INTEGRATED TRANSPORT STRATEGIES: A REVIEW OF RECENT DEVELOPMENTS IN THE UK

Tony MAY
Professor of Transport Engineering
The University of Leeds
and Director, The MVA Consultancy
United Kingdom

1. INTRODUCTION

In two recent papers, (May, 1991; May and Roberts, 1991) the author reviewed the recent development of Integrated Transport Strategies in the UK. Such strategies provide a framework for the development of transport policy over the next 20 years, and demonstrate the importance of an integrated approach, in which infrastructure, management and pricing measures are combined to overcome current and predicted transport problems. The studies reported then had shown that, by appropriate combination of such measures, it should be possible to achieve improvements on today's levels of fuel consumption, accidents, environmental impact and congestion, despite an underlying growth of around 1.5% per annum in person-kilometres.

Since those reviews were published, several other studies have been completed, including two in areas with much higher current levels of car ownership. Their results have called into question some of the earlier conclusions and shed further light on the potential contribution of land use strategies. At the same time, their methodology has demonstrated the need for a more consistent approach to the development of optimal strategies and to their evaluation.

This paper briefly summarises the conclusions of the earlier review; updates it in the light of more recent studies; summarises work which has recently been completed on the development of a common strategy appraisal framework; and describes a study which is about to commence on the optimisation of integrated strategies.

2. INTEGRATED TRANSPORT STRATEGIES

As noted in the earlier review (May, 1991), some 20 urban areas in the UK have commissioned integrated transport studies in the last four years. These studies have largely followed a common structure. The starting point has been a statement of vision for the urban area, usually provided by politicians, which indicates the type of city which they wish to see in the horizon year. Such statements often refer to economic activity, social equity and quality of life. They rarely mention transport as such, but they raise the question of the role which transport should have in helping to realise that vision. This in turn leads to a specification of transport policy objectives, which have typically included issues of efficiency in the use of resources; environmental quality; safety and security; accessibility; economic regeneration; and practicability. Equity considerations have been treated by developing an impact matrix, in which performance against objectives has been assessed separately for different areas of the city, income groups, modes of transport and economic sectors.

The process of strategy development has then started by assessing the problems likely to occur in the horizon year if no new policies are introduced (the "do-minimum" strategy). This, and a review of current proposals, has led to the production of a list of possible strategy elements, which have been packaged for testing into a series of hypothetical, or "cartoon" strategies. These are designed, not to suggest solutions, but to demonstrate the potential of individual strategy elements in their own right, and the extent to which they can achieve more, through synergy, in combination with other strategy elements. The most promising combinations are then tested further to develop one or more preferred strategies which best meet the study objectives, and hence contribute most effectively to the achievement of the vision for the study area.

The analytical challenge of such studies is substantial. It requires the assessment of the full range of potential land use and transport policy measures, the representation of the effects of each on transport supply and demand, and their evaluation against a wide range of objectives. Moreover, such analyses need to be conducted rapidly; most studies have been completed in under nine months, and their most intensive period of analysis has often seen strategy and sensitivity tests being conducted at a rate of 30 or more per week. This process has been greatly aided by the development of strategic sketch planning models, which achieve speed of operation by simplifying the representation of transport networks, and hence enable the full range of demand-supply interactions, and impacts on choice of frequency, destination, timing, mode and route of travel, to be represented. MVA's START model, for example, is able to conduct a full strategy test for a city of 0.5m in under an hour on a microcomputer (Bates et al, 1991).

Tables 1 and 2 summarise the results of a series of preferred strategy tests for the city of Edinburgh. In particular, they demonstrate that, if sufficient finance is available, and if road pricing is considered publicly acceptable, it is possible to devise strategies which reduce city centre traffic levels and city-wide fuel consumption and accidents to below today's levels, substantially improve environmental quality and stimulate economic activity (The MVA Consultancy, 1991).

TABLE 1: THE SIX COMBINED STRATEGIES FOR EDINBURGH

Strategy	C1	C2	C3	C4	C5	C6
Finance (1)	High	High	Medium	Medium	Low	Low
Infrastructure (2)	NS EW WR	NS EW WR	NS EW WR	NS WR	NS EW WR	NS WR
Capacity Reduction (%) (3)	10%	10%	25%	10%	25%	10%
Fares Level (%) (4)	-50%	0	-25%	0	-10%	+25%
Road Pricing (5)	Yes	No	Yes	No	Yes	No

Notes:

(1) High: £200m-£300m PVF
Medium: £100m-£200m PVF
Low: Zero financial outlay

(2) NS: North-South Light Rapid Transit
EW: East-West Light Rapid Transit
WR: Western Radial

(3) Percentage reduction in City centre road capacity
(4) Percentage change from level anticipated in 2010.
(5) Inclusion or otherwise of a charge of £1.50 to enter or leave the City centre throughout the day.

TABLE 2: STRATEGY PERFORMANCE IN EDINBURGH IN 2010, COMPARED TO 1990

Strategy	Do Minimum	C1	C2	C3	C4	C5	C6
Access by car	-----	+++	-	++	--	++	--
Access by bus/rail	----	+++	+++	+++	-	+++	-
Environ-mental quality	-----	+	--	+	---	+	---
Local Economic activity	----	++++	-	++++	--	+++	---
Fuel consump-tion	+16%	-2%	+ 7%	0	+10%	+ 1%	+12%
Casual-ties	+7%	-8%	- 1%	- 7%	+ 2%	- 7%	+ 3%
Benefits (£m NPV)	N/A	+410	+300	+330	+180	+310	+110
Finance (£m PVF)	N/A	-260	-270	-100	-160	+ 10	0
Capital Costs (£m 1990)	N/A	530	520	530	340	530	340

Key < Worse Better >

----- ---- --- -- - 0 + ++ +++ ++++ +++++

NPV: Net Present Value (a measure of economic efficiency) relative to Do Minimum
PVF: Present Value of Financial Outlay relative to Do Minimum

3. MORE RECENT STUDIES

These results, and similar ones from earlier studies of London (May and Gardner, 1990) and Birmingham (Jones et al, 1990) suggest that it is possible to develop sustainable transport strategies for UK cities. However, it needs to be borne in mind that all three of these cities have car ownership levels, and hence car modal shares, below the national average. Two more recent studies, in Bristol, and in Luton-Dunstable, a smaller conurbation some 50 km north of London, have demonstrated that it may be much more difficult to improve on today's conditions through transport measures alone in areas where car ownership is already higher.

Table 3 summarises the characteristics of these five cities, and demonstrates that car ownership levels are some 25% higher and car use, as a percentage of motorised travel, some 40% higher in the latter two study areas.

TABLE 3: POPULATION, CAR OWNERSHIP AND CAR USE IN FIVE CASE STUDY AREAS

City	Year	Population (thousands)	Households with cars (%)	Trip-km by car (%)
London	1986	7200	61	49
Birmingham	1985	980	51	78
Edinburgh	1990	414	58	65
Bristol	1990	669	71	93
Luton-D	1990	224	70	92

In all five cases, future growth has been predicted based on expectations of growth in population, jobs, incomes and car ownership, and initial assessments of the likely redistribution of land use. The earlier review (May, 1991) found a remarkable consistency in the predicted annual growth rate for car-kilometres. Table 4 reproduces those figures and adds the results for the two more recent studies. It confirms the earlier findings that trip-kilometres are likely to grow more rapidly than trips and that car use is likely to grow more rapidly than all travel. It also shows, perhaps surprisingly, that car use is predicted to grow most rapidly in those study areas where it is already greatest. It is clear that the challenge of controlling cars will be significantly greater in these areas.

TABLE 4 PREDICTED ANNUAL GROWTH RATES (%) IN TRAVEL IN FIVE CASE STUDY AREAS

City	Period	Trips	Trip-km	Car Trips	Car-km
London	1986-2001	0.4	0.4	1.3	1.4
Birmingham	1985-2010	1.0	1.2	1.2	1.4
Edinburgh	1990-2010	0.6	1.1	1.1	1.4
Bristol	1990-2015	0.7	1.5	1.0	1.5
Luton-D	1990-2016	1.5	1.7	1.8	1.8

One interesting characteristic of the last three of these studies has been an attempt to redistribute land use in such a way that demands on the transport system were reduced in the horizon year. In Edinburgh this was done by specifying a "balanced" scenario in which jobs and housing were closer to one another. In Bristol two scenarios, one with concentrated and the other with dispersed development, were generated. In Luton-Dunstable, a similar approach was adopted, but with development in the concentrated scenario focused on a spine through the two centres. In all cases, the indications were that concentrated development slightly increased both overall travel and car use, but that the effects were small; the greatest increase, of 2% in trip-km, occured in Luton-Dunstable.

Each study has generated one or more preferred strategies. In many cases, the final decisions on strategies are still being taken, and it is thus inappropriate to compare them. However, it is possible to compare the effects of those strategies which have been designed to impose the greatest restriction on car use. Table 5 does this, for all studies except London, where the context is very different, by comparing the do-minimum and the most intensive strategy with current conditions against a number of parameters.

A complete comparison is not possible, since not all parameters have been estimated for all studies. However, it is clear that the improvements over current conditions predicted for Edinburgh have not been obtained in either the Bristol or Luton-Dunstable studies. In particular, speeds are still lower than today's, and fuel consumption and casualties higher. Only in the case of traffic in the central area of Bristol is there a demonstrable potential improvement. These differences are not the result of testing a different set of measures (except in Luton-Dunstable, where fuel taxes were tested instead of road pricing) or of different modelling assumptions. It must therefore be concluded that they arise from the nature of the study areas and their underlying demand patterns.

TABLE 5: CHANGES IN SELECTED PARAMETERS FOR THE DO-MIMIMUM (DM) AND MOST INTENSIVE (IS) STRATEGIES IN FOUR CITIES (INDEX VALUE: 1990 = 100)

Parameter	Birmingham (2010)*		Edinburgh (2010)		Bristol (2015)		Luton-Dunstable (2016)	
	DM	IS	DM	IS	DM	IS	DM	IS
Trip-km	129	129	123	126	147	147	154	143
Trip-km by car	135	131	131	108	146	138	160	130
Cars into centre	158	130	113	69	117	58	n.a.	n.a.
Speeds in centre	58	108	95	123	92	115	n.a.	n.a.
rest of city	81	88	93	108	97	96	73	94
Casualties	140	137	107	92	137	129	161	131
Fuel consumption	n.a.	n.a.	116	98	n.a.	n.a.	169	131

*: base year for Birmingham 1985

These results have several important implications. Firstly, it appears that sustainability in transport policy, defined as avoiding a worsening in current conditions, will require more draconian action than that currently envisaged. Secondly, while it may be possible to achieve the necessary reductions in car use through pricing measures, they will need to apply over a much wider area than previously conceived. Indeed, there is a danger, in lower density areas such as Luton-Dunstable, that pricing of car use within the conurbation will simply encourage out-migration to areas where car use is less readily replaced by alternative modes. Thirdly, land use policies will almost certainly have a role to play in avoiding the growth in average journey length which represents a major part of the anticipated growth in travel. Yet results to date suggest that it will be difficult to devise land use strategies which are effective in achieving a reduction in journey length. Finally, more analysis is needed of the role of non-motorised modes, and the potential of encouraging a transfer to walking and cycling, coupled with a transfer to shorter distance travel.

4. THE DEVELOPMENT OF A COMMON INVESTMENT APPRAISAL

Studies such as those in Edinburgh and Birmingham have demonstrated the importance of an integrated approach to the solution of transport problems and, in particular, the need to employ solutions involving new infrastructure, both road and rail, management of the existing infrastructure and pricing of its use. One of the barriers to progress with such strategies has been the use, by central government, of different investment appraisal rules for different types of transport policy measure (DTp, 1991). The Birmingham study, for example, produced a preferred strategy in which similar levels of expenditure were required for road and light rail infrastructure. Yet the nature of the government investment rules meant that the finance available for road investment exceeded that required, while that for rail investment fell far short. Indeed, the rules for light rail investment meant that premium fares would need to be levied for the new service, in an attempt to meet the government requirement that users should pay for the benefits which they experienced. Analysis in the study demonstrated that this would result in substantially lower light rail patronage and a far less effective strategy.

In an attempt to overcome these problems, the City of Birmingham commissioned The Institute for Transport Studies and The MVA Consultancy to develop a common investment appraisal method for all urban transport projects. The recommended method drew heavily on experience with the Edinburgh study. In particular, it advocates the clear specification of policy objectives and impact groups; the use of predictive models which reflect the full range of choices of frequency, destination, time, mode and route of travel and which represent all the demand and supply interactions within and between modes; and the use of an analysis framework which can be used at differing levels of detail depending on the complexity of the scheme or strategy being evaluated.

While the recommendations for the efficiency evaluation methods draw heavily on conventional cost-benefit analysis, the recommended treatment of environmental, accessibility, security and economic activity objectives uses a mix of quantified and qualitative indicators. One particularly interesting development is the recommended procedure for treating appraisal in conditions in which finance is constrained.

This again uses a method first developed in the Edinburgh study, in which standard discounting procedures are used to develop an indicator of Present Value of Financial outlay (PVF) which can be compared directly with Net Present Value (NPV) of the costs and benefits of the scheme. The PVF value enables initial capital outlays to be offset against future streams of revenue from measures such as road pricing; it also enables the financial implications of fares subsidies to be directly compared with those of capital investment. Figure 1, from the Edinburgh study, illustrates the use of the technique to assess the strategies summarised in Table 1, together with the three initial "cartoon" strategies. The diagram can be used directly to identify the strategy with the highest benefit within a given financial ceiling. Moreover, it can also be used to identify those changes in strategy which achieve the highest increase in benefit per unit of financial outlay, or which have the lowest reduction in benefit for a given reduction in financial outlay. These indicators are of considerable value in informing negotiations on the level of finance to be made available to a particular city for its transport strategy.

The report on this study (ITS, 1991) has now been accepted by the client, and the Department of Transport has agreed to contribute to a further study which would test its recommendations on a series of case study projects.

5. THE DEVELOPMENT OF OPTIMAL STRATEGIES

Figure 1 illustrates the performance of six strategies against two of the five objectives specified for the Edinburgh study. It also serves to demonstrate two of the problems which arise in trying to develop optimal strategies for a given area. Firstly, it only considers two objectives, and provides a two-dimensional space in which to assess performance against them. In practice, performance has to be assessed against many more dimensions, and it can become extremely difficult to visualise the process of optimisation and the definition of optimality. Secondly, the six strategies have been generated by combining a series measures, some of which, such as infrastructure projects, are discrete, while others, such as fares levels, can be specified as continuous functions. While it is possible to indicate which of the six strategies performs best against the combined objective function, it is not possible to determine whether any of them is the optimal strategy. Indeed, there is no obvious way in which optimal strategies can be generated, other than by trial and error.

The Institute for Transport Studies has recently been awarded a grant from the UK Science and Engineering Research Council to investigate these problems further. The intention is to use the flexibility and speed of analysis provided by current strategic policy models to test a wide range of strategy combinations and to develop response surfaces for each dimension of the definition of a strategy. For example, relationships will be generated between the level, timing and location of road pricing charges and measures of performance such as net present value, fuel consumption and accessibility. These will then be modified by the application of other strategy elements, such as fares and public transport levels. In this way, it is intended to generate a series of response surfaces for strategy elements individually and in combination.

The number of model tests required for such an analysis is substantial, and would make unreasonable demands on even the most rapid of city-specific sketch planning models. Moreover, the results would be specific to that city, and it would be difficult to assess how tranferable they were. To overcome this problem, it is intended to conduct the initial tests using the Institute's microcomputer-based gaming model, PLUTO (Bonsall, 1992), which describes a symmetrical city with ten radials and two ring roads, and enables virtually the full range of transport policy instruments to be tested. The model's symmetry enables an individual run to be completed in 90 seconds, and a programme of perhaps 1000 carefully specified model runs is envisaged in order to obtain an understanding of the nature of the interaction between strategy elements and their effect on benefits.

Once these are complete, analysis will transfer to the START model of Edinburgh, and a companion model of London, which is currently being developed. Some 200 runs of each are envisaged, using a specification based on the PLUTO results and consultations with the transport planning authorities in both cities. It is hoped that the results will enable guidance to be given to decision makers on more efficient ways of generating optimal strategies, which in turn will contribute more effectively to the achievement of sustainability in urban transport policy.

6. ACKNOWLEDGEMENTS

This paper draws on the results of a series of integrated transport studies conducted by consultancy colleagues, and on ideas generated in collaborative research between The Institute for Transport Studies and The MVA Consultancy. The contribution of colleagues is gratefully acknowledged. However, the views expressed are the author's own. In particular they do not necessarily represent the views of the clients for any of the studies reviewed.

7. REFERENCES

Bates, J.J. et al. Building a strategic model for Edinburgh. Proc PTRC Summer Annual meeting. London: PTRC. 1991.

Bonsall, P.W. PLUTO: computer assisted training for transport planners. Proc 24th UTSG Conference, Newcastle. 1992.

Department of Transport. The role of investment appraisal in road and rail transport. London: DTp. 1991.

Institute for Transport Studies. The development of a common investment appraisal for urban transport projects. Working Paper 348. Leeds: ITS. 1991.

Jones, A.D., May, A.D. and Wenban-Smith, A. Integrated transport studies: lessons from the Birmingham study. Traffic Engineering and control 31(11). 1990. pp 572-576.

The MVA Consultancy. Joint Authorities' Transportation and Environmental Study. Strategy Study: Final Report. Edinburgh: Lothian Regional Council. 1991.

May, A.D. Integrated transport strategies: a new approach to urban transport policy formulation in the UK. Transport Reviews 11 (3) 1991 pp 223-247.

May, A.D. and Gardner, K.E. Transport policy for London in 2001: the case for an integrated approach. Transportation 16 (3) 1990 pp 257-277.

May, A.D. and Roberts, M. Demand management for urban road traffic in the UK: towards a sustainable transport policy for urban areas. IATSS Research 15 (1) 1991 pp 14-26.

Fig. 1. Economic and financial performance of the combined strategies compared with initial strategies