Transport Planning and Environmental Assessment: Research, Rhetoric and Reality

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Abstract

This paper reviews recent changes to transport policy in the UK. This is discussed within the context of changes from policies of "predict and provide" to an integrated transport policy and the role of new knowledge on induced travel effects. New assessment procedures, including the move towards strategic environmental assessment, and how this could best be practiced in the transport sector are discussed. These issues are viewed in terms what recent research has revealed about behavioural reactions to new transport capacity and how this can provide a structure for ideal assessment procedures that focus on the objectives of transport policy. Linkages to changes in accessibility and economic effects as described by simple urban economic theory are also discussed. A review of new assessment procedures in the UK as implemented in recent years is then critiqued in light of this theory. The focus is on whether changes to assessment procedures have led to improvements in decision making, especially from an environmental perspective as well as from stated government policy goals. Concluding comments focus on the inherently political nature of this process and the role that theory can provide in highlighting these issues.

Introduction

Transport policy in the United Kingdom[1] has undergone significant changes over the last 15 years. These developments have paralleled and accelerated research into understanding the effects of policy on individual behaviour. In particular, there is now a consensus viewpoint amongst transport researchers that it is not possible to build one's way out of congestion. This consensus has been reached by a range of studies that have examined the issue of induced travel, which is the phenomenon of new road capacity quickly filling up to previously congested levels.

This new knowledge[2] on behavioural effects was formally documented in the UK by the *Standing Advisory Committee on Trunk Road Assessment* (SACTRA) (1994) report and ultimately led to changes in transport policy as embodied by the 1998 *Transport White Paper* (DETR, 1998a). This paper will briefly outline this history and the consequent divergence in actual policy implementation. The research that paralleled these developments is thereby linked to the reality of policy implementation and the political rhetoric that has embodied this.

The key objective of this paper is to examine the implications of the research findings and how best to incorporate these issues into practical assessment procedures. In this context we discuss the *New Approach to Assessment* (DETR, 1998b) which came out of the 1998 *Transport White Paper* and the linkages to Strategic Environmental Assessment. This has led to increased awareness of environmental issues associated with transport investments. A review of selected case studies and other research examines the actual

[1] The United Kingdom includes England, Wales, Scotland and Northern Ireland. Devolution of authority to each country has resulted in minor differences in policy and guidance, but overall the direction of policy is consistent for each. Most of the discussion will focus on policy and guidance for England as stated by the UK Department for Transport. Devolved authorities, such as the Scottish Executive and Welsh Assembly, may have issued parallel, and in most cases, very similar guidance.

[2] This really refers to a consensus that the induced travel effect really occurs. As Goodwin (1996) has documented, the debate over this has been around since the early days of motorization with ample empirical evidence as early as 1938.

implementation of policy and these methods, in light of the new consensus on induced travel effects. Within this discussion the rhetoric of transport policy is examined and the political context of decision making is found to be a key part of the assessment process.

Recent UK Transport Policy

The questioning of existing UK transport policy began with the release of the government white paper, *Roads to Prosperity*, in 1989 (DOT, 1989). This laid out an extensive road building program for the nation that was based upon forecasts of growth trends in private car usage. One of the many criticisms of this plan was the high financial cost of constructing the road schemes laid out in the document and whether it would even be capable of meeting the forecast needs. This triggered a re-evaluation of the methods and practices used by transport planners in forecasting this growth.

One of the key criticisms was that transport planners followed a philosophy of "predict and provide". That is, they would predict transport growth trends based on demographic changes, such as increased population, income, and car ownership, and then simply provide the road facilities needed to match this growth. While this might be argued as meeting consumer demand it neglected to consider the high cost (both financially and environmentally) of providing for this predicted growth, and did not consider that users do not pay the marginal costs associated with use of road transport, in particular the costs associated with congestion (despite relatively high petrol taxes). Another criticism was that the planning models that resulted in these types of forecasts neglected to make any assumptions about how consumers would respond if the facilities were not provided.

In response to many of these issues, especially the reactions of travellers to new road capacity, a reassessment of the cost-benefit analysis framework and the "predict and provide" approach was undertaken by SACTRA.[3] The SACTRA (1994) report examined

[3] SACTRA is an independent committee appointed by the Secretary of State for Transport to advise the government on issues related to the appraisal of trunk roads. Specific remits are given from time to time. In the 1994 report SACTRA considered whether new or improved roads generate traffic above any growth that would be expected without the improvements. Trunk roads refer to those roads for which the Secretary of Transport has responsibility as opposed to those managed by local authorities. In general, these consist of most, but not all, principal arterials and motorways.

the evidence on how travellers respond to new road capacity and concluded that many of the benefits associated with congestion reduction do not occur. That is, they accepted the underlying economic behavioural theory of induced travel demand (discussed further below). This essentially said that new road capacity generated its own demand for the road, thus eroding or even eliminating any expected reductions in traffic congestion. One of the key conclusions of SACTRA (1994) was that demand forecasting and cost-benefit analysis methods did not adequately account for induced travel effects.

After the 1997 change in governments, a review of transport policy was undertaken. This resulted in the 1998 Transport White Paper, *A New Deal for Transport* (DETR, 1998a). This white paper fundamentally redirected thinking on transport policy and led to what was known as the "integrated transport policy". Integration essentially means integration of transport modes and other policy sectors (e.g. land use policies, education policy, environmental policy). One of the key focuses of the white paper was the promotion of non-car modes of travel, demand management policies (such as road pricing), and greater concern for mitigating or avoiding the adverse environmental effects of transport. Government policy was aimed at reducing not just the growth in road traffic but absolute levels. There was a strong statement that road building, while in some cases necessary, would be a "last resort."

One of the outcomes of the new policy approach was the development of a new methodology for assessment of transport projects. This is known as the "New Approach to Appraisal" (DETR, 1998b). This approach, described in more detail below, is fundamentally a method for presenting detailed information to decision makers, rather than any fundamental change in the details of assessment. There are indications that this has allowed environmental concerns to receive greater consideration relative to traditional cost-benefit measures (Nellthorp & Mackie, 2000). Shaw & Walton (2001) suggest that this actually led to an increased certainty that various projects would be built as opposed to the large "wish lists" of previous policy. In some regards, this was one of the first hints that future policy would be more accommodating of new road construction than originally thought.

While the rhetoric of the integrated transport policy continues, some have largely questioned whether government policy has significantly back-tracked on the original commitments to de-emphasize the construction of new road capacity. In order to implement the integrated transport policy, in 2000 the government released its 10-year Transport Plan (DETR, 2000). This plan provides significant funding commitments to both increases in road and public transport capacity. This back-pedalling on initial commitments has been termed "pragmatic multimodalism" by Shaw & Walton (2001), especially given that increased road capacity was seen as a "last resort". Realistically it is in response to political pressure that the government has been "anti-car", demonstrated most notably by the fuel price protests and refinery blockades in September 2000 (Lyons & Chaterjee, 2002). These were partly in response to the fuel-duty escalator that automatically increased fuel taxation by 5-6% more than the rate of inflation each year, resulting in the UK having the highest petrol tax rate in Europe. This was originally introduced in 1995 both as a means of reducing carbon emissions and as a revenue raiser, but has since been abandoned.[4] A series of high-profile rail accidents over the last few years has also suggested that government transport policy has been astray, leading to political controversy and a series of changes in the organization and leadership of the Ministry of Transport.

The 10-year plan does not meet the idealistic commitments of previous policy pronouncements, based on the large commitment to new road capacity. Despite this, it does also provide substantial funding for public transport improvements and government policy now allows local areas to implement congestion charging and work-place parking charges. To date, only London and Durham, in the north of England, have implemented congestion charging (the latter on a very small scale). These experiments, and their documented success to date (see e.g., Transport for London, 2004), offer hope that more innovative policies will eventually be implemented. Currently a number of local authorities are studying the potential implementation of congestion charging and

[4] The fuel tax escalator had been introduced by the previous conservative government. Taxes are still generally indexed by inflation each year.

workplace parking charges, although a recent setback in implementation occurred with the rejection of a proposed congestion charge in a referendum Edinburgh. Begg and Gray (2004) suspect that few, if any, of the 18 demand management schemes laid out in the 10-year transport plan will be implemented.

More recently the 10-year plan was superseded by a white paper released in July 2004, The Future of Transport (DfT, 2004). This document maintains much of the positive rhetoric on finding balanced solutions. However, the Foreword by the Prime Minister first emphasizes that "over 100 road schemes have been completed" and that the M25 is being widened. While acknowledging that "we cannot simply build our way out of … problems" it also mentions that road widenings and bypasses will be built to solve the worst congestion problems. Only later is a road charging mentioned with decisions on actual implementation being deferred. The overall rhetoric attempts to strike a balance recognizing the environmental challenges but is a clear political statement that building more road capacity is one of the key solutions. The bulk of the document maintains the balanced rhetoric of focus on an inter-modal environmentally sustainable system. This is not a critique of this document but merely a recognition that political pragmatism is at play. As will be discussed next, the key issue is how properly implemented assessment procedures can be used to reveal the political stakes behind transport decision making.

Implications of recent research

Before providing details on current practices in the UK, it is useful to provide some context on what our current understanding is of how traveller behaviour responds to changes in transport policy. In particular this should be viewed in light of recent research that has demonstrated the impacts of induced travel and how this should affect the assessment of transport policies.

Recent research on induced travel

Induced travel is the concept that when additional capacity is added to the road transport system, it quickly fills up with new traffic. In the transport literature, there has (until

recently) been little consensus as to whether induced travel is caused by new road capacity. There has been even less agreement among practitioners that these effects should be taken seriously, even if they are present.

Recent literature is reviewed in Noland & Lem (2001), Goodwin & Noland (2002), and Cervero (2002). This recent literature establishes a strong basis for a causal relationship between new road capacity and the generation of more travel. Essentially, this process is nothing more than an economic response on the part of travellers to a reduction in the generalized cost of travel brought on by new road capacity. If the facility is already congested, the reduction in travel times from a road expansion results in several readjustments to when, where and how people travel. Specifically, some individuals who previously avoided peak travel periods may now choose to travel at a more desirable time of day. Others will shift from a slower route to a now (relatively) faster route, while others will abandon public transport in favor of using a car. Trip destinations and frequency of trip making may also change, as some people now increase their mobility to access further destinations. In the long-run, the greater accessibility that is afforded by the new level of mobility, will allow new land parcels to be developed or existing ones to be developed more intensively, ultimately generating more trips.

These concepts are illustrated in Figure 1. The supply curve represents the capacity of the transport system and is related to the price of travel. Demand is downward sloping indicating that as the cost of travel decreases, there is an increase in demand for travel. If there were no induced travel, the demand curve would be vertical – in economic terms this would imply an inelastic demand – where any change in price does not affect the quantity demanded. Therefore, induced travel theory simply asserts that there is a consumer response to a change in price (represented by the travel time costs).

Much of the controversy over this theory is derived from the complexity of real transport systems. Travel demand increases have occurred due to many other factors over time,

especially growth in real incomes and consequent increases in car ownership.[5] Therefore there is an additional shift in the demand curve illustrated in Figure 2. Disentangling these effects is crucial for understanding induced travel. Noland (2001) showed that while the majority of the growth in travel is due to demographic changes, capacity expansions in the US have accounted for about 25% of total growth in vehicle-miles of travel.

Cervero & Hansen (2002) have shown that causality works in both directions. Transport planners anticipate growth in some corridors and plan accordingly. However, there is still a causally induced effect from road capacity expansion. Most studies also have demonstrated that the long-run impacts, usually attributed to changes in spatial development, are the most significant factors associated with inducing travel. Rodier et al. (2001) in particular show how endogenizing land use can capture these effects and the difference that alternative modelling assumptions have on forecast growth in travel.

Implications of Induced Travel for Assessment and Decision Making

Of concern here is how the new consensus on the research results associated with induced travel can be inform the assessment of transport plans and projects. The standard argument has been that when induced travel is not accounted for (i.e., an assumption of zero elasticity in the demand response), then the congestion reduction (travel time) benefits will be overstated. This was one of the key conclusions of SACTRA (1994) leading to changes in assessment procedures by the use of variable demand matrices as opposed to fixed demand matrices in modelling procedures (Highways Agency, 1997).

The other implication is that not accounting for induced travel will lead to an underestimate of potential environmental consequences. Some have argued that if traffic flows are improved, emissions will be reduced. However, recent work by Stathopoulos & Noland (2003) and Noland & Quddus (in press) show that these benefits are illusive at even the small levels of traffic generation that are likely to be associated with most

[5] These factors may not be entirely exogenous. That is, real incomes and car ownership may also have increased due to the mobility provided by transport capacity.

schemes. Environmental costs associated with dispersed land use development would also likely be understated (US Environmental Protection Agency, 2001).

One of the implications that is broadly recognized is that it undermines the philosophy of "predict and provide" and has emphasized the need to manage demand, via various charging mechanisms. Congestion charging in particular is seen as a tool to lock in any travel time benefits that might be associated with new capacity.

While consideration of induced travel effects will generally lead to estimates that the potential costs associated with a project are higher and the congestion reduction benefits are lower, there are added benefits associated with mobility improvements. That is, there are benefits from allowing more travellers to travel when and where they desire. This includes allowing more travel at peak times and allowing more people to travel to more distant destinations. Most assessment practices have historically accounted for this by "the rule of half" which assumes that these benefits are less than the reduced travel time benefits (by half) since they were previously deterred from making these trips due to congestion. That is, previously the costs of congestion exceeded the benefit they would receive from making the trip.

Many of the changes in modelling practice try to account for these factors in assessing costs and benefits of projects. What these transport modelling methods miss, however, is the longer term land use changes that are induced and that can account for up to half of all newly generated traffic, as estimated by Rodier et al. (2001).

Economic theory has long recognized that transport improvements lead to accessibility improvements, which can be measured by changes in the valuation of land. This is another way of looking at the long-term land use changes. As land becomes more accessible, it can be developed more intensely (i.e., more people can engage in activities on that land) and hence the value of the land increases. Urban economic theory leads to the conclusion that much of the benefit of an accessibility enhancing transport improvement will accrue to the current owners of that land (McCann, 2001). This can be

illustrated by the simple relationship shown in Figure 3 and which is the bid-rent function which is a fundamental concept in urban economics that defines the relationship between travel time and the value of land.

Extending this theory somewhat, we can see that some of the benefit will also accrue to consumers. For example, if the land is developed for residential housing, this leads to an increase in the amount of housing available in a given area, putting downward pressure on the price of housing. Another example would be the development of a large retail area, increasing the supply of shopping alternatives. Often, these are large scale "big box" type developments offering low prices to consumers due to economies of scale. These effects are also shown in Figure 3 by the rightward shift of the bid-rent function. This rightward shift lowers the value of land since the profit that can be made is now less (e.g. since more residential housing supply is added, the cost per unit would be less), thus off-setting the benefit to the land owner which is then accrued by the consumer.

These are real benefits to both land owners and consumers, but they are not in addition to travel time benefits as this would lead to "double counting" of benefits. In fact, if we consider induced travel effects to lead to long run land use changes, then the travel time benefits will of any project will be fully captured by current land owners and consumers, who are not necessarily those who currently use the transport network.

In terms of providing a meaningful assessment of the benefits and costs of most transport policies, these effects need to be considered. In particular, the political consequences of how the public perceives the beneficiaries of a project may be different if there is no reduction in congestion. While the public may appreciate the consumer benefits that would accrue (e.g. lower housing prices) they may feel less inclined to support projects that give windfall benefits to existing land owners and also increase environmental costs. Thus, there are clear political benefits to focusing the rhetoric around transport investments as being capable of reducing congestion.

In theory, a valuation of transport costs and benefits based upon the travel time changes should be equivalent to an evaluation of the costs and benefits based upon land use changes and consumer benefits. This equivalency, based on theory, assumes perfectly competitive markets and in particular that both transport and environmental marginal costs are accounted for (SACTRA, 1999). In practice, the latter is not the case and since current individual decisions are not based on total marginal costs of transport the benefits may be overstated when calculated based upon travel time changes. For example, if transport users are not paying the full marginal costs of usage (including environmental costs), then as a starting point more transport is currently being demanded than would occur under competitive market conditions. An increase in transport capacity (usually road capacity) that further reduces the generalized cost of transport could lead to no beneficial impact, for example by increasing various environmental costs.

Another market imperfection that makes assessment difficult is that in which imperfect competition exists in various sectors of the economy. Monopoly or less than fully competitive conditions may cause consumer prices to be higher than they would be if perfect competition prevailed. Additional transport capacity that then allows producers (and consumers) to have access to previously uncompetitive markets could then result in a drop in net consumer prices, leading to benefits being greater than would have been the case if only travel time changes are estimated (Jara-Díaz, 1986).

Properly considering induced travel effects in assessment therefore leads to the conclusion that proper assessment of land use impacts is necessary to fully capture long-term impacts. This is needed both to properly assess the benefits of transport schemes but also the environmental costs. Since benefits need to be assessed in the long term this suggests an approach that considers land valuation and consumer benefits, rather than focussing just on travellers within a designated corridor (i.e., travel time changes and mobility improvements). The political consequences of this are that the real beneficiaries are not likely to be those who expect to experience some reduction in congestion on a given route.

Current Assessment Procedures and Ideal Procedures

One of the key changes to assessment practice in the UK was the introduction of "The New Approach to Assessment" (NATA). This was originally described in DETR (1998b) and was used as a technique to assess those trunk road schemes that would be implemented in the review of the trunk-roads program. Modifications to NATA were included in the *Guidance on the Methodology for Multi-modal Studies* (DETR, 2000a; DETR, 2000b). This guidance, which serves as the main framework for assessment of both transport schemes and transport plans, was originally designed to further review some of the schemes within the review of the trunk-roads program. This guidance is discussed and reviewed in terms of how it matches with the implications of recent research. This is followed with a discussion of how to move towards ideal procedures that fully take into account new knowledge on transport behaviour.

Guidance on the Methodology for Multi-modal Studies (GOMMMS)

UK guidance on assessing transport projects and local transport plans is both quite detailed and flexible. The key objectives are essentially to objectively match the various proposals against how they meet stated government objectives. These objectives, originally outlined in the 1998 White Paper, are as follows:

- "integration – ensuring that all decisions are taken in the context of our integrated transport policy;
- safety – to improve safety for all road users;
- economy – supporting sustainable economic activity in appropriate locations and getting good value for money;
- environmental impact – protecting the built and natural environment;
- accessibility – improving access to everyday facilities for those without a car and reducing community severance." (DETR, 1998b)

Additional local, regional or study-specific objectives may also be considered, but these must be consistent with the objectives of central government policy.

One of the key steps is to define what problems are being studied and what problems policy makers may be seeking to address. These may range quite broadly from an objective of reducing congestion on a specific road to enabling economic development of previously undeveloped land. *GOMMMS* (vol. 1, sec. 2.2.21) specifically states that "the **causes** of the problems [be] investigated before solutions are generated" (emphasis in original). The intent is to address underlying problems rather than simply addressing symptoms. In addition, guidance specifically discourages putting solutions forward before problems are clearly defined. This is clearly a step away from traditional planning approaches that put the solution (i.e., road building) before the actual problem is clearly identified.

The guidance requires substantial public consultation both on defining the problems that currently exist, and eventually in evaluating proposed solutions and determining the importance of various effects, such as the environmental costs and benefits of a proposal. Consultation explicitly states that local and regional authorities, transport providers, business representatives, transport users, environmental interests, the general public within the study area, the travelling public who might be affected, and other statutory bodies as needed should be involved (DETR, 2000a, sec. 2.2.37).

Guidance is provided on possible policy instruments for solving many transport-related problems. These are broadly defined and provide a comprehensive list of both fairly conventional policies such as providing more road capacity or public transport to pedestrianization and promotion of cycling. The specific policy solutions from *GOMMMS* are listed in Table 1 broadly categorized under topical areas (with obvious overlap between some categories). These highlight the broad range of ideas that those seeking solutions are recommended to consider.

Modelling of transport systems has long been used to assess the impact of changes to the network and as a means of forecasting changes in travel and consequent environmental impacts. Over the last 10 years, substantial effort amongst transport researchers has gone into improving the modelling systems available to practitioners. This has been facilitated

by increased computing power making more sophisticated models both affordable and achievable. While this is certainly an admirable goal, in practice it is questionable whether it has been achieved or even if it is possible to achieve this.

GOMMMS (DETR, 2000b, sec. 2.2) appears to take a very pragmatic approach toward modelling principles. There is a recognition of the trade-offs in time and resources of developing sophisticated models and analyzing scenarios with them. However, there appears to be a bias towards requiring greater detail when "assessing some of the more radical transport policies" (DETR, 2000b, 2.2.7). For example, to analyze a time-of-day pricing policy it is clear that one needs greater detail on departure time choice and how variation in costs will affect this choice. However, this is also necessary for conventional as opposed to "radical" policies. Any variation by time-of-day in generalized costs, normally caused by congestion delay, should require this additional detail.

It is explicitly stated that policies that are time-specific in their impact should include a time-of-day choice component (DETR, 2000b, sec. 2.2.36); however, this does not include policies that are not time-specific but may likely also change time-of-day choice. The caveat stands however, that computing limitations may not allow for this type of detail even when necessary (DETR, 2000b, sec. 2.2.37). On the positive side, guidance explicitly states that mode choice models should consider non-motorized modes (vol. 2, sec. 2.2.35).

Induced travel effects are accounted for by requiring models to account for variable demand (DfT, 2003 – webtag Unit 3.1.2). The theory of demand and supply in transport are clearly stated and analysts are made aware that fixed demand assumptions are not advised. Guidance is also provided on using simple travel time elasticity methods to estimate likely induced travel effects (Highways Agency, 1997). Recommended elasticity values are shown in Table 2. These elasticity estimates are recommended for intermediate-level schemes, while simple schemes are still allowed to assume a fixed demand matrix. More complex situations require a fully developed behavioural model.

This is essentially a four-step travel demand model with appropriate iterations and land use modelling to fully account for induced travel effects.

Specific guidance is also provided on land-use/transport interaction models (DETR, 2000b, appendix B). These models endogenously model the changes in land use activity due to changes in the transport network and how relative accessibility is affected. Normal transport models typically assume that all land use change is exogenous, or independent of changes in the transport network. This assumption is generally not valid as any transport system change that affects accessibility will affect the demand and ultimate use of land (recall Figure 3 above). *GOMMMS* states that comprehensive appraisal based upon land-use is not within the scope of current guidance (2.50). For this reason, it seems unlikely that any actual assessments have evaluated these issues. This is probably a major shortcoming of current guidance, but given the resource and skill constraints amongst practitioners, probably realistic.

In response to SACTRA (1999) the Department for Transport has provided guidance on developing economic impact reports (DfT, 2003) for developing background information for the appraisal. These are allowed when economic conditions suggest that not all transport benefits are being captured by other assessment techniques based on travel times (for example, under conditions of imperfect competition). The focus of these assessments is only on those deprived areas where it is desired to initiate some increased economic development (regeneration areas). While this guidance does not require the use of detailed transport land use interaction models, it does focus on how transport will affect accessibility of the area under study. This is then related to an assessment of whether jobs will be generated in that area. The focus is not on what the net national benefits may be, and therefore redistribution of existing jobs is not considered. *GOMMMS* (appendix B, sec. 2.38-2.48) explicitly discusses the difference in benefit estimation when land use effects are properly modelled (as discussed previously). That is, a typical transport-based analysis will determine benefits based on travel times while a land-use based analysis should provide information on how valuation of benefits accrues to land owner and consumers. This distinction is not typically analyzed in appraisal of

benefits even with land-use models and critically needs to be considered. It should be noted that the Appraisal Summary Table used in the UK (discussed below) does provide for a qualitative assessment of economic development and regeneration effects, which could provide some indication of how benefits are distributed.

The overall approach to guidance is thus eminently pragmatic, recognizing the constraints on data, modelling techniques, and professional capabilities. However, in this sense one can clearly argue that it falls short of providing the best guidance to best inform decision making. This is partly off-set by consideration of broader policy objectives within the overall appraisal framework which is discussed next.

Appraisal Summary

The *New Approach To Appraisal* (NATA) is best characterized by the Appraisal Summary Table (AST), which provides a framework for presenting summary information to decision makers. The goal of the AST is to link the key government objectives (integration, safety, economy, environment and accessibility) with the results of analyses examining the effect on these objectives. Table 3 shows the layout of the standard AST from DETR (2000b).

One of the objectives of developing this format was to provide a means for highlighting some of the non-economic costs and benefits associated with specific strategies and schemes. Nelthorp & Mackie (2000) in an analysis of the first round of appraisals, as part of the government review of trunk road schemes, found that environmental objectives appeared to have received increased consideration compared to traditional cost-benefit analysis.

The appraisal table represents summary information based upon detailed environmental impact assessment for specific alternatives. Guidance on the detailed analytical techniques is available in DETR (2000b). While certain measures, such as assessment of air quality and noise allow a quantitative calculation to be performed, others are more

qualitative in nature and often involve analyst judgement as to whether the proposed scheme meets the detailed objective.

Another element of the appraisal summary is that it is applied to the analysis of both specific schemes and more comprehensive transport plans (such as regional strategies or local transport plans). In the latter case the appraisal would involve the assessment of a package of policies and schemes and would tend to be conducted with less analytical rigor.

Overall this framework provides the basis for improved decision making, taking into account the full range of possible impacts associated with transport policies and specific schemes. In particular, if applied at the strategic level, this type of framework can offer the potential to lead to more balanced decision making, taking environmental and other non-quantifiable impacts into account. It also helps to connect assessment with political objectives and provides a mechanism for trade-offs in those decisions to be more explicitly made.

One of the key steps is problem definition and the number of options evaluated to solve those problems. *GOMMMS* provides suitable information and guidance on a large number of potential policy approaches. The selection and consideration of these is critical at an early stage of the planning process. Early decisions on the scope of the project will tend to frame and determine more specific project based assessments, potentially foreclosing more effective non-transport solutions (such as land use options that may minimize the need for more transport infrastructure). This is consistent with the theory of strategic environmental assessment which is discussed next.

Strategic Environmental Assessment and Transport Decision Making

The European Union adopted a directive on strategic environmental assessment in 2001 that was effective as of July 2004 (Sheate et al., 2004). This directive (2001/42/EC) requires an environmental assessment of plans and programs likely to have a major environmental impact. Strategic environmental assessment (SEA) is meant to go beyond

traditional project-based environmental impact assessment. In essence the idea is to consider environmental effects at decision making levels above the project level (Fischer, 2002). Fischer (2004) argues that SEA is more effective if it is done at the policy level, especially in terms of setting objectives and targets, and achieving consensus on these.

While SEA is an outgrowth of traditional project-based assessment methods, it is largely meant to overlay existing procedures such that many of the short-comings of project-based analyses can be avoided. Lee & Walsh (1992) identify several of these shortcomings. These include, foreclosure of alternatives, essentially decisions taken at earlier stages may lead to less then optimal environmental decisions at the project level. More specifically for transport projects, decisions to solve a problem via the building of new infrastructure may prevent further analysis of non-infrastructure alternatives that are less environmentally damaging.

Cumulative impacts may also not be considered at the project level. An evaluation of overall transport plans at a higher tier of decision making can allow environmental analysis that fully examines cumulative impacts, which might be ignored at a project-level of analysis. These include induced development, land use and broader ecosystem impacts where individual projects may have a minor impact, but a large network or plan can have significant long-term impacts.

Guidance on the implementation of SEA for transport plans and projects has been specified within the UK (DfT, 2004). Existing assessment procedures in the UK, as discussed above, are largely consistent with many of these requirements, although the larger question is how to use SEA to assess overall policies and plans at the highest level.

One key factor in SEA is to enable objectives to be clearly defined at earlier stages in the planning process. As an example, a Transport Plan may have a series of objectives ranging from congestion reduction to improvement of air quality. Specifying these objectives upfront and early and connecting them with the specific projects within the plan allows an assessment of whether the plan objectives are consistent with the projects

in the plan. Relationships to induced travel play a key role in disentangling actual effects from assertions made within plans. Hildèn et al. (2004) note that problem definitions are a critical factor in transport planning and assessment. Most conflicts occur over the definition of the problems, since these will likely set the context for all future decisions.

As an example, a plan that seeks to reduce congestion and then lists a number of road capacity expansion projects may be fundamentally in conflict with its stated objectives. That is, our knowledge of behavioural impacts would suggest that adding capacity will generate more traffic, more development, and will in the long run not meet this objective. For consistency, this type of plan must either have policies geared towards that objective (in this case a congestion pricing policy would be clearly directed at congestion reduction) or the objectives must be consistent with the projects (in this case an objective of spurring new land development within the region). SEA provides a broad framework for identifying these inconsistencies at the early stages of the planning process.

Specifying suitable alternatives is also critical. The scoping process for identifying alternatives must be inclusive and should not omit non-transport policies that might solve any stated transport problems. For example, if a stated problem is focussed on improving the local environment, a transport approach might be to take vehicles off of local roads by constructing a bypass. Alternative or complementary approaches might seek to influence the activity of locations, perhaps by increasing local amenities (parks and neighbourhood facilities) and providing more walkable environments. DfT (2004) specifically notes that alternatives that decrease environmental problems or maintain existing conditions should be examined.

SEA has specific requirements (not currently addressed in NATA) for environmental monitoring both to understand baseline environmental conditions and to track future changes (Ferrary, 2004). This is a vital element as it can provide a foundation for future knowledge of actual effects of projects, whether positive or negative.

Conclusions on current framework

Overall, the current transport appraisal framework in the UK offers much promise. The existing framework is largely consistent with SEA requirements. The exceptions in current guidance are the need for more monitoring of actual impacts and a requirement to move towards incorporating assessment of overall policies and plans. The transport modelling guidance has some deficiencies in omitting the need for time-of-day modelling and land-use modelling and maintains a focus on traditional four-step travel demand modelling. While this is pragmatic given the practical difficulties of improving practice in this area, it is a potential weakness in improving information provided within the overall framework. Within this context, we examine actual practice in using these techniques.

Appraisal in Practice

The New Approach to Appraisal has now been practiced in the UK for several years. While it is not possible to assess whether these changes have led to better decision making in transport policy, the analysis of several plans and schemes are reviewed here as well as a review of other perspectives on actual practice. The objective is to provide some flavour for the type of plans that have been proposed and whether the appraisal process has moved towards the ideal assessment procedures previously described. One objective is to determine whether alternative options are considered, how comprehensive these are, and how this may have affected decision making.

Marsden (2005) examined the outcomes of the multi-modal study process which was based on the new guidance in *GOMMMS*. Most of the studies evaluated significant public transport expansion as well as travel demand management measures (especially pricing options). The overall results, however, while recommending more funding for public transport than for road schemes, still contained a significant amount of enhanced road capacity. Most of the study recommendations make the presumption that various pricing policies will also be implemented with the goal of locking in the benefits of additional road expansion, certainly implying some consistency with theories of induced

travel. Overall, Marsden (2005) reports that the process produced substantively different schemes than those originally envisioned prior to the 1998 White Paper. Environmental considerations also appeared to be important in ultimate government decisions to overturn the recommendations of some of the studies. Marsden identifies some inconsistencies with government policy aimed at reducing climate impacts, as the proposed schemes do little to contribute towards targets of reducing greenhouse gas emissions.

The recommendations which came out of the multi-modal studies were a package of measures. One critical aspect was that the analyses and forecasts on which the proposals were based were dependent upon implementation of all the elements within the package – most of these presumed that some form of demand management (generally congestion or workplace parking charges) would be implemented within the implementation timeframe. In many instances, according to Goodwin (2003, as cited in Begg & Gray, 2004) further analysis of the specific measures is being done in isolation. In particular, the road schemes seem more likely to move forward while rail schemes are less likely, and implementation of demand management schemes is even more doubtful. This would effectively reduce the potential benefits of the road schemes as new traffic is generated.

Implementation of local congestion charging and workplace parking charges outside of London have not yet occurred and are increasingly unlikely to be implemented (Begg & Gray, 2004). Recent rejection in a referendum of a major scheme in Edinburgh suggests that the difficulty of implementing these types of schemes will face opposition in many areas. On the positive side, a national charging scheme is under serious consideration and study. However, implementation would still be far in the future and the political likelihood of success is not at all certain.

Begg & Gray (2004) suggest that political circumstances have led decision makers to adopt more traditional road expansion schemes at the expense of environmental measures. In particular, reductions in carbon emissions have not been adequately considered. Much of the rhetoric associated with these schemes is still based on the need

to reduce congestion, yet in the absence of adequate demand management measures this is likely to be unsuccessful. Clearly, while there may be a rebalancing of political objectives to focus on reducing congestion at the expense of environmental objectives, the rhetoric associated with the potential for these solutions, in the absence of pricing, is misleading.

Two multi-modal studies were examined in more detail. These were selected based partly on ease of obtaining the reports, not for any specific objective of evaluating only these particularly studies.

Hull East-West Corridor Multi-modal Study

One of the multi-modal studies (DETR, 1998b) was the Hull East-West Corridor Multi-modal Study (Government Office for Yorkshire and the Humber, 2002). This study sought to evaluate a range of potential policies, aimed primarily at relieving congestion along a major arterial route crossing the region. Other objectives were also identified in the early stages of the study, including making the best use of alternative travel modes, facilitating economic growth and regeneration, improving the economic viability of the Port of Hull, reducing severance and safety problems and reducing environmental problems. These project specific objectives were determined to be consistent with objectives laid out in the Local Transport Plan as well as the government objectives specified in the 1998 White Paper.

A broad range of possible solutions to these problems were examined during initial public consultation processes. These ranged from demand management measures including road pricing to traditional highway improvement projects. Overall the initial list was quite broad and certainly consistent with the scope of policies suggested by DETR (2000a) and listed in Table 1. One key omission was any land use policies to tackle the identified transport problems.

One statement in the study sets the tone, such that it is questionable whether the objectives might be biased towards traditional road building solutions. Specifically,

"Without intervention the trend is forecast to be one of increases in traffic, congestion and delay and declining numbers of people using public transport services." This is in clear contradiction to much of the knowledge of how behavioural processes work. That is, if traffic congestion increases, clearly this will lead to increased public transport usage. If congestion increases too much, then this will lead to a redistribution of economic activity to avoid congested areas. This statement is essentially consistent with "predict and provide" approaches and suggests that the forecasting methodologies used may be inadequate.

The transport modelling procedures used in the study are not innovative. They basically consist of a conventional four-step travel demand modelling procedure which includes trip generation, trip distribution, mode choice, and traffic assignment. The mode choice model appears to only consider cars and public transport and not non-motorized options. There do not appear to be any feedback loops in the model and there is no departure time choice model which would be needed to accurately assess reactions to congestion at peak periods. The model is disaggregated to estimate travel at different times of the day, but this is not sufficient to model departure time changes. In addition, there was no attempt made to model changes to land use or changes in trip generation which were exogenous inputs to the model.

In terms of the assessment requirements in *GOMMMS*, this study did not follow the guidance that was presumably required for multi-modal studies. Specifically, they state that "qualitative assessments" were conducted supported by "limited quantitative assessment" where appropriate. Air quality and noise assessments were based on modelling outputs from the travel demand model. Any biases inherent in the travel demand model would naturally feed into these assessments.

One positive aspect of the study was the wide range of options that were considered. These included traditional road expansion options but also a wide range of public transport service increases, walking and cycling improvements, demand management including charging schemes, and various freight transport options. After initial scoping

and public consultation, five basic strategies were decided upon for further analysis. This included 1) major public transport investment, including a light rail scheme, 2) travel demand management (which includes charging schemes), 3) the original Castle Street scheme, 4) Castle Street tunnel (including increased public spaces on Castle Street), and 5) a Northern Ring Road. All strategies included walking and cycling enhancements, traffic flow management measures, and some more frequent rail and bus services. After initial assessment of these strategies several modified strategies were also examined, specifically replacing the light rail system with a guided busway and reducing severance from the Castle Street scheme by constructing a pedestrian land bridge or concourse underneath the street, instead of a tunnel.

The assessment of the transport strategies found that the travel demand option (with congestion charging) and the public transport option (without the LRT scheme) best matched the scheme objectives. Despite this, the final government decision was to invest in the Castle Street improvements (Secretary for Transport, 2003a). The final recommendation focuses on doing this in a way that reduces severance between the city center and the waterfront (presumably through the land bridge option, although the decision states that solutions would be studied in more detail). Other recommendations are also included on investing in various local and rail improvements, but these are generally less significant. While this decision presumably seeks to balance accessibility improvements with environmental impacts, it is not clear that these have been adequately assessed, leading one to question whether the government guidance on assessment has led to improved decision making. One consideration is that the decision may have been partly based on the transport management scheme not having a high level of public support, which incidentally was highest for the tunnelling scheme (which was rejected at an earlier stage based on cost). However, the original Castle Street scheme also received a low level of support, and the recommended strategy, while aiming to reduce severance from this scheme, was not included in the original public consultation. Therefore, it is unclear how the public consultation influenced the government decision.

The West Midlands Area Multi-Modal Study

The West Midlands Area Multi-Modal Study was also initiated in response to the 1998 roads review (DETR, 1998b). This study focussed on the urban conurbation surrounding the Greater Birmingham region. The need for this study was based upon the fact that the motorway network in the West Midlands serves as a major through route for traffic passing through the region and that these routes are frequently congested. Congestion on radial routes into Birmingham was also cited as being a problem as was the need for regeneration of economically deprived areas. This latter was attributed partly to poor accessibility on the road network (Government Office for the West Midlands, 2001).

The overall plan assesses three general strategies. These include a package of infrastructure measures, economic interventions, and "behavioural change" measures. The infrastructure plans include substantial investments in a light rail network, regional rail, buses, and road infrastructure. Economic interventions include a variety of road pricing options, workplace parking charges and increased public transport subsidies. The "behavioural change" measures focus on various methods to persuade individuals to use alternative modes of travel.

Overall, the package of policies in this study offers something to all constituencies. In this sense, it is truly "multi-modal" as it includes substantial road building and public transport infrastructure. The proposed investment in alternative modes, specifically bicycling and walking infrastructure, is by comparison, minor at only £10 million per year. The road pricing proposals are which involve full electronic road pricing (i.e., tracking of vehicles across the road network and charging according to congestion levels) are dependent upon adoption of this throughout Britain. Interim pricing procedures would include cordon pricing which could be more readily implemented. The "behavioural change" proposals appear to be largely wishful thinking that some 10% of vehicle trips can be reduced or shifted to other modes primarily due to information campaigns and increased public awareness of the detrimental effects of vehicle use.

Documentation on the specific features of the transport model used in this analysis was not provided in the report. However, it is clear that an integrated transport / land use modelling framework was not used as the study clearly states (sec. 3.3.4, p. 38) that regeneration impacts were considered based on professional judgement partly informed by the transport modelling. Interestingly, this considered property valuation and accessibility which likely provides a good measure of development potential.

The study clearly links the policy objectives to the government objectives stated in *GOMMMS*. However, the integration of policies appears to be not strongly considered. For example, the study clearly notes that other policy sectors may have other goals that contradict the travel reduction goals of the study (sec. 6.5, p. 78). For example, the health care sector has a policy of concentrating services to reduce costs, which may necessitate increased car travel to access health care services. Another example is the education sector, which allows parents to choose from a broader sub-set of schools rather than just local neighbourhood schools, often requiring parents to drive students to school. While these issues may be beyond the scope of the regional government to tackle, they are certainly within the scope of national policy making which has not yet reconciled these conflicting goals of different policy sectors.

The public consultation conducted for the plan development included a number of focus groups, surveys, and public information. The public appeared to be generally supportive of most of the infrastructure schemes, with slightly more (but minor) opposition to some of the motorway schemes. The main opposition was to the various economic incentive schemes, specifically road pricing and workplace charging. This finding will clearly make it difficult to implement these schemes over the next 30 years despite these probably being the most effective means of meeting the stated goals of the study.

In terms of the actual impact of the assessment on decision making, several of the major road schemes were not approved due to environmental concerns (Secretary for Transport, 2003b). The public transport networks proposed were also scaled back based upon the

high investment costs with the suggestion that increased bus-based alternatives might be preferable to extensive light-rail expansion. The central government also largely supported the congestion pricing proposals which it saw as largely necessary to maintain the benefits from expansion of the strategic road network.

Conclusions on practical applications

Given the assessment procedures enunciated in government documentation such as *GOMMMS*, it is clear that it was difficult for these two studies to precisely comply with much of the guidance. One clear failure was the lack of sophisticated transport and land use modelling procedures to forecast the impact of alternative policies. On the positive side, there was an attempt to roughly estimate many of the environmental impacts from various alternatives. However, those estimates based on transport model outputs could be in error.

One additional positive feature was the broad range of potential policy solutions that were examined. These cover a large range of innovative approaches, especially focussed on economic incentive policies. In both studies, it is unclear how the ultimate government recommendations on funding are made as they don't necessarily match those projects that best meet stated objectives. This might be partly due to political pragmatism, which would also explain the large mix of traditional road infrastructure projects being offered in addition to extensive public transport expansions.

Conclusions

While the UK has made significant strides in improving decision making methodologies, actual implementation and improved decisions, are not necessarily being produced. There are several factors that might help explain this, which have obvious implications for implementing these methods elsewhere.

DfT (2003) notes that one key constraint on introducing improved and more sophisticated analysis is the lack of skills available amongst transport professionals. This is true in particular of skills needed to develop land-use/transport interaction models. The transport profession as a whole has been trained in more traditional methods and upgrading the skills of consultants takes time. With respect to land-use/transport interaction models in particular, most of the packages available require specific consultants to run the packages which both limits their availability and also limits our understanding of precisely how these models work. Of more interest may be some of the new activity-based transport modelling systems being developed, but these also have been constrained mainly by the available expertise to estimate them.

One of the needs of this type of modelling is also collection of good travel survey data and detailed data on actual land uses, needed for land use modelling. Collection of up to date data is often hampered by resource constraints in assessment budgets, but also, collection of individual survey data is hampered by increasing difficulties with obtaining adequate samples. Expertise in sophisticated survey design, for activity models in particular, may also be limited.

Simplified approaches can provide some information on alternative policy choices. Information on the type of policies that lead to more sustainable transport systems is available, although specific details of effects are more difficult to model. That is to say, in general we know that a policy that increases the cost of motorized travel will generally reduce travel by that mode. Simple elasticity analysis of effects can often provide enough information to inform policy makers of the general effects of alternative choices.

Of equal importance in transport and environmental planning is to create processes that provide good opportunities for public consultation and feedback. As part of this, consideration of a broad range of policy options should be discussed, beyond traditional infrastructure based projects. UK guidance in this area is quite good and offers good guindance for others (as shown in Table 1). Public consultation should also include the development of a consensus on the goals that are to be achieved. For example, if this is

focussed on reducing environmental impacts it will provide a good focus for the type of transport policies that will need to be pursued. The *GOMMMS* framework and the Appraisal Summary Table (see Table 3) provide a procedure for linking transport policies with explicit goals and whether or not they are likely to be achieved.

One of the goals of the assessment process is to ensure that political decisions are made explicit. Transport planning decisions are political, given both the resources involved and the potential impacts, both positive and negative of major infrastructure projects. This is not necessarily a negative aspect of the process. Good assessment procedures are a means for keeping the rhetoric surrounding decision making honest, both by providing the best information and analysis to the public and by establishing a framework for examining this information. Recognizing the distributional impacts of investments can help to understand the underlying political motivations of decisions that are made and whether net benefits exceed both financial and environmental costs.

Understanding how individual behaviour responds to new transport capacity is essential for properly understanding how both the costs and benefits are distributed. When new traffic is induced by un-priced road capacity expansions, it is unlikely that congestion reductions will persist in the long term. Clearly recognizing that this type of project is unlikely to meet a congestion reduction goal is essential for good decision making. The consultation and political process can best be informed by acknowledging how benefits might be distributed either to land owners or consumers in ways that have little to do with travel time reductions. Fully incorporating these type of effects, whether through detailed land use modelling, or a basic understanding of the economic mechanisms at play appears to not have been fully integrated into practice, but is essential for managing the trade-offs between transport and environmental planning.

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Table 1: Policy measures listed in GOMMMS

Land use measures
- Concentration of development in corridors or at transport nodes
- Mixing development so that destinations are closer
- Higher density development
- Parking standards
- Company travel plans to reduce commute trips
- Flexible or staggered work hours
- Developer payments
- Telecommunications such as telecommuting

Infrastructure measures
- New road construction and expansion of existing roads
- New car parking facilities
- New Conventional rail
- Light rail system development
- Guided buses
- Park and ride lots
- Terminal and interchanges to coordinate services
- Cycle routes and lanes
- Pedestrianized zones
- Lorry parks for overnight parking
- Intermodal trans-shipment facilities
- Encouragement of other freight modes (rail, water, pipelines)

Management measures
- Conventional traffic management (e.g. one-way streets, junction redesign, parking controls)
- Urban traffic control systems
- Intelligent transport systems
- Accident blackspot remedial measures
- Traffic restraint measures including traffic calming
- Regulatory restrictions on car usage
- Parking controls
- Car sharing (or encouragement of car-pooling)
- Bus priority lanes
- High-occupancy vehicle lanes
- Increased public transport service
- Bus service management measures
- Improved pedestrian crossings
- Cycle parking
- Lorry routes and bans

Information provision
- Conventional direction signage, including for lorry routes
- Variable message signs
- Real-time driver information and route guidance
- Parking guidance and information systems
- Public awareness campaigns on environmental issues related to car usage
- Public transport timetable and service information
- Real-time public transport information provision
- Information for management of public transport fleets
- Fleet management systems for freight

Pricing measures
- Parking charges
- Workplace parking charges
- Urban and inter-urban road charging, especially congestion charging
- Public transport fare changes and structural changes
- Concessionary public transport fares (e.g. disabled and elderly)

Table 2: Recommended elasticity values for calculating induced travel effects

		Travel time elasticity
Peak period	Urban areas with high modal competition	-0.33
	Urban areas with low modal competition	-0.20
	Inter urban	-0.20
Peak hour	Urban areas with high modal competition	-0.55
	Urban areas with low modal competition	-0.33
	Inter urban	-0.33
Off-peak	Urban areas with high modal competition	-0.40
	Urban areas with low modal competition	-0.24
	Inter urban	-0.24

Table 3: Appraisal Summary Table

Option	**Description**	**Problems**	**Present Value Cost to Government (£m)**

OBJECTIVE	**SUB-OBJECTIVE**	***QUALITATIVE IMPACTS***	***QUANTITATIVE MEASURE***	***ASSESSMENT***
ENVIRONMENT	**Noise**			Net properties win/lose with scheme
	Local air quality			Concentrations weighted for exposure
	Greenhouse gases			Tonnes of CO_2
	Landscape			Score
	Townscape			Score
	Heritage of Historic Resources			Score
	Biodiversity			Score
	Water Environment			Score
	Physical Fitness			Score
	Journey Ambience			Score
SAFETY	**Accidents**			PVB £m
	Security			Score
ECONOMY	**Transport Economic Efficiency**			Users: NPV £m Private providers: NPV £m Public providers: NPV £m Other government: NPV £m
	Reliability			Score
	Wider Economic Impacts			Score
ACCESSIBILITY	**Option values**			Score
	Severance			Score
	Access to the Transport System			Score
INTEGRATION	**Transport Interchange**			Score
	Land-Use Policy			Score
	Other Government Policies			Score

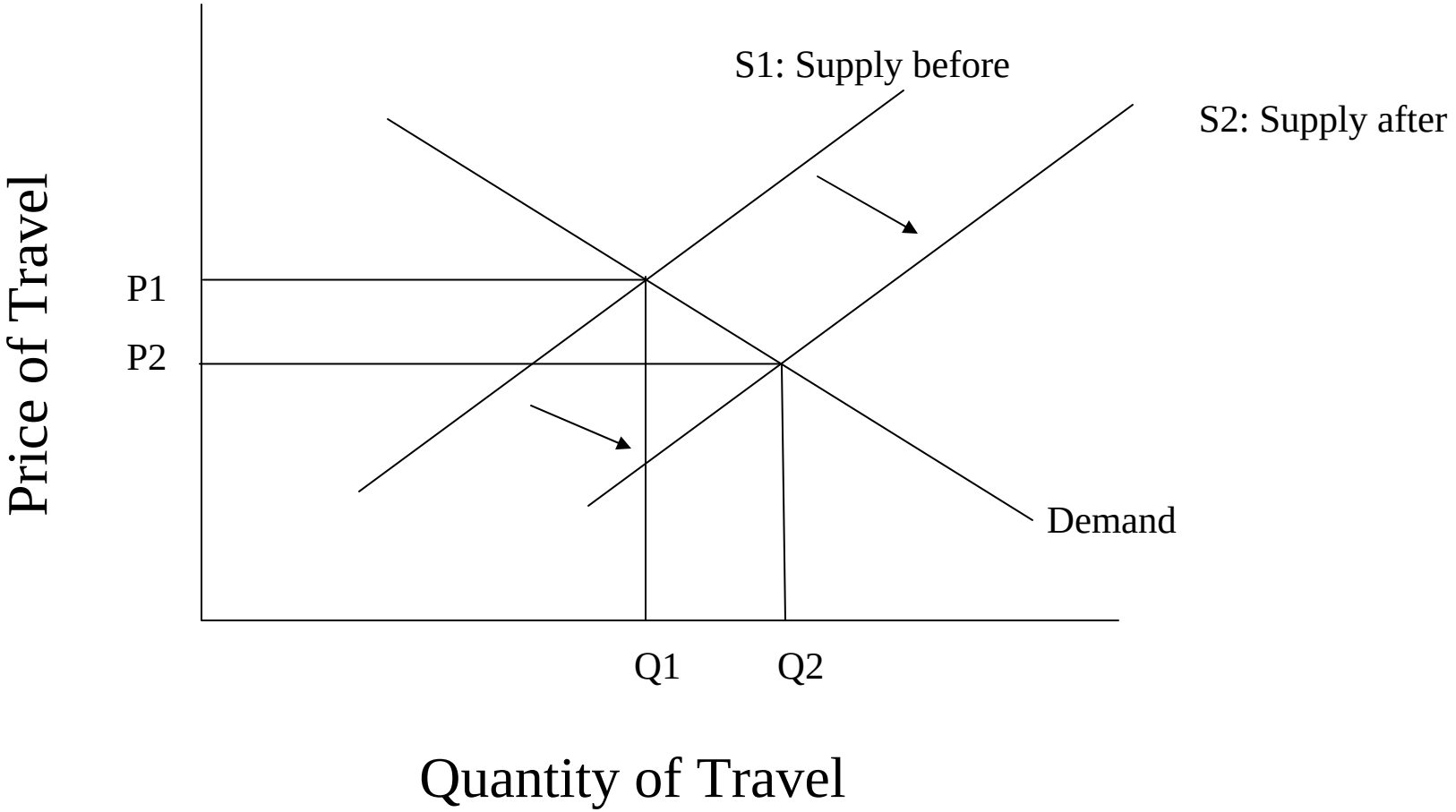

Figure 1: Induced Travel

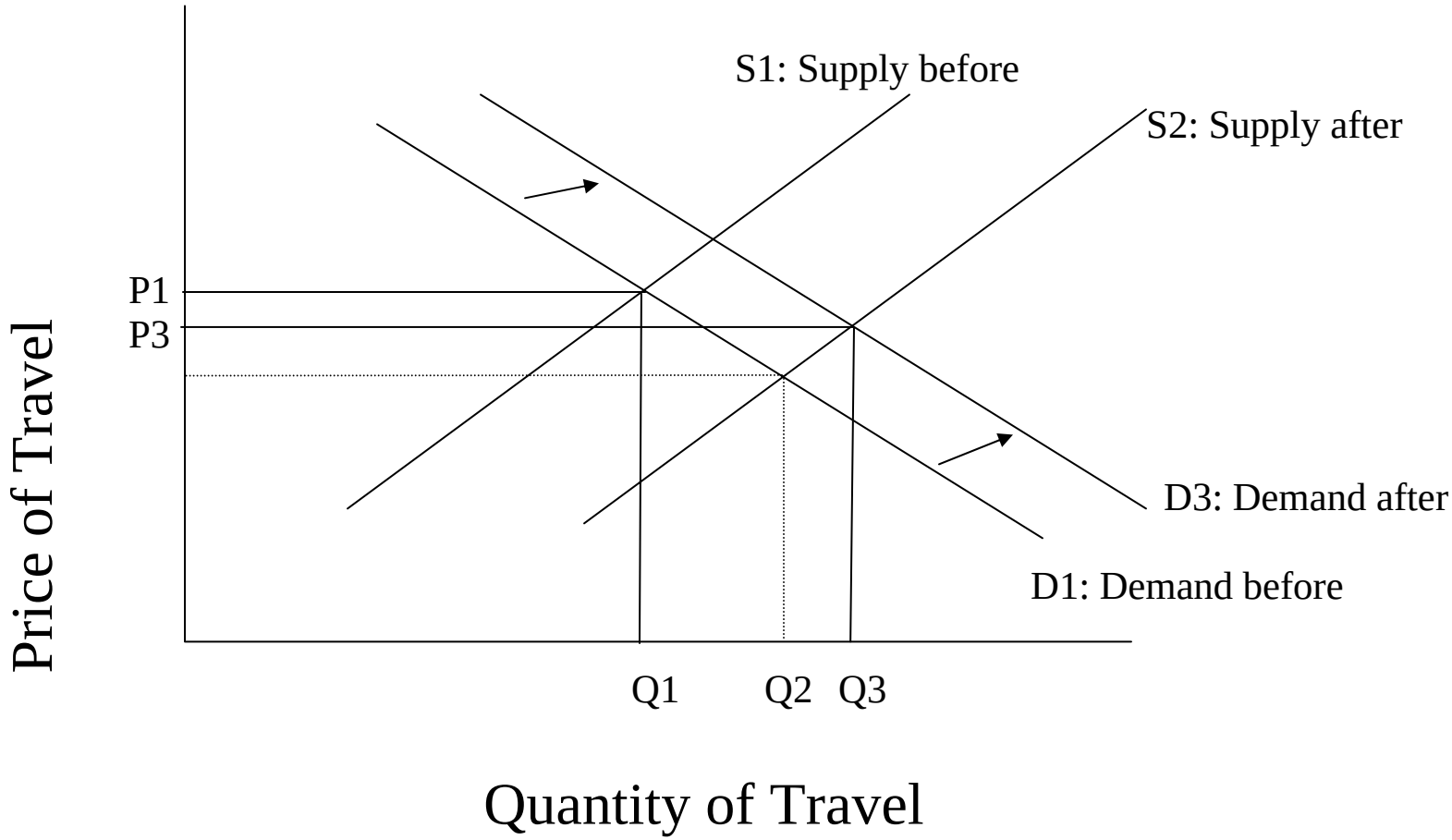

Figure 2: Induced Travel During Period of Underlying Growth in Demand

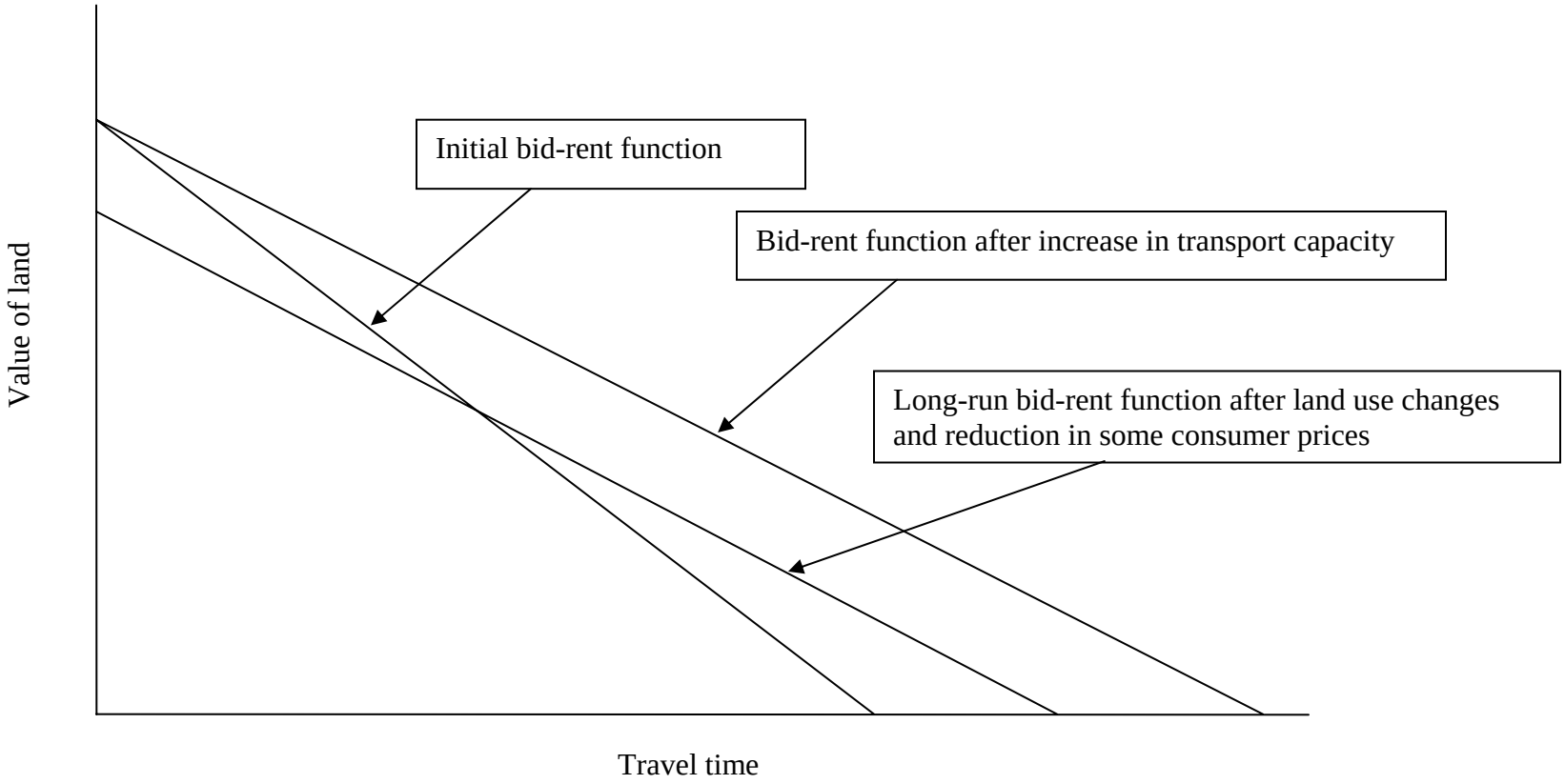

Figure 3: Relationship between travel time and land values with distance from activities