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HEATCO

Developing Harmonised European Approaches for Transport Costing and Project Assessment

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1 Introduction

As set out in the Commission's White Paper “European transport policy for 2010: time to decide”, external effects such as congestion, accidents, health risks from pollutant and noise emissions as well as other environmental impacts contribute to current unsustainable development patterns. The conclusions drawn are that the completion of the trans-European network (TEN) and the internalisation of external effects by infrastructure charges are essential elements of a policy aimed at overcoming unsustainable trends in development. This clearly has implications for the evaluation of TEN (as well as other) infrastructure projects.

At present, evaluation of investments and policy measures takes place in a highly pragmatic manner. National guidelines exist in a number of countries, but these differ widely in terms of their methodology, level of detail and indicators. These differences are partly due to a natural bias of guidelines towards state level economic and social objectives – they were not developed for assessing international projects. In part, however, there are also differences in assumptions between countries in terms of the economic valuation of impacts. The existing guidelines at EU level (DG REGIO: Guide to cost-benefit analysis of investment projects) already was a large step in the right direction; however these do not provide indicators or procedures that are specific enough to act as a standard in the evaluation of e.g. TEN projects.

Guidelines from organisations like the European Investment Bank or the World Bank do include basic economic and environmental indicators but fail to provide an integrative view or to address certain EU-specific concerns. Project assessment guidelines based on harmonised approaches and comparable values were not available. Furthermore, there was a huge gap between existing evaluation practice and theoretical approaches. Quoting the EEA website: “The practice of strategic environmental assessment is growing, but links with actual decision-making are weak”. In an opinion paper the Economic and Social Committee, expressed the need for an unambiguous and harmonised framework for socio-economic evaluation of policies, including transport. Contrary to Japan and the USA, until now R&D in Europe in this area has been highly fragmented, although first steps were taken in the EUNET and IASON projects. Another useful step is the Guideline document for TINA and now UNECE – Cost-benefit analysis of Transport Infrastructure Projects. However, all of these documents lack many of the numbers which HEATCO helped to provide.

The specific objectives of HEATCO were:

- To develop a set of harmonised guidelines for project assessment and transport costing on the EU level in the areas
 - Value of time and congestion
 - Value of accident risk reduction
 - Costs from health impacts and costs of other nuisances due to pollutants and noise
 - Wider economic effects, i.e. indirect effects
 - Infrastructure costs
 - General CBA aspects; e.g. inter- and intragenerational distribution, risk and uncertainty

Starting point was the compilation and analysis of the national assessment practice in EU25 member states and Switzerland, which was carried out in the first project phase.

Based on this, common definitions and consistent valuation methods were agreed. The framework is based on welfare economics and cost-benefit analysis.

- To achieve as much as possible convergence of national guidelines within an international framework by organising interaction with policy makers and other relevant stakeholders. The design of harmonised guidelines was not a straightforward task. The gap between research and practice is large and can certainly not be bridged by research alone. In addition many vested (though legitimate) interests exist in the various guidelines for economic appraisal in different countries. In order to propose guidelines at EU level, the existing differences in guidelines required a careful mediation and uncovering of underlying assumptions and preferences. Therefore, a process approach was required rather than a linear sequence of development tasks. As a consequence a cyclical approach with a series of meetings was established. In cases of non-convergence different options were proposed in order to bridge the gap or insight was provided for the existence of different practices.
- To conduct surveys for selected impacts
Contingent-valuation studies for valuing noise annoyance and travel time changes were carried out in Norway, the UK, Spain, Hungary, Germany and Sweden to explore differences from different geographical, cultural and traffic conditions.
- To perform case studies on a number of TEN transport infrastructure projects
The assessment framework was demonstrated by applying it to selected TEN transport projects and comparing the results with those of existing CBAs.

The main focus of HEATCO was major European infrastructure projects, for which a sound evaluation scheme was established that in the long run may become a standard procedure.

This report summarises the work undertaken in HEATCO for achieving following results:

- An overview of existing national transport infrastructure project assessment practice in EU25 member states and Switzerland (see chapter 2).
- A set of harmonised guidelines for project assessment and transport costing on the EU level as described above (see chapter 5)
- A set of monetary values for noise annoyance based on a number of contingent valuation studies in different countries with different geographical, cultural and traffic conditions (see chapter 4).
- A set of case studies illustrating the applicability of the proposed guidelines and comparing the results with those of existing CBAs (see chapter 6).

2 Current practice in project appraisal in Europe

The primary objective of HEATCO is the development of harmonised guidelines for project assessment and transport costing at an EU level. Therefore in a first step the existing practice of project appraisal in EU Member States¹ and Switzerland was collected, compiled, analysed and compared. The results are documented in Deliverable 1, which besides the overall findings of the analysis and country comparison presents most of the country specific details.

The analysis and comparison of existing practice of project assessment and transport costing has highlighted a number of similarities and differences across countries and modes. The authors acknowledge that national guidelines are generally the results of a long tradition and development of project appraisal methods. National guidelines are not based on the same methodological framework and they are used in different regulatory contexts. For this reason procedures and values used are different. However, from the HEATCO perspective of developing a harmonised "state-of-the-art" approach for assessing European infrastructure projects a comparison and analysis was required. Similarities between countries make harmonisation easier, whilst differences make it more difficult. The main findings are summarised in the following.

The first impression when comparing the country reports was that the principles for project appraisal and transport costing vary considerably across countries and modes. The vast majority of the countries in the North/West region of the EU have comprehensive guidelines for project appraisal, whereas the guidelines in the South and East regions seem less developed. Furthermore, the appraisal framework for rail seems less standardised than for road and only around one third of the surveyed countries have formulated principles for the appraisal of air, inland waterway and sea transport projects.

The data shows that all the surveyed countries use cost-benefit analysis in some form (see Fig. 1 and 2). In the East region of the EU, cost-benefit analysis is most commonly or exclusively used for projects which are promoted for EU co-funding. However, the country reports show that cost-benefit analysis is gaining acceptance also for locally financed projects in several of the countries in the East region of the EU.

For the analysis the elements of cost-benefit analysis were grouped into 11 categories. The analysis shows that there are large differences between the surveyed countries regarding whether and how the 11 main effects should be included in the project appraisal (see Fig. 1 and 2). The vast majority of the surveyed countries include; *construction costs, system operating and maintenance costs, passenger transport savings, time savings to goods traffic, vehicle operating costs, user charges and revenues* and *safety* effects with a money value. Around half of the countries also include *noise effects* and the effects on *local and regional air pollution* in a cost-benefit analysis. *Climate change effects* and *disruption from construction* are in most countries not included with a money value in the project appraisal. In general countries in the East and South regions of the EU seldom include environmental effects with a money value.

¹ No information on Luxembourg could be obtained despite considerable efforts.

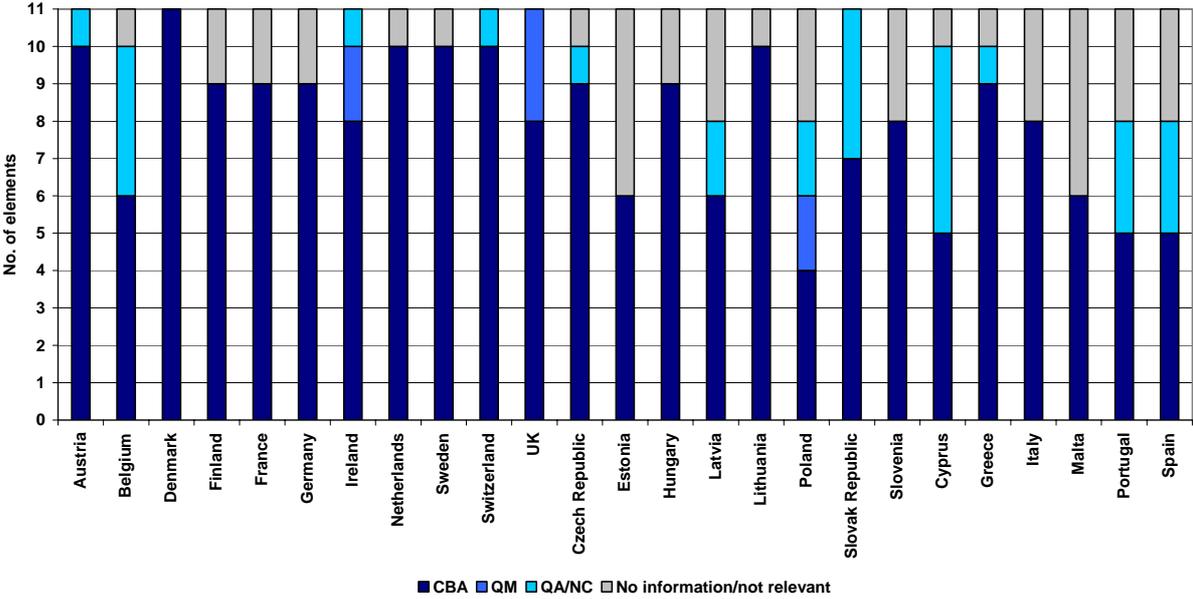


Figure 1 Coverage of main effects by country - Road (no. of elements covered by each type of analysis by country)

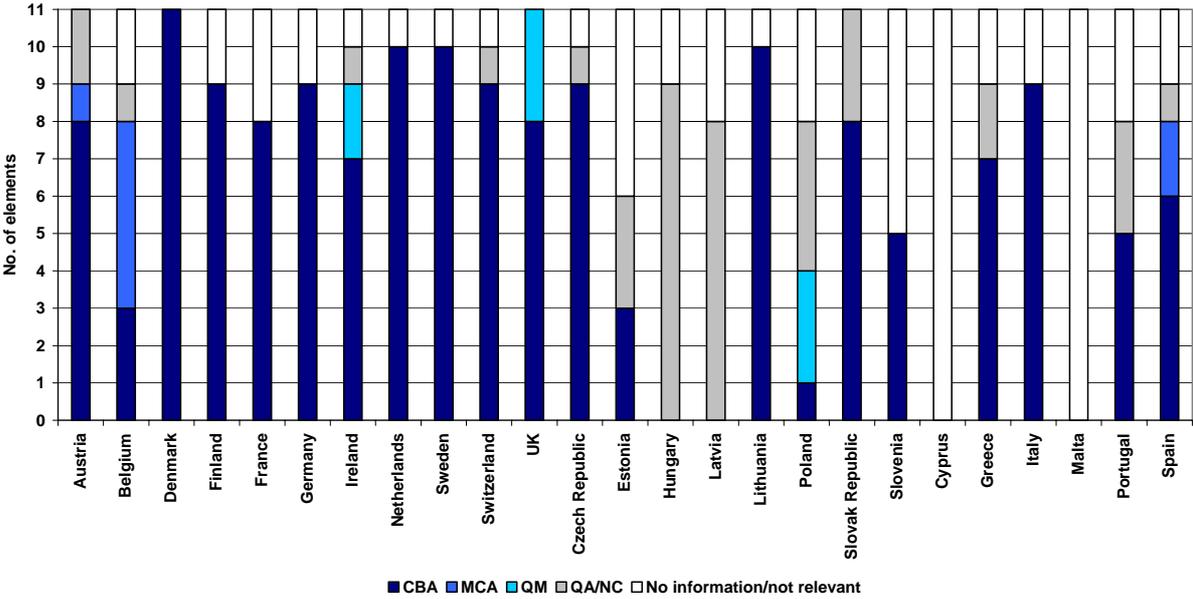


Figure 2 Coverage of main effects by country - Rail (no. of elements covered by each type of analysis by country)

There is no convergence on whether the unit of account of the cost-benefit analysis should be market prices or factor costs. Likewise there is no convergence on which discount rate and appraisal period to use.

Only a few countries include distortion effects from tax financing and transboundary effects. However, there seem to be some consensus on the treatment of distortion effects from tax financing and transboundary effects when they are included.

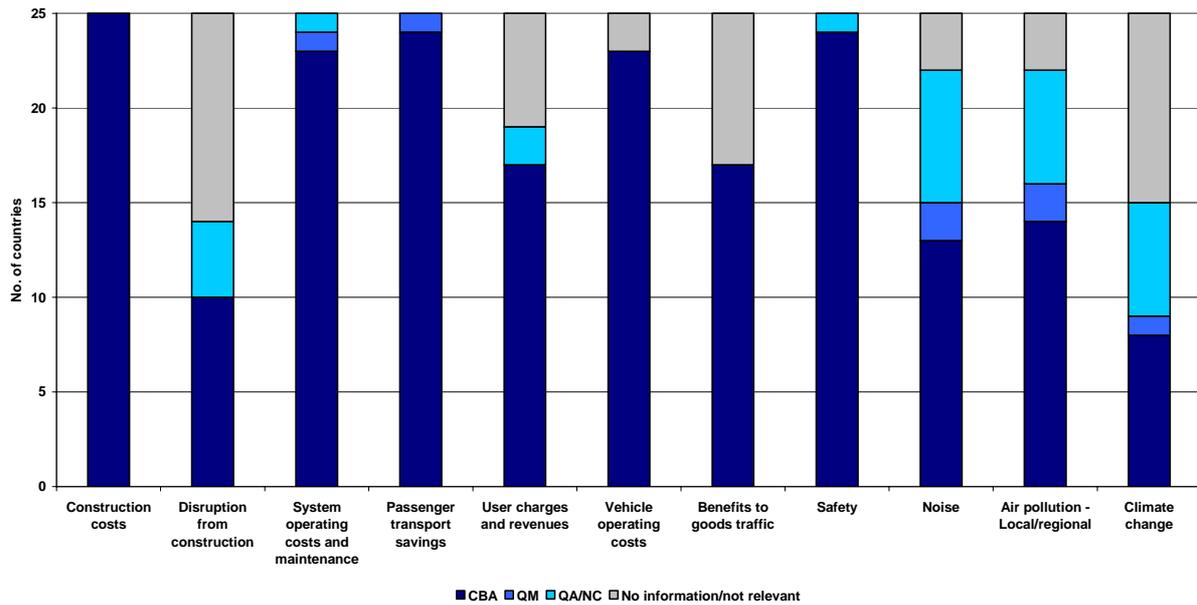


Figure 3 Coverage of main effects - Road (no. of countries)

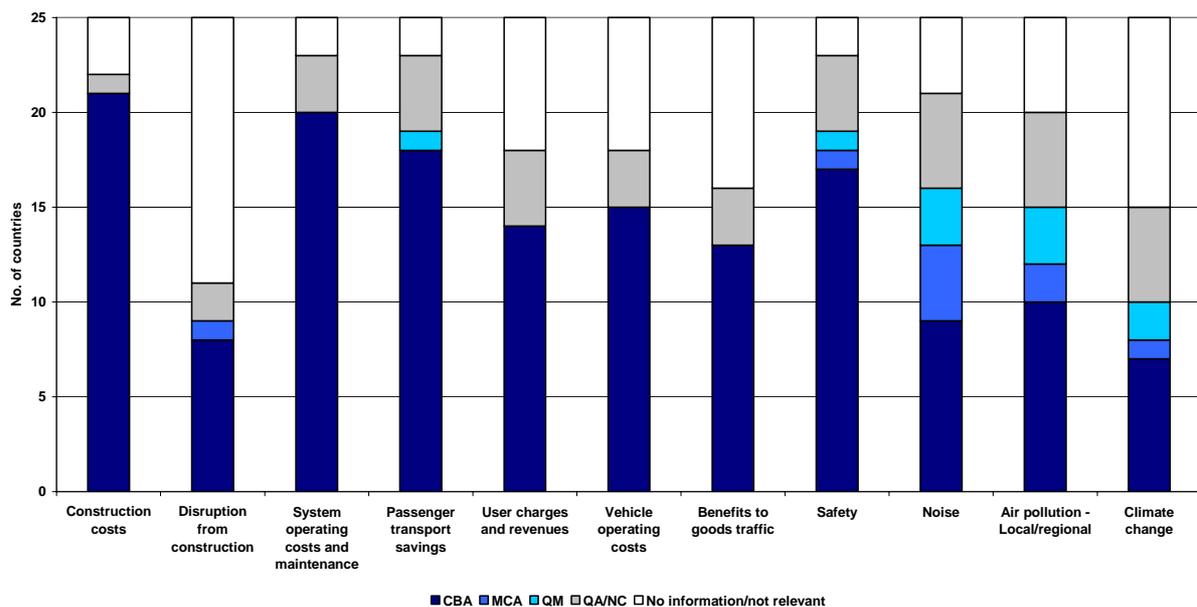


Figure 4 Coverage of main effects - Rail (no. of countries)

There is more convergence on how to treat *construction costs*, though there are still some differences on which elements to include, how to treat the residual value and which lifetimes to use for various components. The majority of countries have systematic methods to tackle uncertainty/optimism-bias in the construction cost estimate. Most often this comprises a form of standard mark-up on the construction cost estimate. Only a few countries use more advanced methods.

Most countries do - as mentioned above - include *system operating costs and maintenance*, and the majority of countries use a definition which is consistent with the EUNET definition. Around half of the countries have standard figures for operating costs and maintenance. Though, in many cases project specific estimates are used.

For *user benefits* and *vehicle operating costs* there are a number of similarities across countries. The data shows that all countries include travel time savings in the appraisal and that these are included via a cost-benefit analysis. Furthermore, most countries disaggregate travel time savings. The most common forms of disaggregating are work and non-work and by mode of transport.

In addition, the survey has showed that all countries (where information was provided) include vehicle operating costs savings associated with road transport in an appraisal via a cost-benefit analysis. There also appears to be a great deal of similarity in the definition of vehicle operating costs between countries.

There are, however, also important differences for user benefits and vehicle operating costs. There appear to be a number of popular methods for assessing travel time savings, but there does not appear to be a single common approach. With respect to time savings for work trips the most popular valuation method is the cost saving approach, whereas for non-work trips willingness-to-pay approaches and a relationship to the wage rate are the most used valuation approaches. Furthermore there are important differences between EU regions (North/West, South and East). For example, for non-work time savings the willingness-to-pay approach is used extensively in the North/West region but not in the East and South regions. It is also more common to have travel time savings guideline values that are commonly used in appraisal in the North/West region, than in the East and South regions and countries in the North/West region are more likely to differentiate their values of travel time saving into a number of different categories (e.g. work/ non work; by mode, etc.).

For safety there are also both similarities and differences across countries. The vast majority of countries do, as mentioned above, include safety effects in a cost-benefit analysis and there seems to be consensus to include all three effects; material damage, personal loss for casualties and costs to society in the money value. There is not a single common approach for estimating the money value of any of these three effects. Furthermore the survey has showed that a significant range of values are used for safety and that there is no consensus on whether or not values should increase over time. The survey also showed that 16 of the 25 countries use a definition of different accident types which is consistent with the definition of EUNET.

Noise is included in a cost-benefit analysis in around half of the surveyed countries. There are clear regional differences on how to treat noise effects. None of the countries in the South region include noise in a cost-benefit analysis, whereas all but three countries in the North/West region include noise in a cost-benefit analysis. Around half of the countries in the East region include noise effects in a cost-benefit analysis.

All countries, which include noise with a money value, include noise annoyance, whereas only a few include health costs related to noise. The money value of noise annoyance is in all

countries except one, based on hedonic pricing. The recommendation of UNITE that values should grow over time is not consistent with country practice.

For local and regional air pollution there is no consensus on which elements to include for cases where the effect is included with a monetary value - which around half of the surveyed countries do. There is also no consensus on valuation techniques, though the impact pathway approach is most commonly used.

There are clear regional differences on the treatment of *climate change* effects. All countries in the North/West region, except three, include climate change effects in a cost-benefit analysis, whereas as only one country in the East region and one country in the South region include climate effects with a money value. The data also shows that there is no single common approach for assessing the money value and that a significant range of values are used.

Only very few countries include other environmental effects than noise, air pollution - local/regional and climate change in a cost-benefit analysis. Some countries are however considering how to include more environmental effects in a cost-benefit analysis. The picture is the same for *indirect socio-economic effects*. Only very few countries include these in a cost-benefit analysis.

In general it can be concluded that the main challenges to the development and use of harmonised guidelines are;

- significant regional differences in the approach to and tradition for transport project appraisals;
- the appraisal framework for road is far more developed than for especially air, inland waterways and sea transport;
- lack of consensus on which elements to include in the cost-benefit analysis (especially environmental effects);
- lack of consensus on approaches to valuation; and
- the significant range of values used (e.g. for safety).

3 Key Issues in the Development of Harmonised Guidelines for Project Assessment and Transport Costing

Based on the work described in chapter 2 advantages and drawbacks of main elements of evaluation harmonisation was discussed. Furthermore, those methodological questions were raised that demand a choice to be made in the harmonisation framework. Bearing this in mind, an issue paper was produced to guide research in the HEATCO project: this Deliverable 3 was meant to identify the relevant issues for further research, and to indicate the questions that had to be answered.

Guidelines for transport project assessment have many faces – they may be very detailed (Japan) or only general (US) and sometimes even non-existent – the current EU practice is that of no institutionalised evaluation approach, let alone harmonised. Now, which level of harmonisation is optimal for evaluating transport projects? We identified various advantages as well as drawbacks of harmonisation. Advantages include a high network value of standardisation, transparency, time saving for decision-makers, and less borders. However, constraints exist: maximum support from member states is needed to make harmonised evaluation work; the European financial budget is relatively low; rent seeking should be avoided; any evaluation standard will be hard to change; and issues exist where harmonisation might harm cultural identity or where the subsidiarity principle is violated.

These considerations were translated into requirements for harmonisation topics. Harmonised guidelines should allow us to address supranational projects and/or projects where EU funding is involved (more precisely, the main candidates for harmonised assessment appear to be TEN-evaluations). They should allow effective decision-making in the sense that results of ex ante evaluation of projects should be as close as possible to results of ex post evaluation, which has the benefit of hindsight. There should be transparent criteria that allow for second opinions. Support from policy makers is essential.

Several topics were identified that had to be researched along these criteria. Main questions to be addressed include the following. First of all, it was important to choose either MCA or CBA as a basis for assessment. MCA has the disadvantage that not all effects are labelled with a price; CBA, on the other hand, forces adding prices to effects that might be less realistic. The conclusion was that HEATCO is using CBA, with the note that one needs to go beyond only transport CBA by including indirect effects in the analysis.

Another important question is that of the treatment of equity. It would be unwise to take over the seat of the politician when evaluating project proposals. Therefore it is perhaps best to take economic utility theories as reference rather than to make political choices ingredients of the assessment. For example, one could choose between Pareto optimality (maximise the sum of individual utilities) or Rawlsian optimality (maximise the minimal individual utility). In either case, it would be wise to indicate the utility basis of research results, as well as how it scores on the equity/efficiency trade-off. For example, evaluating projects in peripheral regions may have very positive results in terms of equity, but it might be at the cost of labour mobility and total income. Finally, it should be clear whether we want to prescribe methods for evaluation of equity scores, or limit ourselves to prescribing the format for presentation of

equity results. The latter seems more appropriate in guidelines for (comprehensive, or full) CBA.

Thirdly, the question of whether to take local, national or EU values should be answered for those indicators and prices that are to be included in the analysis, and where individual preferences have to carry a price tag. A trade-off appears to apply here: standardisation and hence using EU-wide values has clear advantages in terms of transparency, but might be far from actual individual preferences. In any case, it will be important to indicate how proposals for use of values and preferences are located on this trade off curve. Our recommendation is to use local values as much as possible.

4 Economic values for key impacts valued in Stated Preference surveys

The main goal for the work of Work Package (WP) 5 of HEATCO is to find new economic unit values for the external effects considered most important in CBAs of transport projects, and for which we currently lack reliable economic estimates. Such new unit values will increase the reliability of CBAs of transport projects. Based on a review of the existing literature on economic valuation of externalities from transport, inputs from other WPs in HEATCO and a list of criteria, we selected noise and travel timesavings as effects where improved economic unit values were needed. Weighing up the strengths and weaknesses of stated preferences (SP) and revealed preferences (RP) techniques, we proceeded to construct a contingent valuation (CV) survey for eliciting economic values for road and rail noise annoyance and the value of travel time savings (VTTS). The same survey was conducted simultaneously in six countries, in order to reflect the diversity in income and culture in Europe. The six countries were: Germany, Hungary, Norway, Spain, Sweden and the UK.

During the last half of 2005 a total of about 5500 respondents in Germany, Hungary, Norway, Spain, Sweden and the UK were interviewed in-person about their annoyance from noise and their willingness-to-pay (WTP) to eliminate their noise annoyance from road and rail, and their WTP for travel time savings when commuting to work. For Hungary, a similar CV study of aircraft noise was also performed. The respondents asked to value road and rail annoyance were interviewed at home and were selected as far as possible on the basis of ambient noise levels at home, as described by noise databases and noise maps, whereas for the time valuation a random sample of respondents was added. For all externalities valued here, we omit protest zero WTP responses, since the respondents might have a positive WTP but state zero WTP in order to protest against the CV scenario. If we had included these responses, our WTP values would have been biased downwards. All values are expressed in 2005-euros (converted from other currencies using Purchase Power Parity (PPP) corrected exchange rates).

The great advantage of using an identical Contingent Valuation (CV) survey simultaneously in many countries is that the observed differences in values between countries are not due to different methodological differences, but rather differences in preferences and the cultural/institutional settings.

However, there is always a trade-off between what is the best design of a CV survey for each country, versus finding a common design that works reasonably well in all countries. In this instance, the need for a common CV scenario used in all countries may have lead to a higher proportion of people answering zero WTP, especially protest zero WTP than would otherwise be the case. In addition, the pattern of WTP over the range of annoyance levels does not strictly conform to what we might theoretically expect. This may be explained by respondents finding it difficult to distinguish well between the five different annoyance levels. Overall, however, this six-country Contingent Valuation (CV) survey seems to have performed well, and has created new economic values for the selected externalities; noise annoyance from road and rail (and aircraft noise in Hungary, representing the new EU Member countries), and for travel time-savings (going by car or public transport to work).

The results from the survey for road traffic noise annoyance did not show any significant differences between the most annoyed annoyance categories in the pooled national survey analysis; hence the recommended values are the same for the “highly annoyed” and “annoyed” categories. This result might be due to the low number of observations for each of these sub-samples. The pooled samples confirm that WTP increases, as expected from theory, when going from “not annoyed” to “slightly annoyed” and on to “moderately annoyed”. There is however no significant difference in the WTP between the three highest annoyance levels (i.e. moderately, very and extremely annoyed). This could be explained by the fact that people with lower income, and thus lower ability to pay, often live in areas with high road traffic noise levels, since the houses in these areas are cheaper. As mentioned above, it may also be the result of respondents being unable to distinguish effectively between these different annoyance levels, as currently described. Therefore, we suggest using the same value for the three highest noise annoyance levels.

These values from the pooled sample could be used for national valuation purposes by PPP-adjusting the Euro values. The pooled sample for rail noise annoyance confirm that WTP increases, as we would expect from theory, when going from “not annoyed” to “slightly annoyed” and to “moderately annoyed”. However, as with road, there is no significant difference in WTP between the three highest annoyance levels (i.e. moderately, very and extremely annoyed) for rail noise annoyance. As for road noise annoyance, this could be explained by the fact that people with lower incomes often live in areas highly exposed to rail noise.

Therefore, we suggest using the same value for the highest noise annoyance levels. These values should be used in national valuation by adjusting the euro values by PPP. There is no significant difference in WTP between rural and urban areas for either road or rail, hence the same values for both urban and rural, independent of annoyance level, can be used.

For the noise annoyance values to be used with the 4-level noise annoyance scale we have exposure-response functions (ERFs) for, we recommend that the average values of the two highest levels in the new 5-level annoyance scale (i.e. “Extremely” and “Very”) are merged to provide a value for the highest level in the 4-level scale (“Highly annoyed”). For the remaining three annoyance levels the values are assumed to be the same as for the 5 level annoyance categories. Moreover, we recommend not to apply amounts for people stating that they are “not annoyed” by noise for surveyed noise source. This means that we only recommend values for three categories, namely i) Highly annoyed ii) Annoyed and iii) Little annoyed (see Table 1).

Table 1 Recommended values for annoyance categories for road (2005-€ per annoyed person per year)

| | Road | Rail |
|----------------|------|------|
| Highly annoyed | 85 € | 59 € |
| Annoyed | 85 € | 59 € |
| Little annoyed | 37 € | 38 € |
| Not annoyed | 0 € | 0 € |

The value of travel time savings (VTTS) estimated is only for journeys going to work, and estimated by using the same valuation method as used for valuing noise annoyance from rail and road since all valuation scenarios were presented in one questionnaire. The VTTS practice should therefore be regarded as an experiment on applying Contingent Valuation for the value of time. Until this methodology is more throughout tested for other aspects of travel time savings, we recommend that new European values for time savings should be based on the meta-analysis conducted in other parts of the HEATCO project, rather than on the new values from this large-scale pilot study focusing on the use of CV-methods in assessing European travel time savings.

5 State-of-the-Art in Project Assessment and Proposal for Harmonised Guidelines

HEATCO's primary objective is the development of harmonised guidelines for project assessment on EU level. This includes the provision of a consistent framework for monetary valuation based on the principles of welfare economics, contributing in the long run to consistency with transport costing. In the first step current practice was compared with theoretical and empirical evidence from the literature. This prepared the ground for recommendations for harmonised guidelines.

Further analysis confirmed the finding of Deliverable 1 that the principles for project appraisal and transport costing vary considerably across countries and modes. The vast majority of the countries in the North/West region of the EU have comprehensive guidelines for project appraisal, whereas the guidelines in the South and East regions seem less developed. Furthermore, the appraisal framework for rail seems less standardised than for road and only around one third of the surveyed countries have formulated principles for the appraisal of air, inland waterway and sea transport projects.

Based on current practice and latest thinking the HEATCO team identified elements of a consistent framework for project appraisal on EU-level:

- General issues (incl. *non-market valuation techniques, benefit transfer, treatment of non-monetised impacts, discounting and intra-generational equity issues, decision criteria, the project appraisal evaluation period, treatment of future risk and uncertainty, the marginal costs of public funds, producer surplus of transport providers, the treatment of indirect socio-economic effects*),
- Value of time and congestion (incl. *business passenger traffic, non-work passenger traffic, commercial goods traffic time savings and treatment of congestion, unexpected delays and reliability*),
- Value of changes in accident risks (incl. *accident impacts considered, estimating accident risks, valuing accident costs*),
- Environmental costs (incl. *air pollution, noise, global warming*),
- Costs and indirect impacts of infrastructure investment (incl. *capital costs for the infrastructure project, costs for maintenance, operation and administration, changes in infrastructure costs on existing network, optimism bias, residual value*).

Where concrete values were available a comparison between countries was sometimes difficult. This was the case particularly for environmental costs, where various reference units (e.g. €per passenger- or tonne-kilometre, €per tonne of pollutant emitted) were used, which impedes comparability. Furthermore the use of different approaches for quantification and monetisation of costs made comparison difficult. This is an area where HEATCO contributed to a convergence in methods and values applied and thus more consistency in project appraisal.

Based on the review of existing practice in Deliverable 1, further analysis in Deliverable 2 and consultation of relevant stakeholders from EU Member States and Switzerland in two

workshops a consistent methodological framework for project appraisal was developed. Apart from being used for TEN-T projects, it might also be used for other transnational projects to ensure consistency across borders and the application of the state of the art methods. It is not the intention of HEATCO's proposal for harmonised guidelines to stipulate methods and values for national projects, however in the long run these guidelines might help to achieve a more harmonised approach also for national appraisal methods.

Country-specific fall-back values are suggested for application in cases where no state-of-the-art national values are available for valuation of

- time and congestion,
- accident casualties,
- damage due to air pollution, noise and global warming.

Following a summary of the general principles is presented, details on all aspects covered as well as fall-back values can be found in Deliverable 5.

When carrying out a Cost-Benefit Analysis (CBA), we recommend the following 15 general principles:

1. Appraisal as a comparative tool. To estimate the costs and benefits of a project, one has to compare costs and benefits between two scenarios: the 'Do-Something' scenario, where the project under assessment is realised, and a 'Do-Minimum' scenario, which needs to be a realistic base case describing the future development. If there are several project alternatives, one has to create a scenario for each alternative and compare them with the 'Do-minimum case'.
2. Decision criteria. We recommend the use of NPV (net present value) to determine, whether a project is beneficial or not. In addition, depending on the decision-making context respectively the question to be addressed, BCR (benefit cost ratio) and RNPSS (ratio of NPV and public sector support) decision rules could be used.
3. The project appraisal evaluation period. We recommend the use of a 40 year appraisal period, with residual effects being included, as a default evaluation period. Projects with a shorter lifetime should, however, use their actual length. For the comparison of potential future projects, a common final year should be determined by adding 40 years to the opening year of the last project.
4. Treatment of future risk and uncertainty. For the assessment of (non-probabilistic) uncertainty, we consider a sensitivity analysis or scenario technique as appropriate. If resources and data are available for probabilistic analysis, Monte Carlo simulation analysis can be undertaken.
5. Discounting. It is recommended to adopt the risk premium-free rate or weighted average of the rates currently used in national transport project appraisals in the countries in which the TEN-T project is to be located. The rates should be weighted with the proportion of total project finance contributed by the country concerned. In lower-bound sensitivity analyses, in order to reflect current estimates of the social time preference rate, a common discount rate of 3% should be utilised. For damage occurring beyond the 40 year appraisal period (intergenerational impacts), e.g. for climate change impacts, a declining discount rate system is recommended.

6. Intra-generational equity issues. We recommend, at minimum, that a “winners and losers” table should be developed, and presented alongside the results of the monetised CBA. Distributional matrices for alternative projects might be created and compared amongst each other. Additionally stakeholder analyses should be undertaken as well. It is recommended to use local values to assess unit benefit and cost measures.
7. Non-market valuation techniques. If impacts in transport project appraisals cannot be expressed in market prices, but are potentially significant in the overall appraisal, we recommend that – in the absence of robust transfer values – non-market techniques to estimate monetary values should be considered. We recommend that the choice of technique used to value individual impacts should be dictated by the type of impact and the nature of the project. However, Willingness to Pay (WTP) measures is preferable to cost-based measures. Values should be validated against existing European estimates.
8. Value Transfer. Value transfer means the use of economic impact estimates from previous studies to value similar impacts in the present appraisal context. Value transfers can be used when insufficient resources for new primary studies are available. The decision as to whether to use unit transfers with income adjustments, value function transfer and/or meta-analyses will depend on the availability of existing values and experience to date with value transfers related to the impact in question.
9. Treatment of non-monetised impacts. We recommend, at a minimum, that if impacts cannot be expressed in monetary terms, they should be presented in qualitative or quantitative terms in addition to evidence on monetised impacts. If only a small number of non-monetised impacts can be assessed, sensitivity analysis may be used to indicate their potential importance. Alternatively, non-monetised impacts may also be included directly in the decision-making process by explicitly eliciting decision maker’s weights for them vis-à-vis monetised impacts.
10. Treatment of indirect socio-economic effects. We recommend that if indirect effects are likely to be significant, an economic model, preferably a Spatially Computable General Equilibrium (SCGE) model, should be used. Qualitative assessment is recommended, if indirect effects cannot be modelled due to limited resources (high costs for the use of advanced modelling), insufficient availability of data, or lack of appropriate quantitative models or unreliable results.
11. Marginal Cost of Public Funds. Our recommendation is to assume a marginal cost of public funds of 1, i.e. not to use any additional cost (shadow price) for public funds. Instead, a cut-off value for the RNPSS of 1.5 should be used when relevant.
12. Producer Surplus of Transport Providers. We recommend to estimate (changes in) the producer surplus generated by changed traffic volumes or by the introduction and adjustment of transport pricing regimes.
13. Accounting procedures. a) Factor costs should be the adopted unit of account. This requires measures expressed in market prices - which include indirect taxes and subsidies – to be converted to factor costs. b) We recommend to convert all monetary values into € with a price level for a fixed year. In this report, monetary values are given as €₂₀₀₂, i.e. with 2002 as base year. However, the monetary values should be adjusted with the Purchasing Power Parity (PPP) as explained in Annex B, which also contains a table with PPP adjustment factors. However, these factors are only available for past years, whilst future PPP factors are likely to change as the economic growth rates differ amongst countries. As we assume, that income and prices grow faster in Member States with currently low income, PPP factors will tend to converge closer to 1 in the future. Therefore, we

recommend that two calculations are made – one with and one without PPP adjustment – assuming that the true value will lie between the two results. c) Monetary values, i.e. preferences, for non-market goods like reduced risk of getting ill or reduced damage to the environment will increase with increasing income; thus we recommend increasing monetary values based on GDP growth – a table with possible country-specific GDP growth is given in Annex B.

14. Up-dating of values. The unit values supplied in this report represent the state-of-the-art for the individual impacts addressed. Nevertheless, all values will be subject to change as new empirical evidence becomes available and methodological developments take place. As a consequence, we recommend that values are reviewed and up-dated on a regular basis e.g. after three years at maximum.
15. Presentation of results. As far as possible, impacts should be expressed in both physical and monetary terms. The results of the sensitivity analysis and the non-monetised impacts should be reported together with the central monetised results.

6 Case studies

In the final step the appraisal methodology developed was tested. Case studies on four TEN-T projects were selected, the HEATCO methodology applied and compared with the national methodologies and outputs. The outcome can be judged as positive, since the HEATCO methodology was successfully applied in all four cases. No major difficulties were reported on scientific, methodological or technical problems related to the application of HEATCO.

The most important differences between national and HEATCO guidelines are:

- Market prices used in some national appraisals vs. factor costs recommended by HEATCO,
- the choice of the social discount rate and
- the duration of the appraisal period.

An analysis of the case study outputs revealed that the Value of Time plays a dominant role in the appraisals. For the road projects roughly 80%-90% of the benefits are generated through travel time savings (VTTS) and reduced Vehicle Operating Cost (VOC). Quantifiable environmental costs and the reduction of accidents play only a minor role in the assessments considered.

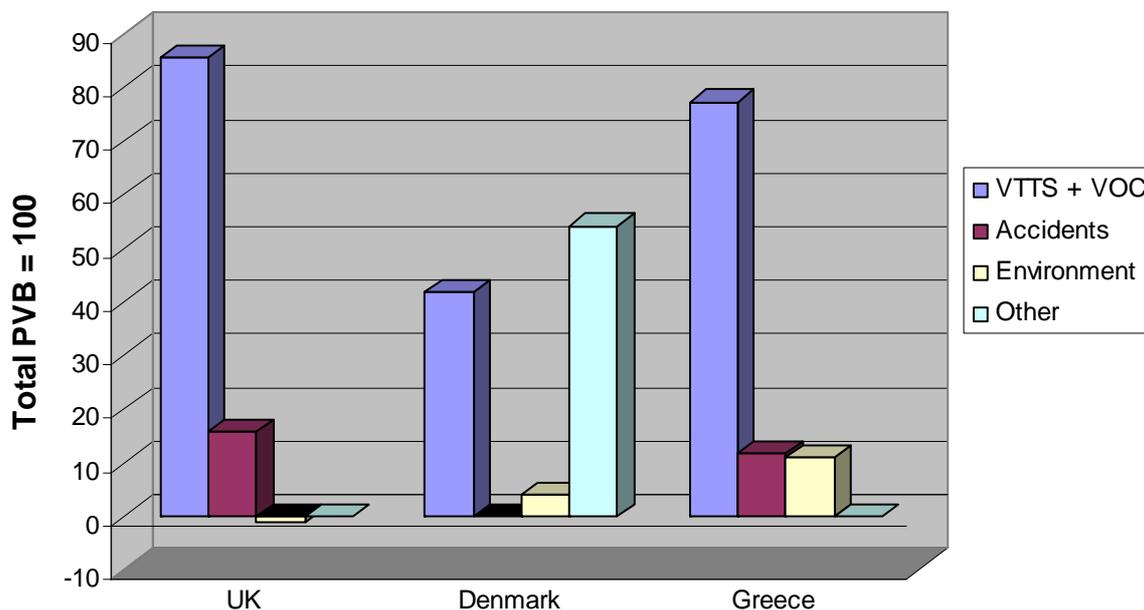


Figure 5 Distribution of benefits (PVB) in the Case Studies

A number of sensitivity tests were conducted. The research revealed that the social discount rate and the value of travel time savings VTTS are of particular importance for the outcome of the appraisals and thus sensitivity tests are highly recommended. Figure 6 illustrates the changes in the Net Present Values (NPV) compared to a discount rate of 3%. In Greece for instance a discount rate of 4% decreases the NPV by 31% compared to a discount rate of 3%. In the case of a discount rate of 6% the NPV decreases by 73%. This implies a change in the

Greek BCR from 2.7 to 1.4. Even if a small change in discount rate (+0.5%) is assumed, as in the case of the UK, the overall NPV will decrease by 19%.

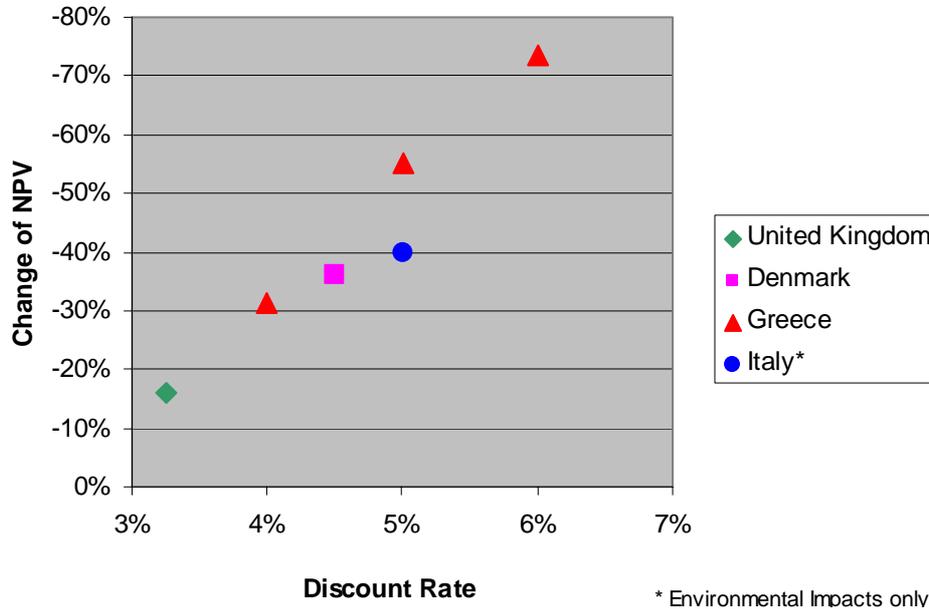


Figure 6 Distribution of benefits (PVB) in the Case Studies

Sensitivity tests for climate change and noise revealed only minor changes (<5%) of overall benefits. Test for accident values entailed no uniform results, which was mainly due to the different design of the researched projects. Another sensitivity test was carried out in order to compensate for the “optimism bias” often observed in past large scale transport projects. The tests revealed strong effects on the projects’ cost efficiency that might put into question decisions based on data that include an “optimism bias”.

To conclude, HEATCO has developed a feasible methodology, which does not only reflect the state of the art, but has proved as well to be applicable in practice. Recommendations given on the methodology, the guidance values and the sensitivity tests are valuable and ready to be used in practice.

However, some questions outside the scope of HEATCO remain to be addressed in future research projects, such as the estimation of future transport volumes, the ascertainment and valuation of induced traffic, and the design of transport models.

Annex A –Project Consortium

| Participant name | Short name | Country |
|---------------------------------------------------------------------------------------------------------------|--------------|-----------------|
| University of Stuttgart, Institute of Energy Economics and the Rational Use of Energy (<i>co-ordinator</i>) | USTUTT | Germany |
| Budapest University of Technology and Economics, Department of Transport Economics | BUTE | Hungary |
| Cowi A/S | COWI | Denmark |
| SWECO Grøner AS (formerly E-CO Tech as) | SWECO (E-CO) | Norway |
| Ecoplan, Economic Research and Policy Consultancy | Ecoplan | Switzerland |
| Universidad de Las Palmas de Gran Canaria, Departamento de análisis económico aplicado | EIT | Spain |
| Herry Consult GmbH | Herry | Austria |
| Istituto di Studi per l'Integrazione dei Sistemi | ISIS | Italy |
| University of Leeds, Institute for Transport Studies | ITS | United Kingdom |
| National Technical University of Athens, Department II, School of Chemical Engineering | NTUA | Greece |
| Sudop Praha a.s. | Sudop | Czech Republic |
| TNO Inro | TNO | The Netherlands |
| University of Bath, Department of Economics and International Development | UBath | United Kingdom |
| Statens Väg- och Transportforskningsinstitut (VTI) | VTI | Sweden |

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Project Website

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Annex B –Project Deliverables

| | Deliverable name |
|----|-----------------------------------------------------------------------------------------------------|
| D1 | Current practice in project appraisal in Europe |
| D2 | State of the art in project assessment |
| D3 | Key issues in the development of harmonised guidelines for project assessment and transport costing |
| D4 | Results of Stated Preference surveys |
| D5 | Proposal for harmonised guidelines |
| D6 | Case study results |
| D7 | Final technical report |

All deliverables (incl. Annexes) are available at the HEATCO Website:

<http://heatco.ier.uni-stuttgart.de/deliverables.html>