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INTEGRATED TRANSPORT STRATEGIES:- A NEW INITIATIVE, OR A RETURN TO THE 1960S?

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1 INTRODUCTION

A recurring theme in the debate on urban transport policy in the last few years has been the appropriateness of developing Integrated Transport Strategies as a basis for identifying solutions to current and future urban transport problems. Their proponents, including a growing number of local authorities, see them as a means of ensuring that each element of transport policy complements the others. Those who argue against them, and particularly the Department of Transport, have likened them to the grand, and unattainable, blueprints produced by 1960s land use - transport studies. This paper draws on experience with such studies in London, Birmingham and Edinburgh to assess the strengths and weaknesses of the approach now being adopted, to suggest ways in which it might be further developed, and to identify, in the light of experience to date, those elements of policy which might most effectively contribute to the solution of transport problems.

2 THE DEVELOPMENT OF INTEGRATED TRANSPORT STRATEGIES

2.1 The need for the studies

The main factors which can be identified as leading to the establishment of a series of Integrated Transport Studies have been a renewed awareness of transport problems, the range of solutions now being proposed, the concern over economic activity and the reacceptance of an important link with land use planning, and the involvement of a wider range of organisations in the supply, operation and financing of transport.

Problems

Among the problems identified, the most common has been that of congestion which, in the past three years, has been the subject of conferences and reports by all the major professional institutions, as well as organisations such as the CBI and NEDO. Congestion is not, of course, a new problem, but it has become noticeably worse as a result of the faster rate of growth of car use (and, to an extent, light commercial vehicle use) in the late 1980s. There appears to have been a marked change in public awareness of the problem from one which was seen as an acceptable irritant to one which was causing serious cost; moreover, there is now far greater doubt that it can easily be overcome.

More recently, there has been a significant increase in concern over environmental issues. This has emerged at three levels. The first concerns the local environmental problems of noise, local (primary) pollutants, visual intrusion, danger and severance. These have been issues of concern for some considerable time, but have been perceived to have become worse, and more intractable, as congestion has increased, and stimulated greater rat running. The second concerns the regional (secondary) pollutants including oxides of nitrogen, ozone and acid rain, whose health and ecological impacts are becoming better understood, and where control of car use at a conurbation level can be seen as a potential solution. The third concerns global warming. This is almost certainly not seen as a problem to be tackled at a conurbation level, but the realisation that it, too, may necessitate a reduction in car use has reinforced the interest in new approaches to transport policy.

A related problem which has been highlighted specifically by the Department of Transport is that of road safety. The Department has set itself a target of a one third reduction in casualties by 2000 which, given the anticipated growth in car use, equates to a halving in the accident rate over the same period. This in turn has presented a substantial challenge to local authorities.

Other problems identified include those of economic activity and equity. In both cases, the argument varies by location. For example, in both London and Birmingham the authorities have been particularly concerned about the problems of trying to attract economic activity to disadvantaged parts of the city, while other authorities have few worries about a loss of economic activity, and are more concerned to channel it where it will be least disruptive. Equally, some have highlighted the particular needs of disabled people, users of vulnerable modes, and those in lower income groups, while others have focused more on the contrasting problems of different areas of the conurbations.

Solutions

In addition to the conventional approaches of road building and traffic management, many cities have been considering rail and light rail investment; deregulation has led to new forms of bus service; there is growing interest in the range of environmental traffic management measures pioneered in continental Europe; computer-based traffic control is beginning to offer new strategies for congestion management; and more widely, the growth of research in information technology is producing proposals for real time information systems, route guidance and road pricing. On a wider front, some local authorities are beginning to accept the importance of land use planning as a source of solutions, with emphasis on the encouragement of development where it is more compatible with current and future transport provision. Such an approach has been particularly apparent in the recent debate on transport policy among members of the Association of County Councils. In part, particularly in the conurbations, it has been prompted by the difficulties created by responding to the transport requirements of Urban Development Corporations, who have been able to stimulate development without ensuring consistency with transport policy.

The Range of Organisations

Even the transport - based solutions are no longer solely the province of central and local government. Several infrastructure proposals have been promoted by the private sector, who are also increasingly involved in service and information provision. Even where the infrastructure is provided by the public sector, finance can be sought from the private sector, from the user and agencies such as the European Community. In the conurbations responsibilities have become more complex with the spatial division of responsibility in the wake of abolition of the GLC and Metropolitan Counties; in the shires and in Scotland area-wide authorities remain, but so do the conflicts between tiers of government. As noted earlier, conflicts between local authorities and development corporations can be particularly acute.

2.2 The Role of the Studies

Against this background, local authorities have had both to reassess their own policies and to respond to the proposals of others. This has led them to become more proactive, in identifying broad requirements and in encouraging proposals, and finance, from others in a way which is consistent with those requirements. While these requirements have led generally to a need to reappraise transport strategy, the nature of the resulting studies has differed in terms of the immediate focus, the clients, the planning horizon and the treatment of finance.

The focus

Two types of requirement have typically triggered the development of such studies: the requirements of government departments, and pressures to make decisions on particular transport investments. In London, where the first such study was commissioned in 1987, the immediate requirement was that imposed by the Department of the Environment, which required advice on the nature of the strategic guidance to be provided to the London Boroughs in the preparation of their Unitary Development Plans. More recently London Boroughs such as Croydon have been seeking studies for direct input to their UDPs. Similarly, the requirements of the UDP process were a major consideration in the commissioning of the Birmingham Integrated Transportation Study (BITS) and subsequently of studies by all the other West Midlands districts.

Birmingham also demonstrated the role of transport policies, and particularly light rail, in stimulating such studies. In their case, the West Midlands PTA (now Centro) were needing to determine priorities among light rail lines, and required local authority support. A more significant case is that of Leeds, where two years of conflict between the PTA and the City Council on light rail plans triggered a decision to commission a study which would help to provide a context for decisions on light rail.

One characteristic of all of these immediate requirements is that decisions have been needed rapidly. The London study had to be completed in nine months and that for Birmingham in six. More local studies such as those in Solihull and Croydon have imposed a three month timetable. Such tight deadlines would have been inconceivable in the last round of transport studies in the 1960s and, as outlined in Section 2.4, have led to an innovatory approach to analysis.

The Clients

While the studies have been similar in terms of their immediate requirements and their timescale, they have differed markedly in terms of the responsibilities for commissioning them. In the London case, the responsibility for providing strategic advice, and hence for commissioning the study, fell to the London Planning Advisory Committee, which had been established, during the passage of the bill to abolish the GLC and the Metropolitan Counties, to consider, advise and inform on matters relating to the planning and development of Greater London. It in turn involved the 33 London Boroughs, both formally, since each has a member on LPAC, and informally through a Borough Officers' Working Party. The Working Party, which included members from London Regional Transport and British Rail, and observers from DTp and DoE, and was chaired by the consultants, played a major part in determining the strategies to be tested, and the objectives against which they should be assessed.

Unfortunately, no such body was established in the other Metropolitan Counties, and most metropolitan districts have commissioned their own studies with, as a result, problems in tackling those policies such as fares, which need to be treated at a conurbation - wide level, and issues such as infrastructure provision and parking policy which can have marked cross-boundary effects. The one exception has been

the Black Country group of districts, which have commissioned a joint study, and it will be interesting to see how their study tackles the problems of a series of local centres, competing with one another for the needed increase in economic activity, and operating in the shadow of Birmingham.

Birmingham itself tackled the question of wider involvement by teaming with the PTA, to ensure consistency of view on light rail, and with the City Action Team, which brought in representatives of the DoE and DTp, and ensured some coverage of the interests of the UDC. It was less successful in involving the interests of public transport operators, and particularly the deregulated bus industry. While cross boundary issues were relatively unimportant for Birmingham, they were for Solihull, given the large proportion of Birmingham commuters who travel through or from Solihull. Their needs were usefully met by commissioning a short study as a sequel to the Birmingham one, thus enabling them to benefit from the findings of the earlier study and to attempt to ensure compatibility with its recommendations.

The Edinburgh study offers the one example to date of collaboration at all three tiers of government, having been jointly commissioned by the Scottish Development Department, Lothian Regional Council and Edinburgh District.

Planning Horizons

The studies which are emerging are providing a strategic overview to a 15 to 20 year horizon, which provides a context for the analysis of medium term issues and, potentially, the determination of priorities for action. The actual planning horizon has varied. LPAC used a single horizon year of 2001, which in retrospect may have been too short a period, but was to some extent dictated by the data and analytical methods available. One particular drawback was the difficulty of identifying a package of infrastructure investments which could be implemented in that timescale. To reduce this problem, infrastructure investment up to the year 2010 was treated as if it had been implemented by 2001.

Birmingham used two planning horizons, a 20 year one, to 2010, for the development of an overall strategy, and a 5 to 10 year one, consistent with the UDP timescale, to identify schemes and policy elements which should be implemented in the near future and which would be consistent with that strategy. Edinburgh is adopting a similar approach, and the joint authorities have commissioned more

detailed traffic and rail infrastructure studies in conjunction with the strategic study to ensure that shorter term measures are consistent with the overall plan and to test longer term plans in more detail. To an extent, Leeds and Bristol are following the Edinburgh approach.

The strategies which are being produced to the longer term horizon are being seen, not as fixed blueprints in the 1960s land use transport study mould, but as frameworks for the encouragement of action by both public and private sector, for the assessment of individual measures on a consistent basis, and for the generation of the necessary finance and private sector support.

Finance

A further marked difference from the 1960s studies has been an acceptance that finance will impose a major constraint on achievements. Most 1960s studies assumed that finance would be available for those schemes which were justified, and produced a legacy of a long list of infeasible projects which demanded staff resources and imposed blight. As an example, Greater Manchester, on its formation in 1974, inherited some £800m of roads proposals, at then current prices, for which a ten year budget of no more than £200m could be envisaged.

As with many aspects of the organisation of transport, availability of finance has become more complex. The main sources are local government revenue and borrowing powers, government grants, EC grants and investment by the private sector. The nature of and rules for local government expenditure have changed markedly in the last two years. Government grants in the form of Transport Supplementary Grant have become more limited in their application (with the notable exception of the recent relaxation to permit expenditure on safety measures). Section 56 grants for rail investment have been more rigidly defined. The results is a system in which different sources of finance can be tapped for different types of investment or operation, and in which different objectives or criteria have to be satisfied for each. The contrast between TSG and S56 grants has become a major bone of contention, particularly in the wake of the BITS study, and the resulting debate is considered further in Section 4.5.

At the outset of a study, it has been desirable to identify the levels of expenditure which might be possible for each type of activity. In the London study, this was

done in an informal way by asking the Borough Officers' Working Party to judge the financial feasibility of the strategies adopted. In the Birmingham study the issue was tackled more formally by commissioning reviews of the likely levels of finance available from central and local government, from the European Community and from the private sector.

2.3 The structure of the studies

Such studies now appear to be following a fairly standard, logical, approach. The starting point is a **statement of vision** by the authority commissioning the study: an expression of the type of town or city which they wish to see. Typically this will not refer specifically to transport issues, but will consider issues such as economic activity, environment and the quality of life, and equitable provision for all residents. Transport policy is then seen in its rightful place as one of a number of means of fulfilling this vision.

Within this context, the next step is to **specify transport policy objectives.** These are typically the conventional issues of efficiency in the use of resources, environmental protection, safety, accessibility and the practical requirements of ease of implementation and of financial feasibility. Each of these can be considered for a range of impact groups in order to treat the distributional concerns in the vision. Most importantly, the objectives are not seen as mode-specific, and do not concern themselves with dogma over private or public ownership.

Against these objectives, the potential **transport problems** can be identified. This requires an ability to predict future conditions, on the assumption that no new action is taken. This is an area of considerable uncertainty, as recent DTp traffic growth forecasts have demonstrated, made more so by the range of possible land use changes which could occur over the forecast period. Rather than avoid this issue, the new approach confronts it by reference to sensitivity and robustness testing techniques. Section 3 considers in more detail the statements of vision and of objectives which have emerged, and the resulting process of evaluation and identification of problems.

Having identified these problems, it is possible to specify a range of possible **strategies.** This is perhaps the most demanding stage of the process, since it is important not to limit the analysis to any one type of approach. As Section 4

indicates, these strategies can encompass a wide range of elements. Land use solutions may well be as important as transport ones. Among transport solutions, infrastructure provision, management and pricing may all have a role to play. Equally, they need to address the requirements of different areas of the town or city, and the interactions between them.

Each of these strategies then needs to be **evaluated** against the full range of objectives, in such a way that the contributions of different policy instruments can be distinguished, and their strengths and weaknesses determined. The best elements can then be combined into a **preferred strategy** which reflects their complementary effects, and the synergy between them. The contrast between this approach and the series of area and mode-specific studies recently completed in London is particularly marked. Preferred strategies developed from specific studies are described in more detail in Section 4.

2.4 The analytical requirements

The formulation of such strategies present a significant analytical challenge. It requires the testing of a wide range of options, against an uncertain future, and usually in an extremely short timescale. The successful studies of London and Birmingham were both completed in well under a year. Moreover, the analytical procedures need to reflect the complex interactions between demand, congestion and overcrowding, between the use of different modes, and between transport and land use. The key has been the development of strategic sketch models, which enable individual tests to be conducted rapidly, the sensitivity of the results to alternative assumptions to be tested, and the robustness of the preferred strategy to alternative futures to be assessed. Such models need to be multi-modal, to represent both demand and supply, and to describe the link between transport and economic activity. They obtain their speed of response by omitting the detailed network representation which has traditionally been so demanding of computing time, and owe much to the pioneering development of the TRRL's London Area Model, which has unfortunately been withdrawn from use by the DTp. This analytical process is described more fully in Section 5.

3 VISION, OBJECTIVES, EVALUATION AND PROBLEMS

3.1 Statements of Vision

As noted in Section 2.3, the starting point for many of the Integrated Transport Studies is a statement of the clients' vision of the type of city they aim to see in the year for which the study is conducted. Such statements consider the desired attributes of the city as a whole, for its residents and for its business enterprises. They tend not to mention transport specifically, but provide the broad goals to which transport policies should contribute, and thus the vital context within which the study should be conducted.

Perhaps the best example is the Fourfold Statement of Vision specified by LPAC at the start of the London study. Four themes emerged from LPAC's studies. Member authorities expressed a desire that these themes should be used to establish a mutually supportive policy framework in the Guidance. They were seen as being of equal importance:

* London as a Civilised City offering a high Quality of Environment for all Londoners.
* London as a World Centre of International Trade and Business.
* London as a City of Opportunities for All.
* London as a City of Stable and Secure Residential Neighbourhoods, capable of sustained community development.

The principal features of this framework are outlined in Table 3.1, which indicates the role of transport.

Table 3.1:

OBJECTIVES FOR ACHIEVING THE FOURFOLD VISION

A CIVILISED CITY OFFERING A HIGH QUALITY ENVIRONMENT	A WORLD CENTRE OF INTERNATIONAL TRADE, BUSINESS AND INDUSTRY	A CITY OF OPPORTUNITIES FOR ALL	A CITY OF STABLE AND SECURE RESIDENTIAL NEIGHBOURHOODS
1. Preserve the best of London's heritage, tackle the environmental problems arising from the past and ensure the high quality of new development.	1. Foster employment, economic growth and enterprise and secure the regeneration of Inner and East London.	1. Promote economic growth and the regeneration of Inner and East London.	1. Protect the existing housing stock by preventing the loss of residential buildings to other uses, particularly where housing is most adversely affected by pressures from other uses.
2. Enhance and conserve the physical environment, including the Green Belt, Metropolitan Open Land, and the other open spaces within the built-up area.	2. Sustain and enhance London's international, national and metropolitan business, tourism and cultural activities.	2. Improve access to London's jobs for Londoners, targetted on those with least access to jobs.	2. Provide an adequate supply of good quality and affordable homes.
3. Provide improved recreation, arts, leisure, and community facilities targetted on areas of greatest need.	3. Promote London as an important, and internationally competitive, location for business and professional services.	3. Make new housing accessible to those on low and middle incomes, and ensure that key low income workers can afford to live here and are not forced out of London.	3. Maintain and enhance the residential environment. Target housing investment and environmental improvement on residential areas most in need. Tackle obsolescence in the existing housing stock.
4. Protect the Capital's skylines views and viewpoints.	4. Ensure adequate provision for Central London and other 'high level' land uses while balancing their space requirements with the need for residential and other uses required in primarily residential areas.	4. Make training provision both responsive to employers' requirements and targetted on residents employment needs.	4. Ensure that the density of new development, the cumulative impact of conversions, and other small scale changes are consistent with the need to sustain a high quality residential environment.
5. Conserve London's ecology and natural environment.	5. Provide an efficient and competitive labour market, and the housing and other facilities necessary for this.	5. Ensure that training provision meets future demands for work in non-manual jobs.	5. Improve accessibility to shopping, recreation and other community services to all residents. Give priority to those areas where this is deficient and local community provision is constrained by development pressures from other uses.
6. Arrest environmental deterioration and reduce blight, particularly in Inner and East London, and invest in bringing derelict and vacant land back into use.	6. Provide a framework which accommodates necessary commercial and industrial restructuring.	6. Promote public transport investments which improve the access of those disadvantaged in the labour market to areas experiencing employment growth.	
7. Promote well designed and harmonious new development which is accessible to all.	7. Reduce cost and space pressures on all business and industrial firms.	7. Improve the public transport system so that it is adequate, accessible and secure for all sections of the community.	
8. Provide a better and more co-ordinated transport system with reductions in public transport overcrowding, road congestion, and the resulting damage to the environment of residential areas, shopping areas and town centres.	8. Consolidate the position of London's manufacturing sector by ensuring provision and protection of good quality industrial accommodation.	8. Target environmental improvements and community provision on residential and other areas which have the greatest environmental disadvantage.	
9. Improve the safety and convenience of all those travelling in London, including pedestrians and cyclists.	9. Enhance London's environmental quality and its image to investors.	9. Ensure that all public spaces, buildings and major new development schemes are accessible to all, including those with physical disabilities and others with low mobility.	
	10. Increase the capacity of the rail system serving Central London, Docklands and the large suburban commercial centres.		

In the case of Birmingham, the clients prepared a statement of Urban Policy Context which included the following three themes, inferred from Birmingham City Council (BCC)'s decisions over the previous decade:-

(a) BCC seeks to consolidate Birmingham's "second city" status, and secure for it a national/international standing equivalent to that of other major European provincial capitals - rather than leaving such matters to other agencies or to market forces.

(b) BCC fosters Birmingham's distinctive specialised and higher level roles in the region - rather than simply adapting to the pressures towards indiscriminate regional dispersal of these activities and homogeneity within the urban area.

(c) BCC seeks a social and cultural environment in which the city's diversity of ethnic, cultural, lifestyle and income groups can each play a satisfying and distinctive part - rather than accepting the pressures towards ethnic, social and economic polarisation which may maintain distinctiveness, but which blight individuals' life-chances.

There is a marked similarity between this set of themes and the Fourfold Vision of LPAC. Once again, transport is not mentioned, and those responsible for the study are left to decide how best to plan transport policy with this vision in mind.

Other study briefs have been less specific, perhaps because the concept of vision in planning has been undermined by one decade of short term expediency and another tied to the demand of market forces. It is easy, in the absence of such a statement of vision, to assume that one knows what the clients want, and that the same transport policy objectives can be transferred from one study to another. While this may be sufficient as a starting point, it is clear from experience that the priorities among objectives, and their distributional emphasis can be much more adequately determined if the wider vision is known.

Thus the starting point for such a study must be the twin questions:-

"What sort of city do you want?"

and "How can transport policy contribute to it?"

rather than simply:-

"What sort of transport system do you want?"

3.2 Transport Policy Objectives

In some studies, where a vision has been stated, the more specific policy objectives have been determined by the consultant, in conjunction with the client, at an early stage in the study. In others they have been set out in the brief. There is a tendency for these objectives to be very similar in different studies; as noted above, it is the priorities between then and their distributional emphasis which differ.

In London, the objectives were determined by the Borough Officers' Working Party, in consultation with the consultants; they were:-

* to foster economic growth, economic regeneration of Inner and East London and employment as required by the Regional Strategy;

* to promote a transportation system which maximises people's choice and accessibility to suitable employment from their homes and to gain access to the goods and services which they require and the people they need to see. This would emphasis particularly those people who have least access to jobs, goods and services and people they wish to meet at present;

* to improve road safety and personal security;

* to conserve and improve the environment and minimise the adverse side effects of transport demands on community life;

* to minimise future additional resources expended on the transport system consistent with the other objectives and to maximise the benefit/disbenefit ratios of the present and future transport system consistently across all modes.

All of these issues were to be disaggregated by area and by income group to highlight the horizontal and vertical equity considerations.

While most of these were reasonably straightforward three deserve specific mention.

The first objective listed, of fostering economic growth, was to be seen as having the highest priority. It itself begs the question of the role of transport policy; it was assumed in the study that, while accessibility (the second objective) was a major determinant of economic activity, so were the environment and the image created by transport policy. While environmental issues were to be assessed in some detail, those of image could only be assessed in the broadest of terms. Moreover, it was realised that the links between these three factors and the level of economic activity were little understood, and that planning policy and land availability were likely to be more dominant determinants. All that could be done was to identify those transport policy options which were particularly likely to be conducive to economic growth.

The third objective listed refers specifically to road safety; had it been written a few months later, in the wake of the series of rail disasters in London, it would almost certainly have referred to transport safety. The more interesting aspect, however, is the reference to personal security. Several studies recently, including the subsequent review for the City of London, have highlighted the growing concern over the dangers of personal assault, particularly for women, on the transport system. The greatest risks appear to arise for pedestrians, cyclists and users of rail transport, particularly late at night and when the system is less frequented. While the problems are understood, however, the links between design and operation on the one hand, and personal security on the other, are at best uncertain. This is an objective to which few studies to date have done justice.

The fifth objective is a restatement of the conventional efficiency objective in transport policy. It proved in practice to be a difficult formulation to apply, given its specific reference to "future additional resources", and the somewhat ill-defined "benefit/disbenefit ratios".

In practice, the efficiency evaluation drew on two measures. The principal cost-effectiveness measure adopted was the benefit per £1 of public expenditure which broadly showed the effectiveness of different types and levels of public expenditure in achieving benefits to travellers. A second measure used was the net social benefit, in which the net costs to the public sector were subtracted from the net benefits to travellers with the former being weighted by a shadow price to reflect the opportunity cost of spending public money on transport rather than other

matters such as hospitals or schools. Two shadow prices per £1 of public expenditure were used - £1.2 and £1.5.

In the case of the Birmingham study, the consultants developed a set of five broad transport policy objectives, in the context of the statement of vision, and based on a review of the stated objectives of the clients, and of those who might potentially finance transport investment. The five were:-

* efficiency in the use of resources;
* accessibility within and outside the city;
* environment, including townscape and safety;
* economic regeneration;
* practicability, including financial feasibility.

Whilst social considerations are a dominant element in Birmingham City Council's vision, equity issues were reflected in the evaluation process through the identification of a range of impact groups:

* spatial groups by area of the city;
* socio-economic groups;
* mobility groups, by type of transport available;
* purpose groups, by journey purpose;
* modal groups by type of transport used;
* operator/provider groups, by organisation.

The relationships between these and the City's statement of vision are clear. The "second city" status requires a high level of economic activity, and good accessibility at a national and international level. The regional role again requires an emphasis on economic activity, coupled with improved local and regional accessibility. As noted earlier, economic activity itself will be influenced by the quality of the environment. The social and cultural conditions, and the underlying quality of life of Birmingham's heterogeneous population, will be affected by the environment, safety and personal accessibility. Efficiency and practicability as objectives are then seen as means of ensuring that the economic resources generated both by individuals and by business are put to good use in the development of transport policy. Despite this apparent hierarchy, it was decided in the Birmingham study not to give priority to particular objectives, since different clients and providers

would have different views, and individual strategies would inevitably favour one objective over another.

Since its completion, the Birmingham study has been disseminated widely by its clients to other authorities. Not surprisingly, therefore, this set of objectives has been quoted in several of the more recent study briefs.

3.3 Approaches to Evaluation

An evaluation procedure is needed for identifying strategic transport problems in the horizon year, and for appraising alternative strategies for that year, in terms of their performance then, and over the intervening period. The evaluation procedures are to a large extent determined by the nature of the objectives specified.

The first requirement is that the evaluation should be disaggregate, rather than aggregate, in nature. The need for this arises from the emphasis on a range of potentially conflicting objectives, none of which is to be afforded priority. This in turn implies that performance against each objective needs to be assessed separately. Moreover, the treatment of impact groups requires that evaluation against each objective must be assessed both overall and for each of the relevant impact groups. Table 3.2 provides an example, from a current study, of the more detailed issues considered under each objective, and the impact groups for whom they are assessed.

The second requirement is for a range of inputs to the evaluation process, at different levels of analytical detail. Some attributes, such as travel times, operating costs and patronage levels, can be estimated from predictive models. Others, such as noise and pollution levels and numbers of accidents, can be related at a broad level to model outputs, but require careful interpretation. Others, such as impacts on perceived danger, personal security, townscape, image and hence economic activity are not adequately understood in analytical terms, and have to be inferred. Table 3.3 provides an example, from Birmingham, of the range of such sources. Thus the evaluation process must be a combination of analysis and professional judgement, and most clients have placed particular emphasis on the latter. This is a marked change from the 1960s studies, in which the main focus was the model and its outputs, largely taken at face value.

TABLE 3.2: ISSUES AND IMPACT GROUPS FOR A DISAGGREGATE EVALUATION

Impact Group:	Spatial	Socio-Economic Objective	Mobility	Purpose	Modal	Economic Operato
Efficiency						
Capital	•	•	•	•	•	•
User Time	•	•	•	•	•	
Operating Cost		•	•	•	•	•
User Money	•	•	•	•	•	
Trip Changes	•	•	•	•	•	
Accidents						
Accessibility						
Local	•			•		•
Parking	•			•		•
Environmental						
Noise	•				•	•
Pollution	•				•	•
Severance	•				•	•
Townscape	•					•
Land Consumption	•					•
Danger	•				•	•
Insecurity	•				•	•
Economic						
Development	•	•				•
Practicability						
Finance						•
Planning						•
Land availability						•
Operation						•
Enforcement						•

TABLE 3.3: EVALUATION SOURCES: BIRMINGHAM INTEGRATED TRANSPORTATION STUDY

EVALUATION SOURCES

Objective	Source
* Efficiency	
- Capital, Maintenance	Clients
- User Time	Model
- Operating Costs	Model
- Accident Costs	Model
* Accessibility	
- Local Access	Model
- Parking Access	Model
- Regional Access	Qualitative
* Environment	
- Noise	Model/
- Pollution	Qualitative
- Visual, Severance	Qualitative
* Practicability	
- Capital, Maintenance	Client
- Operating Costs, Revenue	Model
- Operation, Enforcement	Qualitative

Experience with the 1960s studies, and their aftermath, has introduced another crucial strand of the evaluation process: the treatment of uncertainty. Uncertainty can arise in such studies in several different ways. Predictions of future demographic and employment trends may be in error. The processes by which the transport model reflects levels of travel, choices of destination, and mode and time of travel may be inaccurate. The costs of travel may change as a result of unforeseen changes in resource costs or legislation. Finance available for transport investment and operation may become more tightly constrained. The impacts of transport on land use patterns and economic activity may be very different from those modelled or assumed. Finally, the policy context may well change as a result of transport policy decisions outside the clients' control. For all of these reasons, it is clearly inappropriate to focus on one preferred strategy and pattern of expenditure. Instead, the emphasis has been on sensitivity and robustness testing. The former involves testing the effects of different assumptions of base conditions and of model parameters on the predicted outcome. The latter stresses the need to find solutions which perform well against a range of assumptions, and which are consistent with a range of policy and financial contexts, rather than necessarily choosing the strategy which performs best against the most likely future. This requirement for sensitivity testing is, as section 5 indicates, a major determinant of the analytical process.

3.4 Anticipated Transport Problems

The first application of the evaluation process, ideally, is to identify those problems which would arise were nothing to be done. This in turn provides a useful basis for devising potential solutions. This process of problem-oriented planning has attracted renewed interest since the publication of the studies of methods of urban transport appraisal in the mid 1980s, but can be traced back to the last, and most extensive, of the 1960 style studies: that for West Yorkshire, which was completed in 1976.

The starting point for assessing problems must be to define the conditions which would arise in the horizon year were nothing to be done. This task is not as easy as may at first appear. A "do-nothing" scenario is clearly inappropriate, since some projects are already committed, and some existing policies will continue to induce changes in the future.

This leads to the concept of a "do minimum" strategy, in which only those projects already committed, and the future effects of existing policies, are assumed to be

added to the current situation. Even this is not wholly satisfactory. It is, for example, possible to abandon committed schemes (as happened with the so-called West London Environmental Improvement Route), or to change existing policies, such as those on the gradual withdrawal of company car subsidy or the imposition of commercial parking charges. And how does one treat a government commitment to bus deregulation in London (particularly at a time when the effects of deregulation elsewhere were still uncertain)?

The solution adopted in London was to develop an initial strategy which was defined as a continuation of existing policies. In the case of policies, such as deregulation, whose effects were unclear, the definition was expanded to include the impacts (on service levels and costs) which its proponents advocated. This was not a wholly satisfactory answer to the problem, since government was not particularly keen to specify its current intentions in detail. As a result, despite inputs to the definition from DTp observers, the Minister concerned was able later to criticise the "current policy" scenario as misrepresenting government policy. Unfortunately, too, the timetable for the LPAC study precluded the use of the output from this test for defining alternative strategies. However, it did clearly demonstrate the inadequacy of current policies on their own. It concluded that, if nothing else was done, conditions in 2001 would be much worse than in 1986 against all LPAC's objectives. As a result, travel by all modes and at all times would become more difficult and more expensive, the environment would be increasingly degraded, and the distribution of costs and benefits would become more regressive.

The Birmingham study, and most of its successors, have adopted the more conventional approach of a "do-minimum" scenario. For Birmingham, the results of the demand forecasting procedures suggested that by 2010 there is likely to be an overall increase in total travel of 28% over 1985 levels with growth within the city being out-stripped by commuting travel. The do-minimum strategy incorporated only committed schemes. Most of these were highway projects, but some rail investment was also included. The main transport-related problems envisaged in 2010, in the absence of specific transport polices, were:

* a severe deterioration in speeds in the wider city centre,
* inner city speed approaching those currently experienced in the city centre,
* longer journey times by public transport throughout the city,
* considerable pressure for illegal and peripheral parking in the city centre,

* substantial environmental intrusion on, and through diversion from, main roads, with the city centre and outer city particularly vulnerable,
* discouragement of economic regeneration and lack of assistance to areas of urban deprivation.

It was against predictions such as these that potential strategies were developed.

4. STRATEGY FORMULATION

4.1 Approaches to Strategy Formulation

The formulation of suitable transport strategies is the key to success in the conduct of any strategic transport study. There are several different views on the way in which this should be done. The true problem-orientated approach would take each problem in turn and devise solutions to it, and then test that package of solutions. While this approach may be productive, it is not always clear which is the best solution to a given problem, or whether the best solution to one problem will simply aggravate other problems or create new ones. A second, and related, approach which is often advocated is to specify the transport policy objectives as more precise targets, and attempt to devise strategies which will achieve, for example, a 10% increase in average speeds or a 30% reduction in accidents. Such an approach suffers from the same shortcomings, in that the suggested solutions may conceivably achieve these outcomes, but may at the same time create problems against other objectives. Moreover, they present severe problems of definition, since it is often not clear, until the analysis is complete, what level of investment will achieve a particular target output.

The alternative approach, adopted in both London and Birmingham, has been to start with a series of "cartoon" strategies which present particular approaches to transport policy, and which between them enable the full range of possible elements of transport policy to be tested. This approach is outlined in Section 4.4, and its contribution to the development of a preferred strategy in Section 4.5. Before that we consider in Section 4.3 the elements of transport policy which can be included and, in Section 4.2, the elements of land use policy which might, but to date have typically not been considered.

4.2 Land Use Policy Elements

In order to understand the role of land use planning to the development of solutions to transport problems, it is important to understand the nature of the underlying growth in demand for travel. The National Travel Survey provides a useful basis for this. Comparison of the 1965 and 1985 National Travel Survey indicates that, over that 20 year period, total passenger travel, in person-km, increased by 61%. Within

that figure, public transport use fell, while car use (in car user-km) increased by 101%. Further analysis indicates that the 61% was explained as follows:

*	increased population	4%
*	more journeys	22%
*	longer journeys	35%

Thus the largest single cause of traffic growth has not been people making more journeys (the usually understood result of increased motorisation) but people travelling further to carry out the same activities. This is particularly marked with journeys to work, whose average length increased by 58% over the same period. Increased journey lengths inevitably mean less reliance on those modes which are more suitable for short journeys: walking, cycling and, to some extent, the bus.

These results are for the nation as a whole, but similar results can be found from comparison of the 1975 and 1985 data for London. NTS shows an 11% growth in person-km by London residents, at a time when population fell by 5%. In this case, the growth is made up roughly as follows:-

*	lost population	- 5%
*	more journeys	4%
*	longer journeys	12%

This analysis suggests that one of the major causes of traffic growth has been the encouragement of longer journeys. This has arisen in part from changes in land use, with the trend to lower density development and the encouragement of larger, more remote, schools, shopping centres and hospitals, and in part from provision of transport at less than the marginal cost. One of the major challenges for the future must be to find ways of reversing this trend, and enabling journey purposes to be satisfied closer to home and by less intrusive means. Such solutions need to be found not only in the transport sector, but in land use planning, and in alternatives to transport as well.

Land use policies can be pursued in two broadly complementary ways. The first relies on the traditions of development control. In practice it has become increasingly difficult for planning authorities to deny planning permission on the basis that access is inadequate. At its simplest, this can mean that local roads have

to be improved to accommodate the additional traffic. More seriously it can result in developments which cannot effectively be served by public transport. At its most extreme, in the London Docklands, it can result in a major rescheduling of transport investment away from areas already in need. What is needed is an approach which requires developers of premises of more than a specified size to demonstrate that their premises can be adequately served by public transport, and that they make due provision for access on foot and by bicycle. As a corollary, parking provision must be suitably limited; this will require a reversal of the approach now being adopted in some Development Corporations of attracting development with the promise of extensive free parking.

The complement to this requires planning authorities to provide guidance on the locations in which development is most consistent with the transport strategy, and is thus to be encouraged. In smaller towns this may be a relatively straightforward process. In the conurbations, however, it requires a major reappraisal of the interaction between transport and land use policy, with the aim of seeking those patterns of land use, and of distribution of travel, which are most compatible with reduced need to travel. A reasonable starting point for such an analysis would be to assume that all journeys had their full marginal cost imposed upon them. More recent developments in the analytical techniques for Integrated Transport Studies may enable such land use policies to be devised.

To an extent it may be possible to remove the need to travel altogether for certain journeys. Telematics have for some time offered the potential for remote working, remote shopping and remote personal business activities. Their impact on travel has, however, been somewhat uncertain. It appears that the journeys foregone in favour of telecommunications may well be more than offset by the new journeys promoted by enhanced information on the potential for travel. A move towards a higher cost travel market could, however, change the situation markedly. If travellers had to pay the full marginal costs of their journeys, they could be expected to find telecommunication more attractive, while at the same time being less attracted to the new travel opportunities on which information was provided. The recent Dutch national transport policy review estimated that telematics had the potential to replace 8% of personal travel. If that personal travel were to become more expensive, this may well be a substantial underestimate.

4.3 Transport Policy Elements

Conventionally, the choice of transport solutions has been between private and public transport ones and, particularly, between road building and bus or rail service improvements. In practice, it is often easier to distinguish between those which can be quickly and cheaply implemented, and those which have longer lead times or significant budget implications. In the recent studies, a distinction has thus been made between infrastructure investment, management of the existing infrastructure, and pricing policies. The potential policy instruments under each of these headings are considered briefly below.

Infrastructure

On the private transport side, the main instrument here is clearly road building, although even under this heading one can distinguish between different standards of provision, with a growing interest in the provision of roads with a lower geometric standard on the one hand, and of higher environmental quality on the other. One particular theme in inner city areas has been the use of land acquisition policies and infrastructure replacement to remove the restrictions placed on redevelopment by outmoded road networks. Another interesting development has been the approach adopted in Birmingham, where the existing Inner Ring Road is being downgraded, in both senses of the word, to reduce the severance which it causes. Finally it is worth noting the proposals in Paris and, to a much more limited extent, London, for new high speed roads in tunnel connecting the city centre to the outer ring.

On public transport, the range of options is much wider. In conventional rail, schemes include the reopening of old lines and stations, and rationalisation of existing operations. Light rail, though, offers a far wider range of new solutions, with marked differences in the extent and nature of their operation, and resulting implications for both access and the environment.

Management

Traffic management proposals form an important element in most strategic transport policies. Measures considered fall into three broad groups: those which increase the capacity of the network, those which reallocate road space between competing demands, and those which aim to achieve environmental improvements.

There have been major developments in all three areas which offer potential new contributions to the solution of transport problems. Although urban traffic control methods have been available for several years, recent advances with SCOOT and ideas being developed elsewhere in Europe promise to increase still further the capacity available. In addition, current research into traffic technology is offering further capacity increases, for example through dynamic route guidance schemes. Such developments may also provide new means of giving priority to certain types of vehicle. Bus priority measures are already well advanced, but SCOOT may allow greater priority to be given; moreover, the queue management facilities in the latest version provide the means for giving priority to certain patterns of movement over others. There has been growing concern recently over the needs of more vulnerable road users, and current research on traffic technology is also developing new ways of giving them priority. In the field of environmental traffic management, developments in continental Europe have recently been attracting considerable interest, and "traffic calming", which is open to a wide range of definitions, is now being considered as a means of enhancing the environment on residential streets (particularly where they are used as rat runs), on shopping streets and, increasingly, on main roads through towns.

Public transport management, too, has incorporated a wider range of measures. Conventional approaches such as modifying the service level or coverage can now be combined with the provision of alternative types of vehicle, some of which permit greater coverage, or provision for particular groups of people. Information provision is able to be dramatically improved as a result of recent research and development. Across all of these developments lie the effects of deregulation, which has in some cases led to new services, but in others made service integration and information provision more difficult.

A third area to be considered in terms of management is parking. Here the measures include regulations on the use of on- and off-street parking and, increasingly, the enforcement necessary to make those regulations effective. Information provision for parkers can also be an important management tool. Such controls are seen partly as a means of making parking itself more efficient, partly as a way of reducing its impact on the moving vehicle, and partly as a means of restraint on the private car. As a complement to the latter, many authorities are now reconsidering the role of park and ride provision.

Pricing

There has been a marked tendency in the recent past to ignore the potential of pricing as an instrument of transport policy, perhaps because the debate has tended to focus on the inefficiencies of the subsidy required for fares reductions. In practice fares policies, parking charge policies, and charges for car use, whether by supplementary licensing or road pricing, have played an important part in many of the Integrated Transport Studies commissioned to date.

4.4 Development of Appropriate Strategies

It is clear from this brief review that there is now a very wide range of measures which can be considered for application in a transport strategy, even if, as has tended to be the case to date, the choice is limited to transport rather than land use measures. As noted in section 4.1, several approaches have been adopted to the choice of packages of such measures for testing, the most effective of which appears to be that of formulating "cartoon" strategies. These need to be designed to test the full range of policy instruments to be considered, and to package them in such a way that the interactions between different types of measure can be demonstrated. Such interactions are important both where measures have contrary effects, or duplicate each other, as might happen if additional capacity were provided on competing modes, and where the individual instruments reinforce one another. It is this synergy between different elements of transport policy which is the key to the successful development of an integrated transport strategy. Having met these two requirements, the "cartoons" can represent different approaches to transport policy, and both the London and Birmingham studies did this by focusing on approaches orientated to road investment, rail investment and pricing and management. The actual schemes included are not crucial; the important requirement is to test the effect of a given level of investment, management or charging, applied in a particular way. Provided that the analytical approach adopted can test variants rapidly, a range of levels can then be tested to identify an optimum.

Such an approach can, if well designed, help to identify the roles and contributions of the different policy elements. The following quotation from the Birmingham study provides an example:

(i) rail infrastructure improvements are vital to:

- improve accessibility
- encourage economic growth
- help relieve congestion,

(ii) road building is less vital, but should include:

- an improved Middle Ring Road to relieve the centre
- several limited outer radial improvements to:

    - enhance accessibility
    - encourage economic activity
    - enable environmental relief,

(iii) traffic management measures are needed to:

- improve road capacity
- protect bus services
- enhance the city centre environment
- protect residential areas,

(iv) public transport operations need to focus on:

- integration of rail, light rail and bus
- increasing service levels to match demand
- limiting the real growth in fares,

(v) road user charges are not essential now,

but
- should be kept under review
- for congestion relief
- and to help finance other measures.

4.5 Development of a Preferred Strategy

Such guidance can help the study team to package together those measures which appear likely, through the synergy between them, to contribute most to the resolution of the problems identified in the "do-minimum" case, and the optimum levels for each of these elements. Inevitably at this stage the specification becomes more detailed, but it is still possible to refer to levels of investment, or areas of the city to be treated in a particular way, without having to justify specific schemes in detail. Indeed, such a policy statement should provide the context within which more detailed appraisal of specific schemes, or determination of priorities for the expenditure of specific budgets, can be conducted. Indeed, the more recent studies, such as that in Edinburgh, have commissioned more detailed traffic and public transport analyses to provide this fuller scheme assessment within the context of the overall strategy.

Once again, the Birmingham study provides a useful illustration of the specification of a preferred strategy. On the basis of the guidance provided by these strategy tests, a preferred strategy was developed, not as a blueprint for transport policy for the next 25 years, but as an indication of the most appropriate way of combining individual policy instruments. The main elements of the strategic package developed in the study were:

* enhancement of British Rail lines, and construction of new light rail lines in corridors not served by rail, as a means of substantially improving accessibility, and reducing congestion on the approaches to the city centre;

* orbital highway construction so far as is needed to relieve, and enable the expansion of, the city centre;

* radial highway construction sufficient to improve accessibility and permit environmental relief within corridors;

* traffic measurement measures to:

(a) increase the capacity of the existing road system and improve bus operations,

(b) divert city centre traffic to orbital roads, and improve conditions for pedestrians in the city centre,

(c) ensure that the environmental relief enabled by radial roads construction is achieved;

* integration of services on individual public transport modes to the extent permitted by the legislative and financial framework;

* enhancement of service levels where justified by changes in patronage, while retaining an integrated fares structure at a level as close to today's fares (in real terms) as permitted by trends in patronage and operating costs.

Assessment of a possible way of implementing such a preferred strategy demonstrated the merits of combining complementary transport policy instruments into an integrated transport strategy which benefits from the synergy between policy instruments. However, it also highlighted the difficulties of improving on today's levels of congestion and environmental intrusion. The main findings of the assessment were:-

* a 4% reduction in vehicle kilometres when compared to taking no policy action, but with levels still around 35% higher than today's,

* speeds generally higher than those resulting from taking no action, but 10% to 20% lower than today's,

* substantial improvements on current congestion levels in the wider city centre,

* a greater economic return than any of the specific infrastructure - based strategies, with user-time savings one third higher than the light rail strategy and double those of the private transport strategy,

* accessibility by public transport markedly improved over today's levels in all areas except the very north of the city,

* a substantial shortfall in parking provision in the city centre, which could be remedied by new provision, or by car use controls,

* a greater improvement in freight operating costs, when compared with taking no action, than for any of the specific strategies,

* substantial enhancement of the environment in the city centre through the enabling of pedestrianisation and bridging of the Inner Ring Road,

* some deterioration in current environmental conditions in the inner and outer city, unless positive steps are taken to introduce environmental traffic management measures,

* a much enhanced potential for economic regeneration, particularly through improved accessibility and image.

Such a specification also serves to highlight the barriers to an integrated approach which now exist. In the London case, road user charges were seen as the key to the development of an effective transport strategy, a view which has since been endorsed by a wide range of organisations. Yet the government is still far from convinced of the merits of this argument and, until it is, will not provide the legislation necessary for its implementation. In Birmingham, several barriers to progress were identified. The most pressing concerned public transport management and finance. Deregulation was identified as a major impediment to the integrated fares policy envisaged, as well as to the proposals for coordinating bus and rail services. Financially, the strategy envisaged roughly similar levels of expenditure on road and rail, but it was clear that rail finance would be much more difficult to secure. The report concluded:

"The 'preferred strategy' tested is likely to require expenditure of the order of £385 million on highways schemes (including committed and Trunk Road Schemes) and £420 million on rail-based schemes. The highways schemes should be feasible financially, provided that trunk road expenditure of the order of £130 million is forthcoming. Private sector and ICPP funding should also be sought. The rail schemes are very dependent on Section 56 grant availability. If, as currently drafted, these are only to be justified in terms of non-user benefits, they will ignore the majority of the potential benefits. Some two thirds of the benefits are unlikely to be eligible for grant on current DTp rules, and it is unlikely that user benefits

can be recouped through the fare box. It will be necessary to seek other sources of revenue, encourage DTp to change its policy, or transfer some finance from road to rail. One potential revenue source, for either road or rail infrastructure, would be car user charges."

This particular point has been espoused more generally by the AMA, who are now pressing the government for a change in policy which would permit overall levels of expenditure to be justified on a common basis, and allocated between modes in the most effective way.

Again, the barrier to acceptance of this argument lies in current government thinking, which argues that road and rail investment have little effect on modal choice. This view was stressed most recently in "Traffic in London" which drew the conclusion from the London Assessment Studies that "even the most substantial expansion of rail transport would achieve only a very small change in mode of transport".

An opportunity arose to test this conclusion in a recent study for LPAC. The Assessment Studies had attracted considerable criticism for attempting to tackle London's transport problems in specific areas rather than by considering the strategic needs of the capital and for being ostensibly too strongly oriented towards road construction solutions. To counter these concerns, LPAC commissioned The MVA Consultancy to conduct a comparison of the Assessment Studies' anticipated recommendations with its own strategic advice for London. The study used the same analytical approach as the assessment studies, based on the London Transportation Studies (LTS) model, which is maintained and operated, on behalf of DTp, by The MVA Consultancy.

Each Assessment Study conducted a series of tests using the LTS model, the results of which are specific to schemes in and adjacent to its area, and which are not readily available. However, two composite tests, representing the highest levels of road investment and rail investment in the four studies, have been reported. The "Major Road" test involved on-line improvements to the South Circular, with new links to the M23 and the M4, the Western Environmental Improvement Route, and several schemes in NE London. The "Major Rail" test involved EW and NS Crossrail, a Ringrail service using the North, South and West London lines, the Chelsea Hackney line, extensions to the Northern, East London, Bakerloo, Jubilee

and Metropolitan Lines and Docklands Light Railway, and light rail in Croydon. Both were compared against an agreed Do Minimum base for 2001.

The LPAC study used a slightly different base, the most significant differences being that the effects of urban traffic control were applied more widely, and that the fares were 10% higher than those for the Assessment Studies. In addition it tested three options. Its Highway option included a road construction programme virtually identical to that for the Assessment Studies. All other elements were retained as in the base. The Strategic option, reflecting LPAC's strategic advice, involved a somewhat lower level of investment in rail infrastructure than that in the Assessment Studies, but also introduced fares reductions of 20% on rail and 40% on bus, an Electronic Road Pricing (ERP) strategy in which 50p was charged to cross a series of screenlines and cordons in Central and Inner London (resulting in an average charge of £4 per vehicle entering Central London per day at 1986 prices), and the use of some 10% of road capacity in Central London for environmental traffic management purposes. Road proposals were as in the base. The third, ERP, scenario was identical to the strategic scenario with the exception that it omitted the fares reductions and environmental traffic management.

Some of the most interesting indicators from the tests concern total trip making and cordon crossings by mode. The indicator for cars entering Central London relates directly to one of the DTp's objectives for the Assessment Studies, which none of the studies managed to satisfy:-

"to keep car traffic entering Central London to a manageable level".

Table 4.1 presents the results for these indicators for each of the seven tests. It confirms the first conclusion quoted from the Assessment Studies; neither the road nor the rail infrastructure policy has any significant effect on modal choice at an area-wide level. The only exceptions are changes between public transport modes in the Major Rail test, as a result of switches from bus to rail, and from through rail to orbital rail.

However, the ERP option demonstrates clearly the effect of adding road pricing to the rail investment option. Private travel entering central London falls by 25%, and entering Inner London by 15%. Rail use rises by up to 10%, while bus use falls slightly. In practice, bus use could be expected to rise, as a result of congestion

TABLE 4.1: TRIPS AND CORDON CROSSINGS IN ASSESSMENT STUDY TESTS AND TESTS FOR LPAC ($\times 10^2$)

	Assessment Study					LPAC Study					
	Base	Major Rail (%)*		Major Road (%)*		Base (%)*		Highway (%)+		Strategy (%)+		ERP (%)+	
Trips to Central London													
Public Tpt (3h)	9424	9444	+2	9364	-1	9126	-3	9109	0	9953	+9	9696	+6
Private Tpt (1h)	565	561	-1	577	+2	634	+12	637	0	453	-29	509	-20
All Trips													
Public Tpt (3h)	15131	15549	+3	15006	-1	14584	-4	14538	0	16294	+12	15302	+5
Private Tpt (1h)	6614	6537	-1	6645	0	6775	+2	6787	0	6399	-6	6515	-4
Trips Inbound Across Central London Cordon													
Rail (3h)	4036	3706	-8	3976	-1	3856	-4	3831	-1	4380	+14	4214	+9
LUL (3h)	4241	4467	+5	4215	-1	4102	-3	4085	0	4455	+9	4423	+8
Bus (3h)	1105	920	-17	1101	0	1045	-5	1046	0	1304	+25	1037	-1
Private (1h)	641	630	-2	659	+3	724	+13	729	+1	476	-34	542	-25
Trips Inbound Across Inner London Cordon													
Private (1h)	1008	993	-1	1066	+6	1077	+7	1159	+8	815	-24	918	-15

KEY: *% of Assessment Study Base
+% of LPAC Study Base

relief. Unfortunately, the LTS model does not include a link between bus speeds and car speeds, and therefore does not reflect the effects of congestion relief on bus patronage.

The strategic test, in which a fares reduction has been added, shows an even more marked effect. There is a further 10% reduction in all the private transport indicators, with greater transfer to bus, as a result of the differential fares reduction. The 14% increase in rail travel into Central London compares with an anticipated increase in rail capacity of between 10% and 15% through investment. The comparison of the two bases reinforces the conclusion that fares policy is an important determinant of mode choice; a 10% increase in fares results in a similarly sized increase in private transport use.

It is clear from this analysis that it is possible to develop transport policies which lead to a reduction in road congestion, but that these need to involve pricing measures as well as infrastructure improvements. The Assessment Studies were probably correct to conclude that rail investment on its own would not contribute significantly to an area-wide reduction in congestion. This perhaps is surprising, and is contrary to the argument developed elsewhere that the most appropriate solution is to improve accessibility by rail, which is the main focus of the Crossrail schemes. The explanation appears to be that, while such schemes affect modal choice within their own corridors, those effects are diluted when considered at a London-wide level. Conversely, fares policies and road pricing act at the area-wide level, and thus show more substantial effects.

It is abundantly clear that pricing is a key element in urban transport policy, and that, if congestion is to be reduced, the choice of method lies between means which increase the cost of private car use, reduce the cost of public transport use, or both. In the short term, a combined approach, in which the financial costs of one are met by the other, appears the most sensible. However, it needs to be borne in mind that the main source of growth in travel in London, as elsewhere, has been people making longer journeys. In the longer term, this trend is most likely to be reversed if all travellers are required to pay the full marginal costs of their journeys. Road pricing provides the essential means of achieving this; indeed, it appears that it is the only means by which congestion can be significantly reduced. If this is the case, then it will be crucial for further work to be conducted to ensure that it becomes, in the Department of Transport's terms "a proven proposition".

5 THE ANALYTICAL APPROACH

5.1 Requirements

As Section 2.4 indicated, the recent development of Integrated Transport Studies has posed a major challenge for those involved in transport modelling. Analytical methods have been required which are capable of testing a wide range of options, against an uncertain future, and to a tight timetable. This section considers those requirements in more detail.

The range of transport options to be tested includes, as indicated, the full range of vehicular modes, including light rail, for which little experience is as yet available. Some studies have also required the treatment of walking as a separate mode where it affects demand for other modes in city centres. Where relevant, the impacts of infrastructure provision, management changes (to increase capacity, to provide priority for particular users, or to enhance the environment), and pricing policies have to be represented for each mode. In addition, land use policies, which are increasingly being seen as a contributor to the solution of transport policies, have to be represented.

Demand for travel needs to be disaggregated to a sufficient degree to represent the range of conditions, both spatially and temporally, the differing responses of those who can be expected to be more or less sensitive to policy changes, and the sectors of the travel market of particular concern in evaluation and to decision-makers. As outlined later, the spatial requirements have typically been met by dividing the study area into zones representing different types of land use and complexities of transport network. Most models have considered conditions in both peak periods and an interpeak, although in some cases off peak conditions have only been assessed in broad terms. The studies have differed significantly in the number of purpose categories which they have considered; following the example of the London Area Model, the model being developed for Edinburgh will use six separate purpose groups for person travel. It is notable, however, that no model has yet attempted to analyse freight transport choices separately.

It is particularly important that the models represent the full range of interactions between demand and supply. On the demand side, these include the conventional processes of mode and route choice, although the former is made more complex by

the need to incorporate light rail, and the latter by the simplified treatment of networks, as described below. In addition, it is necessary to consider the processes of generation and distribution, which are themselves linked to land use changes. At present, the models developed permit redistribution, given fixed trip ends; the model developed for Edinburgh also relates total travel to changes in generalised cost. Current developments envisage the inclusion of a feedback between supply and land use, which will permit the fuller representation of generation of new journeys. One other aspect of demand, largely ignored in earlier models, but generally accepted as one of the most natural choices for the traveller, is that of change of time of travel. The LAM model developed by TRRL for London made an attempt to represent the process; the model recently developed for Edinburgh includes procedures for transferring trips between three time periods, based on earlier models developed to examine the implications of road pricing.

On the supply side the most crucial link is that between traffic levels and travel times, and considerable effort has been made to develop area speed-flow relationships which are robust and reliable. Changes in vehicle speeds directly affect the cost of travel by car, but also impact on bus travel. Few conventional models incorporate this feedback and, as a result, it is difficult to represent the effects of decongestion on transfer to bus use. The most recent area models provide such a link, including representation of the more severe effect of congestion on the performance of buses than of cars, and the potential relief from congestion provided by bus lanes. For public transport generally there is a further interaction between demand for the service and waiting and (for buses at least) in-vehicle times. The LAM model and that developed for Edinburgh represent these interactions; they also permit, in one operating mode, the level of service provided to respond to the demand for it. LAM also included one further interaction, between service levels, fares, patronage and revenue. It permitted the model user to specify a policy on subsidy and obtain an output in which the other three parameters were consistent with that subsidy level. It was, however, judged to be rather crude in terms of the cost functions employed. The final aspect of supply effects, and perhaps the most difficult to treat, is that of parking. The process is complex for several reasons. The different types of supply, some of which (e.g. private non residential parking) are only available to a subset of users, present particular problems. Pricing and regulation affect different durations of parking in different ways. Supply constraints impinge more severely on later arrivals and thus induce a marked time of day effect. Finally, the driver's response may be to search for an available space, thus adding to

congestion, or park illegally, thus making supply a difficult concept to define, or park further out and walk, thus adding to demand elsewhere. Some attempts have been made to reflect these processes in the Edinburgh model, but further development is needed.

The studies have had to confront the problem of uncertainty in several ways. Firstly there is inevitably uncertainty about forecast future land use, demographic and economic conditions. Secondly, the demand responses represented will be uncertain, particularly as demand is further disaggregated, and as less well understood demand responses, such as time of day changes, are incorporated. Thirdly, the supply will itself be uncertain, either because, as in the case of deregulation, the responses of suppliers are unknown, or because the optimum level of a fare or charge is uncertain, or because the response of supply performance to charge in demand is inadequately understood. The simplest reaction to these uncertainties is to conduct sensitivity tests, which enable different values of model parameters, and different levels of service or charge to be tested, and robustness tests, which indicate those strategies which perform best against a range of possible futures.

The final, and particularly critical requirement of the models is that of speed of response. All of the strategic studies commissioned to date have been required within a matter of months. The original London study had an eight month timescale, that for Birmingham six months, and that for Edinburgh, including more detailed studies of traffic and public transport, nine months. Within this period, models have had to be developed and calibrated against available data, and then used to conduct a large number of main strategy tests, and an even larger number of sensitivity and robustness tests. In Birmingham, for example, a total of six strategies were tested against different futures, and around forty sensitivity tests were conducted on the main strategy. This is only feasible if a model can be developed which can be run, in its entirety, in around an hour. As computer technology has developed, this constraint has become less severe, enabling models to become more complex, but they still need to operate in a very different way from conventional four stage models.

5.2 Strategic Sketch Models

The approach to meeting these requirements was developed initially by the Transport and Road Research Laboratory through its London Area Model, LAM,

which in turn drew on earlier work by the Mathematical Advisory Unit. LAM was originally prepared for use in advising the Department of Transport on its transport policies for London, but was later made available to the consultants involved in the first Integrated Transport Study, commissioned by the London Planning Advisory Committee in 1987. It was subsequently subjected to an audit for the Department of Transport which, while identifying some weaknesses, generally concluded that the model performed well, and provided a basis for assessing transport interactions not treated in other models. Unfortunately the Department of Transport later withdraw LAM from public use, thus denying LPAC the opportunity to use it for further policy studies. No detailed reasons were given for this decision, but it appeared that its basis was not wholly technical.

LAM resolved the problem of speed of response by abandoning the conventional network description in favour of one which described road capacities in terms of area speed-flow relationships for separate areas of London. For this purpose, the whole of the Greater London Transportation Study area was divided into 13 zones, of which one represented central London, four covered inner London, and the remainder described the inner and outer suburbs. A standard linear relationship between area network speed and network vehicle-kilometres was adopted, based on earlier research at TRRL. Changes in capacity could then simply be represented by shifting the relationship in either direction along the vehicle-kilometre axis. This formulation was subsequently modified, for the LPAC study, by introducing a steeper fall in speed beyond an identified critical speed, to increase the sensitivity of the model to increased congestion. Routeing and assignment were treated, simply by determining the kilometres involved in a trip between a given origin and destination, and assigning these to zones in proportion to the extent of travel in each. This assignment procedure required a degree of manual intervention in the rare cases in which infrastructure provision was likely to induce substantial rerouteing.

For public transport, trips were allocated between modes through the mode choice procedure, and a best route between each pair of zones was identified for each mode. All public transport modes included a reflection of the effects of loadings on waiting times; in addition, in-bus times were related to those for other traffic derived from the area speed flow relationships.

These simplifications in the representation of transport networks and matrices provided a substantial reduction in model run times, which in turn permitted

additional detail in the representation of transport interactions. In addition to a nested logit model which represented choice among seven modes, these included provision for trip generation and distribution, a simple treatment of choice of time of travel, the representation of public transport capacity described above and a means of determining service levels consistent with a given subsidy level.

The LAM model proved its worth in the LPAC study particularly through its ability to enable a wide range of sensitivity tests, which were used both to test parameters, such as the slope of the speed-flow relationships, and to optimise the definition of elements of strategies, such as fare and road pricing levels. It thus provided the obvious basis for responding to the needs of the clients for the Birmingham Integrated Transport Study. Unfortunately, LAM had by then been withdrawn and instead a simplified version of the model, representing Birmingham by 12 zones, was developed on a spreadsheet. Given the time available, several elements of LAM had to be omitted; in particular there was no representation of off peak conditions, and relationships between bus speeds and general traffic speeds were incorporated manually. Despite these simplifications, the BITS model again proved extremely effective. It enabled a wide range of sensitivity tests to be conducted within a matter of days, thus providing valuable evidence on the impact of strategy options such as changes in network capacity, increases in service frequency, priority for buses, and the introduction of premium fares.

Experience with LAM and the BITS model provided the basis for specifying an improved model, which has now been built for the Edinburgh study. It represents Edinburgh by 14 zones, with a further 7 external zones. Demand is represented by four person types, three car ownership levels, six purposes, and three time periods. Area speed-flow relationships are again used, but in this case differentiating between inbound, outbound and orbital movements. Hierarchical demand models for each mode represent choices of frequency, distribution, mode and time of day. Car trips are then assigned among up to three alternative routes, based on times determined from the area speed-flow models. In addition to the speed-flow relationship, supply responses are reflected by relationships for bus waiting and in-vehicle times, rail waiting and crowding and parking search and egress times. A facility is also provided for modifying public transport service levels in response to changes in demand. Thought is currently being given to the treatment of land use responses to transport cost changes. The model currently has a run time of around an hour on a 486 microcomputer, and promises to provide an effective tool for strategy assessment.

6 CONCLUSIONS

It is clear from their approach that the current series of Integrated Transport Studies differ markedly from the 1960s land-use transport studies. The main differences can be identified as:-

* the emphasis on a vision, which provides a context for developing transport policy objectives,

* the appreciation that financial targets, or constraints, need to be identified at the outset,

* the treatment of a wide range of transport policy (and, potentially, land-use policy) instruments,

* the use of "cartoon" strategies to test the full range of instruments and identify the interactions between them,

* the emphasis on strategies which maximise the potential for synergy between transport policy instruments,

* the treatment of these strategies as frameworks to facilitate action, rather than fixed blue prints,

* the use of multicriteria evaluation methods, with reliance both on model output and professional judgement,

* the use of robustness testing as a way of treating uncertainty,

* the speed with which the studies have been conducted, facilitated in turn by:

* the development of strategic sketch planning models.

This new approach should enable transport strategies to be developed rapidly, not just for the conurbations which are already active, but for larger and smaller freestanding towns, and for the more rural areas which are coming under increasing

pressure. It will be important for the DTp at least to recognise, and preferably to encourage this process.

Already, the process has identified several policy issues of considerable importance. The main ones are:-

* the need to consider policies which encourage a reduction in trip length, without necessarily reducing trip making,

* the need to accept that synergy between transport policy instruments is achievable, provided that the search for possible instruments is drawn more widely than simply infrastructure provision,

* the importance of pricing measures in particular as a regulation of demand which, virtually alone among policy instruments, can have area-wide effects,

* the particular need to develop the concept of road-user charging, particularly for London, but in due course elsewhere too,

* the need to accept a common basis for evaluation of all elements of transport policy and, coupled with this:-

* the importance of providing finance on a consistent basis for different types of measure, and removing undue constraints on its availability.

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