WIDER ECONOMIC BENEFITS: THE BEGINNING OF THE END OR THE END OF THE BEGINNING?

Taking stock of transport appraisal methods and practice in eight foreign countries

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Executive summary

In a project for the UK Department for Transport (DfT) an inventory was made of how other countries include wider economic benefits in their appraisal of transport schemes. Officials and researchers in a selection of foreign countries with a record of developing and implementing transport appraisal methods and who were known to project sponsors or to the authors of this report were contacted. Those who expressed an interest in participating in the study were sent a questionnaire and a note setting out the UK DfT's approach to estimating wider economic benefits to provide a benchmark for their replies.

8 out of the 9 countries contacted responded to the questionnaire. 6 of these were from Northern Europe (including France), with Australia and New Zealand constituting the others. While not geographically representative, the aim was to cover countries which were likely to have made the greatest advances in appraisal methods so that any such developments could be shared more widely. In many cases the individuals approached either invited colleagues to participate in drawing up their response or referred the questionnaire to a colleague who they perceived as being in a better position to respond

Despite the interest expressed in the study's findings by participants, there was limited evidence of major new analysis being undertaken to take forward the estimation of wider economic benefits or to develop existing appraisal guidance. Some countries, including Germany, reported on an awareness of the potential relevance of such effects and noted the UK's TAG as an example.

The countries which responded to the questionnaire all had well documented clear appraisal guidance. In all cases this guidance covered benefits defined by DfT as 'level 1' effects.

Only New Zealand and Australia make provision in their appraisal guidelines for the inclusion of wider economic benefits on a comparable basis to the UK's TAG, with separate reporting of static and, where estimated, dynamic impacts. The responses indicated that agglomeration and labour supply impacts assuming fixed land use are more commonly included in the information given to decision makers.

Countries which had access to land use-transport interaction models or other spatial economic models used these models only in exceptional circumstances (such as for large projects or for the national infrastructure plan). Examples are the Grand Paris Express scheme, Toulouse Metro, and certain large projects/infrastructure plans in the Netherlands and Sweden. Most countries found the estimation and application of such models challenging. No country made recommendations for the choice of any specific spatial economic model. Different models produced very different findings and gave rise to doubts among experts about the reliability of the results. In the case of the Netherlands, this resulted in the adoption of a rule of thumb as a proxy for a modelled estimate.

Where wider economic benefits were part of the appraisal, the results were invariably presented separately from the conventional categories of impacts. The wider impacts were generally valued in terms of a conventional cost benefit welfare-based metric. Some special studies provided estimates of GDP effects.

A clear understanding of the expected spatial impacts of a project, informed either by modelling, by land use planning policies or by expert advice, helped to fill out the economic narrative and was seen as valuable information by decision makers.

Many respondents expressed reservations about the inclusion of wider economic benefits because of the risk of double counting the risk of interpreting substitution/relocation as generative effects and because of problems in obtaining place based appropriate data and estimating the relevant parameters.

We conclude that in a multinational perspective, wider economic benefits are still far removed from becoming a standard component of social cost benefit analysis. Here and there, some of the initial enthusiasm appears to be fading. However, we do not regard this situation as the beginning of the end of wider economic benefits in social cost benefit analysis but as the end of the beginning. There is still a long way to go for wider economic benefits, but there also is a lot of interest in estimating these in most of the countries for which we carried out interviews. Including these benefits in appraisal will be difficult in practice and needs more time, for more data collection and more research. Furthermore, even when methods would have been established for calculating wider economic benefits, it is unlikely, even for megaprojects, that these effects will be very large (see or instance the upper bound of 30% of the time and reliability benefits used in The Netherlands for wider economic benefits). Besides this, wider economic benefits, not only when applying this rule of the thumb, but also when doing project-specific calculations on the basis of accessibility changes, are most likely to be found for those projects that already have the largest direct benefits. Such projects tend to have a strong strategic case and convincing narrative to support their approval.

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1. Introduction

1.1 Background

Cost benefit analysis has had an essential role in informing decision makers in the UK about the case for individual transport projects over the past 60 years. The welfare economics framework, which initially identified and, where feasible, attributed monetary values to transport user and environmental impacts, has been extended throughout this period as techniques for valuing impacts were developed and as new evidence on the range of effects that were an outcome of a transport project became available. The Department for Transport's appraisal methods are explained in TAG and the information derived from the appraisal to be presented to decision makers is set out in the document describing the framework used for drawing up the value for money assessments and communicating this assessment to decision makers.

A notable extension of transport appraisal methods took place in response to the 1999 SACTRA Report on Transport and the Economy and the Eddington Transport Report. The research undertaken by Graham and others (Graham et al., 2003; Graham, 2006) provided evidence of the link between accessibility and productivity and of transport's role in causing this effect on productivity. Following Eddington's recommendations, a method based on this research was developed for estimating and valuing these effects and incorporating them in the Department's appraisal methods. At the same time, guidance on employment effects and on induced investment was issued to complete the advice on the inclusion of what was initially defined as Wider Economic Benefits (WEBs) in the appraisal framework.

Much of the appraisal of Wider Economic Benefits, which were subsequently classified as Wider Impacts, can be undertaken using conventional transport models combined with additional information from official sources on employment and output or from research into parameters such as the elasticity of labour supply. Conventional transport modelling methods assume that land use remains the same in the do-minimum and with scheme alternatives so as to ensure that the impacts identified in the appraisal can all be attributed to the transport intervention. However, to the extent that a transport scheme results in a change in the location of economic activity in response to the change of the relative attractiveness of the places it serves, the assumption of fixed land use ceases to hold and some supplementary modelling methods are required to estimate these additional responses.

These supplementary modelling methods are less well established in transport applications, data intensive and, unlike a conventional transport model, do not easily lend themselves to being validated against observed behaviour. There are several reasons for this problem such as the long period of time over which the changes being modelled take place and because of the difficulty of establishing a counterfactual. For these and other reasons, when presenting the appraisal of a transport scheme to decision makers, it is practice in the Department for Transport to present results derived from models which explicitly account for transport

induced land use change as constituting less certain 'level 3' impacts. These impacts are presented as a sensitivity analysis and do not form part of the core BCR. But they can also inform the overall Value for Money (VfM) category/assessment and the strategic case for the scheme where fostering local or regional economic growth forms part of the rationale for the scheme.

The Department for Transport has published guidance on the application of supplementary modelling techniques and while some examples of their application have been published, the applications are often part of on-going policy development or are based on proprietary models that are not publicly available.

1.2 The context for this study

The Department commissioned this study to investigate how other countries with a record of using economic analysis to inform decision makers about the case for investment in specific transport projects address the challenges that analysts face when incorporating land use change in the appraisal or imperfections in labour or product markets. A previous study commissioned by the Department for Transport reviewed transport appraisal practice in a number of countries with a reputation for using evidence based appraisal methods. This covered the full range of impacts included in each country's appraisal methods and did not focus on wider impacts, having been completed before some of the approaches to modelling the dynamic impacts of transport investment described in this current study had been developed. Certain other organisations, in particular the OECD's International Transport Forum, have held workshops and Round Tables to enable members to share their experience of methods for assessing Wider Economic Benefits. However, this study would appear to be the first that covers the guidance issued and the methods that have been considered in these countries, their limitations and their role in the decision making process for a range of countries.

1.3 Research Methods

Officials and researchers in a selection of countries with a record of developing and implementing transport appraisal methods and who were known to project sponsors or to the authors of this report were contacted. Those who expressed an interest in participating in the study were sent a questionnaire (see appendix 1) and a note setting out the Department for Transport's approach to estimating 'level 3' impacts to provide a benchmark for their replies. This note also explained the relationship between this set of impacts and the benefits under the assumption of fixed land use (see appendix 2).

8 out of the 9 countries contacted responded to the questionnaire. 6 of these were from Northern Europe (including France), with Australia and New Zealand constituting the others. While not geographically representative, the aim was to cover countries which were likely to have made the greatest advances in appraisal methods so that any such developments could be shared more widely. In many cases the individuals approached either invited

colleagues to participate in drawing up their response or referred the questionnaire to a colleague who they perceived as being in a better position to respond.

1.4 Contents of this report

In section 2 of this report we first present what the existing standard guidelines in the eight countries for which we interviewed experts say on the treatment of WEBs. For specific projects, especially large projects, the treatment of WEB might be more elaborate. Such projects and how they incorporated WEBs are discussed in section 3. Section 4 then continues on the gaps that the experts identified concerning the treatment of WEBs of transport projects in their own countries. Further considerations provided by the experts are bundled in section 5. Finally, section 6 presents an overall summary and conclusions. The annexes to this report contain the list of questions used and a summary of how WEBs are treated in the UK's TAG which was sent to provide some context to these questions .

2. WEBs in the current standard guidelines

France, Germany, The Netherlands, Norway, Sweden, Denmark, Australia and New Zealand all have standard guidelines for the appraisal of transport projects.

2.1 France, Germany, Norway, Sweden and Denmark

The national/federal guidelines for France, Germany, Norway, Sweden and Denmark do not include treatment of WEBs (and effectively these effects are not incorporated in the CBAs following the guidelines). The guidelines in The Netherlands use a practical markup for indirect impacts, without trying to calculate the WEBs for specific projects. Of the eight countries investigated, only Australia and New Zealand have procedures for WEBs in their current guidelines at a level of detail that is comparable to the UK's TAG.

In France, the standard approach is to assume that the project does not affect employment, economic activity or land use (but to use national projections, also in the with-project case). For larger projects, the possibility of including agglomeration effects is mentioned, but no guidance is given on methods for estimating such impacts. Two projects in France that tried to go beyond the standard approach and include WEBs in some way are discussed in section 3.

Germany even had the option of including employment effects of the project in older guidelines, but this was removed in the current guideline BVWP2030 (that assumes full employment). No components of WEBs are included in the current standard guidelines and now discussions are ongoing whether these should be included again, and if so, how? The standard federal guidelines in Germany do not apply to international-level port and airport projects or international road or rail cooperation projects with for instance Denmark. Examples of how WEBs have been treated in some of these large projects are discussed in section 3.

In Norway transport projects are appraised using conventional cost benefit analysis that does not include WEBs. On the other hand, the current guidelines leave open the option of including WEBs as additional information. It is explicitly specified that any values based on this analysis should not be added to the original CBA but be considered as part of this supplementary information. The official Norwegian guidelines restrict these additional impacts to agglomeration benefits and the effects of increased labour supply. Labour supply effects are valued in this supplementary information in terms of the additional tax revenues paid on the additional earnings.

WEBs are usually not included in appraisal of transport projects in Sweden, because such effects are considered unlikely for small and medium sized projects. Furthermore, one additional motivation for not including such effects in the conventional CBA is the risk of double counting; e.g. wage and employment effects may overlap with travel time savings included in the CBA (level 1 impacts' in the UK's TAG). For 'large' or strategically important projects an analysis of wider economic impacts may however be conducted. To the extent

that WEBs are assessed, this is usually done for an entire infrastructure investment plan (a large set of new investments) or large investments like high speed rail (also see section 3).

The existing transport appraisal guidelines in Denmark include the conventional user benefits ('Level 1 impacts' in the UK's TAG), but typically the CBAs in the transport sector are performed based on results from transport/traffic models, with no transport-induced land use change and no change in labour supply. Some projects that are exceptions to this rule and try to include WEBs are discussed in section 3.

2.2 The Netherlands

The current guidelines for transport appraisal in The Netherlands do not include a worked out method for the calculation of WEBs, but do acknowledge that these effects may be present and should then be incorporated in the appraisal. The guidelines therefore include a standard mark-up of 0-30% on travel time and reliability savings to indicate the indirect impacts. The guidelines state that one needs to argue (qualitatively) what the effect consists of (causal relationship) and that one can apply an additional effect between 0 and 30%. In practice quite often a 15% increment is used on top of the direct benefits without a detailed explanation. While this 0-30% mark-up is still current practice, some new efforts are being undertaken (see section 3).

2.3 Australia

WEBs were introduced rapidly in Australia in the late 2000s, primarily for larger projects. These effects have been incorporated into appraisals for progressively smaller projects, but still not for all. Since the mid-2010s, dynamic land use effects have gradually been incorporated into major project appraisals, though the methods applied vary widely across practitioners. In the 2020s, second round effects which follow from the land use change have been included in appraisals**.** A core CBA and its resulting BCR without WEBs is generally presented to Australian decision makers. WEBs are then presented as 'below the line' and not as part of the core BCR.

Australia's current appraisal guidance – Australian Transport Assessment Planning Guidance (ATAP; Australian Government, 2023) – includes a description of the methods employed and details of the appropriate values and parameters to be applied for the assessment of WEBs. In addition, Infrastructure Australia provides guidance on methods for assessing infrastructure projects which includes the application of cost benefit analysis (Infrastructure Australia, 2021). This guidance includes advice on the use of supplementary modelling techniques including the use of Computable General Equilibrium Models and of Input/output modelling as having the potential to provide decision makers with additional information but at the risk of double counting the effects that are measured in the conventional appraisal method.

Land use changes

On land use effects under imperfect competition, the guidance is comparable to DfT's TAG A2.2 Induced Investment guidance. The Australian Transport Assessment and Planning Guidelines (ATAP) distinguish in Report O8, Land Use Benefits of Transport Initiatives, between the concept of land value uplift, which includes the capitalised benefit of the transport investment, and that of higher land values resulting from the unlocking of a constraint on development and hence in increasing the supply of land zoned for higher value and more transport intensive uses. Methods of estimating and modelling land use change are outlined in the guidance, including the use of LUTI models. The Guidelines also discuss the DfT's TAG A2.3 dependent development framework as an alternative.

The Guidance advises that land use change impacts should only be estimated where the project is likely to result in significant land use change, where there is clear evidence of imperfections in the market for land use, usually on account of the transport intervention resulting in an increase in permitted development densities, and there are feedback loops between the markets for land use and for transport. Results for the BCRs should be presented both with and without the land use change impacts.

The changes in land use covered by ATAP O8 are not subject to the dependency test required in the DfT TAG guidance: all cases of 'unlocking' would appear to be eligible for inclusion in the appraisal. In addition, the changes in travel demand and travel costs as a result of the changes in land use are input to the transport model and the costs and benefits of these additional trips after the land use change, valued using the conventional Rule of a Half, are labelled as a second round dynamic transport benefit.

Dynamic clustering/agglomeration and changes in productivity

ATAP T3 covers the set of WEBs that feature in Australian appraisal methods, made up of agglomeration, labour supply and output changes in imperfectly competitive markets. In the case of agglomeration and labour market impacts, the guidance recommends the estimation of the static impacts and, where appropriate methods are available, the dynamic effects. The guidelines provide a detailed description of the estimation methods and appropriate parameter values. Attempts to estimate distance decay functions and agglomeration elasticities by sector using Australian data were unsuccessful, partly because of the absence of adequate spatial detail on the location of firms and their output. ATAP Guidelines for agglomeration impacts recommend the use of DfT TAG productivity elasticities and decay curve parameters, simplified by combining the construction sector with consumer services. Guidelines for estimating labour market impacts and the imperfect competition effects also follow closely DfT TAG guidance.

When reporting WEBs, ATAP specifies that this should be done incrementally, with the results first showing the project's BCR based only on the conventional set of transport user,

environmental and social benefits and then presenting estimates of each of the WEBs under an assumption of fixed land use followed by any further estimates of the dynamic impacts. In each case the estimate of each of the WEBs is shown first separately and then when added to the initial BCR. Estimates based on static and dynamic models should be reported separately.

The guidelines set out in section T3 of ATAP are concerned exclusively with the estimation and appraisal of WEBs. It is similar to DfT's TAG A2 in that it does not review modelling methods. ATAP T4 describes the development of Computable General Equilibrium Models as forming one approach to modelling and estimating the dynamic impacts of transport induced land use change. It discusses the links between SCGE models and CBA, noting that while in the past CGE models have been used to model changes in GDP, more recent Spatial Models can be used in combination with CBA to estimate the welfare impacts of changes in the location of economic activity. Similar to TAG, Australian national guidance does not prescribe a single model as evidence of best practice. Several innovative hybrid LUTI models have been developed since ATAP T4 was published: in Victoria a simplified version of the government strategic transport model has been joined to a full SCGE model developed at a university and the private consultancy Veitch Lister (VLC) has linked a proprietary full strategic transport model (Zenith) to a simplified SCGE model.

Changes in labour supply

ATAP guidelines cover the effect of changes in labour supply on account of the change in the perceived net returns from working following the reduction in commuting costs as a result of a scheme. The appropriate calculation steps and parameter values are set out in the guidance, along with suggestions for developing a narrative to support the economic case in terms a description of the constraints on commuting that the scheme is intended to address. A major difference between the ATAP Guidelines and UK approach is that the increase in labour supplied is estimated in ATAP with a semi-elasticity of labour force participation with respect to the perceived weekly net return to working. At a participation rate of 67%, the 0.18 semi-elasticity estimate is equivalent to a labour supply elasticity of approximately 0.18 / 0.67 = 0.27. This is considerably higher than the labour supply elasticity in UK DfT guidance (2018) set at 0.1.

The guidelines discuss the extent to which reduced generalised transport costs enable workers to move to more productive jobs, thus changing the geographical distribution of employment and increasing productivity and tax revenues. Estimates of this impact require information on productivity differentials between locations after adjusting for employer and employee characteristics such as sector, skills and occupation to identify the place based effect. This information is not generally available in the case of Australia and so, until place based productivity differentials become available, the guidance advises that impact of the move to more productive jobs should not form part of the reported CBA. In the event of such information becoming available, the estimate of the move to more productive jobs

impact should be considered as a sensitivity test. The economic narrative can provide the opportunity to explain why job shifts are likely to occur as a result of the transport initiative and the reasons for the shifts being from low to high productivity areas.

Changes in Output

The Australian Guidelines focus on cost benefit appraisal and on the BCR as the key indicator of the expected outcome. Infrastructure Australia's Assessment Framework includes a brief discussion on the use of alternative appraisal methods including the use of CGE models, noting that the outputs from such an approach are defined in terms of changes in GDP rather than in welfare benefits.

Transformational vs other projects

No distinction is made between transformational and other projects. As noted below, Wider Benefits have been increasingly incorporated into the appraisal of smaller projects.

2.4 New Zealand (NZ)

The methods for transport project appraisal are set out in the Monetary Benefits and Costs Manual (MBCM)[1] published by the NZ Transport Agency (Waka Kotahi) . The first set of guidance on agglomeration benefits was published in 2009 which comprised New Zealand specific agglomeration elasticities developed from NZ microdata. The guidance was published in response to claims of potentially significant impacts based on UK methods despite the very different scale of projects in New Zealand.

The next major change was to develop specific procedures for national estimates of WEBs in 2011 which included New Zealand based parameters for imperfect competition and labour supply effects. More recent developments include land use change benefits and dynamic clustering although neither of these has yet been formally incorporated as benefits in the official guidance (MBCB).

As far as WEBs are concerned, New Zealand's guidance manual identifies agglomeration, labour supply, move to more productive jobs and imperfect competition impacts. It discusses the differences between static and dynamic impacts, in particular in respect of agglomeration effects. The guidance notes that wider impacts are likely to be present only in a small number – perhaps 3-5 – of the cities in New Zealand. The manual contains values for the key parameters relevant to the calculation of WEBs. It explains how these can be used in conjunction with the outputs from the relevant transport model and appropriate employment and output data to estimate the static and, if combined with a model of land use change, the dynamic effects.

Land Use Changes

The methods and values for estimating agglomeration impacts set out in section 3.10 of MBCM are applicable to both static and dynamic estimation. While work has been undertaken on the development of models for estimating transport induced land use change in New Zealand, no functioning model has been approved for use by the country's transport department.

A research report on modelling urban development in New Zealand describes a simple dynamic spatial general equilibrium model of urban development using data for New Zealand cities. However, the existing version of this model lacks any representation of the transport network and so is not in its existing form able to estimate transport induced land use change. While our respondents reported that partial equilibrium models are generally used to estimate WEBs, CGE models have been used in certain cases, but they have tended to produce significantly larger WEBs than partial equilibrium models. LUTI has been used at least once, for the central Auckland rail study, but this approach was deemed unsuccessful by analysts in the NZ Transport Agency (Waka Kotahi) .

Dynamic Clustering/agglomeration

The New Zealand appraisal guidance provides details of the parameter values and the transport model outputs required to estimate both static and dynamic wider impacts. The country has commissioned research which reviews the concepts relevant to dynamic clustering and its role in transport appraisal and includes an evaluation of the land use and other impacts of a New Zealand urban road scheme based on data collected some years after opening. However, the spatial economic models that are required to estimate changes in the location of economic activity are not at a level of development at which they can be used as part of a full WEBs estimation methodology. Thus the guidance on parameter values anticipates the development of appropriate modelling method.

Changes in Productivity

The New Zealand MBCM provides the parameters needed to estimate the changes in output as a result of an increase in effective density that follows from an increased level of employment or better accessibility for zones affected by a transport scheme. Agglomeration elasticities relating the change in effective density to the change in productivity are published (MBCM table 37) for 17 sectors. References are given to sources of data for base year and do-minimum forecasts of employment and output by sector and zone.

Changes in Labour Supply

The impact of reduced commuting costs on labour supply is part of the MBCM's assessment of WEBs. The guidance outlines the difference between the impact on overall output from the increase in labour supply and the impact on welfare, measured through additional tax revenue. The Manual notes that benefits to the individual are assessed through the benefits to commuter transport users. The Manual notes that labour supply effects can add up to an

additional 10% of wider economic benefits over conventional user benefits. The Manual includes a discussion of job creation and displacement effects and concludes that for most transport schemes displacement is likely to be 100%.

Transformational vs Other Impacts

The New Zealand MBCM notes that regional development, including transport investment, as an outcome of increases in international tourism, can result in additional demand based wider benefits and the MBCM includes advice on estimating and valuing these impacts. The Manual notes that such impacts will only be additional if they result from an increase in international visitors to the country: additional domestic tourism to one location is likely to be displaced from elsewhere. The MBCM includes estimates of the average expenditure per tourist night which varies by holiday location. After accounting for crowding out and multiplier effects, the net increase in value added is between 30% to 50% of additional spend and the MBCM includes a set of values to be used in the business case. The Manual notes that this category of benefit should not be added to the reported BCR for the scheme but should be presented separately.

Imperfect Competition

The MBCM notes that, owing to imperfect competition in the New Zealand economy, the prices that consumers pay exceed the costs of production by a margin of around 20%. Together, with evidence on how the economy responds to a reduction in transport costs at an aggregate demand elasticity of -0.6, this gives an estimated wider economic benefit from increased competition of 10.7% of business user benefits. The Manual notes that for a typical scheme, inclusion of the imperfect competition effects adds up to 5% of wider economic benefits to conventional user benefits.

2.5 Summary

In summary, most of the countries studied do acknowledge that WEBs might be present, but that these will probably only be prominent for large projects in major urban areas. Methods to calculate project-specific WEBs are (besides UK's TAG) only included in Australia and New Zealand. The Netherlands uses more a rule of thumb for including WEBs, which is not purely restricted to large projects. The other countries studied provide some examples of studies that try to include WEB for specific large projects and on a more ad hoc basis. This is discussed in the next section.

3. Studies for major projects by specific countries

3.1 Introduction

No country reported an established method of modelling and estimating the wider impacts of land use change induced by a major project. While the use of LUTI models as a means of estimating such changes was referred to in the guidance used in both Australia and New Zealand, neither country suggested that an established and validated method of estimating the effects of a transport scheme on land use change was part of the available modelling and appraisal framework. Australia reported on the use of a range of models without prescribing any single model as representing best practice. In New Zealand spatial economic models are not at a stage of development at which they can be applied to estimate the dynamic impacts of a transport scheme.

In France and Germany the official guidelines do not allow for the inclusion of 'level 3' impacts, although in certain exceptional circumstances the land use changes induced by the project are modelled and estimates of their impact are provided to decision makers although these are described as 'below the line'. A comparable approach was taken in a case of a land reclamation scheme in Denmark, in which case the standard appraisal was combined with a spatial economic model describing the housing market reactions to the new project and the effect on residential location choice. In Norway approaches to estimating the dynamic 'level 3' impacts of transport schemes were developed by Norwegian consultancies and research teams over a number of years in response to the publication of the Wider Economic Benefits guidance by the UK Department for Transport in 2011. A number of modelling methods were adopted with a wide range of sometimes implausible results emerging. As a result of the interest generated by these studies, the Norwegian transport agency issued guidelines limiting the extent of the wider impacts to static agglomeration and labour supply effects and reporting them as part of the supplementary evidence rather than as part of the conventional cost benefit appraisal.

3.2 France

In France the models for specific projects in Paris and in Toulouse have been developed by the scheme promoters. The Grand Paris Express project considered a range of methods for assessing changes in the location of economic activity. Two LUTI models were utilised - Relutrans and Urbansim. The two models were used for estimation of the effects on productivity, through the causal chain: changes in transport costs induce changes in locations, and changes in locations, added to changes in accessibility, induce changes in productivity, and these benefits are added to the conventional transport benefits.
A similar procedure has been used for the 3rd metro line in Toulouse, although, because of time and budget constraints, in place of a LUTI model, changes in location were based on the judgement of experts in urban development in Toulouse while accounting for differences in the change in accessibility between zones. Furthermore, the impact of the

project on employment was estimated through a model linking changes of accessibility to changes in the matching process of the labour market, inducing changes in employment.

3.3 Germany

The most comprehensive appraisal of 'level 3' dynamic impacts was carried out in connection with the expansion of Frankfurt am Main Airport (European Center for Aviation Development, 2008). Firstly, using evidence from large-scale regional and national business surveys, the importance of access to international markets for business location choice and development as well as for the choice of workplace and place of residence for skilled personnel and executives was investigated. Secondly, the relationship between international accessibility and regional gross value added per capita and its growth was statistically analysed.

For the appraisal of the Fehmarn Belt Tunnel between Denmark and Germany (now under construction), an additional effect was calculated of approximately € 40 million per year (2003 prices) for the first 5 years after opening and of € 50 million per year as a long-term effect, owing to increased productivity due to lower transport costs for freight transport (Copenhagen Economics Aps and Prognos AG, 2004). This was estimated to increase the benefits for freight transport identified in the conventional cost-benefit analysis by 25%. In addition, effects are to be expected:

- During the construction phase
- Through additional tourism
- For commuters
- For cross-border settlement activity
- For increased shopping traffic.

These effects however have not been quantified in detail. Surveys of the economy in the municipalities near the northern (Danish) access road to the Fehmarn Belt were carried out. Particularly in the logistics sector, considerable investment intentions were identified.

In a follow-up study by Copenhagen Economics (2014), on the basis of a systematic evaluation of corresponding studies on transport projects (especially in Scandinavia and the United Kingdom), the following ranges of wider economic impacts identified as being additional to the benefit assessment in conventional benefit-cost studies were:

- The prices of the goods and services markets, by reducing imperfect competition by 5 to 10 %
- In the labour market by partially reducing the transport time required for productive times of 2 to 5 %
- Agglomeration advantages by better accessibility or enlargement of markets (including labour market) of 10 to 15 %.

Overall, the wider economic impacts would contribute to an average increase in the benefit measured in conventional CBAs of 20%, but in some cases up to 50% (Copenhagen Economics, 2014). There is no concrete statement on the Fehmarn Belt project; however, reference is made to the investigations carried out so far and it can be seen that other comparable projects are in the same order of magnitude in terms of the expected wider economic benefits. In addition, the study compiles or proposes calculation rules for the determination of wider economic impacts with the help of transport studies or models and structural data analyses.

3.4 Sweden

In Sweden, for 'large' or strategically important projects an analysis of wider economic impacts may be conducted. To the extent that wider economic impacts are assessed, this is usually done for an entire infrastructure investment plan (a large set of new investments) or large investments like high speed rail. In the former case the analysis usually serves a descriptive purpose regarding the impacts of an investment plan. In the latter case impacts are not included in the conventional CBA but are presented separately and considered as a sensitivity analysis to the main analysis.

The degree of detail reported to decision makers may pertain to: (i) a description at a regional/municipality level of employment and population gains and losses, (ii) impact on aggregate earnings or GDP/cap, (iii) housing investments.

For large or strategically important projects, descriptions at a regional/municipality level of employment and population gains and losses as well as impacts on earnings and/or gross regional products are usually presented. It seems that the main purpose of this assessment is to consider whether the magnitude of such effects may change the conclusion reached by the conventional CBA based on the level 1 impacts of the project.

Models are sometimes used for estimating wider economic impacts for an entire infrastructure plan or large investment projects (see above); these are quantitative spatial models. To the extent that WEBs are assessed, both models of location of employment and population, respectively, have played a role. Models of wage earnings and reduced unemployment are other examples. All of them rely on a measure of accessibility (effective density) retrieved from the transport models. Most often the models of WEBs pertain to level 2 impacts. Relocation of employment may of course be used to assess level 3 impacts but this is usually not done.

3.5 The Netherlands

In the Netherlands, there was a strong interest in the wider economic benefits in the first years of the 21st century (around 2000-2007). An intensively debated project in this field was the planned (so far not realised) high speed rail (or MAGLEV) connection between Amsterdam and Groningen in the north of the country. In that period, several models were

developed (or imported) to calculate these wider economic benefits including the RAEM model (a SCGE model developed in The Netherlands), REMI (economic model imported from the US), Mobilec (locally developed model linking transport infrastructure and economic development) and TIGRIS XL (an integrated land use-transport model developed principally by Dr. Barry Zondag at RAND Europe and Delft University of Technology). These models were summarised in Elhorst (2004).

However, efforts into calculating the indirect impacts in a detailed way for specific projects did not produce satisfying results. In an attempt to find the most adequate method a comparison between models for a fictional case study was made (Hof and Heyma, 2008). The models resulted in very different outcomes and the answer to the question of which model was best to use in project appraisal remained inconclusive.

Lessons from this period were that it was difficult to estimate some of these models empirically, that the models were labour intensive to maintain and apply and that in general the wider economic effects were relatively small compared to the direct effects. Especially the last observation caused a lack of interest by agencies in national and regional government in applying these models. Of the models mentioned, only the TIGRIS XL model is still operational (this is a LUTI model that focuses on the regional distribution, not an SCGE model; it does not contain generation of additional benefits).

The TIGRIS XL model was developed in the period 2002-2006 and has since been updated and applied for policy studies (Zondag et al., 2015). This model includes the national transport model (LMS) as its transport component and adds residential choice and changes in the location of employment. It was estimated on micro-data. The current version is v7 and TIGRIS XL is owned by the Ministry of Infrastructure and Water Management. The primary reason for the development was to get insight into the 'structuring' impacts of transport infrastructure, in this case focusing on the spatial distribution of households, through a housing and land market module, and of jobs, through a labour market module . In practice the number of studies on the 'structuring' impacts of infrastructure (as defined above) has been limited and the model has been more commonly applied on developing consistent multi-regional and sectoral scenarios (adding spatial component to national trend or what-if scenarios), impacts of alternative urbanisation strategies and integrated land-use and transport strategies (including accessibility benefits – calculated using geographical accessibility indicators and geographic-economic indicators, the so-called logsums).

Examples of regional or national studies in transport in The Netherlands that include land use effects are:

- Regional urbanisation and infrastructure plan for Rotterdam and The Hague region. Four integrated land-use and transport strategies were developed for the larger Rotterdam and The Hague region. The TIGRIS XL model was used to calculate the

impacts on job distribution by sub-region, mobility indicators (modal split, congestion) and accessibility indicators (to jobs, services) by subregion and accessibility benefits by socio-economic group (such as access to car ownership or income level);

- Infrastructure studies to address congestion problems on the Motorway A2 in the Den Bosch region as part of the province of Brabant. The TIGRIS XL model was used to research whether alternative land-use strategies could improve the accessibility of this region as alternative to increasing the road infrastructure. Impacts included were modal split, vehicle km, congestion, accessibility to jobs, services and accessibility benefits;
- National research study on the accessibility impacts of urbanisation strategies. Alternative urbanisation strategies (urban densification, transit-oriented-development, sprawl) were evaluated on their accessibility impacts including congestion, accessibility of jobs (including distribution of jobs) and accessibility benefits (logsum approach). Follow-up research has focussed on urbanisation strategies to reduce infrastructure investment needs while maintaining accessibility levels.

3.6 Summary

The examples discussed in this section present a rather mixed picture. Several countries try to determine WEBs not through a standard procedure, but using tools developed particularly for the analysis of specific, usually large, projects. While it is clear that estimates of the 'level 3' impacts can be of value to decision makers and provide for a better understanding of the likely outcomes of the project, the estimates of these impacts can, as the Norwegian and Dutch experience has shown, be very dependent on the choice of model.

4. Gaps identified and some ideas to fill these gaps

4.1 Introduction

Several of the experts interviewed have also responded to the question about gaps in the current knowledge on WEBs that are relevant for transport project appraisal in their respective countries, and also about discussions going on how to fill these gaps. Below we discuss these responses for the countries for which such information was obtained.

4.2 France

Respondents from France noted that, while others might regard the French approach to the inclusion of WEBs as limited, in order to take proper account of the consequences of an investment on productivity, good forecasts of the effect of the investment on the location of economic activity are needed. These forecasts require the use of LUTI-type models: they are difficult to calibrate properly, and their calibration is time-consuming and expensive. So, the approach described in this report has been used only for transformational projects such as Grand Paris Express and 3rd metro line in Toulouse, which are urban projects. There are no comparable models for intercity projects.

4.3 Germany

In spite of its absence in the current guidelines, wider economic benefits, defined as all effects over and above consumer and producer surplus (Rothengatter, 2017) and whether and how to include these in federal transport project assessment (BVWP) are being discussed in Germany. Researchers and decision-makers are aware of the fact that dynamic clustering/agglomeration effects and corresponding changes in productivity are included in other countries. Examples from Norway, Denmark (Great Belt and Oresund fixed links), Switzerland and especially the UK are regularly quoted. The discussions in this respect focus on the impacts of shortening commuting distances (other than the direct time or cost savings of these, which are included as direct effects in the CBA). To include effects on other markets than transport, such as the labour market and the housing market, system dynamics models have been suggested. The accessibility of regions and increasing their role in economic/social processes are also discussed, but at the same time there is an awareness of the danger of double counting.

Rothengatter (2017) distinguished three types of wider economic benefits:

- Economic output effects, noting that this may partly overlap with direct effects
- Other positive economic effects (agglomeration/clustering under imperfect competition)
- Social consequences (accessibility of specific regions and jobs, quality of life)

An even more detailed classification (based on US DoT, 2021) has also been discussed:

- Productivity effects through agglomeration

- Labour market effects (and additional tax revenues) through agglomeration
- Reducing regional monopolies
- Opening up underdeveloped regions for housing and economic activities.

It was noted that, in countries that consider agglomeration effects, these may need to be rethought now that, because of ICT innovations and accelerated greatly though the Covid-19 pandemic, home-office working has become increasingly popular, which may have changed the notion of accessibility.

4.4 Norway

Having reviewed data from Norway and from other countries, analysts in Norway decided to use a simplified version of the Department for Transport method and elasticity values for estimating agglomeration impacts, while noting that ideally estimates based on the Norwegian context would be used.

The response from Norway noted that the assumption implicit in the estimation of wider impacts that such impacts occurred immediately on the opening of the scheme is questionable and that it would seem more likely that these effects would take time to materialise (Tveter and Laird, 2018).

4.5 Sweden

Two key methodological challenges in this context as perceived in Sweden are:

- The risk of double counting effects already included in the level 1 impacts.
- The risk of not being able to measure wider economic benefits consistently and with sufficient accuracy.

Another gap that was identified is the need for a better treatment of the heterogeneity of the impacts, since the potential for wider economic impacts probably varies considerably between different parts of the country depending, inter alia, on the regional composition of industry. In addition, a better assessment of employment effects has been discussed: Which jobs are relocated and between which regions? To what extent does an estimated employment effect relate to new jobs and to what extent does it merely reflect relocation of existing jobs?

4.6 Denmark

Some spatial economic models have been developed in Denmark and analysed in scientific papers, but they are still not commonly used in practical transport appraisals. Often, they do not generalise to a broader use – as they are designed for specific purposes.

While there is generally quite a lot of interest in the WEBs and in the potential for including them in standard project appraisals, still no overall guidelines have been established. This is

likely most due to the awareness of the methodological and empirical challenges in establishing these impacts, and not a general resistance against it.

These challenges are of both theoretical and empirical nature, where it is the problems of preventing double counting, establishing correct causalities, taking into account biased samples, sorting etc. that have to be dealt with. However, there is still a lot of interest in the subject and ongoing work, and it is likely, that some/more effects will be included in future guidelines in Denmark.

4.7 The Netherlands

Also in The Netherlands, the quantification of indirect/wider impacts and estimating an appropriate module for this on empirical data is still regarded as a research gap. More recent efforts for better quantification of indirect/wider impacts include the model Orange by TNO (under construction, no information available) and the CPB Luca model (see the more general report by van Maarseveen and Romijn, 2015). This is exploratory research, focusing on SCGE-type models. There is no mandatory use of spatial models/LUTI or otherwise in the current guidelines.

There are concerns among the experts involved in SCBA in The Netherlands that monetary valuations for direct effects and (through the 0-30% rule) for indirect effects remain soft/uncertain and there is legitimate debate in the field about this. The impacts on health and labour productivity of a shift towards more cycling and walking remain highly uncertain and possibly incomplete. One of the interviewed experts stated that administrators attach great importance to SCBA analyses, and that they should be more critical.

The policy formulation and evaluation of transport infrastructure projects in the Netherlands consists of several stages: policy formulation/design, research phase and formal evaluation phase (CBA and environmental assessment). In the appraisal phase, work on wider economic benefits and equity considerations is more restricted by standard procedures/guidelines and the use of the rule of the thumb of 0 to 30% of the direct effects. In the research phase, the regional/urban government plays a more dominant role and at this level of government there is a stronger focus on integrated approaches and wider benefits than on the national level (dominant in the evaluation phase as main financial contributor). At the central government level there are concerns about crowding out at the national level (substitution between regions, e.g., of employment and production).

4.8 Australia

Two challenges were identified:

- The lack of data on productivity differentials by detailed location, occupation and industry sector. The absence of such data inhibits attempts to estimate any

productivity gains when jobs move between locations with differing levels of productivity.

- The difficulty encountered when estimating Australian parameters for agglomeration elasticities owing to shortcomings with the spatial data for firms' location.

4.9 New Zealand

New Zealand is considering revisiting the work on how the MBCM WEB elasticities were derived given the fixed effects econometric approach adopted. The methods included within the Monetised Benefits and Costs Manual could also be simplified to make them more user friendly, as this is seen as a barrier to wider usage. The response noted that matching disaggregated data (such as employment and GDP) across model zones and developing forecasts was invariably subjective and often inconsistent. Tourism demand estimation remains difficult in a post-Covid environment.

4.10 Summary

A gap in the current knowledge that was mentioned in practically every country is the difficulty of getting accurate and robust forecasts from LUTI or SCGE models that have been properly estimated on data representative for one's own country. This is connected to the problem that geographically detailed data on productivity, which can be used as estimation data, is often lacking. At the same time such models should be transferable to other projects instead of being applicable only to a single (large) project, and also should be user-friendly.

Another issue that comes back in the responses from several countries is the risk of double counting (the ongoing debate whether direct effects already include WEBs). The same applies to the risk of including relocation or substitution effects instead of truly additional effects for the nation as a whole.

Most other gaps were mentioned only once, but they are not necessarily restricted to a single country. An example is the unknown impact of Covid-19 and the rise of home-office working on the importance of accessibility and of agglomeration effects. Other examples are the questions when after the opening of the new infrastructure the WEBs would materialise, or whether several types of jobs and/or regions should be distinguished.

5. Further considerations

Respondents to the questionnaire were asked to report on certain additional considerations about the way in which the findings of a wider impacts assessment were presented and the respondents' views about the influence of this part of the appraisal on the decision and the credibility decision makers attached to it.

5.1 Scenarios

All countries present to decision makers the results of the appraisal on the basis of the conventional 'level'1' impacts and with the estimates of wider impacts (if any) as additional 'below the line' information. Only a few countries reported using scenarios as a means of illustrating the uncertainty about the possible range and levels of wider impacts in the case of major schemes. In Sweden the use of ranges has been extended to cover uncertainty about the impact of agglomeration on wages. The upper limit of the range was motivated by an interpretation of wage earnings effects as being the result of spillovers only. The lower limit was motivated by an interpretation of the wage earnings effects as being the result of matching in the labour market (see Eliasson and Fosgerau, 2019). The Norwegian guidance also recommends the use of scenarios in the estimation of wider impacts by varying the distance decay function and agglomeration elasticity.

Some other countries report on using scenarios to cover level 1 impacts either through a range of assumptions about inputs to the transport model (e.g., The Netherlands) or about the values used in the appraisal, while policy makers in others favour a single point estimate. In France scenarios are also used to assess the extent to which the road map for decarbonizing transport by 2050 will be achieved and the appropriate shadow price for carbon under these different scenarios.

5.2 Influence on decision makers

New Zealand reported that that the estimate of Wider Impacts has some limited effect on decisions in the case of transformational projects. The existence of additional Wider Impacts helps decision-makers if they wish to convey the benefits to the public or key stakeholders. Wider Impacts are rarely included in business cases. Where they are included, they feature both at option selection stage and as in informing the final business case although their influence is judged to be relatively minor. Decision makers in New Zealand usually give WEBs much less weight than more tangible benefits. Typically, the larger the WEBs (relative to standard benefits) the less credible they appear – as they are often viewed as an attempt to compensate for insufficient benefits elsewhere.

Estimated WEBs, if applicable in the case of New Zealand schemes, are considered at the option selection stage during the development of the business case and at the investment decision stage. Benefit cost ratios are reported to NZ Transport Agency (Waka Kotahi)

decision makers with and without WEBs. Whether or not WEBs form a major part of the investment conversation depends on the nature of the project.

Respondents in Sweden observed that the fact that there were few proposals for schemes with the potential to deliver wider impacts meant that it was not possible to draw any conclusion about the impact of such estimates on decision making. They noted that sponsors probably see them as interesting and view them as complementary information to the conventional CBA, which is based on level 1 impacts and which did seem to have an effect on decisions. Similar considerations apply to Denmark, where the interest and expectations among decision makers and the public about the likely wider impacts of a project exceed the capabilities of the analytical methods to provide reliable estimates.

France provided another example of a country in which the estimation of WEBs was restricted, in this case to two projects, and so no general conclusions about their influence on decisions could be reported. But conventional transport benefits were perceived as having an influence, although what would be defined as the strategic case in UK terminology provides the initial motive for promoting a scheme. And cost benefit analysis has also provided a useful means of informing the debate about the case for specific proposals.

5.3 Other information

The response from Denmark noted that the use of a shadow price of public funds, set initially at 1.2 but later reduced to 1.1, had been standard practice in appraisal for some years but that this practice was shortly to be discontinued.

Cost benefit appraisal guidelines in France are reviewed by a committee of users who meet to make recommendations on proposed changes and on specific issues such as future scenarios. France has also established a committee of independent experts which reviews the quality of the cost benefit appraisals undertaken for all projects benefiting from at least 100 M€ of state financing. The review takes place shortly before the public inquiry and their report is published.

6. Summary and conclusions

A summary of the findings from the above sections is in Table 1 below.

Table 1. Summary of findings, topic and by country

	France	Germany	Norway	Sweden	Denmark
WEBs in current standard guidelines	Not included	Not included	Not included	Not included	Not included
WEBs in studies for specific (large) projects	Accessibility effects on productivity in Grand Paris Express project and 3rd metro line project in Toulouse	Location and production effects in Frankfurt airport expansion project; Productivity effects in Fehmarn Belt project (with Denmark)	Several models were tested; wide range of results; Guidelines therefore limit WEBs to static agglomeration and labour supply effects, reported separately	For an entire infrastructure investment plan or large investments like high speed rail; Location effects, wages, unemployment	Location effects in a land reclamation scheme; Productivity effects in Fehmarn Belt project (with Germany)
Gaps identified	One needs good forecasts from LUTI-type models; Calibrating these is difficult, costly and time-consuming	Agglomeration effects need to be rethought now that (ICT Covid-19) working from home has become popular - may have changed the notion of accessibility	Will WEBs occur immediately on the opening of the scheme or take time to materialise?	Accurate measurement of WEBs; Risk of double counting; Relocation or additive effect? Heterogeneity of jobs and regions	Spatial economic models are often purpose-specific; Risk of double counting ; How to establish correct causalities? Biased samples, sorting
Other information	Scenarios are used with respect to decarbonisation; Guidelines are reviewed by a committee of users; Also established a committee of independent experts to reviews the quality of the CBAs undertaken for all projects with at least 100 M€ of state financing.		Recommends use of scenarios in the estimation of wider impacts by varying the distance decay function and agglomeration elasticity	Extended use of ranges (scenarios) to cover uncertainty about the impact of agglomeration on wages; Sponsors see WEB as interesting and view them as complementary info to the conventional CBA	Sponsors see WEB as interesting and view them as complementary info to the conventional CBA

	The Netherlands	Australia	New Zealand	United Kingdom
WEBs in current standard guidelines	Mark-up of 0-30% on direct effects to include WEBs	Land use effects; Dynamic Clustering/ Agglomeration; Changes in Productivity; Changes in Labour Supply; Change in Output	Land use effects; Dynamic Clustering/ Agglomeration; Changes in Productivity; Changes in Labour Supply; Change in Output	Land use effects; Dynamic Clustering/ Agglomeration; Changes in Productivity; Changes in Labour Supply; Change in Output
WEBs in studies for specific (large) projects	Several models were tested; wide range of results; Only LUTI model (without nationally additive effects) still used, especially for combined transport/land use schemes	See standard guidelines	See standard guidelines Schemes which increase international tourist visits assumed as resulting in additional economic activity.	See standard guidelines
Gaps identified	Valuations remain soft; Relocation or additive effect? Treatment of walking and cycling	Lack of data on productivity differentials by detailed location, occupation and industry sector; Difficulty when estimating Australian parameters for agglomeration elasticities owing to shortcomings with the spatial data for firms' location	More user friendly methods; Matching disaggregated data across model zones and developing forecasts is invariably subjective and often inconsistent; Tourism demand estimation remains difficult in a post-Covid environment	
Other information	Scenarios are used for inputs of transport model (Level 1 impacts)		Wider impacts has some limited effect on decisions in the case of transformational projects; Estimated WEBs are considered at option selection during the development of the business case and at the investment decision stage	

Despite the interest expressed in the study's findings by participants, there was limited evidence of major new analysis being undertaken to take forward the estimation of wider impacts or to develop existing appraisal guidance. Some countries, including Germany,

reported on an awareness of the potential relevance of such effects and noted the UK's TAG as an example.

The countries which responded to the questionnaire all had well documented clear appraisal guidance. In all cases this guidance covered benefits defined by DfT as 'level 1' effects.

Only New Zealand and Australia make provision in their appraisal guidelines for the inclusion of wider impacts on a comparable basis to the UK's TAG, with separate reporting of static and, where estimated, dynamic impacts. The guidance indicates that agglomeration and labour supply impacts assuming fixed land use are more commonly included in the information given to decision makers.

Countries which had access to LUTI or other spatial economic models used these models only in exceptional circumstances (such as for large projects or for the national infrastructure plan). Examples are the Grand Paris Express scheme, Toulouse Metro, and certain large projects/infrastructure plans in the Netherlands and Sweden. Most countries found the estimation and application of such models challenging. No country made recommendations for the choice of any specific spatial economic model. Different models produced very different findings and gave rise to doubts among experts about the reliability of the results. In the case of the Netherlands, this resulted in the adoption of a rule of thumb as a proxy for a modelled estimate.

Where wider impacts were part of the appraisal, the results were invariably presented separately from the conventional categories of impacts.

A better understanding of the expected spatial impacts of a project, informed either by modelling, by land use planning policies or by expert advice, helped to fill out the economic narrative and was seen as valuable information by decision makers.

To the extent that wider impacts were part of the appraisal, these were generally valued in terms of a conventional cost benefit welfare-based metric. Some of the special studies referred to in section 3 provided estimates of GDP effects.

Many respondents expressed reservations about the inclusion of wider impacts because of the risk of double counting the risk of interpreting substitution/relocation as generative effects and because of problems in obtaining place based appropriate data and estimating the relevant parameters.

We conclude that in a multinational perspective, WEBs are still far removed from becoming a standard component of SCBA. Here and there, some of the initial enthusiasm appears to be fading. However, we do not regard this situation as the beginning of the end of WEBs in SCBA, but as the end of the beginning. There is still a long way to go for WEBs, but there also is a lot of interest in estimating WEBs in most of the countries for which we carried out

interviews. Including WEBs in appraisal will be difficult in practice and needs more time, for more data collection and more research. Furthermore, even when methods would have been established for calculating WEBs, it is unlikely, even for megaprojects, that these effects will be very large (see or instance the upper bound of 30% of the time and reliability benefits used in The Netherlands for WEBs). Besides this, WEBs, not only when applying this rule of the thumb, but also when doing project-specific calculations on the basis of accessibility changes, are most likely to be found for those projects that already have the largest direct benefits. Such projects tend to have a strong strategic case and convincing narrative to support their approval.

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Appendix 1. The questions asked to the experts in each country

List of key questions – level 3 international comparisons appraisal methods and practice

- How a selection of other countries include impacts from land use changes, dynamic clustering/agglomeration, changes in productivity, labour supply and output in project appraisal?
- How are transformational project and wider economic benefits estimated around the world and in other sectors? What are their official appraisal guidelines and what do they say?
- What are seen as the key methodological challenges?
- What types of model are used e.g. CGE, LUTI, quantitative spatial models, other approaches (there is not a requirement to delve deeply into Supplementary Economic Modelling techniques, or review specific international models in any great level of detail).
- What are the key data and evidence gaps?
- Where these appraisals are done, how have they evolved over time?
- Do they influence decision making?
- Are scenario ranges typically presented and if so, what are they based on?
- How credible are the methodologies seen by the funders (e.g. government) and/or the wider public?
- What more needs to be done in these settings to better capture these impacts?
- How do their methods compare to TAG?
- How other countries' decision making agencies factor wider economic impacts into the decision making process, at what stages and to what degree of detail?

Appendix 2. Treatment of WEBs in the UK's TAG

Brief description of UK practice on the assessment of wider economic impacts in transport cost benefit analysis and of the advice to decision makers on the assessment of these impacts

Level 1, 2 and 3 impacts in TAG and its guidance on the treatment of level 2 and 3 impacts

The DfT classify the range of impacts that might result from a transport project into 3 levels[1].

Level 1 impacts

Level 1 impacts are defined as the conventional user benefits, such as travel time savings and established environmental impacts, estimated on the assumption of no transport-induced land use change. The appraisal at this level provides a metric defined as the initial BCR.

Level 2 impacts

The next stage of the approach used by the DfT is to define, quantify and value so-called Level 2 impacts. While our project is primarily concerned with Level 3 impacts, we thought it would be instructive to explain the DfT's practice since the two categories of benefit are closely related. At level 2, the level 1 benefits are extended to include 3 categories of wider impact, assuming land use remains unchanged on the 'Do-Minimum' counterfactual. These level 2 impacts are made up of:

- Static clustering, which is defined in terms of the changes in accessibility that are the result of the scheme, and the effect of these changes on the measure of effective density (also described as economic mass) and hence on productivity, with the changes in accessibility being incorporated in the 'do something' run of the transport model.
- Labour supply effects, which are estimated from available evidence on the effect of changes in out of pocket costs – in this case on the effect of changes in public transport fares - on people's willingness to join the labour market. The DfT guidance assumes that potential workers respond to the change in the returns to joining the labour force, estimated on the basis of the change in post-tax earnings minus the costs of commuting, which are reduced in the 'Do Something' option, with an elasticity of 0.1. Workers induced by the scheme to join the labour force are

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/955343/tag-unit-a2-1-wider-impacts-overview-document.pdf

assumed to have an output of 0.69 of the productivity of the average worker. Benefits in the economic appraisal are valued through the additional labour taxes on these new workers. Labour supply impacts are included in the appraisal only for places where there is evidence that the absence of good transport links are a barrier to people entering employment and that the proposed intervention will eliminate that barrier. In many cases they do not form part of the appraisal.

- The effects of imperfect competition in the supply of goods and services is accounted for by increasing the modelled estimate of freight transport and all other business user benefits by a factor of 1.10. This adjustment reflects the finding that, for the typical mix of goods and services benefitting from a transport improvement, imperfect competition results in the price that consumers pay, and hence the value they place on the change, exceeding the change in the resource costs of production by this factor. This uplift, which is in effect an adjustment from the resource cost basis of the business cost calculus to a market price, is conceptually different from the assessment of spatial impacts. We mention it here so as to cover all of the Level 2 impacts.

Level 3 impacts

Level 3 impacts, which are the subject of the research study we have been commissioned to undertake, are defined as those which include changes in the attractiveness of different locations and the consequences of these changes in land use or the sectoral mix of employment for the level and location of economic activity. Such approaches generally require the use of land use transport interaction (LUTI) models, spatial computable general equilibrium (SCGE) models or a more aggregate reduced form or structural models. While the UK has issued guidance on the use of such supplementary economic models[2], there is no suggestion in the guidance that any specific model should be used. Over the past decade scheme promoters responsible for the appraisal have made use of a variety of models supplied by consultants. These include versions of the Delta land use model, of the Steer Urban Dynamic Model and the PWC SCGE model. While some of these remain proprietary models owned by those responsible for their development, details of others, including the PWC SCGE model on High Speed 2, are in the public domain[3].

The productivity impacts, which are the key source of the level 3 wider impacts, generally arise through the relocation of economic activity to agglomerations with higher output per capita than in the areas from which the jobs are transferred. The approach assumes that the productivity of those who move jobs changes from the average in the zone which they have left to the average of the zone to which they have moved. The economic appraisal takes the

[2] https://www.gov.uk/government/publications/webtag-tag-unit-m5-3-supplementary-economic-modelling-may-2018

[3] https://www.gov.uk/government/publications/spatial-computable-general-equilibrium-s-cge-model

estimate of the additional tax revenue generated from this change job location: the user benefits estimated in the transport model are the measure of the benefits to the individual and these are included in the 'level 1' effects. With the exception of supply side effects, of which, as far as the transport market is concerned, the reduction in commuting costs, as described in the section on 'level 2' impacts above, is the main impact, UK appraisal practice assumes full employment at a national level and that any job created in one location is the result of a job displaced elsewhere. The DfT's National Trip End Model[4] (NTEM) provides control totals for projections of population and jobs at a zonal level. In the case of major schemes where level 3 impacts are anticipated, transport induced changes in the distribution of jobs and population between zones within a spatial control total (usually the relevant region or sub-region) is allowed to take place. Where decision makers have an interest in whether a scheme is likely to deliver specific place based objectives and has either positive or negative impacts on economic activity in that location, guidance on place based appraisal[5] should be followed. The advice in this TAG unit is aimed at reaching a view about the likely spatial distribution of the employment and local GDP benefits of the scheme. In addition, a metric based on the overall increase in productivity generated by the scheme has been used by decision-makers as a GDP effect, an effect which, as TAG makes clear (reference) is a departure from the social welfare methods that underlie cost benefit appraisal.

Guidance on the decision making process and the assessment of Level 3 impacts

We have also been asked to find out what credibility decision makers and project sponsors or funders attach to estimates of wider economic impacts and about the role they play when they are considering the case for the scheme. As background to this request, we have set out in this section the approach that decision makers in the UK are advised to take when assessing the economic case for transport schemes where wider impacts are identified.

The UK's DfT has published several documents including the Value for Money Framework[6] and Supplementary Guidance[7] which describe the decision making process which ministers, local authority politicians and officials to whom decisions are delegated are advised to follow in the case of projects which are supported by estimates of wider economic impacts. The level 3 impacts, defined as dynamic clustering, the move to more productive jobs, dependent development and certain further impacts identified in the model are counted as indicative benefits despite the use of a spatial economic model or its equivalent to quantify

[4] https://www.data.gov.uk/dataset/11bc7aaf-ddf6-4133-a91d-84e6f20a663e/national-trip-end-model-ntem
[5] https://www.gov.uk/government/publications/tag-unit-a4-3-place-based-analysis
[6] https://www.gov.uk/government/publications/dft-value-for-money-framework
[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918481/value-for-money-supplementary-guidance-on-categories.pdf

and value these effects. Uncertainty about robustness of spatial economic or SCGE models is, it would seem, the main reason for treating level 3 impacts in this way.

The rule generally adopted by policy makers responsible for decisions on transport schemes is that the BCR, including only Level 1 and Level 2 benefits, should exceed a threshold value of 2.0:1, a value defined as demonstrating high value for money and which effectively serves as a proxy for a shadow price of public funds in the transport sector. For schemes with a lower BCR, decision-makers are asked to consider whether the implicit value of the Level 3 effects (and any other unquantified impacts) would, if these values were added to the scheme benefits, result in the BCR exceeding the BCRs of other projects expected to deliver high value for money but which, because of the budget constraint, would become unaffordable.

The DfT has previously published annual tables which set out the proportion of the Department's investment in projects by value for money category[8]. The Department has set out in this publication a range of categories ranging from poor VfM (BCR<1.0) to very high VfM (BCR.4.0) with the VfM category to which a scheme is assigned taking account of decision makers judgement on the likely value of the wider impacts. The DfT does not publish any additional information to identify those schemes which were considered by decision makers to merit a shift to a higher value for money category on account of a judgement made about the extent of the wider impacts.

[8] https://www.gov.uk/government/publications/percentage-of-dft-s-appraised-project-spending-that-is-assessed-as-good-or-very-good-value-for-money#:~:text=The%20indicator%20gives%20the%20proportion,in%20the%20reported%20calendar%20year