

The application of joint consideration of indicators: Some practical examples

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Our goal

To assess the applicability in the real world of the theoretical approaches highlighted in the previous section of the Report.



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An initial proposition

Advances in theoretical methods for the joint consideration, and even the would-be aggregation of impacts, broadly differ from practical implementation exercises



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Some hurdles to overcome

- The allocation of significance factors to impacts so that some crude form of aggregation of impact indicators into high level indices could be attained, even though lacking a meaningful dimension
- Valuing impact indicators into common units –not necessarily monetary- in order to (partially) aggregate all or some indicators.



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What have we done?

We asked WG members to put forward relevant cases studies at national. Unfortunately not very many cases came forth, albeit fairly broad in goals and methodological scope. The amount of the information made available was, again, quite diverse.



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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Bundesamt für Umwelt BAFU
Bundesamt für Landwirtschaft BLW

LIFE CYCLE ASSESSMENT OF ENERGY PRODUCTS:

ENVIRONMENTAL ASSESSMENT OF BIOFUELS

Information provided by Patrick Wäger



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The Goals of the Project

- To evaluate the environmental impact of the entire production chain of fuels made from biomass used in Switzerland
- To conduct an environmental life-cycle analysis (LCA) of alternative biofuels in order to ascertain, in an un-biased manner, which ones should be relieved from taxation in Switzerland



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Self imposed limitation

Neither the economic costs of biofuels nor the social consequences of their production are evaluated.

Thence:

An integrated evaluation is not attempted



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CONCLUSIONS

- The goal of the research was NOT to evaluate in an integrated way all the consequences of biofuels production
- The assessment was limited to comparing **environmental** impacts
- The method used, LCA, is suitable for **partially aggregating** environmental impacts and, in that regard, the outcome of the research can be considered satisfactory



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The Eganatia Motorway: Greece



Information provided by: Tasos Mouratides



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Methodological approach

- *“By means of specific and measurable standards it became possible to carry out an estimation of the development of social, environmental and transport features of the areas served by the Egnatia Motorway and all adjacent road links”.*
- *“The indicators fall into three main classification groups: a) transportation and road-network operation indicators, b) environmental indicators and c) socio-economic indicators”.*



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Conclusions

- 30 indicators have been surveyed. Some of these indicators seem to categorise direct impacts whereas others apply to indirect ones. It is not clear what selection criteria have been used, nor is it evident the geographical area or the time horizon of the evaluation.
- From the documents submitted, no aggregation method seems to emerge. Mention is made about remedial costs to offset some environmental impacts. These involve Landscape Restoration measures and Protection of Archaeological sites.





Facts and results from the Stockholm Trial

Final version – December 2006



Case description

- On 2 June 2003, the Stockholm City Council adopted a majority proposal to conduct a trial implementation of congestion charging.
- The Stockholm Trial consisted of three parts: expanded public transport, environmental charges/congestion tax and additional park-and-ride sites in the city and in the rest of the county.
- They have been evaluated continuously from a number of different perspectives.



The Goals of the Trial

A 10-15 per cent reduction in the number of vehicles that cross the inner city segment during morning and afternoon rush hours.

Improved access on the busiest roads in Stockholm traffic

Reduced emissions of carbon dioxide, nitrogen oxides and particles in inner city air.

Better street-level environment perceived by people in the inner city.



Joint consideration through
achievement of attainable
goals



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Some methodological issues

- Goal formulation imposes a goal attainment approach to assess results.
- Thence, no formal method of integrated aggregation has been attempted
- Statements on achieved results are not always conclusive but open to subjective interpretation



Examples of results attained (I)

- The goal of traffic reduction has been achieved
- However, the degree of achievement of the city environment goal is more difficult to interpret.
- Effects varied for different times and routes: Traffic decreased on most major roads, but increased on others.



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The formulation of attained results lends itself to individual, subjective interpretation



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Examples of results attained (II)

- The Stockholm Trial reduced local emissions of both carbon dioxide and particles. However, seen across the county, it can only be regarded as one of several measures required to achieve national climate objectives.
- As the reduction in traffic took place in densely populated areas, it brought a major health benefit to a large share of the country's population.



Examples of results attained (III)

- The health benefit is about three times higher than the benefit that would have been gained had the reduction occurred through an increase in fuel prices.
- The Stockholm Trial only had a marginal impact on noise levels.



Examples of results attained (IV)

- The expanded public transport during the trial did not reduce motor traffic to a demonstrable extent. However, effective public transport is deemed necessary to cope with increasing levels of patronage.
- The regional economy was not affected to a greater extent, and it is not likely that it would have been in the long-term.



Acknowledged methodological limitations (I)

- The evaluation spans a wide range of fields. Studies do not only cover travel patterns and effects on motor traffic and public transport, but also environmental consequences, effects on trade and industry, pedestrian and cycle traffic, changes to the city environment as well as macro-economic impact and effects on the regional economy. Many of the effects of the trial are very dependent on factors in the surrounding world, such as the economic trend in the region and country.



Acknowledged methodological limitations (II)

- The consequences of the trial are affected by external factors.
- Some changes occurred during the trial period as a result of decisions made in the city and region, such as the switch to flat fares in public transport.
- Traffic and the trial's effects also varied during the six months of the trial, but most studies only present a snapshot of the situation at one point in time.



Benefits and costs distributed unevenly (I)

Essential winners from the congestion charges were:

- those public transport passengers who received a larger selection of services
- those who were exempted from charges
- those who drove a car without driving across the charge zone and thus achieved shorter travel time at no cost
- cyclists (seem to have received a better traffic environment)
- those who value their time and feel a time gain is worth the money
- commercial drivers (bus drivers, taxi drivers, truck drivers, etc., who received a better work environment)



Benefits and costs distributed unevenly (II)

Essential losers from the congestion charges were:

- those who drove a car across the charge zone and for various reasons could not adapt their travel, but still don't think the time gain was worth the money
- those who were “forced off” the roads
- those public transport passengers who experienced more crowding in public transport



Some indicators used for the assessment

- number of vehicles crossing the inner-city segment during the morning and afternoon rush hours
- travel times for private vehicles and bus services
- emissions of carbon dioxide and particles
- noise levels
- changes in public transport patronage
- road accidents



An attempt to add up (some) costs and benefits for the society as a whole (I)

- shorter travel times were valued at SEK 600 million annually,
- increased road safety at SEK 125 million annually
- health and environment effects at SEK 90 million annually.
- The revenue from the congestion tax is estimated to be about SEK 550 million annually

For every *krona* collected in congestion tax, there is a cost-benefit profit to society of a further .90 *krona*.



An attempt to add up (some) costs and benefits for the society as a whole (II)

- The expanded bus service is estimated to be (macro) economically unprofitable, both during the trial and if it were to be made permanent. The benefits are expected to be in the region of up to SEK 180 million annually, compared with a economic cost of operation of SEK 520 million annually.
- The price level and evaluation of both road safety and the environment are characterised by considerable uncertain factors.



Additional (personal) remarks

- Some policy decisions (e.g. public transport improvements) are deemed necessary in any case.

Should the revenue loss be charged onto the transportation plan under consideration?



CONCLUSIONS

- The assessment methodology is based on the achievement of policy goals
- Indicators are used to measure the ex-post situation after the trials
- No integrated aggregation exercise is attempted although a reduced CBA is included
- Uncertainty in the allocation of prices to environmental effects is acknowledged
- Benefits and losses are not accrued by the same societal groups



The COSIMA Approach to Transport Decision Making: Combining Cost-benefit and Multi- criteria Analysis for Comprehensive Project Appraisal

Information provided by: Henrik Gudmundsson



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This is, perhaps, the most comprehensive of all the cases analysed in terms of the application of theoretical considerations into practice. Likewise, it is the one case where the main shortcomings associated to that practical application become more obvious



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A main goal for the project

To examine a project where a mix of CBA and non-CBA effect has been found relevant to be included in the appraisal study

**THAT IS, INDEED, JOINT
CONSIDERATION**



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Methodological approach (1)

1. Some relevant impacts in transport infrastructure planning can be included in CBA. These are calculated before the COSIMA procedure is undertaken, and they do not change during the whole procedure.
2. The next task is to determine the MCA impacts of relevance, where possible measured in a appropriate quantitative unit.



Methodological approach (2)

3. Effects that cannot be measured quantitatively must be **described by judgement** (e.g. using a numerical scale) or compared by pairs (Analytical Hierarchical Process- AHP) with a score allocated to each
4. COSIMA assigns rating values or scores to MCA effects. **How?**
5. The quantitative units and the point and AHP scores are then translated into a final rating or score **.How?**





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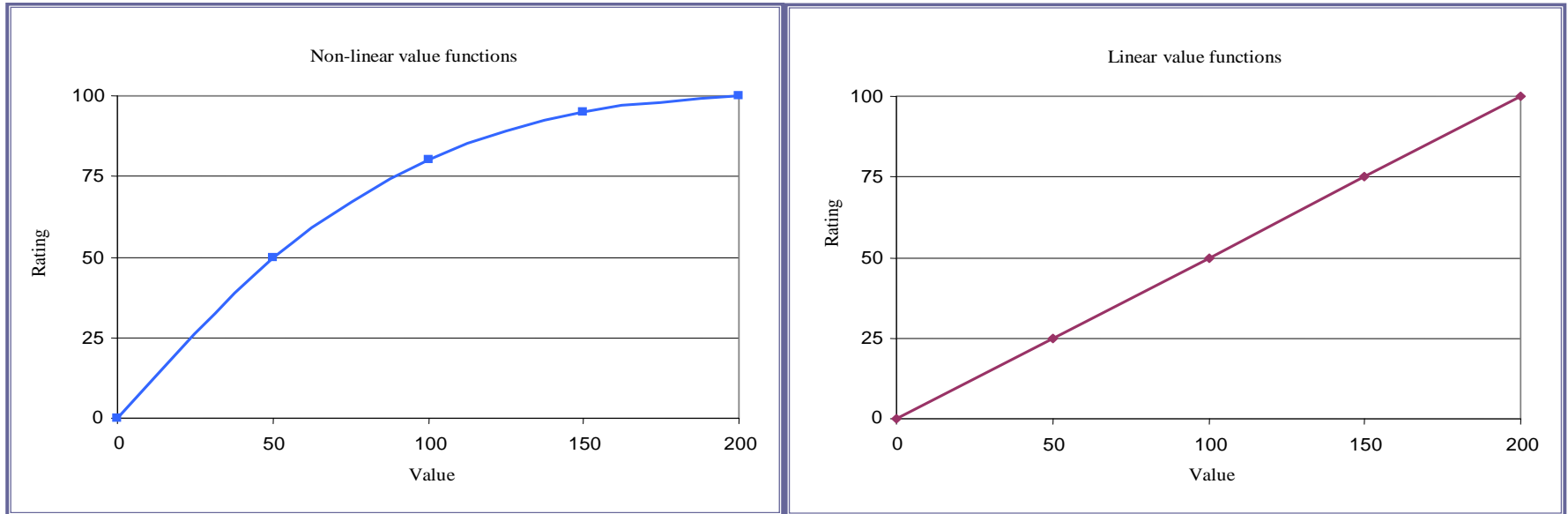
Methodological approach (3)

6. The quantitative units and the point and AHP scores are then translated into a final rating or score (0 to 100) by using value functions.

- What sort of value functions?



Methodological approach (4)



If it is possible to assess an effect quantitatively, the value function gives the rating for each alternative directly from the actual quantity, but other units such as the formulated point scale values or AHP scores can also be made use of to assign the value function rating.



Methodological approach (5)

7. With the CBA and MCA effects specified, the importance of the MCA effects against the CBA effects, i.e. the overall MCA vs. CBA trade-off, and for the MCA effects among each other, i.e. the determination of MCA **criteria** weights, must be established.

- How are weights determined?



Methodological approach (6)

- After an agreement on the MCA effects and their assigned weights, COSIMA can be run. As previously mentioned, COSIMA includes the MCA effects or criteria along with those usually treated in a CBA, thereby calculating a total gross value (TV) **in monetary units** for alternative A_k obtained by spending the investment cost C_k :

$$TV(A_k) = CBA(A_k) + MCA(A_k)$$



Application: More questions!

- Seven Danish Standard CBA **criteria**:
Travelling time, vehicle operating costs, accidents, maintenance costs, noise, air pollution, and severance & perceived risk.

QUESTION: How are all those CBA criteria valued in money terms?

- Three MCA criteria: Network accessibility, **urban planning** and landscape



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Application: A lot of subjectivity!

By use of the methodology from the Danish Road Directorate, first year benefits (FYB) have been calculated for the seven alternatives. This information has been put together with point scores for the three MCA criteria, *where the point scores are determined by thorough examination of the alternatives based on a rating protocol*. The three MCA effects are assigned a value describing their **performance** on a scale from -5 to +5, where +5 is best.



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Application: Ratings, Functions, Discounting, Weights!!!

- The scores are translated into **ratings between 0 and 100** using a **linear, local value function**
- A normalisation exercise is undertaken and **normalised values are discounted**. Final values for the four indicators are added together into a single TRR (Total Rate of Return) index applying **equal weights to CBA and non-CBA indicators**.



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The COSIMA approach is
quite orthodox in its theoretical
basis

BUT



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A high degree of subjectivity is noticeable

- a) In the (limited) number and selection of non-CBA criteria (e.g. Urban planning?)
- b) In the format of the value functions (linear)
- c) In the allocation of scores to non-CBA criteria
- d) In the ROD weights allocated to non-CBA effects: Weights are the same in both examples surveyed, even though effects are different.
- e) In the trade-off coefficient applied to compare CBA and non-CBA effects (however, a sensitivity analysis is later applied)



Some methodological considerations are debatable

- a) The use of FYB as an indicator of economic performance, mainly for public financed infrastructural programmes.
- b) The “calibration procedure”, as a method to transform into monetary values?
- c) The definition of Total Rate of Return as Total Gross Value in economic terms over the Total Investment Cost?
- d) The normalisation method/definition of scales?
- e) Discounting non-monetary figures?
- f) Sensitivity analysis seems to be inconclusive (Case Study 1): Could an ELECTRE approach provide more sound results?

HOWEVER: The available information is limited. Or maybe I have missed relevant parts?



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SOME FINAL REMARKS

- The method does not provide a definite breakthrough into the evaluation of transportation alternatives
- It contains some highly subjective elements throughout the evaluation process, which may render the decision debatable
- However, it is a clear step forward in putting into practice a great deal of theoretical considerations
- Some of the intermediate steps (weights) are agreed upon through “Conferences” (participatory exercises)
- The application of sensitivity analysis provides some ground for democratic decision-taking.



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Forward looking

In addition to the submitted case studies, a state-of-the-art bibliographic review has been conducted in order to seek for additional updates on aggregation methods. The following comments are based on the HEATCO PROJECT



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



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Developing Harmonised European Approaches for Transport Costing and Project Assessment

The development of tools, indicators and operational parameters for assessing sustainable transport and energy systems performance (economic, environmental and social)

Project duration: March 2004 - May 2006



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- 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
- 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. There is a huge gap between existing evaluation practice and theoretical approaches.





A specific goal was:

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



From a methodological viewpoint:

- In most surveyed countries projects are assessed through CBA, occasionally supplemented by MCA.
- The project appraisal also includes other quantitative measures (QM) and qualitative assessment (QA)
- Appraisal and (eventual) aggregation are based on the use of indicators



From a methodological viewpoint:

- For the CBA effects are usually grouped into 4 main categories:

Category of main effects	Element
Infrastructure costs	Construction costs, costs for maintenance operation and administration
User benefits	Passenger transport time savings, vehicle operating costs, benefits to goods traffic
Externalities	Safety, noise, air pollution - local/regional, climate change
Other	User charges and revenues, disruption from construction.

From a methodological viewpoint:

- Several countries include estimations of money values for some selected environmental impacts (Air pollution –Local/regional, Climate change, noise, severance, visual intrusion, etc), however, assigned values are quite inconsistent.
- Some other environmental effects are qualitatively covered, if at all.
- A small selection of indirect socio-economic effects are sometimes assessed.





From a methodological viewpoint:

- In practice, many effects are left out either due to difficulties of estimating a trustworthy monetary value, difficulties of quantifying the effects or because the effects are considered to be of minor importance.





From a methodological viewpoint:

Notwithstanding the type of indicators used in the appraisal, other inconsistencies are also evident:

- ❖ around half the countries refer to factor costs and half to market prices;
- ❖ there is a significant range in the values used for the discount rate.
- ❖ there is large variation in the appraisal period, ranging from 20 years to an infinite time horizon.



CONCLUSIONS

- While acknowledging **HEATCO** is centred on project appraisal, the methodological approach for impact aggregation in plans and programmes, relying on indicators and the use of CBA and MCA, presents limitations similar to the ones described above



THANKS FOR YOUR ATTENTION

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