There is currently an increase in secure cycle parking, such as cycle lockers, or the wardened facility in Leicester.

2.5.29 **Pedestrian crossing facilities** are primarily a safety measure but may also reduce travel time for pedestrians. Indeed, it is not uncommon to find that total delay to pedestrians at city centre junctions exceeds that for vehicle users. In such circumstances, reallocation of signal time and linking of pedestrian phases, alone or as part of UTMC, may achieve accessibility benefits and reduce severance. There are relatively few other ways in which pedestrians' travel time can be improved, but other measures such as parking controls and footway widening may improve their environment and safety. Unfortunately there has been little or no analysis of the effects of such measures on pedestrian activity.

Provision for Freight

2.5.30 **Lorry routes and bans** are primarily designed to reduce the environmental intrusion of heavy lorries, rather than to improve their operating conditions. Routes can be mandatory, but are more frequently advisory, and thus avoid serious reductions in freight access. Bans can be area-wide (for example in the cells between lorry routes) or limited to particular roads, or applied solely to short lengths of road forming a screenline or cordon. They can be complete, or limited to certain times and certain sizes of vehicle, or with exemptions for access. Such exemptions avoid problems of lost accessibility, but are difficult to enforce. CCTV is being increasingly used as an enforcement presence (IHT, 1997). Generally, restrictions on lorries are likely to result in reduced efficiency, and will require

increased enforcement costs. Conversely they should, if well designed, improve the environment and safety. There have been relatively few studies of such measures, although that for the Windsor cordon demonstrated that any environmental benefits may be more than offset by increased operating costs, and by environmental losses on the diversion routes (Christie *et al*, 1978).

2.6 Information Provision

Improved provision for the Car

2.6.1 **Conventional direction signing** can provide benefits to car users, and other traffic, by reducing journey lengths and travel times; evidence suggests that around 6% of travel time may be accounted for by poor routeing, and that inadequate destination signing may as much as double the time spent searching for unfamiliar destinations (Jeffery, 1981). Conversely, direction signing can be used to divert traffic away from environmentally sensitive routes; however, familiar drivers are unlikely to respond to such measures.

2.6.2 **Variable message signs** enable drivers to be diverted away from known, but unpredictable congestion. They are very location-specific in their application, and hence in their benefits (Brown and Mackenzie, 1994). Potential benefits are primarily in terms of travel times; drivers are unlikely to be willing to divert in significant numbers to avoid environmental and safety problems. Inter-urban VMS signs from the Highways Agency MDIS (Midlands Driver Information System), have been found to significantly influence route choice in response to accident warnings on the carriageway ahead, although magnitudes of diversion were not given (Carden *et al*, 1999). At the urban level, VMS in London was found to be less effective for immediate warnings than for advanced warnings, and that drivers actual behaviour (around 5% diversion response rate) did not always match their previously stated intentions, of up to a 54% diversion response (Thompson *et al*, 1998).

2.6.3 **Real-time driver information systems and route guidance** are a type of Intelligent Transport System application. Information from equipped vehicles or traffic sensors is used to provide radio or in-vehicle display messages (such as Trafficmaster) of delays, or to indicate preferred routes to avoid congestion. Dynamic route guidance systems can provide recommended routes to all equipped vehicles, dependent both on their destinations and the current traffic conditions. Evidence suggests that familiar drivers are more likely to prefer information, and to choose their own routes, while unfamiliar drivers prefer guidance (Bonsall, 1992).

2.6.4 Several studies have predicted reductions in travel time of around 10% from such systems, when applied in urban areas, together with reductions in accidents (Jeffery and Russam, 1984). Unfortunately, the only documented field trial of dynamic route guidance, in Berlin, has suggested that the benefits may be much lower than this (May *et al*, 1998). Most benefits will, of course, accrue to equipped vehicles in the form of reduce travel times ; benefits for other private traffic and for buses may well be very small, thus raising important equity considerations. It has also been suggested that improved information may generate additional travel. There is, however, little evidence to support such claims. What is more certain is that this is a very fast growing area, with new developments such as RDS-TMC and DAB (digital audio broadcasting) allowing detailed information about traffic conditions all over Europe. In development are detailed mapping devices and combined route guidance and travel information systems. Thus there is potential

for systems of this sort to be linked in with wider ITS. This would allow network managers to control the information sent to cars, and potentially enhance network efficiency.

2.6.5 **Parking guidance and information systems** are a further application of ITS principles, designed to reduce the high level of traffic searching for parking space in urban centres. Detectors identify car parks which are full or almost full, and trigger signs indicating the route to the nearest available space (examples can be found in IHT, 1997 and DoE/DoT, 1995). Studies have demonstrated a significant reduction in time spent finding a parking space, but it has proved more difficult to estimate the resulting reduction in vehicle-km (Polak *et al*, 1990). As with VMS, the actual response levels to PGI are lower than expected, due to the complexity involved in the behavioural choice (Thompson and Bonsall, 1997). The efficiency and accessibility benefits from reduced searching may be associated with some reductions in environmental intrusion and accidents, but these will depend on the local circumstances.

Measures to Restrain Car Use

2.6.6 **Public awareness campaigns** have been developed recently by several local authorities as ways of making residents, and particularly car users, more aware of the effects of their travel behaviour on the environment and in terms of sustainability, and to alert them to the alternatives available, including use of other modes and changes in destination and frequency of travel. Such campaigns typically cost from £50-£100,000 per annum (DoE/DoT, 1995). Early surveys have highlighted the conflict between individuals' preferences for car use and their concern over the impacts of car use (Ciaburro *et al*, 1994). It may therefore be possible to channel the resulting sense of guilt into more environmentally appropriate travel behaviour. A full survey of different scheme types is given in INPHORMM (1998).

2.6.7 The key objective of public awareness campaigns is to produce a mode shift, and/or decline in car use. A Swedish study as part of the INPHORMM study has claimed traffic reductions of up to 15%. Jopson (forthcoming), finds the UK studies generally claim lower shifts, around 5-6% in car trips, although over what area and time period was not reported. There is still a lack of assessment of these schemes against a common set of objectives, especially over a longer period of time.

Provision for Public Transport

2.6.8 **Timetable and other service information** is the basic form of information to public transport users, but has become degraded in many areas since bus deregulation. Indeed, studies of deregulation have identified lack of service information, aggravated by more frequent timetable changes, as one of the main causes of increased loss of patronage (AMA, 1990) and surveys have indicated the potential for improved information to generate additional patronage (Pickett, 1982). This, in turn, could have accessibility and equity benefits and, potentially, help to reduce car use. One problem is the reluctance of any operator to contribute to information which includes competitors' routes. However, with the trend towards fewer, larger operators, this problem is being reduced. It is also relevant to point out that local authorities may have the duty of provide adequate bus information, subject to future Government legislation.

2.6.9 **Real time passenger information** is now being provided, not just at major terminals, but at individual stations and bus stops, and on trains and (on the continent) in buses. Such information, on delays and alternatives, may on occasion enable travellers to save time by taking alternative routes. Its main impact, however, is in reducing the uncertainty and stress associated with late running services. Studies on the London Underground have attempted to estimate the benefits of such information, and have indicated the potential for increasing patronage (Silcock and Forsyth, 1985). As with static information, the main barrier to implementation is the fragmentation of the bus industry, but costs of the newly developing technology are still high. However, there is now some evidence that larger bus operators are prepared to invest in such information systems, in conjunction with local authorities, in order to increase market share. There is some indication that real-time information can increase bus patronage (HCC, 1996), and if this is the case it offers considerable accessibility and equity benefits.

2.6.10 A further recent development are Trip Planning Systems (IHT, 1997), based on either dedicated terminals (at public transport interchanges and stations), over the telephone, or via the Internet. Again there appears to be no study of how effective these are in maintaining or increasing public transport patronage, nor about their reliability or use.

2.6.11 **Operation information systems** use ITS-based fleet management facilities to identify locations of buses and to reschedule services to reduce the impact of unreliability. Such systems were studied initially in the 1970s (Finnamore and Jackson, 1978) and have been tested more recently (given the advances in technology) under the EU DRIVE programme (Keen, 1992). Examples have been tested in London and Southampton (IHT, 1997), but there has been little interest as yet in broader applications in the UK's deregulated environment, particularly as an effective system requires the entire bus fleet to be equipped, entailing considerable expense, and it is also necessary to keep the timetable information up to date.

Provisions for Cyclists and Pedestrians

2.6.12 **Static direction signs** are virtually the only measure available under this heading, but can be used to enhance the use of cycle priority routes and to improve access within pedestrian areas for disabled pedestrians. Tactile footways are a further facility providing specifically for visually handicapped pedestrians. Public awareness campaigns (see paragraph 4.6.6), can be used to encourage walking and cycling, and familiarise road users with appropriate signing.

Provision for Freight

2.6.13 **Static direction signs** may be the main element in voluntary lorry routeing schemes (see paragraph 4.5.30).

2.6.14 Fleet management systems have been introduced widely for freight vehicles, enabling them to respond more rapidly to the changing demands of Just in Time delivery schedules, and reducing the number of empty return journeys. They can also extend to dynamic route guidance to avoid congestion. Most such systems are, however, introduced by freight operators, and local authorities have little role in their implementation or operation.

2.7 Pricing Measures

Measures to Restrain the Car

2.7.1 **Parking charges** provide one of the most widely used forms of parking control. Uniquely among parking control measures, they enable demand to be kept below the supply of parking space, thus reducing time spent searching (see paragraph 2.5.14). The long standing rule of thumb that meter prices should be pitched so that one space in seven is free was developed with this in mind. Elasticities with respect to parking charges vary depending upon the availability of alternatives, but figures in the range -0.2 to -0.4 have been quoted (Feeney, 1989). The wider impacts depend on the alternative used by the car driver; parking on the fringes of the controlled area, or in private parking spaces, will inevitably have less impact on the environment and travel time than switching to public transport. A recurring concern with the introduction, or increasing, of parking charges is that it will encourage drivers, and particularly those shopping, to go elsewhere, thus adversely affecting the urban economy. There is evidence that this can happen, although a review of aggregate studies found no significant relationship reported between parking restraint levels and urban economic vitality (Still and Simmonds, forthcoming). Parking charges will affect low income drivers more, and thus have equity implications. They may as a result have some minor effects on accessibility. They are a source of finance, although the potential for profits is usually small.

2.7.2 As with parking controls (paragraph 2.5.14), parking charges can readily be applied to publicly controlled parking space. Legislation is available to permit the licensing of privately operated public car parks, but its requirements dictate that operators must be compensated for losses at individual car parks, while they can retain any profit at others. This has discouraged the use of the legislation. Parking charges cannot be imposed at private car parks and, by definition, do not apply to through traffic. As noted in paragraph 2.3.1, these represent major loopholes in the effectiveness of any form of parking control. It has also been argued that parking pricing policies are more effective when introduced as part of a package of measures, including a regional strategic approach to parking policy, and public transport improvement (Coombe *et al*, 1997). Parking Advice from LPAC (1997) provides some useful information on these considerations in applying parking policy.

2.7.3 **The Workplace Parking levy** is a potential new policy instrument, currently at the consultation stage. They would enable local authorities to implement a levy on all private non-residential parking at the workplace (DETR, 1998). Retail parking for consumers is excluded. The levy is likely to be based on the number of vehicles parked, not the number of spaces. The objective of this instrument is to reduce

car based commuting, and ease traffic congestion. The possible impacts on the economy are large, and will depend upon the level of levy, and how businesses respond when faced with a charge. These impacts have been examined in a recent interview study in Nottingham and Westminster (MVA, 1999). This concluded that around a quarter of firms would pass on their costs to customers, but that the effects on goods and services would be slight (well under 0.1% of business turnover). The effect on car travel was heavily influenced by the level of the tax, and alternative incentives offered (such as cash for spaces surrendered). However, displaced users still expressed a preference towards continued car use and public parking, which may erode some of the desired traffic benefits.

2.7.4 **Urban and Inter-urban Charging:** New powers have been proposed for local authorities to introduce urban charging, and these proposals are currently the subject of Government consultation (Breaking the Logjam, DETR, 1998b). Whilst there are no current plans to introduce widespread charging on the inter-urban network, the Government acknowledges that in some circumstances objectives would best be achieved by such charging. Powers to charge on inter-urban roads are therefore also proposed. Further guidance on the applicability of charging in the study areas will be need to be issued, not least because primary legislation would be needed before charging could be introduced.

2.7.5 It may be possible to learn from experience of charging in other countries. Singapore is the first country to implement an electronic road pricing (ERP) system using in-vehicle units and cashcards. This has replaced the licence system (Soo, 1998). Systems which charge continuously in a defined area, based on distance travelled, time taken, or (as tested in Cambridge) time spent in congestion, have also been proposed (May *et al*, 1998). However, research using a driving simulator has shown that the latter two can lead to increased risk taking (Bonsall and Palmer 1997). Empirical evidence of the impact of early urban charging schemes comes from Singapore (Holland and Watson, 1982) and Norway (Larsen, 1988). However, the latter scheme was primarily designed to raise revenue rather than to control traffic levels. A good deal of our understanding of the impacts of road pricing come from modelling studies, such as Richards *et al* (1996). Experience of inter-urban charging is extremely limited.

2.7.6 Urban congestion charging (as proposed in Breaking the Logjam) could significantly reduce car use in the charged area, and hence reduce environmental impact and accidents. Traffic would divert to boundary routes, other times of day and other modes; much of the transfer would be to bus, which would benefit from the reduced congestion. Careful design is needed to ensure that these alternatives do not themselves become congested, and for cordon schemes, the location of the controls is critical. Subject to this, congestion charging can achieve significant road user travel time, environmental and safety benefits. It will also generate substantial revenue, which can potentially be used to finance other elements of a transport strategy (May *et al*, 1992).

2.7.7 There are three major concerns about urban road pricing. The first is the potentially adverse impact on the economy of the charged area if charging encourages drivers to travel elsewhere, on which there is no empirical evidence. However, a number of desktop and attitudinal studies have concluded that there would be minor negative economic impacts, although it is very much dependent upon the characteristics of the urban centre (e.g.. Flowerdew 1994, Richards *et al*, 1996, Still, 1996). Most studies have highlighted the need for complementary public transport improvements. The second concern are the equity implications. Bus users, pedestrians and cyclists will benefit; rail users will be little affected

except, perhaps, by increased patronage; but car and commercial vehicle users, and particularly those on low incomes, will suffer. The third concern relates to the practicability of the technology, which is largely untested, and the enforcement procedures.

2.7.8 **Inter-urban charging** has been common in Europe for many years, often implemented as a means to finance and maintain high quality motorways (as in France), or as used to fund bridges and tunnels in the UK (e.g. Severn Bridge). However, the use of charges in the UK is increasingly being seen as a possible congestion management measure. Early studies of such road charging found that charging around 1-4 pence/km for cars and 3 pence/km for goods vehicles could cause diversion of up to 10% of traffic (MVA, 1993, TRL, 1999a, but based on 1993 research). Clearly the economic benefits implicit here may be reduced by the routeing of the diverted traffic, which may lead to congestion elsewhere on the network. However, there has not been much research on diversion which is clearly a major issue for inter-urban charging, and these studies have been challenged recently (Hills, 1998). Diversion may also have environmental, equity and safety implications as traffic diverts to the non-motorway road network (TRL 1999b). DETR is currently undertaking an extensive programme of work into road-user charging to implement the commitments given in the White Paper. Work includes an on-road demonstration project at site in England and Scotland and complementary off-road research and a programme of pilot urban implementations.

Provision for Public Transport

2.7.9 **Fare levels** can be adjusted on all public transport services, and will have a direct effect on patronage and on car use. Evidence suggests a short term fares elasticity of around -0.3 for buses and slightly higher for rail (Goodwin, 1992). Long run public transport own cost elasticities are usually lower than the short run equivalents (as users gradually return to the service), unless the magnitude of change is such that other responses occur, for example in residential location or car ownership. Available cross-elasticities for car use have been found to be around +0.05 (Webster et al, 1980) although this figure may be in need of updating. Thus a 10% reduction in bus fares could increase patronage by around 3%, but would only reduce car use by 0.5%. However, unlike service level changes (Section 2.3.2), fares changes apply throughout an urban area, and may thus have a greater absolute impact on car use. The Fares Fair campaign in London in the early 1980s, which reduced fares by 32%, was estimated to have reduced cars entering central London by 6% (GLC, 1983). Fares reductions can, therefore, contribute to efficiency and environmental objectives, as well as improving accessibility for public transport users and hence equity. There is also some evidence that they can reduce accidents (Allsop, 1993). Their major drawback is the cost. There is also some evidence that low fares may encourage longer distance travel, and hence land use patterns which are in the longer term less conducive to sustainability. Fares generally are to a large extent outside local authority control, except where PTEs exist.

2.7.10 **Fares structures** include the introduction of flat and zonal fares as alternatives to conventional graduated fares; lower off peak fares; and travelcards and season tickets which allow unlimited travel within a defined area. There is some evidence that simplification of fares structures may do more than fares reductions to increase patronage (Gilbert and Jalilian, 1991). Since the Fares Fair campaign also involved a zonal fare structure and travelcards, it is difficult to isolate these two effects. Changes in structure may thus also contribute positively to efficiency,

environmental and safety objectives, as well as improving accessibility by reducing the cost of marginal journeys. If appropriately designed, they may not impose a significant additional financial burden. However, many such structures rely on the ability to offer a common set of charges, and free interchange to all services in an area. Deregulation has made this more difficult, and many innovative fare structures have been abandoned or drastically curtailed as a result.

2.7.11 **Concessionary fares** provide lower fares or free travel to identifiable categories of passenger with special needs. These may include schoolchildren, elderly people and people with disabilities. While statutory school travel must be funded by local authorities, the others are currently optional. Their main objective is equity-related, in enabling people who would otherwise find public transport too expensive, or who cannot use cars, to travel. They probably have no significant efficiency or environmental benefits, but they do improve accessibility for the target population (Goodwin *et al*, 1988). They do, however, impose a substantial financial burden on the local authorities which support them.

Provision for Cyclists and Pedestrians

2.7.12 Pricing is rarely an issue for cyclists or pedestrians. However, some charges are made for secure cycle parking, especially if other amenities such as showers are available.

Provision for Freight

2.7.13 The fiscal measures described in paragraph 2.7.1-7 are relevant for freight as well. Parking charges typically vary with vehicle type, and some congestion charging proposals envisaged doing this.

National Policies

2.7.14 The instruments mentioned below are:

- either only applicable at a national level, or
- cannot be enacted due to national legislation.

As such, they are outside the remit of the multi-modal studies, but are included here for completeness.

2.7.15 **Vehicle ownership taxes** are the most obvious direct charge on the private car. However, there is little evidence that they, or taxes on car purchase, have a significant impact on car ownership. Even if they were to do so, they would have no effect on car use. Indeed, by increasing the proportion of car use costs which are fixed, they could potentially have the opposite effect. They are, however, a major source of revenue which can potentially be used to finance transport investment. Such taxes are, of course, the responsibility of government, and cannot be influenced directly by local authorities. Current government policy involves charging higher vehicle ownership excise duty (VED) for larger vehicles to reflect the additional costs they impose, particularly on road maintenance. There is, however, some evidence that the higher licence charges fail to do this (Fowkes *et al*, 1992). Recent budgetary changes reduce VED for vehicles involved in road-rail goods shipment.

2.7.16 **Fuel taxes,** being a variable cost, have a more direct effect on usage. The government is committed to a 6% p.a. real increase in the tax rate until 2002 as a contribution to its sustainability objective, and the Royal Commission on Environmental Pollution has advocated more rapid increases than this (RCEP, 1994, 1997). Short run elasticities are generally under –0.3 (Goodwin, 1992), with long run figures slightly larger, but generally close to this. However, the studies suggested that most reductions would occur in evening and weekend leisure travel (Atkinson and Lewis 1975). The initial impact on congestion would thus be very small, as appears to be borne out by the response to the current real term rise in fuel duty. In the longer term, drivers are also more likely to switch to more fuel efficient vehicles.

2.7.17 This would still contribute to fuel savings and hence to the environmental and economy objectives, but would have little effect on safety. Fuel taxes bear most heavily on low income drivers and rural residents, whose accessibility they may adversely affect. Fuel taxes are again a major source of revenue. These policies are the responsibility of the Treasury, and hence even further removed from local authority influence (Glaister et al, 1998).

2.7.18 **Company car taxation** policies provide a significant loophole in the impact of taxes on car ownership and use; company owned cars account for 11% of all cars and over 20% of all car mileage (Lex, 1995). The effects of this are aggravated by the current tax rules, which encourage drivers to exceed 18,000 miles per year on business in order to benefit from lower taxation. Changes announced in these tax rules will abolish the mileage limit in favour of tax bands related to carbon dioxide emissions, aimed to meet environmental objectives.

2.8 Summary of the Performance of the Policy Instruments

2.8.1 The following Tables 2.1 to 2.6 summarise the impact of each of the measures described above. The tables are split into two parts each: the first deals with the performance of the measures in relation to the Government's Objectives of the environment, safety, economy and accessibility; and the second deals with the performance in relation to the supporting issues of equity, finance, and practicality and acceptability. The fifth objective of Government, integration, is dealt with separately in Section 4.9.

2.8.2 The tables use the following standard code for assessment:

✓	Positive impact
x	Negative impact
✓/x	Both positive and negative impacts
?	Uncertain impact
0	No significant impact

2.8.3 Those measures which are likely to be of particular relevance to the Studies, as discussed in Section 2.2, are indicated in bold print.

2.8.4 Any summary table of this nature is, of course, limited in its applicability; there will be circumstances in which a particular measure may be much more (or less) beneficial than suggested by the table. Moreover, the measures are assessed as if operating alone; as noted in Section 2.9, they may be much more effective when combined with others.

Table 2.1a: Performance of Land-Use Measures in Relation to the Government's Objectives

Objectives Measures	Environment	Safety	Economy	Accessibility
Flexible Hours	0	0	✓	0
Development Density	?	?	?	✓
Corridor Development	✓?	?	✓?	✓
Development Mix	?	?	?	✓
Developer Contributions	0	0	0	0
Commuted Payments	0	0	✓	0
Green Travel Plans	?	?	?	?
Parking Standards	✓	?	✓	✓/x
Telecommuting	✓	✓	✓	**0**

Table 2.1b: Performance of Land-Use Measures in Relation to the Supporting Issues

Issues Measures	Equity	Finance	Practicability	Acceptability
Flexible Hours	0	0	x	✓
Development Density	✓	0	x	✓
Corridor Development	0	0	x	✓
Development Mix	✓	0	x	✓
Developer Contributions	✓	✓	x	✓
Commuted Payments	✓	✓	x	✓
Green Travel Plans	0	0	x	?
Parking Standards	0	0	x	?
Telecommuting	**0**	**x?**	**x**	**?✓**

Table 2.2a: Performance of Infrastructure Measures in Relation to the Government's Objectives

Objectives Measures	Environment	Safety	Economy	Accessibility
New Roads	**✓/x**	**✓**	**✓/x**	**✓/x**
Parking Supply	✓	✓	✓/x	✓?
Rail	**✓**	**✓**	**✓**	**✓**
Light Rail	✓/x	✓	✓	✓
Guided Bus	✓?	✓	✓?	✓?
Park and Ride	✓	✓	✓	✓
Terminals/Interchange	✓	✓	✓/x	✓?
Cycle Routes	✓	✓	?	✓
Pedestrian Areas	✓	✓	✓/x	✓/x
Lorry Parks	✓	✓	0	0
Transhipment	?	0	?	?
Other Freight Modes	**?**	**?**	**0**	**?**

Table 2.2b: Performance of Infrastructure Measures in Relation to the Supporting Issues

Issues Measures	Equity	Finance	Practicability	Acceptability
New Roads	**x**	**x**	**x**	**x**
Parking Supply	x	x	x	?
Rail	**✓**	**x**	**x**	**✓**
Light Rail	✓	x	x	✓
Guided Bus	✓	x	x?	✓
Park and Ride	0	x	0	✓
Terminals/Interchange	✓	x	x	?
Cycle Routes	✓	x	0	✓
Pedestrian Areas	✓	x	x	✓
Lorry Parks	0	x	0	?
Transhipment	0	x?	x	?
Other Freight Modes	**0**	**x**	**x**	**?**

Table 2.3a: Performance of Management Measures in Relation to the Government's Objectives

Objectives Measures	Environment	Safety	Economy	Accessibility
Traffic Management	**✓/x**	**✓**	**✓?**	**✓/x**
Urban Traffic Control	✓	✓	✓	0
Intelligent Transport Systems	**?**	**✓**	**✓**	**0**
Accident Remedial	**0**	**✓**	**0**	**0**
Traffic Calming	✓/x	✓	x	✓
Physical Restrictions	x?	✓?	x?	x?
Regulatory Restrictions	✓	✓	✓?	✓/x
Parking Controls	✓	✓	✓	✓/x
Car Sharing	0	0	✓	0
Bus Priorities	**?**	**✓**	**✓**	**✓/x**
HOV Lanes	**0**	**✓**	**✓**	**✓/x**
Public Transport Service Levels	**✓**	**✓**	**✓**	**✓**
Bus Service Management	0	0	✓	✓
Quality Bus Partnerships	✓	✓	✓	✓
Cycle Lanes	✓	✓	?	✓
Cycle Parking	✓?	✓?	0	✓
Pedestrian Crossings	0	✓	✓	✓
Lorry Routes and Bans	**✓/x**	**✓**	**x**	**x**

Table 2.3b: Performance of Management Measures in Relation to the Supporting Issues

Issues Measures	Equity	Finance	Practicability	Acceptability
Traffic Management	**✓/x**	**0**	**0**	**?**
Urban Traffic Control	0	✓	0	?
Intelligent Transport Systems	**✓/x**	**x**	**0**	**✓**
Accident Remedial	**0**	**0**	**0**	**✓**
Traffic Calming	✓/x	x	0	✓
Physical Restrictions	?	0	x?	x
Regulatory Restrictions	✓/x	x	x	x
Parking Controls	✓/x	0	x	x
Car Sharing	0	0	x	x
Bus Priorities	**✓**	**0**	**x**	**x**
HOV Lanes	**✓**	**0**	**x**	**x**
Public Transport Service Levels	**✓**	**x**	**x**	**✓**
Bus Service Management	✓	x	x	✓
Quality Bus Partnerships	✓	?	x	✓
Cycle Lanes	✓	0	0	✓
Cycle Parking	✓	0	0	✓
Pedestrian Crossings	✓	0	0	✓
Lorry Routes and Bans	**✓/x**	**0**	**x**	**✓**

Table 2.4a: Performance of Information Measures in Relation to the Government's Objectives

Objectives Measures	Environment	Safety	Economy	Accessibility
Direction Signing	**0**	**?**	✓	**0**
Variable Message Signs	**0**	**0**	✓	**0**
Driver Information	**0**	**0**	✓	**0**
Parking Information	?	?	✓	✓
Public Awareness	?	?	?	✓
Timetables	?	?	✓	✓
Real Time Passenger Information	?	?	✓	✓
Operation Information	0	0	✓	✓
Fleet Management	0	0	✓	✓

Table 2.4b: Performance of Information Measures in Relation to the Supporting Issues

Issues Measures	Equity	Finance	Practicability	Acceptability
Direction Signing	**0**	**x**	**0**	✓
Variable Message Signs	**0**	**x**	**0**	✓
Driver Information	**x**	**x**	**x**	✓
Parking Information	0	x	0	✓
Public Awareness	✓	0	0	✓
Timetables	✓	0	x	✓
Real Time Passenger Information	✓	x	x	✓
Operation Information	✓	x	x	✓
Fleet Management	0	x	x	✓

Table 2.5a: Performance of Pricing Measures in Relation to the Government's Objectives

Objectives Measures	Environment	Safety	Economy	Accessibility
Parking Charges	✓?	✓?	✓?	✓/x
Workplace Parking Levies	✓?	✓?	✓?	x/?
Urban Charging	✓	✓	✓	✓/x
Inter-Urban Charging	**x**	**x**	**?**	**0**
Fare Levels	✓	✓	✓	✓
Fare Structures	✓	✓	✓?	✓
Concessionary Fares	0	0	0	✓

Table 2.5b: Performance of Pricing Measures in Relation to the Supporting Issues

Issues / Measures	Equity	Finance	Practicability	Acceptability
Parking Charges	✓	✓	x	x
Workplace Parking Levies	✓	✓	?	x
Urban Charging	✓/x	✓	x	x
Inter-Urban Charging	x	✓	x	x
Fare Levels	✓	x	x	x
Fare Structures	✓	x	x	✓
Concessionary Fares	✓	x	0	✓

Table 2.6a: Performance of National Pricing Measures in Relation to the Government's Objectives

Objectives / Measures	Environment	Safety	Economy	Accessibility
Ownership Taxes	x	0	x	0
Fuel Taxes	✓	0	✓	0
Company Car Tax Changes	✓	✓	✓	0

Table 2.6b: Performance of National Pricing Measures in Relation to Supporting Issues

Issues / Measures	Equity	Finance	Practicability	Acceptability
Ownership Taxes	✓	✓	0	x
Fuel Taxes	✓	✓	0	x
Company Car Tax Changes	✓	✓	0	✓

2.9 Integration of Policy Measures

Need for Integration

2.9.1 It will be clear from the previous sections that no one measure on its own is likely to provide a solution to transport problems. Most have at least one positive contribution to make, in reducing travel time, environmental impact or accidents, but also have adverse impacts on, say, accessibility or equity. Some, such as traffic calming, can achieve benefits in one area at the expense of deterioration elsewhere. Some, such as bus priorities, would be more effective if they could influence mode choice; without such an impact they only benefit the users of the affected mode.

2.9.2 For all of these reasons, a package of measures is likely to be more effective than selecting any one measure on its own. A set of measures is likely to tackle more problems; one measure can offset the disadvantages of another or avoid the transfer of problems to another area; a second measure can reinforce the impact of the first, for example, inducing a change of mode and generating greater benefits.

2.9.3 In these ways, synergy can be achieved between measures; that is, the overall benefits are greater than the sum of the parts. The identification of measures which might achieve such synergy is at the core of successful transport planning.

Potential Benefits from Integration

2.9.4 Integration can potentially achieve benefits in several ways. The first involves measures which complement one another in their impact on users. Obvious examples are the provision of park and ride to increase rail or bus patronage; the use of traffic calming to reinforce the benefits of building a bypass; the provision of public transport, or a fares reduction, to intensify the impact of traffic restraint; and the encouragement of new developments in conjunction with rail investment.

2.9.5 The second involves measures which make other elements of the strategy financially feasible. Parking charges, a fares increase or road pricing revenue may all be seen as ways of providing finance for new infrastructure.

2.9.6 The third concerns public acceptability, and the need to package measures which are less palatable on their own with ones which demonstrate a clear benefit to those affected. Once again an example is to be found in road pricing, which attitudinal research demonstrates is likely to be much more acceptable if the revenue is used to invest in public transport.

2.9.7 Table 2.7 shows in matrix form, for a selection of those measures described in previous sections, those which are particularly likely to complement one another in one of these ways. This table is intended to be used as a broad design guide only, not, as a definitive assessment of instrument capability.

2.9.8 There are important messages here, not just for the development of an integrated strategy, but for the sequence in which measures are to be implemented. Clearly those which need to be implemented to facilitate others are required first. It will also be essential at least to be committed to those measures which generate income before investing in those measures which depend on that revenue for finance. Similar considerations arise with measures which influence public acceptability: commitments are needed to publicly attractive measures before embarking on those which on their own are less attractive. Here, however, there is the continuing risk that the less attractive measures will still not be implemented, for fear of public criticism. It is preferable if both positive and negative measures are implemented together.

Table 2.7: Interactions between strategy measures

	Land-Use Planning	**Travel Reduction**	**New Highways**	**Parking Supply**	**New PT Infra**	**Park and Ride**	**Cycle/ Ped**	**Freight**	**Traffic Management**	**UTC /ITS**	**Traffic Calming**
Land Use Planning		C	C	C	C	C	C	C			
Travel Reduction	C		C	C	C	C					
New Highways	C							C			C
Parking Supply	C						C				C
New PT Infrastructure	C	C									
Park and Ride	C	C			C						
Cycle/ pedestrians	C	C			C						C
Freight	C		C								C
Con Traffic Management	C		C		C		C	C		C	C
UTC/ITS					C	C	C	C	C		
Traffic Calming			C				C		C		
Parking Control	C	C		C	C	C	C		C		
Capacity Reduction	C	C			C	C	C		C		C
Bus Priorities		C	C			C			C		C
PT Service Levels		C				C					
Car Information provision			C				C	C	C		
PT Information provision		C	C		C	C			C	C	
Awareness		C			C	C	C				
Parking Charges				C/F	C/F	C/F			C		C/F
Workplace Levies	C	C/F			C	C			C		
Road Pricing/Tolls	C		F	F	C/F	C/F		C			C/F
P T Fares				C	C/F	C/F					C/P

Key: Measures in the left hand column can reinforce the measure in the appropriate column by
C - the row measure complements the column measure
F - the row measure can provide finance for the column measure
P - the row measure can make the column measure more publicly acceptable.

Table 2.7 (con't): Interactions between strategy measures

	Parking Control	Capacity Reduction	Bus Priority	PT Service Levels	Car Information provision	PT Information provision	Public Awareness	Parking Charges	Workplace Levies	Road Pricing	PT Fares
Land Use Planning			C	C				C		C	
Travel Reduction								C	C	C	
New Highways		C	C							C	
Parking Supply	C										
New PT Infrastructure	C/P	C/P		C				C/P		C/P	
Park and Ride	C	C/P	C					C	C/P	C	
Cycle/pedestrians		C	C						C/P		
Freight Con Traffic Management		C	C	C						C	
UTC/ITS	C	C	C	C	C	C		C		C	
Traffic Calming	C/P	C	C					C/P		C/P	
Parking Control			C	C							
Capacity Reduction											
Bus Priorities				C					C/P		
PT Service Levels	C/P	C/P	C					C/P	C/P	C/P	C
Car Information provision		C									
PT Information provision			C	C			C		C/P		
Awareness			C	C							C
Parking Charges	C			C/F							C/F
Workplace Levies				C/F							
Road Pricing/Tolls			C	C/F							C/F
P T Fares	C		C	C				C/P	P	C/P	

Key: Measures in the left hand column can reinforce the measure in the appropriate column by
C - the row measure complements the column measure
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