EVALUATION AND APPRAISAL OF SUSTAINABLE AND INTEGRATED URBAN TRANSPORT PROJECTS

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1.   INTRODUCTION

A reliable urban transport system provides citizens' access to workplaces, social engagements and other services (Browne and Ryan, 2011). At the same time, high levels of traffic impose negative externalities on society, including congestion, accidents, noise pollution or environmental damage (Santos et al., 2010). Decision-makers objectives are made up of a variety of different impacts (economic, social and environmental) resulting from urban transport projects or measures. Also, investments in urban transport should deliver the maximum economic, social and environmental benefits; in times of constrained budgets, projects' economic viability is often the deciding factor. To make informed decisions, decision-makers need information on the potential costs, benefits and overall impacts of urban transport measures or projects.

The concept of evidence-based decision-making is intended to help policy-makers to maximize the benefits from their investments, and to prevent investments in measures or projects that fail to address critical problems. Transport appraisal systems have evolved ever since they were first introduced; several different methods have been devised and further developed, each with different foci, strengths and weaknesses. Cost-benefit analysis (CBA) and multi-criteria analysis (MCA) are common methods for ex-ante and/or ex-post evaluation of transport projects or measures (Beria et al., 2012). Other approaches are *cost-effectiveness analysis*, which is designed to identify the lowest-cost option to achieve a specific objective, and *environmental impact assessment*, which focusses on a selected set of impact factors rather than all of a project's or measure's impacts (Browne and Ryan, 2011).

Cost-benefit analyses are widely used to assess transport projects or measures, especially large-scale infrastructure projects or other politically sensitive projects (e.g. congestion charges). Odgaard (2006), in a survey of 26 European countries, found that all use CBAs in road project appraisal. The UK's and the Netherlands' guidelines for the appraisal of transport projects

require CBAs for major transport projects (Geurs et al., 2009). In the Netherlands, national funding for local and regional spatial infrastructure plans is contingent on the completion of CBAs for the plans (Beukers et al. 2012).

Besides large infrastructure projects, there are a variety of urban transport measures implemented by cities which are not directly affected by national guidelines or funding guidelines. These projects are often small scale and not infrastructure-based. Nonetheless, cities are obliged to show that these projects and measures provide value for money in order to justify their implementation.

This paper discusses current practices and challenges in cities in assessing urban transport interventions. On this basis, it identifies and describes options with which decision-makers can appraise small-scale, sustainable urban transport policy measures.

2. THE ROLE OF PROJECT APPRAISAL IN LOCAL DECISION-MAKING

A number of surveys and analyses, such as those of the EC-funded TIDE and EVIDENCE projects[1], obtained insights into the actual assessment practices in cities across Europe. TIDE surveyed 14 variously sized European cities (ranging from 50,000 to 2.7m inhabitants) and from 10 different countries (the results may be influenced by the respondents' various roles and positions within the local administration). The analysis revealed that the cities usually do not have a standard appraisal method for all transport projects, while some cities stated that they select or adopt a method depending on the measure being assessed. In line with the results from the literature, CBAs are often applied to assess larger infrastructure projects in the cities; several respondents referred to national regulations requiring them to do so. For instance, in Italy a CBA is "the ordinary tool for projects above €10m and mandatory for projects above €50m". Several other cities referred to national guidelines on the CBA method and cases to which it must be applied (Hüging et al., 2014b).

Additionally, some cities also use MCAs in their project appraisal. The survey's British participant city highlighted the importance of the WebTAG tool, and mentioned that although smaller schemes may be assessed in a simpler way, "there would need to be a very good justification for not following the guidelines".

Many projects are not subject to a cost-benefit analysis as such. Nevertheless, financial viability checks are of major importance. According to

the survey, economic viability is not necessarily the decisive factor in transport decision-making. City representatives mentioned that "local issues", "the service offered to the citizens" and "impacts which cannot be quantified" can balance or dominate the CBA results. Additionally, the cities were asked about the challenges presented in carrying out a CBA. Issues like "the monetization of qualitative externalities and not-clear impacts", "putting value on all the externalities", "lack of statistical and traffic data", "[lack of] evidence base for ... small schemes and soft measures" and "lack of standard guidelines" were mentioned. It can be concluded that especially the quantitative and monetary basis of a CBA is challenging for a city and that this limits the method's applicability to local projects (Hüging et al. 2014b).

EVIDENCE conducted in-depth analyses of urban mobility planning processes in five European cities (Munich in Germany, Bristol in the UK, Utrecht in the Netherlands, Kaunas in Lithuania, and Piran in Slovenia), focussing on the process of measure selection and appraisal (Rudolph et al, 2015).

The case studies illustrate contemporary decision-making. Four out of the five cities used CBA in their decision-making processes. The main rationale of Munich and Bristol in conducting CBAs was to access funding for some of the measures which their mobility plans had stipulated. In Utrecht and Piran, CBAs were used to determine the measures' cost-effectiveness, but not to compare the cost-effectiveness of measure alternatives. Table 1 lists the appraisal methods used in the cities' decision-making processes and the basis for measure selection.

Table 1: Rationale in applying project appraisal and measure selection (Rudolph et al., 2015)

	Munich	Bristol	Utrecht	Piran	Kaunas
Main reason(s) for project appraisal	Access to funds / Comparison of alternatives		Justification of measures' cost-effectiveness		No project appraisal
Main reasoning for measure selection	Achievement of local (sustainable) transport goals / Other reasons			Access to funds	

Measure selection in all five cases was mainly based on the political agenda or as a response to looming problems in the city. The projects were discussed in public participation processes and approved by politicians. In the cases of

Munich, Bristol and Utrecht, CBAs did not play a significant role for decision-making, but project appraisal had been conducted for other reasons regardless. In Piran, the main purpose of conducting a CBA was to verify already envisaged effects rather than to fulfil funding requirements. This observation was also made in a survey conducted by Mackie et al. (2014), which showed that even if cities conduct project appraisal, there is often a risk that it enters the planning process too late to play any meaningful role.

None of the cities conducted CBAs or similar project appraisal methods for schemes not requiring significant investment. In these cases, the cities mainly relied on rough self-estimates. It appeared to be too expensive to apply traditional appraisal methods for small-scale measures.

Another important issue for cities is the appraisal of packages of measures. Recent UK studies have highlighted that 'packages' of measures supporting alternatives to the car can provide greater financial benefit than major road schemes, and have positive impacts on employment, and investment (DfT, 2014; Highways agency UK, 2013). Both the TIDE survey and the EVIDENCE case studies revealed that appraisal of packages goes beyond the cities' current appraisal capabilities.

In conclusion, data requirements and complexity are cities' main obstacles to appraise projects and to compare potential alternatives. Conducting a CBA ex-ante is often only envisaged if the implementation of the measure in question is already likely. Often, a CBA is a means to access funds rather than a basis for decision-making. Project appraisal of small-scale and non-investment-based measures is simply too expensive.

3. POTENTIAL SOLUTIONS

On the basis of the findings on current practice and challenges, the following sections discuss three options for policy-makers to appraise sustainable and integrated urban transport projects.

1.1. Option 1: learn from others

Cities are actively seeking to learn and search for implementation experience from one another. By its nature, information available on websites, portals and good-practice guides is of mixed quality (Marsden et al., 2011), and the scientific literature on economic and other impacts of sustainable transport is not compact and often not accessible for practitioners. It includes a very wide range of academic articles and whole books, spread over many different disciplines. The main body of empirical experience is led by local policy

agencies, especially local government and transport providers, who have different (and sometimes very low) publication priorities, in formats including committee papers, conference presentations, popular pamphlets and PR material. The evidence is international and some very important aspects of it are recorded in the various countries' own languages. The authors estimate that there are several thousand, perhaps over 10,000, relevant sources in the public domain which point to socio-economic costs and benefits of small-scale, sustainable urban mobility and transport projects.

There are initiatives to evaluate available data and (where it is available) to provide credible evidence to demonstrate that sustainable transport measures are able to generate value for money.[2]

The EVIDENCE project is currently creating a 'dossier' of interventions across seven 'themes' and twenty-two 'measures', a categorisation drawing on existing EU urban mobility programmes. This analysis shows, for instance, that measures fostering *clean vehicles and fuels* depend very much on the manufacturing economies-of-scale of these vehicles (Shergold et al., 2015). The analysis also points out that use-cases are beginning to emerge where electric vehicles (buses, vans etc.) are already economically viable for owners and operators. Other economic benefits will flow from reductions in pollution and emissions, while the effect on greenhouse gas emission is largely dependent on the sources of the local electricity generation. Moves to alternative fuels for existing vehicles can also deliver benefits in respect of air quality, and will again be cost-effective for operators in some specific conditions (see Table 2).

Table 2: Economic benefits of measures fostering clean vehicles and fuels (Shergold et al., 2015)

No	Measures	Typical Interventions	A. Economic benefit	B. Sources
1	Electric Vehicles	Electric vehicles used for public transport and freight delivery	✓	📖
2	Enhancements to ICE technologies	Technology to improve fuel efficiency Alternative fuels for current vehicle fleets	✓✓✓	📖📖📖📖

Examples:
Milan: electric delivery vans. Lower operating costs balance higher costs of initial investment – sufficient range for all-day use
Vienna: electric microbuses integrated into bus network. More expensive than diesel to purchase but lower operating and maintenance costs.

Other themes analysed by EVIDENCE are urban freight, demand management strategies, mobility management, collective passenger transport, transport telematics, and less car-dependent mobility options. This project and other initiatives may be good starting points for cities to grasp the costs and benefits of their envisaged measures and to convince politicians of these measures' merits.

1.2. Option 2: a holistic but simplified assessment approach

Based on the observations in the TIDE survey, Hüging et al. (2014a) concluded that there is a demand for a simple (i.e. the effort required is not excessive compared to the magnitude of the measure itself), but holistic (i.e. including all factors) assessment approach that can be applied to a variety of urban transport measures. The approach suggested is primarily based on the MCA method, but also allows the integration of CBA aspects if required and if sufficient data is available. Table 3 provides an overview of the assessment method.

The approach is designed to compare a measure or project to a reference case or/and to a set of alternative measures, primarily ex-ante. A CBA can be conducted in parallel within the process, on all criteria for which monetization is feasible. The performance of the remaining criteria can be assessed either quantitatively (non-monetary, e.g. tonnes of NOx) or qualitatively (i.e. expert-based and literature-based scoring). In the overall assessment all criteria are included after undergoing normalisation.

Table 3: Steps of the suggested assessment approach for cities (Hüging et al., 2014a)

Step	Description
1. Describe project and alternatives	The planned project and alternatives, including the reference (BAU) case are described. The assessment details (e.g. appraisal period) are determined.
2. Identify effects and indicators.	The effects by which measures should be assessed, along with the indicators by which the performance should be measured, are identified.
3. Impact assessment.	For BAU and the proposed project (and any alternatives), the magnitude of each of the effects selected in step 2 is determined.
4. Normalisation	The performance figures are converted to unitless, relative numbers.
5. Criterion weighting	The criteria are assigned a weight value reflecting their relative importance.
6. Visualisation and interpretation	Final scores for each measure are calculated from the normalized performance and weighting value, which are displayed in graphs.
7. Sensitivity analysis.	The significance of individual effects is assessed to test the effect of less-reliable assumptions/values.
8. Communicate results.	The results and key information about the assessment procedure are communicated to the decision makers.

A key aspect of the method is the combination of different kinds of performance values (monetary, non-monetary but quantitative, qualitative), which is facilitated by normalisation (step 4). All performance figures, including the monetary values, are normalized using a maximum score approach, i.e. Measure A's score for Criterion 1 (C1) is based on its original performance value (x divided by the largest (absolute, i.e. positive or negative) performance value for Criterion 1 ($x_{C1(max)}$) for any of the measures being assessed. To ease communication of results it is recommended to use a scaling factor (F_{scale}) of 10:

$$Score\ C1(A) = \frac{x_{C1(A)}}{\left| x_{C1(mox)} \right|} \times F_{scale}$$

This internal normalisation approach (i.e. relating data from the different alternatives to each other) was chosen by the authors over a transformation based on a linear function drawn from the minimum and maximum performance for a specific criterion. Developing a linear function would require additional efforts - either to determine threshold values or the inclusion of a larger number of measures from which the threshold values could be obtained. The selected maximum score approach is assumed to better reflect the cities' needs and capacities.

For the criteria weighting process (step 5), the authors suggest a process based on AHP (Saaty, 1977), with considerable simplifications: the criteria are clustered on a hierarchical basis; and a limited, predetermined number of weighting points are allocated to the categories in the first hierarchy level. Those points are then further allocated to the subcategories until the lowest hierarchy level is reached. This relatively simple weighting procedure allows for stakeholder participation without needing to expend significant extra effort. Also, the authors suggest the weighting be carried out in a group setting, wherein the various stakeholders agree upon the weights in a deliberative process. This allows the participants to change their preferences based on exchange of information, rational reflection and social learning (Garmendia and Gamboa, 2012). It should be noted, however, that such open weighting procedures are susceptible to bias (e.g. by the dominance of very powerful stakeholders), although extensive processes and mathematical algorithms have been developed to reduce the bias in eliciting weights (e.g. Rogers and Seager, 2009, Garmendia and Gamboa, 2012). Such sophisticated methods might be suitable to apply for larger scale measures, but for small, low-cost measures, a low effort approach is suggested. Based on the normalized performance scores and the weights, an overall score can be obtained for each alternative measure or the reference case. If a CBA is included in the process, the economic viability indicators can be obtained and communicated to decision-makers together with the overall score.

This method has not yet been applied in practice, but Hüging et al. (2014a) present an example to underpin the method's usability. In practice, cities may already apply similar approaches.

1.3. Option 3: normative decision-making

Current appraisal practice suggests that there is a fundamental contradiction in the need for assessments to be well founded, and yet not cost too much to perform. Policy-makers should appraise alternatives to increase overall value for money. In order to limit undue expenses, they should also try to simplify

appraisal techniques and adapt existing methods to local circumstances. If they do so, they should also discuss whether the steps taken to simplify performing assessments (e.g. replacing verifiable data with assumptions or judgements) detract from the results to the point of making the assessment (politically) unusable.

Assuming assessments are simplified by replacing solid data with assumptions and judgements, policy-makers should also discuss what could be done to prevent these being manipulated to tailor the results to confirm already-made decisions, as is sometimes the case with CBA currently.

Thus, a core question is whether the results of project appraisal matter at all. It is possible that the public may care more for rhetoric than calculations. Especially if there is no workable solution for project appraisal, sustainable urban mobility measures may be better served by convincing local decision-makers of their benefits and then to increase the policy-makers ability to convince their electorates of such policies' merits. For example, the identification of local issues such as congestion, parking pressure or air pollution and the promotion of measures as (partial) solution might help to increase public support. This would not necessarily lead to best value for money, but at least favour sustainable over unsustainable transport schemes.

4. CONCLUSIONS

This paper has presented and discussed three options for policy makers to appraise sustainable and integrated urban transport projects: 1) learn from others, 2) use a simplified assessment method, 3) rely on norms and values. All of these options aim to cope with the trade-off between effort and certitude. In practice, some cities' policy makers may already apply one or more of these options, but possible applications have yet not been documented in a systematic manner. A systematic documentation of such practices could be a major step forward for implementation of sustainable and integrated urban transport projects, as it would shed some light on the reasoning behind decisions, from which conclusions could be drawn on the likely follow-on effects thereof and also possible improvements to the process.

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NOTES

[1] See project websites at www.tide-innovation.eu and www.evidence-project.eu.

[2] For instance, the EU-funded databases KonSULT and EVIDENCE provide comprehensive information about socio-economic benefits of such measures, see http://www.konsult.leeds.ac.uk and http://www.evidence-project.eu. Information on internet platforms such as ELTIS and CIVITAS is less detailed.