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International Comparisons of Transport Appraisal Practice

Overview Report

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International Comparisons of Appraisal Practice

Country Reports

Annex 1	A Guehnemann, C Kelly, P Mackie and T Worsley (2013) Transport Appraisal Practice in England.
Annex 2	A Guehnemann (2013) Transport Project Appraisal in Germany
Annex 3	G de Jong (2013) Project Appraisal in the Netherlands
Annex 4	J Eliasson (2013) Project Appraisal in Sweden
Annex 5	G Weisbrod (2013) Transport Project Appraisal in the US
Annex 6	N J Douglas with T Brooker (2013) A Review of Transport Project Appraisal in NSW Australia
Annex 7	N J Douglas, I Wallis, A Lawrence and D Wignall (2013) A Review of Transport Project Appraisal in New Zealand

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Executive Summary

This report is a review of recent developments in economic appraisal in the transport sector and the use of appraisal in the decision making process. Appraisal practice in England, and its development, is compared with that in Germany, Netherlands, Sweden, USA, Australia (NSW), and New Zealand as exemplars of good practice and varied institutional arrangements. Country experts were used to provide the country reports which are available as Annexes.

There is much to be learned from international practice both in appraisal guidance and conduct and in the ways in which appraisal results inform decision making.

The framework of economic appraisal in transport is well established practice across the countries studied. While there are differences of values, emphasis and content, the similarities far outweigh the differences. No radical alternative frameworks are in use by these seven countries.

The evidence base in England is comparable in quality with best practice elsewhere. Progress has been made in the treatment of significant components such as the evaluation of reliability, crowding, carbon and other emissions and wider economy impacts.

WebTAG remains the leading model of open documentation of appraisal guidance and is frequently used as a benchmark by other countries.

English practice has gone further than most in extending the use of appraisal beyond its core application to road and rail investment. Guidance now covers policy areas from walking and cycling to aviation and dimensions such as social and distributional impacts.

There are interesting differences of country practice according to institutional organisation, notably between unitary and federal countries. This has resonance for possible future development of appraisal guidance in the context of the localisation agenda in England.

All countries use transport appraisal results to input into decisions but how this works is not always fully transparent. The Transport Business Case approach introduced in 2011 brings together the economic, strategic, financial, commercial and management strands together in an overall case informed by a single evidence base.

1. Introduction

In 2005-6 a study was commissioned by the EU entitled Harmonising European Approaches for Transport Costing and Project Assessment (HEATCO). This was a review of the practice of cost-benefit analysis in transport across member and accession states which remains useful as a statement of the position at the time. Subsequently the Department for Transport commissioned a review based on HEATCO as an input to the refresh of the New Approach to Appraisal (Mackie and Kelly 2007). These reports are reviewed in Annex 1 and form the background against which subsequent developments in the state of the art are described.

Along with the Netherlands and Scandinavia, the UK has been a leader in the sense of having

- A strong tradition of doing transport project appraisal
- Guidance Manuals which constitute a clearly defined framework for appraisal which is to be followed throughout the project cycle
- A Framework populated with measures and values of the impacts which are based on evidence generated from research studies
- A policy intention that the results of appraisal work should be a significant influence on the case for investment and on prioritisation within programmes.

The question being addressed in this study is how English practice benchmarks now against appraisal practice elsewhere. Inevitably, to answer this question involves assembling evidence and then making judgements, taking English practice and appraisal guidance as the reference case. There is really little point, even if there were time and budget, in repeating the HEATCO study of all European Union and accession countries. Instead we compare developments since 2006 with those in Netherlands, Sweden, Germany, USA, Australia (New South Wales) and New Zealand. We chose these comparators to be exemplars of countries with serious track records, a mixture of unitary and federal forms of organisation and because we were in a position to call on academic/consulting expertise and knowledge of those countries within the ten week timescale of the project. We undertook or commissioned country reports for England (Guehnemann, Kelly, Mackie and Worsley 2013), Germany (Guehnemann 2013), Netherlands (de Jong 2013), Sweden (Eliasson 2013), USA (Weisbrod 2013), Australia (NSW) (Douglas and Brooker 2013) and New Zealand (Douglas, Wallis, Lawrence and Wignall 2013). These reports are more detailed Annexes 1 to 7 to this overview which is intended to be read as a free standing document.

Appraisal is the servant of institutional and legal processes which vary from country to country. Therefore it is important to recognise that the requirements of appraisal are not precisely the same everywhere and this can condition the shape of the appraisal process. At a generic level, various purposes and uses of appraisal may be distinguished:

- To aid the process of screening out weak performers at an early stage
- To aid comparisons across modes and policy mixes
- To help refine a large number of options down to a manageable short-list for public consultation
- To help refine scheme design

- To provide indicators and metrics of social value for money and facilitate prioritisation within a programme
- To frame the case on which planning permission is being sought at Public Inquiry
- To provide substantive input to the final yes/no decision making process.

The first three of these purposes are likely to involve cut down methods and data while the last four require full appraisal. 'Full' may vary according to size and type of intervention; proportionality is an important concept.

At a generic level, the assessment process can be described in the following way:

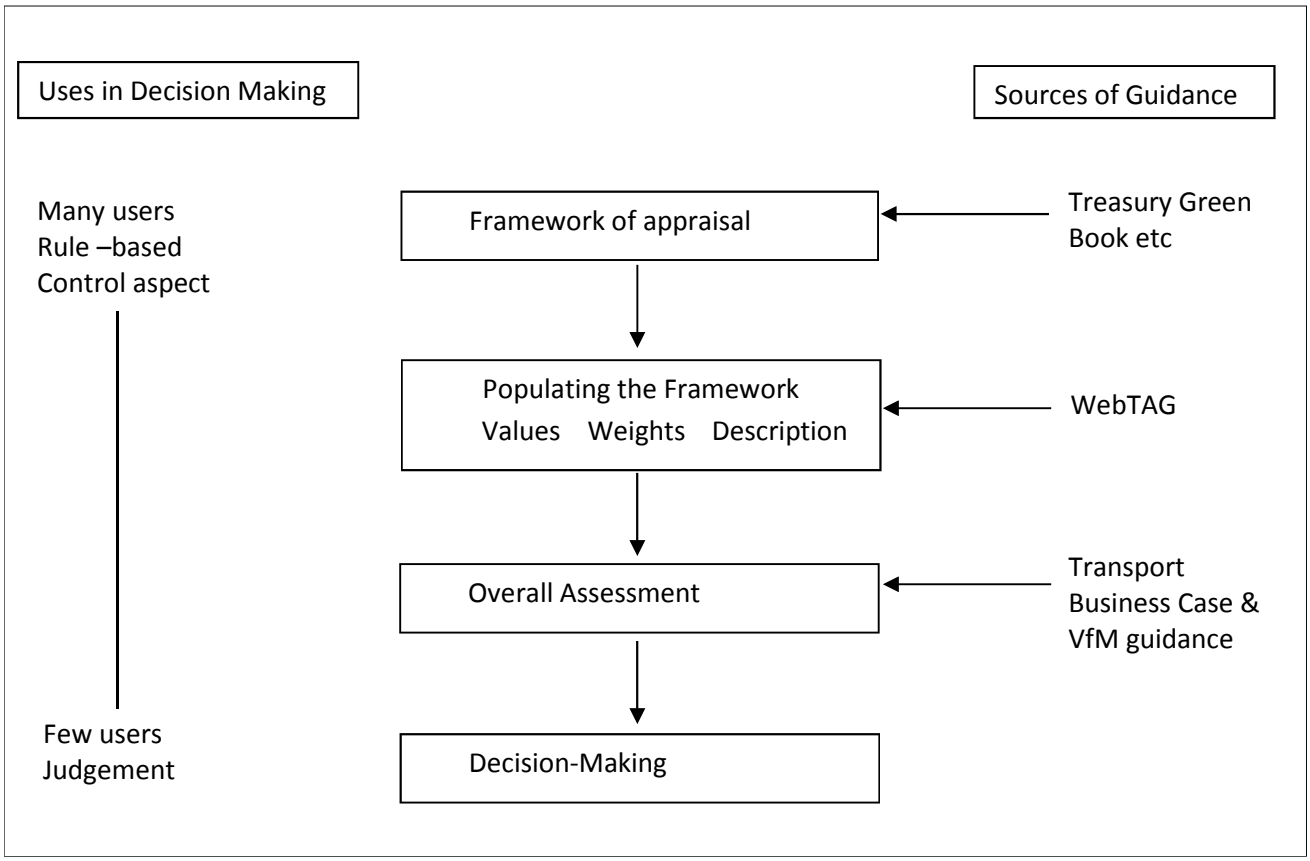

Fig 1. The Assessment Process in England

A particular feature is the concept that appraisal should provide a level playing field for appraisal work which takes place at a decentralised level for many sponsors and across transport modes and location types. Therefore the appraisal methodology is relatively highly codified while the decisions themselves are more judgement based. How the appraisal rulebook interfaces with decision-taker judgement is therefore also of interest.

In the next section we review the framework of economic appraisal, in section 3 we examine how it is populated with values and weights, in section 4 we examine the applications of appraisal across modes and policy instruments, and in section 5 we examine developments in the linkages between

technical appraisal and the broader Transport Business Case approach introduced in 2011. The approach we use is to compare the English[1] appraisal system and WebTAG guidance against the other countries. This is done in a selective rather than an exhaustive way in the text and is supported by four comparison tables. Finally in section 6 we draw conclusions.

2. The Framework of Economic Appraisal

In this section we will consider the economic appraisal process reserving for section 5 how this interfaces with other components of the overall appraisal. There are far more similarities than differences in the economic appraisal frameworks used within these countries. There is an international literature and practical experience and a degree of commonality is to be expected. So we find that the aim of these systems is to help assess national value for money, and that the tools used are cost-benefit analysis for the monetised components, and a mixture of quantitative and qualitative approaches for the non-monetised components. The overall tendency has been to move in the direction of monetisation as, for example, in the cases of climate change, local pollution and noise.

To varying degrees, the appraisal guidelines are a transport sector application of broader policy guidance from the ministry of finance. This is particularly true in areas such as the choice of discount rate, numeraire and appraisal metrics where there is no good reason for the transport sector to be different from any other sector. All seven countries have transport appraisal manuals, and the federal countries more than one (for example Germany has at least three).

The comparison of appraisal framework rules is shown in Table A on page 21. Again there is a fair degree of similarity but also some differences:

- The four European countries use low (3 to 4%) discount rates together with quite long project lives whereas the USA and Australasia use higher discount rates with shorter lives. This raises the question in the European cases of how transport capital is rationed because it implies that the minimum hurdle of a BCR of 1 is set rather low and more projects will jump it than there is budget to fund.
- Both market prices and factor costs are used as the appraisal numeraire. The New Zealand authors question whether treatment of appraisal entries is always consistent.
- No overt shadow prices for public funds or unskilled labour are used except that Sweden uses a 30% uplift to the face value for net public expenditure.
- Benefit : Cost Ratios are commonly used. Precise definitions vary, for example Sweden uses total investment cost as the denominator implying a capital constraint.
- In addition to the usual NPV and BCR, New Zealand uses a first year rate of return to test for optimal project timing. The US in addition has GDP per dollar and jobs per dollar metrics.
- Non monetised impacts are always presented in a framework table. Germany has a red flag procedure where environmental constraints are violated. Generally, the non-monetised impacts are not explicitly traded off but Australia (NSW) is an exception.

[1] We focus on the English appraisal guidance WebTAG being aware that the Scottish equivalent STAG while broadly similar differs in a number of respects.

- Treatment of risk and uncertainty is less uniform with a range of approaches including discount rate uplift (Netherlands), no explicit guidance (Sweden, Germany) with England's Quantified Risk Analysis approach in this respect more like US/Australia/NZ.
- The appraisal was in general seeking to measure the benefits to the nation, but this could vary according to the funder and there were acknowledged issues concerning the treatment of international traffic and transboundary impacts.

Probably all of these countries now have rather similar analytical framework practices. However whereas English transport appraisal practice is largely founded on the Leitch Committee Report (ACTRA 1978), most of the comparators were building their frameworks in the 1990s and 2000s. Our impression is that England has gone further than other countries in systematic codification through WebTAG, which we believe is an international reference point. Other countries have their own practices and evidence base but UK work is frequently referred to. However there is now much more to be learned than there used to be from international experience.

Equally, appraisal guidance in England can be seen to have pushed the envelope in various ways over the last decade. The guidance on subjects such as wider impacts, walking and cycling, social and distributional impacts and aviation has developed as has the concept of proportionality and a degree of flexibility in appraisal according to what is assessed to be significant. So, within the established framework, there has been evolution.

3. Populating the Framework with Values and Weights

At the broadest level, the content of the appraisal frameworks of the seven countries is similar. It is also broadly the case that the same components have received most development attention over the last decade: reliability, comfort and crowding, wider economic impacts and climate change warrant mention. The development of appraisal frameworks appears to be relatively mature so that there are interesting differences but broad similarity. Tables B and C below give the appraisal treatment and provenance of the values and these are discussed below.

Travel Time Savings

All countries use monetary values for travel time savings (VTTS). All have standard appraisal values but in some cases (Germany, New Zealand for example) differentiation by transport mode is used. Some particular features are noted below:

- Commuting time savings are valued 10% higher than Other Non-Work journey purposes (e.g. leisure) in England but the differential is larger in Netherlands and Sweden
- Germany applies a 30% discount to the VTTS for road travel time savings below 5 minutes
- Whereas England does not differentiate VTTS by journey length, Sweden does differentiate VTTS for short and long distance trips with appreciably higher values for car long distance.
- Walk and wait multiples to in-vehicle time are widely used; the multiples are a bit higher in England than USA and Australia.

- The England employers business values appear high both absolutely and relative to the non-work values (over 5 x the non-work value versus 3-4 x in the other countries.
- For logistics values, the UK approach includes drivers' time and vehicle operating cost changes. In Sweden, the interest on capital in transit is also included. The Dutch approach is a total willingness to pay approach based on stated preference (SP) interviews with shippers and carriers.

It is not quite clear from Table C which studies contain genuine empirical evidence and which are reviews, but the England values of non-work time, based on original work by AHCG (1994) seem dated relative to other European countries. However the values used in the UK have also been informed by meta-analysis work which can provide a wider source of evidence to supplement the national value of time studies. Whereas twenty years ago national value of time studies were the principal source of evidence that is not the position today. New work is about to be reported for the Netherlands and is under way for Germany. The value(s) for travel time savings remain a crucial parameter for the economic appraisal of transport projects in all countries both because time savings tend to dominate the monetised benefits of most schemes and because other values such as reliability or public transport crowding are themselves multiples of the value of time savings.

Reliability, Comfort and Crowding

Reliability benefits is a topic which has seen progress in the last decade; indeed all entries in Table C are post 2000. All countries except Germany have guidance on valuing changes in reliability. England and USA have similar reliability ratio methods for road travel. England, Sweden and Australia (NSW) use a multiple of 3-4 x the value of in-vehicle time for the value of lateness including variance on public transport. This is a topic where the bigger challenge lies not so much with appraisal as with modelling the impact of projects and interventions on user behaviour, system performance and outturn reliability. It is important to note that currently the reliability evidence base in England is more embryonic than that for travel time and safety, so reliability impacts do not appear in the core BCR but are incorporated in the adjusted BCR which informs the value for money assessment.

Most countries except USA have multipliers to in-vehicle time for crowding relief on public transport, and English practice has developed strongly in relation to rail commuting and long distance travel. Unlike England, Sweden and New Zealand have mark ups on in-vehicle time for driving in congested conditions. Comfort and crowding have seen a significant amount of research work in recent years; it is probably true to say that the focus of policy attention is shifting from travel time savings to journey reliability and quality and that the effort to improve the appraisal system is responding to this development.

Safety

By contrast, the methodology for valuing safety benefits based on the value of statistical life (VOSL) with relativities to serious and slight injury was largely worked out in the 1980s and 90s. The England standard values are in the same ballpark as others except that the USA is an outlier with a VOSL now over three times the England value following a 50% uplift earlier in 2013. The US approach, using a hedonic model of wage compensation for risk applied to occupational mortality data is different

from European methodology based on lost output and stated willingness to pay to reduce risk. The rule of thumb that if VOSL = 100, value of serious casualty =10 and slight casualty=1 works well except in Sweden where serious casualty =80. All countries have new reports since the turn of the century but it is not known whether all contain new empirical evidence on willingness to pay or economic output effects. Like the VTTS, the VOSL has an importance beyond the category of benefit to which it was originally applied, being the basic value for deriving the value of fitness and health benefits from walking and cycling.

Fitness and Health

A significant development to appraisal guidance has been the inclusion in WebTAG from 2010 of specific guidance on health benefits and physical fitness impacts. This comes through particularly in the appraisal of walking and cycling schemes for which the use of the World Health Organisation's HEAT tool is mandated. Progress in this area is common, thus Sweden now follows the same WHO methodology, and Australia and NZ have extensive guidance relating to walking and cycling. In the US, funding for walking and cycling is from a different pot from other urban transport and is in competition with amenity and recreational projects, so assessment is handled differently and methods for benefit valuation are at the experimental stage.

Wider Impacts

This has been one of the most dynamic areas in appraisal over the last decade. For many years, English appraisal practice was based on the proposition that the measured transport benefits were an acceptable proxy for the final economy wide benefits. This proposition came under scrutiny in the 1998 SACTRA report on Transport and the Economy. Subsequently, a work programme was undertaken leading to a discussion paper (DfT 2005), the current WebTAG guidance and computation software (WITA).

Four sources of additional wider impact on economic efficiency are acknowledged in the guidance :- agglomeration impacts; output changes in imperfectly competitive markets ; labour supply impacts ; move to more or less productive jobs. The last two of these are valued in terms of the additional tax revenues generated by the change in labour supply. DfT (2005) and later papers on agglomeration impacts supported by evidence from Graham et al in a series of studies have been influential worldwide. Australia and NZ have applied Graham's work in their city contexts while Sweden has done work along similar lines.

Other countries have been developing other lines of approach including input/output models (Netherlands REMI; USA TREDIS). Computable general equilibrium models including RAEM and CG EUROPE have been tried as research tools (Elhorst and Oosterhaven (2008) ; (Brocker et al, 2010)) but have not entered official practice. Gunn(2004) in a report for DfT concluded that without much better regional accounting data it would not be feasible to use SCGE approaches in UK practice. The USA is notable for considering a range of impact pathways beyond commuting. These include logistics and supply chain impacts, connectivity to corridors and gateways, and intermodal interchanges. Some of these approaches extend well beyond the economic welfare framework of cost-benefit analysis and are based on regional or local macroeconomic models.

Recent economic history has further accentuated the importance of understanding the wider economy impacts. This topic has probably shown the greatest pace of development of any in recent years with the consequence that control of good practice is especially required. Further research has been commissioned by DfT on the connectivity impacts of joining up regional labour markets and on international business impacts.

Regeneration

This is a topic which is important politically but where there is least consensus on what should be included, how it should be measured and where within the appraisal it should be picked up. In England, Wider Impacts (above) is the category used for external economies at national level. Regeneration is used for local impacts of a distributive nature, where there is a local benefit associated with changes in conditions in target areas. Three of the other six countries responded that regeneration impacts are not included. In Germany employment effects from construction and operation of infrastructure are central in its appraisal method with regional differentiation based on regional unemployment rates. The USA considers regeneration as a separate element within a multi-criteria analysis rather than as a monetised component of the CBA. Australia reports estimating induced population and employment changes at corridor level which is more akin to the efficiency benefits of induced land-use change than to the distributive impacts.

Not much work has been done on this WebTAG unit in the last ten years during which time other material on Wider Impacts and Social and Distributional Impacts has been introduced and the economic environment has changed. This WebTAG unit could be ripe for revisiting in the context of Treasury's forthcoming review of the Green Book and the desire for consistency across skills, land development and accessibility in the assessment of urban regeneration.

Noise

Values have been introduced for noise in the last decade in Europe. Comparisons are not straightforward because the units and scales are not the same. The European approaches are based on willingness to pay whereas in US and Australia, the mitigation cost approach is used. The English approach based on a 2004 study of noise values by residents in the West Midlands by Bateman et al is reasonably up to date and is used for road, rail and aviation appraisal. Work for DfT by Nellthorp, Bristow and Day applied the benefit transfer method to derive national values from those estimated in the West Midlands but issues remain concerning valuations in particular locations (town, rural) and property (rented) categories.

Local Pollution

This area has seen a great deal of work in recent years with English values based on a 2008 DEFRA study. Again comparisons are difficult and some pollutants eg PM2.5; volatile organic compounds are included in assessment in one or more countries. The method uses the impact pathway approach, a bottom-up approach linking changes in air quality to the modelled health effects and willingness to pay for changes in health/life quality. As with some other impacts, modelling and forecasting changes in impacts is probably a greater challenge than valuation.

Climate Change

These impacts have universally been monetised in the last decade, with the 2006 Stern Report being hugely influential. The English approach is to use a price which includes the forecast European Trading System prices for the appraisal of costs/benefits in the traded sector and marginal abatement costs for the non-traded sector. The latter are currently substantially higher, with the two sectors assumed to align by 2030. In other countries, shadow price of carbon approaches are commonly used and are applied to all transport energy use. The values used in England, Germany and Netherlands for the non-traded sector seem comparable for the early years, with Sweden's values higher and the US and New Zealand much lower.

Environmental Capital

The landscape, biodiversity and heritage impacts are generally assessed in a qualitative or descriptive way, sometimes with the use of a scoring scale. The treatment of these impacts has remained relatively stable since 2006 in England. The view of many is that expert judgement based on case by case assessment is the most credible way to handle these impacts. A recent study by Atkins and Metroeconomica looking at how an ecosystem services approach, based on the services provided by the natural environment and how they might be affected by transport schemes, may take this area forward.

Other

We asked country authors for other significant components. Responses included traffic fumes; water pollution; severance; spatial impact assessment; security/resilience to landslides, flooding etc; option values. Several of these are covered in WebTAG but were not explicitly included in our listing for reasons of length. Within the English approach, the guidance on assessment of Social and Distributional Impacts stands out as substantially more ambitious than is attempted elsewhere. A different category also mentioned was the appraisal treatment of induced effects—both traffic and land use change.

4. Applying the Guidance

It has not always been clear exactly what the appraisal regime applies to and where the boundaries are. Therefore we asked the countries and the responses are set out in Table D.

The core application of appraisal is to capital projects requiring public funding. So, road, rail and bus/tram infrastructure projects are mandatory for appraisal in all countries. The general appraisal guidelines may be supplemented by specific guidance for particular modes; the rail PDFH in England is a well developed example which, though focussed on forecasting, also has appraisal content. Guidance on appraisal of walking and cycling schemes has developed rapidly in the last decade.

Application to air and water transport is less uniform. Thus the Swedish response on air is 'seldom' and for Germany there is no specific appraisal guidance. New Zealand sees air (and sea) as commercial sectors. Here, the aviation guidance section within WebTAG is in advance of practice

elsewhere if it is accepted that there are national planning reasons for social appraisal of projects in the air sector. By contrast, the Dutch and Germans do seem to have more extensive appraisal guidance than the English for ports, maritime and inland waterways (not surprisingly in the latter case given the importance of the Rhine, Scheldt and other waterways for freight movement).

The next distinction is between National, State and Local. In Federal countries with legal specification at the different levels, this is well developed. So, Federal Government may require appraisal to its specification and standards of its own projects and of State/Local projects seeking Federal funding contributions. For these projects therefore, there is a double hurdle—does the project meet the Local or State criteria according to local assessment guidance and does it meet the appraisal criteria for Federal funding support? For unitary countries including England, these formal distinctions are less clear, but the current moves towards devolved or localised forms of governance increase the importance of considering how national appraisal meshes with local and the respective accountability of local and central government for public money spent on transport investment.

Turning from capital projects to current expenditures, the position is patchier. Maintenance of both road and rail infrastructure is a large sector for which cost-effectiveness and life cycle models for asset renewal are more appropriate than full scale appraisal. The issue is usually not whether to close down an asset but how best to renew it and with what priority. Questions of upgrading and betterment may be more suitable for appraisal (what line speed, what capacity) and Australia makes reference to train refurbishment cases in this context.

For public transport revenue support, there is a mixed picture. So, in England, appraisal of changes to rail franchise specifications has been common and recently appraisal guidance has been applied to national revenue support programmes for bus service provision in the context of Spending Reviews. Appraisal guidance for the other European countries seems rather limited in this area. In some cases (eg Australia) other agents such as regulators come into the picture.

Finally, the role of appraisal in the public consultation and public inquiry processes should not be overlooked. Appraisal provides the framework, and much of the content around which planning issues such as route location, land take, mitigation and compensation are determined. The appraisal regime underpins a great deal of work on design choices and option development. This appears to be similar in most of the other countries even if the precise arrangements differ.

5. The Use of Appraisal in Decision-making

In this section, we make the transition from the technical content of the economic appraisal and its application to its use in decision support. The starting point for the comparison is England, where recent developments have occurred which are reviewed in more detail in Annex 1.

The DfT provides extensive documentation of the decision-making process used for transport projects and programmes. There are 3 stages to the process, starting with the Strategic Outline Business Case, moving through the Outline Business Case and refining the chosen option in the Full

Business Case. The Transport Business Case[2] is made up of 5 separate components, the strategic, economic, commercial, financial and management cases, each of which provides evidence on a different aspect of the project to inform decision-makers about the strength of the case for the project. The DfT's Value for Money Guidance, referenced in the Transport Business Case, explains the approach taken to determine the value for money category into which a project is placed. One of the DfT's published input indicators is the proportion of investment spending on schemes with 'high' or 'very high' value for money, which in 2011 amounted to 99.6%.

The Transport Business Case recognises that there is a gap between the economic appraisal and the information required to support decisions. In the same way, none of the countries studied rely entirely on the results of the economic appraisal to prioritise the projects which are under consideration. Decision makers' roles extend much further than simply setting the budget and approving all schemes, suitably ranked, that can be funded from the budget. Information on the ways in which the cost benefit analysis is complemented by other evidence and analysis was not always easy to obtain, and we set out below our understanding of the approaches used in those countries which provided us with some information on the decision-making processes that they employed.

Our assessment shows that countries which employed cost benefit analysis were aware of two limitations of the approach and attempted to ensure that decision-makers were provided with information that helped to ensure a more holistic process. The first limitation occurs because of the extent to which cost benefit analysis, as practised in the countries we have examined, is restricted to the impacts whose effects can be measured and valued in monetary terms. Most countries had adopted a means of scoring other significant impacts against a qualitative scale to ensure that the welfare economic framework that underpins cost benefit analysis was more comprehensive than a process which omitted all non-monetised impacts and that these impacts were therefore drawn to the attention of decision-makers. However, the process for assessing the weights that were given to these impacts was largely judgemental and not documented.

A second limitation is the policy priority given to the potential impacts of transport schemes which fall outside the welfare-based economic cost benefit framework. The recession, and its uneven impact across many of the countries we have studied, has resulted in public investment being targeted on productivity and growth. Decision-makers need to know how far the investment in transport schemes that they approve will contribute to increased productivity and to redressing the regional imbalance in output. Of the countries we have studied, the US and Germany (and for some purposes New Zealand) follow the practice of identifying strategic objectives which are additional to the objectives covered in the cost benefit analysis. While all countries provided documentation of the methods of cost benefit analysis used, none were able to tell us how quantitative or qualitative estimates of the likely performance of the option against these wider strategic objectives are obtained. It was not clear how such risks as double counting and consistency were managed when decision-makers were provided with both the BCR from the cost benefit analysis and the additional information about the expected effects of the scheme. In the following paragraphs we describe briefly the ways in which appraisal is used in four of the countries studied, selected because our

[2] https://www.gov.uk/government/publications/transport-business-case

contacts in these countries provided us with more information than others on the influence that economic appraisal had on decisions.

The USA

The US, as a country with a federal government, has adopted processes for making decisions which differ according to whether the source of funding is through a discretionary federal grant or through state funding, supplemented by a formula-based federal contribution. The US DOT requires projects it funds to be appraised using a traditional cost benefit analysis, with most environmental impacts valued in monetary terms. Interestingly, there is no guidance about those environmental capital impacts that European countries tend to measure on a qualitative scale, since, under US law, heritage is protected against any incursions. GDP related objectives have recently been taken into account in the guidelines for applications for funding under the TIGER (Transport Investment Generating Economic Recovery) programme (2101-12) which state:

> "Priority consideration will be given to projects that: (i) Improve long-term efficiency, reliability or cost competitiveness in the movement of workers or goods (including, but not limited to, projects that have a significant effect on reducing the costs of transporting export cargoes), or (ii) make improvements that increase the economic productivity of land, capital or labor at specific locations."

There is no mandatory appraisal method required for projects funded by individual states. All use an appraisal process but the information provided to decision-makers differs between states. Some states use Multi Criteria Analysis, identifying factors of particular importance to that state and its transport users, effects on productivity, and the degree of public support and then weight these criteria to provide a summary table and score. Others use cost benefit analysis supplemented by an analysis of the impact on the local economy, while other states focus more on the impact on the local economy. Estimation of local economic impacts is facilitated in the US by the existence of regional economic models, such as REMI and TREDIS, and the fact that, with freight being the major beneficiary of many state highway schemes, transport cost changes are more easily modelled than in the case of business time savings, since regional or national accounts do not generally include business travel as an explicit input cost to the provision of business services.

Germany

Germany provides another example of a federal system with some differences between the methods of cost benefit analysis used by the different tiers of government. The German approach is based on ranking schemes according to their benefit cost ratios after taking full account of non-quantifiable impacts on habitats and on the environment. The appraisal of these impacts serves to establish what mitigation measures or alternative will be implemented in order to protect natural resources and whether this is feasible and affordable. No analysis of the impacts of a scheme on the economic performance of the state or of region is carried out, although additional 'points' are attributed to schemes which serve low income regions. It was not clear whether this difference from most other countries was explained by the absence of a reliable evidence base on which to base a model of the impacts on regional economic output and productivity, or whether decision-makers in Germany believe that they have no need of such information in order to make defensible decisions. Projects are ranked by their BCRs and projects with BCRs below 1 are not proceeded with.

New Zealand

New Zealand makes extensive use of cost benefit analysis based on techniques and research which is advanced for a country of its size and which draws largely on English practice. Cost benefit analysis forms only a part of the evidence seen by decision-makers and is supplemented by an assessment of the project's strategic fit with policy objectives and of the project's effectiveness in resolving the problem identified, the 'three case model'. Consideration is being given to moving to a Treasury Better Business Case Model which is based on the HM Treasury model, modified to take account of the Australian State of Victoria's Investment Management Standards.

The evidence we have seen on the use of appraisal in New Zealand does not explain how decision-makers weigh up the information provided to them under the 3 case model currently in use. However, evidence of declining BCRs for the schemes approved suggests that considerations other than the economic welfare impacts are increasingly being taken into account. The assessment made against these three criteria is used to rank schemes, with prioritisation being subject to the further requirement of maintaining spending in line with past levels on each 'activity class'. The final decision on a scheme is made by the NZ Transport Authority Board on the basis of the information provided through this multi-criteria approach.

Sweden

The principles of cost benefit analysis are widely accepted as a means of delivering transport policy objectives in Sweden. Appraisal takes place in the context of the Ten Year Transport Plan which is updated every four years. Schemes included in the Plan generally have BCRs in excess of unity. The understanding that schemes with BCRs below unity are unlikely to be included in the Plan influences the choice, design and specification of projects put forward for inclusion and therefore serves as a valuable tool for sifting out options which are weak in cost benefit terms.

Evidence on how the ranking of schemes in the Plan on the basis of their BCR influences decision makers when they decide on which schemes to fund is more mixed. Decisions delegated to officials generally show that ranking by BCR is the norm. However, where (presumably in the case of larger schemes) the decision is made by politicians, other criteria, primarily those related to their perception of the local, regional or national economic impacts, tended to influence the decision. Road schemes approved by ministers tend to show higher BCRs than the rail schemes that they fund. Analysis of the decisions made on transport schemes shows that the BCR has become more dominant over the past 20 years in the decision making process and that the appraisal process is better suited to highway schemes than to rail projects.

How other countries compare

No other country provides the information now published on the DfT Website about the process whereby cost benefit analysis informs the decision-making process. The DfT publishes both WebTAG, which details all of the requirements for the economic appraisal of a scheme, and information in its Value for Money Guidance[3] on the process used by decision-makers for

[3] http://assets.dft.gov.uk/publications/value-for-money-assessments-guidance/vfmguidance.pdf

determining priorities between options which have been appraised. Nor to our knowledge do other countries set objectives for and publish information about the performance of the transport schemes that they approve which is the equivalent of the DfT's value for money input indicator[4]. While we have found it relatively straightforward, in the case of the countries we have reviewed, to get access to the methods and values used in the application of cost benefit analysis to schemes, no information was available on its role in the decision process and the contribution of other evidence and analysis to support the decision. Nor were our contacts, all of whom were academics who had worked with their transport ministry in developing cost benefit analysis, always able to describe to us the process or refer us to guidance describing its application.

We surmise from the information provided to us that in each of the countries reviewed the appraisal process plays a role in the decision-making process. It serves at a minimum to provide a hurdle, to sift out weak proposals and to provide some discipline on the design and specification of the project. In most countries decision-makers reserve the right to put their own weights on the final decisions on the grounds either that the cost benefit analysis fails to provide appropriate values for impacts that matter to them or that there are other priorities that fall outside those within the welfare economics framework.

The DfT's adoption of the Treasury's Business Case Model provides good information on much of the evidence that decision-makers have access to when exercising their judgement about the case for a scheme. While the make-up of some parts of the business case is clear from the published guidance, the content of the strategic case is described in very general terms. This is understandable since the guidance is intended to be applicable to the full range of interventions from small to large and across modes and location types. No guidance is provided on how the strengths and weaknesses on the five components of the Transport Business Case are balanced off in reaching a decision in circumstances where the conclusions under each strand are not closely aligned. Rather, decisions on whether to proceed are made by ministers based on their reading of all the evidence presented, supported by recommendations from the relevant boards which are also based on the entirety of the Business Case. As noted above, DfT is not alone in this respect; indeed it provides a better and more comprehensive description of its approach than the other countries in our review. It is a process new to the DfT and we might expect more information and codification to become available as it is put into practice and refined in transport applications.

An assessment of the local or regional economic impacts informs the decisions reached in several US states and in some cases in Sweden, although we did not ascertain whether analysts considered that these estimates were robust and fit for purpose. The greater importance of freight transport, which is more amenable to macro-economic modelling, in these countries and, to a lesser degree, better available data and models, explain why English practice in the area of local and regional economic impacts lags behind best practice.

As the Government moves towards a more regionally driven approach to transport planning and prioritisation, the decision-making process will need to be informed both by the outputs of the cost benefit analysis consistent with national guidance as well as by an assessment of the local or

[4] https://www.gov.uk/government/publications/input-and-impact-indicators

regional economic impacts. However, any assessment of the local or regional economic impacts is hampered by the absence of a widely accepted and codified evidence based method of estimating these effects. This seems to us to be a constraint on sound and consistent decision-making in a future with greater devolution to cities and regions. It appears that most other countries lacked a means of assessing the impacts of a scheme on the local or regional economy which was as well established as the cost benefit methods they used. Countries in which freight cost savings dominate the scheme's benefits had achieved some successes in linking these savings with models of the region's economy. We also noted from the information provided by our contacts that such estimates as might be provided on the level and distribution of economic activity in the regions served by the scheme was particularly important in the case of mega-projects or other national flagship schemes.

Our assessment of the use of appraisal in countries with a federal structure has identified some of the strengths and weaknesses of a more devolved approach to decision-making which is of potential relevance to the government's policy of localisation. Local objectives for transport schemes are not always aligned with national ones. Some US States prioritise projects according to the state government's objectives: for example, in the case of Kansas and North Carolina, in relation to the scheme's impacts on freight and labour market costs, the degree of community support and on engineering considerations. Spending which has been funded locally or delegated to the state by the federal government is not required to be subjected to the cost benefit based methods which are applied to all schemes funded by federal grants.

The City Deal and other policies which implement the government's localisation agenda introduce similar challenges to decision-making process in terms of the relative weights on local and national objectives against which a scheme is appraised. A scheme which delivers objectives for local economic growth may well do so largely at the expense of other parts of the region or other regions, thus suggesting that the local case for the scheme may be rather different from the national one. Unlike most of the countries in our sample, English cities have very limited powers for raising additional local taxation with which to fund local schemes. The DfT has specified, in its recent guidance on local frameworks for funding major transport schemes[5], the role that it will take in auditing and scrutinising the processes used by the Local Transport Body (LTB) for determining priorities and for reaching a decision on the investment programme it approves. LTBs are required to demonstrate that decisions are made in the context of the DfT's Transport Business Case.

Work is in hand to provide the Department with a better understanding of the strengths and limitations of the various approaches to measuring land use changes and other regional, sub-regional and local economic impacts of schemes in this country. If this work is used to develop guidance on the fitness for purpose of the different approaches that have been used, the Department would be at significant advantage in providing scheme sponsors with a codified and transparent approach. The structure of the DfT 5 case business model, with the economic case being based on the cost benefit analysis, while the separate strategic case provides the opportunity

[5] www.gov.uk/government/publications/guidance-for-local-transport-bodies

for assessment of the regional and local productivity effects, is well adapted to multi-criteria analysis where conceptually different impacts are being assessed. While the structure of the decision-making framework is well suited to this approach, the evidence to support the strategic part of it is very much weaker at present than is the well established method of demonstrating the economic case.

The methods of cost benefit analysis in the countries we studied follow a generally similar pattern. Most of them make some allowance for impacts that cannot easily be valued and yet can be a significant part of the costs or benefits of the scheme. But none provided any explanation of how this was done and which might be compared with the DfT Value for Money guidance and the publication of the DfT Value for Money input indicator[6]. This Guidance is relatively recent and the Department has yet to build up evidence of decision-makers' judgements on the weight given to these unquantifiable effects, which would make the process still more transparent and provide evidence for future decisions. The DfT provides in WebTAG extensive information about the content and method of the economic case and publishes details of the economic appraisal of the majority of schemes funded. It seems likely that there will be demands by the public for information about the rest of the decision-making process. This might include both the implicit weights attached by decision-makers to the unquantified benefits in determining the value for money category of a scheme as well as greater detail than in the current explanation of the composition of the strategic case for a scheme.

6. Conclusions and Recommendations

1. Appraisal practice depends on the structure of government-- so countries with a federal structure have national and local (State and/or Metropolitan Area) guidance and schemes therefore need to jump two or more different hurdles.
2. The economic appraisal framework for transport projects, which is a combination of cost-benefit analysis and non-monetised items, is mature technology. The English economic appraisal framework set out by ACTRA (1978) and progressively developed since is an example of good practice. The other countries in our mini comparison have broadly similar frameworks.
3. Many of the developments in economic appraisal for England in the last decade have been in terms of application rather than principle – thus the Department has progressed the guidance for proportionate appraisal and to sectors such as public transport, walking and cycling and aviation.
4. The most significant developments in English appraisal guidance in the last decade have been in the appraisal of wider impacts, reliability, carbon (led by DEFRA/DECC), local air quality and social and distributional analysis. This trajectory is broadly similar in our comparator countries.
5. Some of the most critical values in WebTAG in terms of reported value for money, such as those for travel time savings and safety benefits are based on studies which are approaching

[6] https://www.gov.uk/government/publications/percentage-of-dft-s-appraised-project-spending-that-is-assessed-as-good-or-very-good-value-for-money

twenty years of age. Of course the values have been updated formulaically but it is possible that the underlying preferences have changed. Most other countries in our small sample have more up to date studies. Unlike twenty years ago, there are other sources of evidence such as meta-analysis studies and the Department has commissioned scoping studies and meta-analysis to inform the process of deciding what to do next. The Department is currently considering what to do about modernising the evidence base for its WebTAG time and safety values and depending on that, revising the values themselves. The international values reported in this study are useful evidence against which to benchmark if social preferences in western countries are thought to be similar.

6. In other areas such as reliability and crowding, progress has been made in valuation, and English practice benchmarks well, but the real challenges lie in modelling the impacts of policy interventions. These values are often based on the valuation of travel time and will be affected by changes to the value of time.
7. The key appraisal metrics vary across countries -- for example England uses benefit per unit of net transport public expenditure while Sweden uses benefit per unit of capital (all sectors). The choice of metrics could make a difference for example for pricing and charging interventions and where capital contributions feature.
8. WebTAG remains the leading model of open documentation of appraisal guidance and is frequently used as a benchmark by other countries. However, England is in line with international practice in not having very explicit procedures for summing up the monetised and non-monetised elements in the economic appraisal. This is widely left to judgement within the decision process and trade-offs are permitted. In some countries there are absolute stops on development with certain categories of location (National Parks) or impact (eg habitat) With the exception of Germany, there is little formalised basis for the weights used in the trade off.
9. A significant development in England has been the adoption of the Five Business Case approach. This effectively recognises that the economic case, based on economic appraisal, is not the only determinant of decisions; strategic, economic, commercial, management and financial considerations need to be brought together in a formalised way.
10. There is half a century of experience of undertaking economic appraisal of transport projects and a high level of codification of practice through Manuals, WebTAG etc. By contrast, guidance on what constitutes the strategic case and how to gauge or demonstrate strategic fit is provided in the form of a list of key questions. The DfT guidance on the Transport Business Case goes further than other countries in setting out the overall requirements but delivering them consistently is demanding. For example, delivering economic growth is one of the Department's objectives so the impact on the economy is to be considered in the strategic case. However, there is currently no guidance on how this impact should be measured or reported. If methods are developed to include the impact on the economy, measured by the change in GDP or GVA, as part of the strategic case careful consideration will have to be given to how it meshes with the economic case. Similar issues arise in other countries, especially the USA where there is more experience of Economic Impact Assessment.
11. Localisation and the City Deal mean that the institutional environment within which appraisal of urban schemes has to sit is evolving. The role of appraisal guidance will require

reconsideration as the changes in responsibility and accountability of the various parties work out in practice. This needs to be informed by the experience and arrangements in more federal countries.

12. There could be scope for an occasional international forum and information exchange on appraisal involving both officials and academics/consultants.

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WebTAG see http://www.dft.gov.uk/webtag/documents/index.php

Table A General Appraisal Framework Rules

	England	Germany	Netherlands	Sweden	USA	NSW Australia	New Zealand
Appraisal Period	Default 60 year operating life	BVWP 2003 and review 2009/2010 (federal roads, rail, inland waterways) Component specific service lives and annuity factors	Varies, e.g. 100 years or infinite	Varies 40-60 years depending on type of investment	Varies depending on project life cycle, typically 25 – 30 years	Varies – 30 years life for roads, 50 for rail tracks & tunnels, 35 for rail rolling stock, 15 for buses. Most rail evaluations adopt 30 year horizon.	Max 30 years for road projects, "from the year in which significant benefit or cost commences" (in practice, understand this is usually taken as from the start time of significant construction expenditures). [EEM1, 3.7; EEM2, 5.8] Currently subject to EEM Review [EEM1 2.6]
Discount Rate	3.5% for first 30 years then 3%	3%	2.5% (plus 3% risk premium)	3.5% (changed from 4% recently)	Federal: 7% with sensitivity for 3%; States: vary 3-7%	7 %, with sensitivity tests of 4% and 10%.	8%--rate recommended by NZ Treasury (2008) for public sector transport evaluation. Reduced from 10% in 2008.
Unit of Account	Market Prices 2010 price/value	Factor prices 1998 basis (updated to in review 2009/2010)	Was factor cost, but now includes VAT	Market prices	Market price in constant dollars for base year	Resource cost (aim to exclude indirect taxation primarily Goods & Service Tax)	Factor costs to be adopted throughout, ie representing national resource costs and benefits (hence excluding GST) [EEM1 2.2]
Shadow price of Public Funds	No shadow price	No shadow price	No shadow price	1.3 (net public expenditure get a 30% uplift)	No shadow price	No shadow price	No shadow pricing.
Shadow price of unskilled Labour	No shadow price	Partly in accident costs	No shadow price	No	No shadow price (Market price for labour is used)	No shadow price	No shadow pricing.
Scenario Definition	Do Something vs. Credible Do-Min ; Multiple DS cases	2 scenarios, 'integration' basis for appraisal with/without investment	Multiple standard scenarios for reference	Do Something vs. Credible Do-Min ; Multiple DS cases	Base case defined as "do minimum" to allow for comparison to alternative options	Base case (usually do minimum) vs. alternative options	All realistic options (variations on the proposal) to be evaluated relative to the Do Min base. [EEM1, 2.13, 2.14]
Key appraisal metrics	NPV ; BCR	BCR, based on annualised cost / benefit streams in forecast year; MCA scores for ERA and SIA	NPV ; BCR ; IRR	Benefits/inv.cost. Denominator includes total investment, but not maintenance costs. Other funding sources are not subtracted in the denominator unlike e.g. UK and Norway	NPV, BCR are primary; GDP and jobs are also metrics for some programs);	NPV, BCR, NPVI, FYRR	Primary is BCR(n), where denominator is national econ costs. Also use BCR(g), where denominator is govt costs (same as BCR(n) for roads, differs if external service provider or private financing). Use FYRR to indicate optimum start date. [EEM1, 2.9, 2.11]

Treatment of non-monetised items in overall assessment	Included ; may adjust BCR VFM category	Included, procedure to red-flag for special planning mandate	Presented in a standard format table	Presented in a standard format table. The CBA results are a part of the "Comprehensive Assessment" ("Samlad effektbedömning"), which also describes non-monetised effects, role in spatial planning etc.	Qualitative assessment (most State DOTs use multi criteria analysis)	Accident costs, noise, GHG emissions, agglomeration benefits monetised. Procedure to translate non monetised factors into normalised benefit-cost score which can be included in a hybrid BCR calculation	In addition to time, VoC, accident costs, some other items are generally monetised: noise, GHG emissions, agglomeration benefits, security of access, investment option values. [EEM1, A8, A9, A10]. Others (non-monetised) are presented in a standard format table EEM1, (Worksheet A8 series).
Risk and Uncertainty	QRA; Optimism Bias	Initially not included; sensitivity tests for demand and modal shift risks in review	3% risk premium in discount factor	Not explicitly; maybe implicitly captured by discount factor, but does not vary between types of investments.	Uncertainty must be identified; risk analysis done where warranted	Contingency for risk added to base cost estimate-allowance for a specified level of risk in project implementation	Detailed risk analysis procedures described [EEM1, 3.8, A13] No specific adjustment of costs or benefits for optimism bias, but guidance on cost contingencies at various stages in planning process .[EEM1 3.6]
Area of interest	UK	National, transboundary connections included in benefits	The Netherlands	Default is that Swedish benefits are included. For international transport starting or ending in Sweden, default is that half the benefits are assumed to go to Sweden.	US or State or Region (depends on the level of govt providing the funding and making the decision)	National perspective since state/federal tax gains/losses are usually not taken into account (main indirect tax (GST) goes to Commonwealth Govt).	Not addressed specifically but noted under National Strategic Factors (EEM1 A10.5, A10.8). Have been occasional discussions as to how to treat benefits and costs relating to international tourists (who account for a large proportion of traffic in some locations/times of year).
Form of documentation	Green Book ; NATA ; WebTAG .	Report	OEI guidelines, SEE website	National guidelines in the "ASEK report", revised every ~3 years	Federal guidelines for each mode; states have own guidelines –on web & published docs	Guidelines –memo circular to transport agencies, publish on intranet	Economic Evaluation manual (EEM), maintained by NZ Transport Agency—comprehensive manual for all tpt project types.
Mandated/ Approved by Ministry of Finance -- delegated powers?	Yes provided high value for money	Mandated by national parliament and Federal Council	Not involved	Decided by the Transport Administration, after consultations with external experts and other public administrations	Office of Management and Budget (OMB) sets discount rate; other guidelines set by federal and state DOTs	Larger schemes reviewed by NSW Treasury. All appraisals go to NSW Cabinet. Appraisals seeking national funding reviewed by Infrastructure Australia. Rail freight proposals usually assessed by ARTC with financial analysis important.	Ministry/Minister of Transport set strategic investment direction (eg desired impacts, priority of the 'Roads of National Significance'). Funding agency has statutory independence on funding and procurement. Treasury would rarely be involved in individual scheme decisions except where direct Crown funding is involved.

Table B Impacts --Unit Values

		England	Germany	Netherlands	Sweden	USA	NSW Australia	New Zealand
Travel Time Savings:	EB	£34.12/hr average of working persons	€19.97 /hr (1998), €23.50 /hr (2008) resulting in mode and vehicle type specific values	33-34 of (old values; new values soon)	247 SEK/h for trains, 291 SEK/h all other modes	$23 for car, bus & train travel, $57 for air & high speed rail	Business A$44/hr 2012 128% of av weekly earnings/38 hrs per week	Driver-car 32.67, LCV 32.13, MHCV 27.54. Pass-car, LCV, PT, cycle, pedn 29.73. [EEM1, A4.2]
	Commuting	£6.46/hr		9-10 (old values; new values soon)	Differentiated for trips shorter/longer than 100 km (all values in SEK/h): Car 87/108 Bus 53/39 Train 69/73 Air 108	$12 local commute, $17 intercity commute	Private A$13.76/hr 2012 for roads & recommended TfNSW equity VOT. Rail NSW $14/hr for work commuting Commuting 40% of AWE/38hrs per week	Driver-car, CV 10.69; Pass-car, CV 8.01; PT seated 6.44; PT standing, cycle, pedn 9.04. [EEM1, A4.2]
	Other	£5.71/hr Walk 2x IVT Wait 2.5x IVT	€5.47/hr (1998) (€6.3 /hr 2008) reduced by a 30% time threshold for small time savings to €3.83/hr (1998) for road transport; For 2008 cost values for time savings below 5 min are reduced using a declining function;	6-7 (old values; new values soon)	Car 59/108 Bus 33/39 Train 53/73 Air 108	$24 Walk & wait; Personal time: $12 for local vehicle travel, $23 for intercity travel, $32 for air & HSR travel	A$13.76/hr recommended by TfNSW. Rail uses $7-9/hr for educ/other trips but peak/off-peak values mostly used. TfNSW recommends Walk 1.15-1.5xIVT Wait 1.5xIVT	Driver-car, CV 9.45; Pass-car, CV 7.12; PT seated 4.18; PT standing, cycle, pedn 5.82. [EEM1, A4.2]
	Goods and Bus Drivers	£13.00/hr				$24 bus drivers, $25 truck drivers, $40 rail transit, $76 airline pilots	Freight/vehicle hr, i.e. A$20.29 articulated 6 axle A$29.37 B-Double A$57.84 Triple road train	
	Logistics benefits	-		Cargo-related cost savings included		based on reliability factor		
Reliability Effects		RR 0.8-1.4 Value of lateness incl variance 3 x IVT	-	25% surcharge on time benefits (old; new values soon)	Car: standard deviation of travel time is valued by 0.9*VTTS. Long unexpected delays is valued by 3.5*VTTS per hour. PT: Average delays are valued by 3.5*VTTS	RR 0.8 – 1.1 based on the 80th – 50th percentile	Value of travel time variability set equal to IVT. For rail, average lateness, valued at 3.7 x IVT used.	Congestion: increase base VoT (above) by up to 4.32 (driver) and 3.22 (pass) for EB; up to 3.77 (driver) and 2.81 (pass) for other purposes. Reliability—road traffic: value based on SD of day-to-day TT variability.

Comfort/ Crowding	IVT multipliers for rail 1.03-1.16 sitting in crowded conditions 1.65 short distance-2.11 long distance standing	-	surcharges	Driving in congestion: 1.5*VTTS. PT crowding: multipliers of VTTS (1.0-3.0). depending on crowding level.	No	Use of train crowding multipliers (relating to reduction in total IVT associated with the amenity improvement), pedestrian environment review system (PERS), RailCorp has used a passenger rating approach to value station and train refurbishments.	VoT for standing PT pax 40% higher than for seated pax (above), commute/other purposes. [EEM1, A4.2]
Safety	VOSL £1.65m Serious £0.186m Slight £ 0.014m	accident costs differentiated by road types for accidents with material damages and accidents with personal injury;	Fatal 2.744 mln Serious 0.282 mln Light 0.005-0.009 mln Damage 0.004 mln	Fatality 23.7 MSEK Serious 4.4 MSEK Slight 0.2 MSEK	Fatal $9.1 million Serious $0.955m Moderate $0.427m Minor $0.027m Damage $3285 per crash	A$6.3m fatality risk reduction $466,614 serious injury risk reduction. RailCorp evaluations have used per km figures.	Costs per person ($M): fatality 3.798, serious injury 0.401, minor injury 0.021. Costs per injury accident ($M)—50km /hr speed limit: fatal 4.020, serious 0.432, slight 0.025, PDO 0.002; 100km/hr fatal 4.560, serious 0.486, slight 0.029, PDO 0.003 [EEM1, A10; MoT 2012]
Wider economic impacts	Agglomeration Output change (Imp Comp) Labour mkt effect	Special bonuses for cross-border transport and connections with airports/seaports;	From RAEM or REMI model. Or: 1% more agglomeration gives 0.023% higher wages	Estimated relationship accessibility=>wage exists. Result may be quoted as “additional benefit” but not included in the standard CBA.	Using TREDIS or REMI model; covers labour market and truck delivery mkt	Welfare impacts (eg, agglomeration benefits) and GDP impacts. Only included to date in large projects (adding around 10-20% to project benefits). E&Y Toll road analysis estimated lower national than NSW WEB benefits.	Agglomeration economies—apply only to large/complex urban tpt projects in major centres. Procedures use tpt model data and set of agglom elasticities to estimate changes in effective densities and hence productivity gains [EEM1, A10.4]
Regeneration	Employment effects in RAs	Employment benefits regionally differentiated	Not included	No	Used in multi-criteria analysis	Population & employment gains on corridor from Transit Orientated Development included in larger PT schemes.	Not included.
Noise	Annoyance Value £10.91 per dB change per household per annum at 45dBA to £127 at 80dBA	WTP for annoyance €54.71 (1998) / €67.68 (2008) per noise resident equivalent value to achieve low noise levels at night (< 37 dB(A)); Avoidance costs for noise outside built-up areas (59 dB(A) sensitive sites, 64 dB(A) open space)	29.97 per dB per person	Table of values for different dB values, in SEK/person. Different for train and road noise, and for indoors/outdoors exposure.	based on cost of sound barrier or land value impact,	Noise impact calculated by change in property values predicted to occur with noise level changes, estimated at 0.9% per dB Change in noise level below 50 dB(A) L10(18h) are considered to have no impact to community. Estimated construction cost of each option. Rail projects have included per km figures.	Cost of road traffic noise = $410pa * dB change * # of h’holds affected [EEM1, A8.2]

Local Pollution	PM10 damage costs ; NOX damage costs ; NOX marginal abatement costs where EU limits exceeded.	Damage cost; global pollution €365 / t NOxe (1998), €420 (2008;) local air quality: €3.37 / yr per resident equivalent (1998), €1.24 in 22008; Carcinogenic: €0.79 million per death (1998) / €1.24 million (2008)	PM10, SOx, NOx: combination of methods	Costs for PM2.5, VOC, SO2, NOx.SEK/exposed person. Varies with "ventilation zone" (topography etc.).	PM10, Nox, SOx. VOC, based on	Mortality costs = 0.001 * Δ PM_{10} concentration * population exposed * normal death rate * value of life where Δ PM10 concentration is the change in the average concentration for the period being analysed. Rail projects have included accident savings on per vehicle km basis.	Local emissions costs calc as: 0.001 * change in PM10 concentration (ave over period analysed)* exposed population * normal death rate * value of life. [EEM1, A9.3]
Climate Change	Non traded £/tonne CO2e 2010 £ 53.58 2050 £207.28	€205 /t CO2 (1998) €70 /t CO2 (central), €20 low, €280 high (2008) for review	62.66 per tonne CO2	1 SEK/kg short run (short term policy, timetables etc.) 1.5 SEK/kg long run (investments)	$19 - $21 per ton CO2	Australia has introduced a carbon tax which has raised electricity charges and also reduced rail fuel duty rebate (in response Pacific National increased rates by around 1%).Road freight exempt to mid-2014.	CO2 emissions valn calc as $40/tonne Co2 , or 4% of VoC changes. Valn to be included in BCR assessment and also reported separately (in tonnes) in summary table. [EEM1, A9.7]
Environmental Capital (Landscape, Biodiversity, Heritage)	Qualitative assessment	Qualitative and MCA scores from ERA and HDA	Qualitative, but we now have a professor in the economic valuation of cultural heritage at VU	Qualitative assessment	Qualitative assessment, represented in multi criteria analysis		Largely descriptive/qualitative [EEM1, A8]
Other significant--please specify		Qualitative and MCA score from spatial impact assessment; Special recognition of project interdependencies; Mark-up for induced traffic	Noxious fumes		--	Water Pollution Urban separation Upstream & Downstream costs	Category of 'national strategic factors'—includes Security of access (in the light of potential earthquakes, land slips etc) and Investment option values (providing flexibility to future uncertain demands etc) [[EEM1 A10.5]

NOTE At the time of reporting, £1 = 1.15 EUR = 9.75 SEK = 1.50 USD= 1.45 AUD= 1.80 NZD

Table C Impacts--- Research Source and Date if known

		England	Germany	Netherlands	Sweden	USA	NSW Australia	New Zealand
Travel Time Savings:	Employers Business	WebTAG 3.5.6	On-going projects for time costs in passenger and freight transport for BVWP 2015.	HCG (1998)	Eliasson & Karlström (2010)	2011 USDOT Revised Guidance on Valuation of Travel Time	TfNSW Principles and Guidelines for Economic Appraisal of Transport Investment & Initiatives	Beca Carter Hollings & Ferner Ltd, Steer Davies Gleave, Forsyte Research, Brown Copeland & Co., (2002), Review of Benefit Parameter Values for Economic Evaluation
	Commuting	1994 AHCG National Value of Time Study plus		HCG (1998)	Börjesson & Eliasson (2012)	Same as above	Values based on 1997 Austroads harmonised travel time valuation review study. For rail, estimates based on Douglas Economics 2010/11 Survey	Beca Carter Hollings & Ferner Ltd, Steer Davies Gleave, Forsyte Research, Brown Copeland & Co., (2002), Review of Benefit Parameter Values for Economic Evaluation
	Other	2003 ITS Value of travel Time Savings in UK		HCG (1998)	Börjesson & Eliasson (2012)	Same as above	Douglas Economics/ RailCorp Survey 2010/11	Beca Carter Hollings & Ferner Ltd, Steer Davies Gleave, Forsyte Research, Brown Copeland & Co., (2002), Review of Benefit Parameter Values for Economic Evaluation
Reliability Effects		WebTAG 3.5.7 Range of sources for Netherlands MOT 'Value of reliability in Transport (2005)	n.a.; Recent research project by significance et al. (2012) for BVWP 2015.	Besseling et al. (2004)	Stddev: Eliasson (2004), Train delays: Börjesson & Eliasson (2011)	2012 Report, SHRP L03	TfnSW Principles and Guidelines DEL/RailCorp ATC Guidelines	Congestion and reliability, roads: Beca Carter Hollings Ferner Ltd and Sinclair Knight Merz (2002). PT reliability: M Vincent (2008). LTNZ Research Report 339
Comfort/ Crowding		PDFH informed by MVA (2010) and Wardman (2012).	-	CPB and KIM (2009)	Crowding: Wardman 2012, Congested driving: Wardman 2012 and Eliasson 2004	none	Rail train and station crowding SP studies and rating survey by Douglas Economics/RailCorp 2004-06, TfNSW train load surveys.	Beca Carter Hollings & Ferner Ltd, Steer Davies Gleave, Forsyte Research, Brown Copeland & Co., (2002), Review of Benefit Parameter Values for Economic Evaluation
Safety		WebTAG 3.4.1 Based on Hopkin and Simpson TRL RR163, 1995 updated for parameters+value	BAST (2000);	SWOV (2009)	Hultkrantz & Svensson 2007	2013 USDOT Guidance on Treatment of the Economic Value of a Statistical Life	TfNSW Principles & Guidelines, Willingness to Pay Study (Hensher & PWC)	See EEM1 A6.11. Also for unit crash costs (MoT 2012):http://www.transport.govt.nz/ourwork/Land/landsafety/Pages/TheSocialCostofRoadCrashesandInjuries.aspx
Wider economic impacts		WebTAG 3.5.14 Based on DfT (2005) informed by Graham et al (2005/6/9)		Groot et al. (2010)	Anderstig et al., unpublished. Variant published in Anderstig et al. 2012	Description of US practice in NCHRP 02-24 Lit Review (2013); methods in REMI and TREDIS documentation	WEB model developed by TfNSW, Hensher et al (2012) referenced in TfNSW Manual	Graham DJ and Mare DC (2009) Agglomeration elasticities in New Zealand. NZ Transport Agency research report 376

Regeneration	WebTAG 3.5.8 Based on DfT (2003) Guidance on Preparing an Ec. Impact Report		-			Variable. Benefits included for rail projects forecast to regenerate brown field sites e.g. Airport Rail Link. Denis Johnson & Associates, 1994.	
Noise	WebTAG 3.3.2 Values based on Bateman et al (2004) with benefit transfer by Nellthorp et al.	Weinberger et al. (1991) for WTP for residential noise Jansen (2000) for outdoor noise	INFRAS/IWW (2000)	Train: Swärdh 2012	2011 USDOT Noise Analysis and Abatement Guidance	RTA & Austroads Economic Analysis Manuals	See EEM1 A8.2, A8.11
Local Pollution	WebTAG 3.3.3 Based on ICGB (AQ) DEFRA 2008	UBA (2007)	CE Delft (2001)	Derived from ARTEMIS	2012 TIGER Grant Guide; 2010 NHTSA Regulatory Impact	RTA & Austroads Economic Analysis Manuals	See EEM1 A9.8
Climate Change	WebTAG3.3.5 Shadow price of carbon based on Stern (2006) and updated in line with DECC 2011	UBA (2007)	CE Delft (2001)	Derived from CO2 on fuel	US Govt. Inter-Agency Working Group (2010); also US EPA, 2010	RTA & AustRoads Economic Analysis Manuals	See EEM1 A9.6
Environmental Capital (Landscape, Biodiversity, Heritage)	WebTAG 3.3.6-9 Approach unchanged since 2006 but recent study by Atkins/ Metroeconomica	PÖU (200)	Ruijgrok et al. (2007)		--	RTA & AustRoads Economic Analysis Manuals	See EEM1 A8.11 etc
Other significant--please specify		Induced traffic: STASA et al. (2000) SIA (Würdemann & Sieber, 2004)	Bogaert et al. (2005)		--	RTA & AustRoads Economic Analysis Manuals	

Table D Applicability of Appraisal

		England	Germany	Netherlands	Sweden	USA	NSW Australia	New Zealand
Capital projects--- large/small	Road	Mandatory	Mandatory for	Mandatory	Mandatory	USDOT Grants: Mandatory CBA StateDOTs: varies	Mandatory	Mandatory for all projects applying for central government transport funding allocation from the National Land Transport Fund.
	Rail	Mandatory ; WebTAG values supplemented by rail specific values from PDFH	Mandatory (BVWP for federal, Standardisierte Bewertung for state / regional)	Mandatory	Mandatory	USDOT Grants: Mandatory CBA StateDOTs: varies	Rail Passenger mandatory. Rail freight depends on locality. ARTC mainly responsible for rail freight infrastructure appraisals outside metropolitan Sydney. Within metropolitan area, evaluations have been undertaken by agencies of NSW government eg Northern Sydney Freight Corridor.	Complicated. 'Above rail' urban pax projects –mandatory for NLTF funding. 'Below rail' projects— 'catch-up' investment programme been funded direct from central govt funds over last 10 years; current segregated funding for passenger transport (NLTF service only subsidies) and freight (now fully commercial and no subsidisation) with below rail track access charge according to use.
	Bus/Tram	Mandatory	Mandatory for investments above ??	Mandatory	Sometimes; mandatory if national funding is applied for	USDOT Grants: Mandatory CBA StateDOTs: varies	Mandatory	Mandatory for infrastructure seeking NLTF funding contribution. (Most vehicles funded by operator through operating contracts.)
	Air	WebTAG Unit 3.18 provided guidance for government intervention including policies, strategy, regulation, planning applications	State responsibility; general budgetary and planning law; no specific appraisal guidance	Mandatory	Seldom	USDOT Grants: Mandatory CBA StateDOTs: varies	Largely Commonwealth responsibility. larger airport evaluations usually submitted to NSW Treasury.	Completely separate from funding of land transport. Airport authorities and airlines operate on a commercial basis and have own evaluation/funding procedures.
	Sea/Water	Port capacity through planning system. Mode shift from road appraised (ref to Waterborne Freight Grant)	Mandatory for Inland Waterways as part of BVWP; Seaports are state responsibility and fall under general budgetary and planning law with no specific appraisal guidance.	Mandatory	Sometimes	USDOT Grants: Mandatory CBA StateDOTs: varies	Passenger (urban) Ferry covered under TfNSW Economic Evaluation Manual. Port expansion via Environmental Impact Statement including Economic Impact Assessment and road/rail traffic analysis.	Completely separate from funding of land transport. Ports and shipping lines operate on a cxommercial basis, with own procedures.

National		Mandatory for national vfm	Mandatory (BVWP)	Mandatory	Mandatory	USDOT Grants: is Mandatory CBA	Mandatory for NSW transport projects seeking national funding (Infrastructure Australia).	Mandatory evaluation procedures (EEM) for all national roads
State		n/a	Mandatory for large public transport investments (Standardisierte Bewertung); non-binding guidance for road investments (EWS)	n/a	n/a	StateDOTs: CBA or MCA (varies), usually also EIA	Mandatory for strategic alignment and VFM	n/a
Local		Local/Regional GVA approaches increasingly for Local Econ Impact	Guidance (Standardisierte Bewertung and EWS)	Discretionary	Seldom	Metropolitan Planning Orgs: MCA or EIA	Discretionary	Mandatory evaluation procedures (EEM) for all local rods projects seeking central government funding.
Revenue Expenditures:	Maintenance	Unlikely except betterment	Investments for renewal of federal roads included in BVWP;	?	Attempts are made	Use lifecycle cost models for pavement & bridges	Major train refurbishment s subject to appraisal, programs above business as usual.	Roads: other than routine mtce, road/bridge renewals etc are subject to EEM procedures [EEM1, 4.2 etc]
	Subsidies	Variable; increasing use. Yes for assessing rail franchise bids and for mode shift revenue support	According to budgetary law (§7) all public expenditures have to undergo an appropriate economic assessment, but no specific procedures are prescribed.	?	Seldom; certain pricing measures (e.g. kilometre charges)	Yes, CBA and FIA for PPP, toll projects	Increasing use for bus fleet evaluations and assessment of franchise bids. PT fares & subsidy levels assessed by Independent Pricing & Regulatory Tribunal of NSW.	Changes in PT operating subsidies associated with service changes/new servicer are subject to EEM procedures. On-going op subsidies for current PT services not subject to EEM, but scrutinised using various VfM indicators.
Appraisal relevant for:	Public Consultation	Yes	Yes	Yes	Yes	Varies among states	As required	To a limited extent.
	Planning Inquiries/ Permission	Yes—significant quality control role in PI setting	Yes	Yes	Yes	Varies among states	Yes, CBA for road and rail projects often included. Economic Impact Assessment plus traffic assessment for ports and airports).	To a limited extent.

US terms: CBA= cost-benefit analysis, MCA=multi-criteria analysis ranking; EIA=economic impact analysis, FIA=fiscal impact analysis