WORKING PAPER
ITS-WP-00-03

Evaluation Methodologies for Transport Projects in the United Kingdom: Dealing with Multi-modal Questions

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February, 2000

ISSN 1440-3501

Established and supported under the Australian Research Council's Key Centre Program.

INSTITUTE OF TRANSPORT STUDIES
The Australian Key Centre in Transport Management

The University of Sydney and Monash University

NUMBER: Working Paper ITS-WP-00-03

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ABSTRACT: This paper reviews the basic methodology for the evaluation of transport projects in the UK and explains the changes currently being undertaken. The paper identifies the key elements as a very rigorous economic evaluation of direct user benefits, but rather less progress on the evaluation of environmental or wider economic effects. Changes are currently being made to develop a common framework for multi-modal applications which introduces new challenges.

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DATE: February, 2000

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Introduction

The methodology for the appraisal of transport projects in the UK is undergoing a period of substantial change after a long period of relative stability.

The changes in the UK have been driven by three main forces:

- a recognition that the basic national road network is essentially complete and that the environmental and social consequences of further expansion were an increasing concern;
- the decision to privatise the national rail network through a fully private sector infrastructure company, Railtrack, responsible for major investment and a series of private franchise holders for passenger rail services, operating a rolling stock fleet owned by leasing companies;
- the election of a new government in 1997 committed to the development of an integrated transport system with a more transparent system of comparing investments in different modes.

In this paper we first review the institutional structure of decision making on transport investment in the UK before looking in more detail at the methods followed in the appraisal of investments in roads and then railways and how these are changing. We then take up a number of the key elements involved in appraisal. Finally we look at the new problems posed by trying to develop a consistent methodology for investment in all modes as part of a system to select the most appropriate resolution of a given problem.

Institutional aspects

Roads in the national motorway or trunk road network are the responsibility of the national Department of the Environment, Transport and the Regions (DETR), which sets the overall national policy and provides the funding, although day to day responsibility is now devolved to the Highways Agency. Roads which have primarily a regional or local role are the responsibility of the relevant local authority, although varying proportions of funding come from the national government through annual Transport Supplementary Grant provisions decided on the basis of Transport Polices and Programmes submitted. The local authority also acts as local agent for the Highways Agency.

Thus far almost all capital expenditure has been the responsibility of government, but there has been some introduction of DBFO (design, build, finance, operate) in the hope of bringing forward key schemes. The major schemes have been tolled estuary crossings, of which two have been completed, the Dartford - Thurrock Crossing (Queen Elizabeth II Bridge) with a capital value of £150 million, opened in 1991 and the Second Severn Crossing (construction cost £331 million) opened in 1996. These are financed by tolls with maximum concessions of 20 and 30 years respectively or until the costs have been recouped. Each has involved the concessionaire taking over the existing crossing, its maintenance and its toll revenue.

In addition, there have been eight concessions granted for construction and maintenance, both of new routes and the upgrading of existing routes. with a combined capital value of £591 million, for which the operator receives a shadow toll. A further 6 schemes with a capital value of £508 million are at various stages of the planning process, the which may include a new type of payment mechanism with incentives to provide a good level of service for buses and heavy goods vehicles, and with scope for additional payments to reward a good safety record..

The only example of a proposal for a fully tolled private sector road, other than bridges or tunnels, is a scheme for the Birmingham Northern Relief Road. This would be 27 miles of new motorway to relieve the heavily congested M6, with a capital value of £350 million. A 53 year concession was awarded in February 1992, since when there have been substantial legal challenges It is now likely that works for the construction of the road will start in Autumn. The tolls charged and collection methods will be entirely for the concessionaire.

Railway investment has always been handled at arm's length from the government department, formerly by British Rail, now by Railtrack for infrastructure and by the individual train operating companies for rolling stock. Financial appraisal has dominated decision making in rail investment where the benefits are argued to be able to be captures in fares. However, again a substantial part of the funding comes from government through subsidy. This subsidy is typically paid at arm's length through the operator for a specific service. A large part of this will be transferred to the track operator through its charges which, although regulated, are supposed to guarantee an adequate return on capital employed. Some direct subsidy is paid top infrastructure where it can be shown that this achieve wider objectives, usually relating to congestion relief or environmental improvement. The government can therefore control both the total level of investment and require details of specific proposals.

Private finance has also been sought for rail investment. The new construction for the Heathrow Express, capital value £440 million, has been financed exclusively by British Airports Authority, with Railtrack responsible for improvements to existing track. The Channel Tunnel Rail Link, with a total value of £5.8 billion, will have a government contribution of £1.8 billion to secure wider benefits to the regional rail system, the rest is financed by the private sector, though also involving Railtrack.. Other projects at various stages of development include the Thameslink 2000 and Crossrail schemes for cross-London rail improvements and the £2.2billion West Coast Main Line upgrading. In addition there are several schemes for urban light rail construction and modernisation or extension of the London Underground at various stages of development.

System of transport project evaluation

Until recently there has been a standard pattern in which road projects have been subjected to a formal cost benefit analysis using a procedure called COBA (COst Benefit Analysis). Benefits accrued principally as a result of the evaluation of time savings and reductions in accidents. This produced, in effect, a rank list of

projects according to the benefit-cost ratio (BCR). Which of these projects was selected then depended on an overall cash limit of finance for roads. Rail projects were appraised essentially on their financial viability alone, although again overall cash limits to British Rail could limit the actual investment to a level well below that showing a significant positive rate of return. A modified cost benefit framework was applied to urban schemes of any mode which might produce wider benefits

Typically, in preparing a road project, a set of alternatives is developed and each of these is subjected, where possible, to the same evaluation procedures. Thus project selection is seen to be part of the formal process. This is important for ensuring transparency. SACTRA (1992) identified a 28 step process from the identification of need to opening a road, of which the formal appraisal constitutes only a small part.

If there is no objection to the scheme, there is a smooth transition through these stages. In most major schemes, however, there will be objections of various kinds. The Public Inquiry is the formal procedure by which such objections to road schemes can be heard. Presided over by an Inspector appointed by the Secretary of State the Inquiry hears evidence in a quasi-judicial setting. The Inspector reports to the Secretary of State with recommendations.

COBA is used both to evaluate and rank projects and COBA results are an important element in both the decision procedure for road projects and in any resulting official Public Inquiry procedure. The basis of the COBA procedures cannot be questioned as part of the Inquiry (except to ensure that they have been properly carried out). As a result the procedures err on the side of caution. The Inspector's recommendations are, however, only recommendations which can be accepted or not by the Secretary of State, although usually the Secretary of State will find it necessary to set out reasons for the final decision, for example where it is felt that there are other factors which have not been adequately considered by the Inquiry.

The decision process for rail projects has been rather different for historical reasons. Most major schemes require an Act of Parliament which means that scrutiny is referred to a parliamentary committee. A simplified procedure was introduced under the Transport and Works Act (1992) whereby schemes can be authorised by the Secretary of State by an Order in Council. This was designed to reduce delay in private finance schemes, although where there are substantial objections the Secretary of State can refer the proposal to a Public Inquiry.

Manuals for Project Evaluation: Road Appraisal from COBA to NATA

The standard procedure for the assessment of roads in the UK for many years has been the COBA (COst Benefit Analysis) procedure. This computer-based assessment procedure has been part of the official *Design Manual for Roads and Bridges* (Highways Agency and others, 1996) which has to be followed for all

projects receiving public funding[i]. The essence of the COBA procedure is to have a rigorous evaluation of those aspects of road appraisal which can be unambiguously defined and to ensure common treatment of all projects.

COBA is a conventional cost-benefit procedure which concentrates on measuring as accurately as possible those elements which are capable of measurement and monetisation. These procedures were formally underwritten by the Advisory Committee on Trunk Road Assessment (the Leitch Committee) in 1978 and are been subject to periodic scrutiny by the Standing Advisory Committee on Trunk Road Assessment (SACTRA), a committee of experts, which recommends any changes in procedure to the Secretary of State[ii]. Subsequent reports from SACTRA have dealt with such issues as urban roads, environmental impacts, induced traffic and, in the latest report, the impacts of transport on economic growth and competitiveness. Again the Secretary of State is not obliged to accept the recommendations from SACTRA, which deals mainly with technical matters and not procedure.

COBA depends first on a rigorous transport model which assesses the change in traffic resulting from a particular project. Benefits are gained first from time savings, valued at a constant rate, and secondly from reductions in accidents (again valued at a given value of life, reduction in injury etc.). COBA is thus strongly biased towards projects which generate major time savings and reductions in accident costs, the two principal measured benefits. What is not directly included in COBA is any environmental cost or benefit from a project (this is considered outside the COBA procedure through the Environmental Impact Assessment required by European law) nor any economic impact on the surrounding regions (expect where a given number of jobs can be directly and wholly attributed to a given project, for example, where a new road opens access to a site not otherwise served by a road and which can only be developed because of that road). Compared with the procedures used in other countries COBA can thus be considered to be rather narrow in scope, but highly detailed in the appraisal of what it does cover.

The new UK government elected in 1997 had as one of its priorities a desire to move towards a more integrated transport system and thus towards a planning system which acknowledged this. The White Paper of 1998, *A New Deal for Transport* (DETR, 1998a), carried with it a set of parallel detailed policies for individual sectors or aspects of transport, including *A New Deal for Trunk Roads in England* (DETR, 1998b) which set out a strategic review of road building policy[iii]. This included the outline of a *New Approach to Appraisal* (NATA) (DETR, 1998c,d) which was to "develop a clear and open framework to appraise and inform the prioritisation of trunk road investment proposals."[iv v]

NATA has at its core a new Appraisal Summary Table (AST) which introduces the previously excluded elements from COBA in a more formal manner, but retains COBA as one, perhaps the key, element. The AST has five main criteria, environmental impact, safety, economy, accessibility and integration, each of which has a number of sub-criteria as shown in Table 1.

Each criterion has, where possible, both qualitative and quantitative elements. The quantitative elements are directly measurable factors such as the number of properties experiencing a specified noise level, the numbers suffering accident injuries of various degrees or the time savings or losses. Qualitative measures are evaluated as far as possible on a seven point scale from large negative to large positive effects. These can have a quantitative dimension, but are more subjective. The core of the COBA method is incorporated in the safety criterion and the first and third elements of the economy criteria, evaluated according to normal present value methods. The remaining criteria are new elements in the appraisal process.

No weighting is implied between the criteria, the objective of the AST is to provide a single sheet summary to policy and decision makers which characterises the project. This includes, for example, the conventional COBA BCR (benefit/cost ratio) score of the project. There is, however, no guidance as to what level of, for example, net negative environmental impact would cancel out a given positive COBA score. It remains to be seen how this is interpreted during Public Inquiries.

Rail Appraisal

Whereas a standard national procedure using detailed appraisal methods has been developed for road projects as discussed above, only in urban areas has any common approach to appraisal covering all modes been used, and then only relatively recently (URECA and CAF). Likewise, it has only been in the major urban areas that cost-benefit analysis of rail proposals has taken place. To an extent this was because rail and road were seen to be closer substitutes in urban areas such that a common appraisal framework was deemed necessary, but it also reflected the extent to which local governments had greater powers over transport planning in these areas. This procedure is now in the process of change towards the production of a standard evaluation procedure, based on the NATA, which will allow the comparison of different modal solutions to the problems of specific areas or corridors.

In the main it was regarded that the railways were able to capture user benefits through fares and thus a financial appraisal would give a fair picture of any investment scheme. Unlike with roads, where the main benefits accrue from time savings, these time savings in the case of rail would be associated with an increased number of journeys and an enhanced quality of journey which could justify increases in fares. The key forecasting element was therefore of the appropriate elasticities to generate the expected increase in revenue.

The advent of privatisation caused two main changes. First, the unified railway was broken into functionally different parts. Essentially, for any one passenger service, three elements are involved, a monopolist owner of infrastructure, Railtrack; a provider of rolling stock, one of three rolling stock leasing companies; and a service provider, one of 25 franchised operators. The operating franchises are for periods of between 7 and 15 years, depending on the degree of improvement required, in order to ensure a sufficiently long payback period for

any necessary investment. The objective in each franchise is to minimise the subsidy received, or maximise the net payment to the government, by the end of the period. Each of these elements is subject to regulation by the Rail Regulator. Competition occurs for the initial awarding of a franchise through a bid, which in practice is on the basis of the minimum level of subsidy to operate a given level of service. Although the franchises are largely geographically separate, there is also the provision for a limited amount of direct competition through alternative routes between major centres and even some on track competition.[vi]

Secondly, the government is much less directly involved in investment. Railtrack is a privatised public limited company responsible to its shareholders. It undertakes investments on the basis of their profitability to Railtrack, subject only to constraints imposed by the Rail Regulator. Its revenues come from track access charges to the franchised passenger operators and the privately owned freight operators.[vii] These charges are negotiated and can in theory be priced according to demand. Where competition occurs access charges may be higher for the marginal train path. Where investment in route improvement occurs Railtrack recoups the investment cost through higher charges. The operator can pay these higher charges because higher fares can be charged for the improved service.[viii] The Rail Regulator has to ensure that these fares are not excessive and that the charges made by Railtrack do not exploit its monopoly position.

Such a system provides a simple basis for the continuation of financial appraisal of investments. However, franchised operators do continue to receive public subsidy and hence the Office of Passenger Rail Franchising (OPRAF), has to ensure itself of the value of any subsidy given which is used. To this end OPRAF has developed its own cost benefit analysis framework to cover the rail case. The OPRAF guide to planning criteria identifies the impacts in Table 2. For many of these, for example environmental impacts and congestion effects, cross reference is made to the standard practice in road investment. For others, such as safety and option values, rather different approaches have to be taken to reflect the difference of public transport provision. OPRAF specifically excludes economic and regeneration benefits for the usual reasons of difficulty of prediction and the danger of double counting, but invites proposals to identify where such benefits may exist as an additional factor not included in the net benefits.

This represents a clear step forward in developing a wider framework for appraising rail investments which are supported by OPRAF. However, major infrastructure investments requiring expenditure by Railtrack will continue to be largely based on the financial business case. There has been much criticism of Railtrack's investment programme as being too limited in the early years of its existence and failing to make up the backlog of investment created in the run-up to privatisation. The Rail Regulator has also been criticised for failure to ensure sufficient value for money return from track access charges paid, substantial amounts of which are still paid out of public subsidy.

Recently a new Rail Regulator has begun to take a much tougher approach with both the train operating companies and Railtrack. As part of the Government's policy towards integrated transport a Strategic Rail Authority has been

constituted out of the former British Railways Board, which will take over responsibility for the functions of OPRAF, but also have formal responsibility for overall strategy for the rail sector, something which had been missing under the original privatisation arrangements.

Demand forecasts

We now turn in this and the following five sections to examination of some key elements in the operation of the road appraisal procedure. In this section we deal with demand forecasting before looking at values of time, traffic safety issues, environmental impacts, regional economic effects and equity considerations.

Until recently the COBA procedure assumed a fixed trip matrix of origins and destinations such that new road project would simply reassign traffic volumes. As a result of SACTRA (1994) the procedure now allows for a variable trip matrix such that it caters for traffic induced by the project itself. SACTRA (1994) argued that failure to allow for this could lead to circumstances in which a large part of assumed benefits could in fact be lost due to the additional costs imposed by induced traffic which had not been accounted for.

Essentially COBA assumes that traffic growth in each vehicle category will be similar on all links of a network. Traffic forecasts are thus highly dependent on the procedures for forecasting traffic at a national level, which are provided by the periodic *National Road Traffic Forecasts*, the latest version of which was produced in 1997 (DETR, 1997). These forecasts are localised by reference to local planning data on population, jobs etc. The NRTF uses various forecasting procedures, but is heavily dependent on vehicle ownership and use elasticities. NRTF typically produces high and low forecasts which are used to test the sensitivity of the COBA results. This is simply a means of allocating an exogenous forecast increase in traffic to a network of which some characteristics have changed. The allocation to the network is heavily time-cost dependent. The use in COBA of a link-by-link approach is thus more appropriate for link upgrades than it is for whole network improvements. What is ignored here is the possible response of overall traffic demand on the network to a change in network characteristics.

This is the issue which was addressed in the SACTRA (1994) report. This led to the issuing of specific guidance on induced traffic by DETR. This proposes the use of an elasticity approach in which the change in network characteristics produces an increase in traffic on the whole of the relevant network (due to time shifts, redistribution between origins and destinations, mode shifts or new generation) as well as reassignment of routes on the network. The allowance for induced traffic in this variable trip matrix also creates valuation problems because it involves (in effect) measuring an area under a shifting demand curve.

Figure 1 shows how measuring the static demand curve at the original price p_0 and trips t_0 suggests that the additional benefits are the area under demand curve D_0 leading to trips t_1 after the fall in price/cost to p_1. . However, if the improvement induced traffic, this shifts the demand curve to D_1 implying a

longer run or general equilibrium demand curve D_g and thus we need to measure the area under this curve D_g to the new induced trip level of t_2.

If, in addition, the induced traffic itself changes the cost characteristics of the improved route by leading to increased congestion and accidents, then this would reduce the implied net benefits. Concern about the adequacy of the techniques to reproduce the theoretical situation caused there to be a requirement always to compare the fixed trip matrix situation as a benchmark.

Value of time

Whatever traffic forecasts are made, the major impact of an improvement in the road network is a reduction in the time taken to travel along the link in question. The imputed value of time savings is thus a critical measure. Standard values of time are used in all calculations. These are based on the assumption of a constant marginal unit value of time regardless of time saved or the income of the person involved (though the values for each vehicle category depend on an assumed distribution of incomes of individuals and their appropriate income-related values of time). Two categories of time are involved, working and non-working (including both commuting and all other non-work activities), two categories of people, drivers and passengers, and four categories of vehicle, car, light good vehicles (LGV), other goods vehicles (OGV) and public service vehicles (PSV). These values are given both per person and (assuming standard occupancies) per vehicle (Table 3).

These standard values of time are applied to all time savings, both link transit times and junction delay times. These are assumed to grow at between 1.625 and 3.055% per year depending on the economic growth forecast adopted.

Traffic safety

The cost of accidents is a major element in COBA. The preferred method is to separate link and junction accidents. Actual data is used to value the existing cost of accidents and standard accident parameters for improved links and junctions. Accident types are distinguished using fifteen different road types, and within these for different speed limits, and these are given as personal injury accident (PIA) rates per million vehicle kilometres. These range from 0.088 on dual four lane motorways to 0.333 on urban dual three lane roads with speed limits up to 40 miles per hour (64 km/h).

Casualties are then expressed in three categories, fatal, serious and slight per PIA. Rates of fatal casualties range from around 0.02 on non motorway urban roads to over 0.06 on rural single carriageway main roads (with speed limits over 40 miles per hour). Slight injury casualties range from a low of 1.00 on minor rural roads to 1.38 on motorways.

Standard monetary values of both casualties and property damage (Table 4) are then used to provide a cost per accident figure which ranges from (1994 values) £64,760 on urban dual carriageway roads to £109,160 on rural single

carriageway roads. The value of life figures incorporated in the casualty costs are based on data from stated preference studies.

Rather more complex calculations are made of accident incidence, casualty rates and hence costs at 96 different junction types.

Environmental impacts

The environmental impacts of a road scheme have never been formally included in COBA. Despite the recognition of the environmental costs of traffic, including the SACTRA (1992) report, these have always been considered as an additional element. This has typically been done through the required Environmental Impact Assessment which is handled qualitatively for decision making purposes. The argument is that environmental costs are subject to a degree of imprecision, which would make their inclusion inconsistent with the COBA philosophy, despite the enormous progress which has been made towards getting robust figures on the economic costs of such impacts.

The move to NATA has allowed the introduction of environmental issues in a more formal way as part of the AST, though still not fully integrated as part of an overall *economic* evaluation. However, the environmental impacts are presented in NATA in a much less rigorous way than could be possible. The only quantified elements are global carbon emissions (tonnes of CO_2), local air quality (expressed relative to the number of properties experiencing better or worse air quality in terms of PM10 and NO_2) and noise (again in terms of properties with increases or decreases in noise). Other environmental effects (landscape, biodiveristy, heritage and water) are all expressed in terms of the (usually) five point scales of qualitative impacts.

Regional economic impacts

COBA specifically excluded regional or local economic impacts because of the concern over double counting of such effects in the direct transport benefits. NATA aims to deal with some of these elements, but detailed definition has been left until decisions following the SACTRA (1999) Report.

Some new elements are, however, included in the AST. In the economy section, there are two new elements, journey reliability and regeneration. Journey time reliability is an increasingly important issue in a congested network, but one on which there is no agreed methodology. Whilst work on refining a better measure continues the interim solution is to use the ratio of vehicle flow to capacity as an index of stress on the road. This is then modified in the qualitative indicator by looking at the product of the difference in stress levels with and without the scheme and the number of vehicles affected daily. This modifies the traditional time savings element in COBA, but is felt to have an important qualitative effect on the perception of road needs in an area.

More directly related to a regional economic effect is the regeneration indicator. The simple indicator used is therefore just whether a scheme serves a regeneration priority area, and if so whether specific development schemes are

dependent on the road improvement. This is a very weak indicator in the absence of any more robust means of assessing the wider economic impact of a scheme, a point to which we return later.

The accessibility criterion is not a rigorous evaluation of impacts on accessibility indicators, but is the refinement of some existing indicators which assess the extent to which a road scheme has impacts on the use of other modes, including walking. Each indicator is classified on a four point scale.

The contribution to integration is simply an assessment of whether a scheme does or does not contribute towards the achievement of other polices and plans, principally those relating to land use and transport.

Efficiency and equity considerations

COBA is based on a straight net present value calculation. All costs and benefits are reduced to their present value, discounted at a standard rate (currently 6%) over a 30 year period. This is used to produce a benefit-cost ratio which is used to rank projects. In practice a series of options is defined for each project and incremental BCRs calculated for each incremental option. COBA does not allow explicitly for equity considerations. There is some implicit allowance which arises from schemes with different traffic mixes which carry different values of time. However, the effective unit of observation is a unit of traffic not the individual user hence all values of time and life are average values. Under the traditional use of COBA there is no explicit valuation of non COBA elements such as environmental impacts. COBA could be used to express implicit values however by quoting the NPVs of competing schemes with quantifiably different environmental outcomes.

NATA also does not make any explicit trade off between the elements, The AST is simply a tableau which allows all the factors to be expressed on a single sheet. The comparisons are made by the policy maker or decision taker in each specific circumstance.

A recent review of the technical issues in cost-benefit analysis for DETR (Sugden, 1999) has made a number of recommendations for improvements in practice. First, market prices should be used rather than the traditional factor costs as the basis of any CBA designed to estimate welfare changes as these are closer to the theoretically superior willingness to pay criterion. Secondly, a modified basis is proposed of calculating the benefits to travellers who change their behaviour as a result of a scheme; essentially there is a need to ensure a consistent treatment of both users and non-users of a particular proposal. Thirdly, values of time for all journey purposes should be based on willingness to pay rather than the equity based values which have been applied traditionally.

Application of NATA

In order to illustrate the way in which NATA is being used, in Figure 2 we compare the outcomes of the application of the AST to two schemes, both close to London. One is a scheme to widen a major radial route to the South-east of

London from dual 3 lane to dual 4 lane, which has a low BCR of 1.5, but a strong implied wider economic impact which was accepted on the new method. The other, to improve two junctions on a major radial route to the West of London, has a very high BCR of 25, but was rejected on the basis that alternative traffic management solutions might provide a more immediate solution. The difficulty with these outcomes is their dependence on rather ad hoc and subjective judgements whilst the only rigorous evaluations clearly indicate an alternative ranking. One of the difficulties here is to substantiate the case for ignoring available net present value benefits of £240million directly attributable to users whilst seeking unquantified, and possibly illusory, wider economic benefits elsewhere.

The development of NATA is an ongoing process. The first point to recognise is that within the context of the development of an integrated transport policy it is important to consider solutions to transport problems which involve more than one mode. This is the start of a genuinely multi-model version of NATA. However, when more than one mode is involved some of the criteria become less appropriate or need modification, for example those concerning accessibility, reliability and integration. In addition some further factors become more important, such as how to incorporate option values. Discussion is also proceeding on the desirability of moving from a resource cost basis for evaluation of standard COBA elements towards a welfare basis.

Future Changes: An Integrated Approach to Appraisal?

Clearly there is a strong movement towards more integration both in the way transport is planned and the way transport projects are appraised. The key emphasis is a shift from a "predict and provide" pattern for roads where the appraisal is mainly to prioritise within a given externally set budget constraint, to one of investigating further the nature of the problem and whether alternative approaches would be more appropriate. These alternative approaches could involve either traffic management (including road pricing) or, more ambitiously, corridor studies which aim to assess alternative solutions to a given problem in a multi-modal context.

Much thought is currently being given to how to extend the basic principles of NATA to a multi-modal context. The same five objectives of environment, safety, economy, accessibility and integration are used. Here the issue is how to treat the rather different characteristics of different modes in a consistent manner. Within the economy an objective, for example, a multi-modal study will need to assess the extent to which a change in provision of one mode affects the revenues and costs of other modes (both public and private sectors) and the implications for taxes, subsidies and grants. The overall objective is to obtain a consistent set of user benefits related to willingness to pay. Within the economy objective, the reliability sub-objective is seen to be of increasing importance. Although measures of reliability exist for roads in terms of stress ratios (ratio of average

annual daily traffic to capacity), what is really needed is a consistent measure of the coefficient of variation of travel times by all modes.

The wider economic impacts sub-objective continues to be based on the simple regeneration indicator introduced in NATA. This indicates that wider benefits can be included in cases where the main impact of the strategy or plan being appraised may be to assist the economic regeneration of specific areas. To be included, it has to be shown that: a proposal is significantly beneficial for designated regeneration areas; and there are significant developments within or adjacent to the regeneration area which are likely to be dependent upon the proposal being approved. We consider below how this may be improved.

There are some difficult comparison issues in the accessibility objective as well. Measurement of access to the transport system becomes critical as does the need to assess option values, especially for public transport modes which are not used regularly.

Central to many discussions, however, is the impact on the economy which a move from an underlying philosophy of predict and provide will have. Whilst there has always been a clear view that a good transport system has an impact on the overall efficiency of the economy and therefore on its growth, it has been difficult to demonstrate the quantitative significance consistently through time and space. More specifically, although transport is clearly a major determinant of early development, the marginal contribution of individual schemes to an already well developed network (even very large schemes) is more difficult to assess. Furthermore, the proposition that failure to invest will actually harm overall growth in an economy is particularly difficult to assess. What does seem more likely is that changes in transport provision may lead to specific local growth, but much of this will be a redistribution of economic activity between regions or localities rather than net overall growth.

It is this difficulty of identifying and measuring a consistent contribution of transport to economic growth which has led to a view that such effects should typically not be included in any appraisal procedure. The view has prevailed (following Dodgson, 1973, and Jara-Diaz, 1986) that the transport benefits fully capture any wider economic benefits. There is therefore no direct provision for any wider benefits, except, as identified earlier, for those which are solely and directly attributable to a specific project. The main effort should therefore be put into ensuring that the transport benefits and any external costs are measured and evaluated correctly. However, this conclusion does depend on the assumption that transport users are operating in a perfectly competitive market environment such that their willingness to pay accurately reflects the economic benefits to society as a whole. In an imperfectly competitive environment such user benefits may either under- or over-estimate the true benefits (Venables and Gasiorek, 1998).

Whether such benefits are additional to, or subtract from, the direct transport benefit will depend on the nature of competition in the transport using industries in the area affected by the project, recognising that it is not just the conditions within the immediate area which are relevant. New transport projects can open

up the affected area to extra competition from outside. Such competition may reduce the monopoly power of local businesses, and hence reduce employment in the area, but create increases in welfare for local consumers through lower prices or access to a wider range of activities. The net effect thus has redistributional affects between economic agents within a region as well as between regions. Such effects may on average be fairly small, but the real problem is the uncertainty of their existence and size which makes it difficult to be confident that the transport benefits are an adequate measure of total benefits (SACTRA, 1999).

The structure still faces the difficulties that the source of funding differs for different transport projects, and that the risks faced by different investors are not only different, they may also be less transparent than is desirable. The industry faces differing types and degrees of regulation in different locations, for different modes and even for different parts of the same mode. If we were, for example, to investigate further the complexities faced in investing in urban light rail schemes, we would identify even greater problems. There is a commitment towards making evaluation and appraisal more consistent and transparent, but there is still someway to go to produce a universal approach which can deal with multi-modal solutions to an integrated transport system. NATA is intended to be so extended, but this is not likely to be an easy development.

Conclusions

In this paper we have reviewed the ways in which the appraisal process for transport projects is undergoing major changes. This process needs to deal with a situation in which a consistent and transparent procedure is required for different modes, different types of project (traffic restraint and management as well as capital investment), and different sources and types of finance. It has been shown that it is not an easy task to expand a well-tried, if limited in scope, cost-benefit analysis procedure to include these additional elements. In particular there are serious remaining difficulties concerning the inclusion of environmental impacts, accessibility issues, the question of reliability, and the wider economic impacts on a region. What remains clear is that any advance will have to produce transparent and challengeable criteria if it is to become acceptable as the basis for taking decisions which can be defended.

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Table 1 NATA Criteria

• **environmental impact**	noise local air quality landscape biodiversity heritage water
• **safety**	
• **economy**	journey times and vehicle operating costs journey time reliability scheme costs regeneration
• **accessibility**	access to public transport community severance pedestrians and others
• **integration**	

Table 2 OPRAF Checklist of Impacts

• **Impacts on operators/providers**:	Financial costs and revenue
• **Rail user impacts**:	Fares Journey time Frequency Reliability and punctuality Interchange requirements Crowding Rolling stock quality Station facilities Information facilities Ticketing facilities Time of first and last services Passenger security Disabled access On-train cycle facilities Safety
• **Impacts on travellers by other modes**:	Congestion Crowding Safety
• **Environment:**	Local Regional
• **Other impacts**:	Option values Transitional costs of change Preference for status quo Accessibility

Table 3 Annual average values of time per person (1994 values)

Vehicle	Occupancy	Time mode	Value of time (pence per hour)	
			per occupant	per vehicle
Car (working)	1.00 driver	Working	1289.8	
	0.11 passenger	working	1070.6	1407.6
Car (non-work)	1.00 driver	Non-working	315.0	
	0.74 passenger	non-working	315.0	548.1
Average car	1.00 driver	Assumes 14.6%		
	0.65 passenger	in work mode		673.6
LGV (working)	1.00 driver	Working	1003.1	
	0.42 passenger	working	1003.1	1424.4
LGV (non-work)	1.00 driver	Non-working	315.0	
	0.60 passenger	non-working	315.0	504.0
Average LGV	1.00 driver	Assumes 72% in		
	0.47 passenger	work mode		1166.7
OGV	1.00 driver	Working	945.0	945.0
PSV	1.00 driver	Working	983.1	
	12.1 passenger	non-working	315.0	
	0.1 passenger	working	1064.4	4901.0
Average vehicle				784.4

Table 4 Values applied to accident costs (1994 values, £)

Accident type	Casualty	Insurance Admin	Property Damage			Police Costs		
			Urban	Rural	Motorway	Urban	Rural	Motorway
Fatal	784090	163	4224	7165	9114	1034	980	1435
Serious	89380	101	2264	3266	7776	87	242	226
Slight	6920	62	1336	2165	3934	31	31	31
Damage only		29	956	1427	1372	2	2	2

Figure 1 Measuring benefits with induced traffic

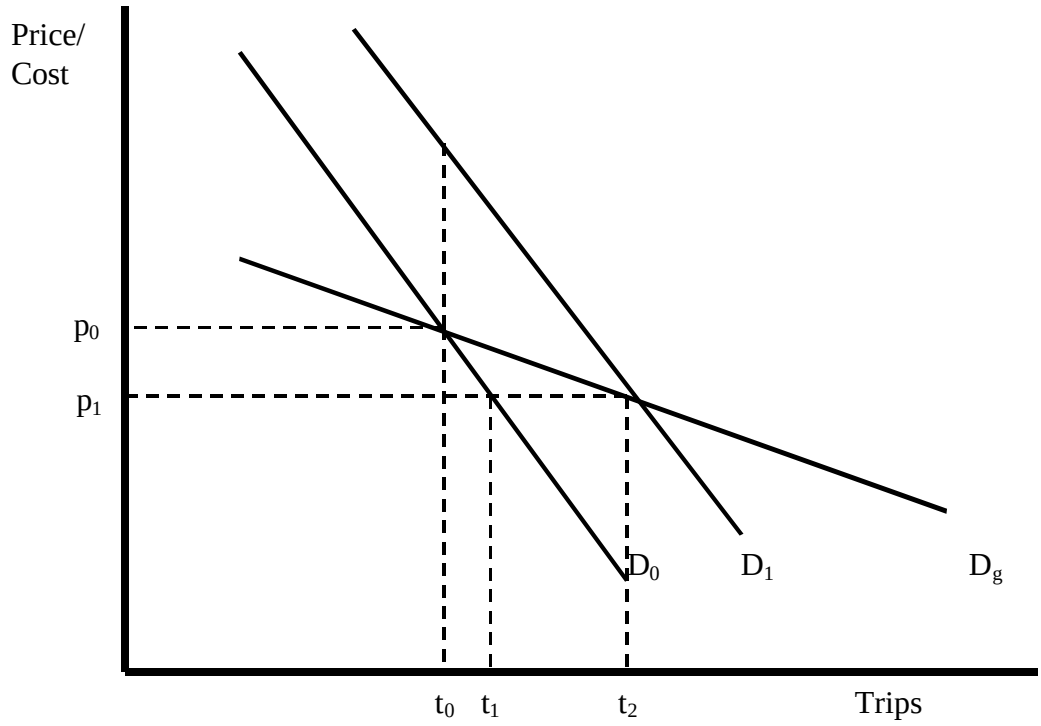

Figure 2 Comparison of AST Results for Two Schemes (DETR, 1998c)

SCHEME		**A2 (Bean-Cobham Ph.1) (GOSE) 1996 Scheme - 6km D4 on-line widening Cost £44m**	**A4 Waggoners/Henlys Corner (GOL) 1996 Scheme - two A4 jct. improvements Cost: £14.1m.**
OBJECTIVES		**ASSESSMENT**	**ASSESSMENT**
ENVIRONMENT	**Noise**	0 properties win or lose with scheme	0 properties win or lose with scheme
CO_2 : 0-2000 tonnes added	**Local air quality**	+ 12 PM10 + 27 NO_2	-9 PM10 -32 NO_2
	Landscape	Slight -ve	Neutral
	Biodiversity	Slight -ve	Neutral
	Heritage	Neutral	Neutral
	Water	Moderate –ve	Neutral
SAFETY	-	PVB £*2.0*m 7% of PVC	PVB £2.4m 24% of PVC
ECONOMY	**Journey times & Vehicle op costs**	PVB £41m 141% of PVC	PVB £248m 2490% of PVC
	Cost	PVC £29m	PVC £10m
	Journey time reliability	Moderate*l* High rel. to PVC	N/A N/A
	Regeneration	Yes Yes	Yes -
ACCESSIBILITY	**Pedestrians and others**	Neutral	Slight *+ve*
	Access to public transport	Neutral	Moderate +ve
	Community severance	Neutral	Slight *+ve*
INTEGRATION	-	Positive	Neutral
COBA		PVB £43m PVC £29m NPV £14m BCR 1.5	PVB £250m PVC £10m NPV £240m BCR 25

Footnotes

[i] Urban road schemes are appraised with a variant URECA (URban EConomic Appraisal) and in 1994 a Common Appraisal Framework (CAF) was developed to deal with the comparison of different modes or package approaches but the basic principles are similar.

[ii] Trunk Roads are the main national road network (including motorways) which are wholly the responsibility of central government, through the Highways Agency. Other roads are variously the responsibility of central and local government to different degrees. However, all roads for which any central government funding is provided are subject to COBA procedures.

[iii] Separate, but similar exercises were conducted for Scotland and Wales by the Scottish and Welsh Offices.

[iv] The *New Deal* also proposes the reduction of the national trunk road network to about 60% of its previous length with a gradual transfer of responsibility for the remaining routes to local authorities.

[v] For a review of NATA see Price (1999) and a more critical assessment see Glaister (1999)

[vi] In practice such competition has been "moderated" for the first few years of most franchises.

[vii] Freight operations were split into different types of traffic and sold rather than franchised. In practice most operations have been regrouped in the private sector into a single operator.

[viii] It is of course more complicated where a major route improvement investment is to occur which also requires new rolling stock, but the same basic principles can be extended to cover this case.