International Transport Forum



Improving the Practice of Transport Project Appraisal



Roundtable Report

OECD

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TABLE OF CONTENTS

SUMMARY OF DISCUSSIONS 7

The Practice of Cost-Benefit Analysis in Transport: The Case of France, by Emile QUINET (France) 25

1. Introduction 29
2. Origins of Changes in the Doctrine 30
3. Project Evaluation Guidance 32
4. Assessments of Recent Programmes and Projects 37
5. Overall Decision on Cost-Benefit Analysis *vs.* Multi-Criteria Analysis 43
6. Some Ideas for Improving Cost-Benefit Analysis 46
7. Conclusion 50

The Practice of Cost-Benefit Analysis in the Transport Sector: A Mexican Perspective, by Vladimir RAMÍREZ SOBERANIS (Mexico) 55

1. Introduction 59
2. Institutional Framework (Stages of the Public Investment Process) 60
3. The Role of Cost-Benefit Analysis in the Decisionmaking Process 63
4. Key Elements of Cost-Benefit Analysis 65
5. Potential Development of Project Assessment Procedures 69
6. Conclusion 72

Cost-Benefit Analysis in Transport: A UK Perspective, by Peter J. MACKIE (United Kingdom) 75

1. Introduction 79
2. The Role of Transport Appraisal 80
3. Transport CBA in the UK 84
4. Critiques of UK Transport Appraisal 87
5. Transport and the Economy 92
6. Concluding Thoughts 96

LIST OF PARTICIPANTS 101

SUMMARY OF DISCUSSIONS

SUMMARY CONTENTS

1. INTRODUCTION 11

2. WHAT IS CBA AND WHAT PURPOSES DOES IT SERVE? 11

3. THE PRACTICE OF CBA 15

3.1. Filtering out bad projects or selecting the best ones 15
3.2. Other uses of CBA 17
3.3. The impact of CBA on decisions 18

4. IMPROVING THE PRACTICE OF CBA IN TRANSPORT 18

4.1. Improving communication 18
4.2. CBA, MCA and Strategic Policy Objectives 19
4.3. Customisation and compartmentalisation 20
4.4. Discount rates, benefit-cost ratios and costs of public funds 21

5. CONCLUSION 22

NOTES 23

BIBLIOGRAPHY 24

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1. INTRODUCTION

Cost-benefit analysis (CBA) is widely recognised to be helpful, even indispensable, for making good decisions on what transport projects to fund. It essentially aims to figure out which projects offer the best value for money, one of the core criteria for making decisions. However, the practical relevance of cost-benefit analysis does not always live up to its appeal in principle. One problem is that there is disagreement about what to include in both the costs and the benefits side of the analysis, so that value for money is not always a fully transparent concept. A second problem is that value for money is only a partial criterion for decisionmaking, leading to disagreement about the relative importance of the results from CBA compared to other inputs into the decisionmaking process.

Discussions at the Round Table aimed to shed light on these conceptual problems by analysing the practice of CBA and comparing approaches to it in different countries. In short the aim was to identify a checklist of items that should be included in a socially relevant cost-benefit analysis, i.e. analysis that can be produced in reasonable time and at reasonable cost but is good enough to help resolve trade-offs.

2. WHAT IS CBA AND WHAT PURPOSES DOES IT SERVE?

In order to make the best possible use of cost-benefit analysis in transport project appraisal a good understanding is needed of what CBA is and what it is not. This section provides a quick overview of how CBA works, how it is evolving and what are its shortcomings. Section 2 then goes on to consider the role of CBA in decisionmaking, taking account of the policy and institutional context, which varies across countries and over time within countries.

CBA is a method for appraising the socio-economic impact of projects

CBA is first a method for project appraisal, i.e. for assessing the impact that a project is likely to have on social welfare. Such evaluation implies comparison to other projects and/or to a do-nothing scenario. Projects are broadly defined as discrete changes to the prevailing situation, often with multi-faceted impacts and objectives (Small, 1999, 137-138). CBA can be used for the appraisal of technical variants of a project, e.g. comparing different alignments for a planned bypass of a congested transport link. It can also be used for assessing clusters of projects, e.g. the construction of rail networks, for programming and hierarchising a set of independent projects, either for the same mode or for different modes under a given budget allocation, and for strategic policy choices, e.g. in the context of decarbonisation or broader sustainability policy, or for deciding the relative shares of the public budget to allocate to transport versus other sectors.

The level of detail and the emphasis of the modelling work need to be adapted to the particular context of the appraisal. For example, when comparing two bypasses, the focus will be on calculating time savings through a transport network model and on construction costs and environmental and safety impacts. But where decarbonisation is concerned, broad trade-offs between environmental concerns, public finance, and the pros and cons of various types of spatial development patterns need to be addressed. The methodological principles underlying the analysis (those of welfare economics) are the same in all cases, but when appraisal moves into the planning and policy arena, narrow time, cost and safety concerns will no longer suffice to obtain a good appraisal; instead, more attention will need to go to the impacts on spatial distribution of activities, on macro-economic impacts and on the definition of the transport problem itself (Tomlinson, 2004). At the heart of current debates about CBA are its suitability as a framework for handling these meso-economic questions.

In principle CBA is equally applicable to private and public projects, but because of its focus on social welfare (instead of, e.g., profits) the method is most frequently used for public decision-making. CBA could be used in the appraisal of all kinds of public projects, e.g. building a new school, or hospital, but in practice it is more often used in the transport sector than in other sectors. CBA can be applied to infrastructure projects and also to other policy measures, e.g. comparing the impacts of alternative ways of pricing the use of transport networks.

That CBA is used more often in transport than in other sectors is a potential cause for concern. If non-transport projects work with a different metric, allocating funds across sectors in a way that is explicitly aligned with expected social benefits, as calculated in CBA, is not possible. And if CBA is conservative in estimating benefits, as is sometimes believed (see below), then it is possible that its use in transport weakens the political case for steering funds to the sector. On the other hand, the prominence of CBA for evaluating transport sector projects (at least in the countries that use it systematically) means that the sector has a clear idea of how much value for money it generates, and this can strengthen its case in arguing for budgets. It is plausible that this helped limit the impact on the transport sector of the significant overall public spending cuts that took place in the UK in the Autumn of 2010.

The apparatus of CBA is designed to estimate costs and benefits as well as possible in order to make statements on net benefits ("value for money") with a reasonable degree of confidence. The core methodological approach of CBA for transport infrastructure is to measure benefits through the willingness of users to pay for the transport benefits, i.e. the "direct benefits" of the infrastructure. The choice to work with willingness-to-pay reflects the welfare economic fundamentals of the method: what matters in the end are consumer benefits. The approach to work with direct benefits to users can be seen as one rooted in practicality. A transport infrastructure project will affect travel times and more generally the benefits of travel that accrue directly to users. Traffic models help analysts form a picture of what these direct effects will look like. Measuring user benefits is far easier[1] than tracing the ultimate incidence of project impacts throughout the economy, and therefore provides a practical avenue to producing robust results relatively quickly. Practicality, however, comes at a cost in terms of scope and policy-relevance. The scope issue arises because direct user benefits represent total benefits only under restricted conditions. Relevance becomes a problem when policy-makers are less interested in total benefits than in distributional impacts whether by income group or spatially. We discuss these issues in more detail under the next two headings.

Extending the scope of CBA

With respect to scope and accuracy, user benefits are an exact measure of total benefits only if there are no external costs or other market imperfections and if returns to scale are (locally) constant. Since neither condition holds in reality, user benefits, even if correctly measured, are only an approximation to total benefits. This shortcoming of standard CBA has long been understood, and much progress has been made with conceptualising and quantifying the impacts ignored in standard CBA. The inclusion of some external costs (e.g. local pollution, congestion) is known to be important for good appraisal in a very wide range of situations. For other, broader impacts, there are strong indications that they are worth exploring in at least some circumstances, notably the agglomeration impacts of large urban projects.

The most commonly used method is not to replace the direct benefits approach of CBA with an alternative and more comprehensive concept of impacts (e.g. through general equilibrium modelling), but rather to extend the direct benefits approach with "add-ons" to capture a broader range of impacts. As argued in more detail below, this gradual approach makes methodological sense given the limited operational viability of alternative methods, but it may pose problems in the understanding of CBA that contribute to scepticism regarding the method's validity.

Whatever the shortcomings, the add-on approach has broadened the scope of CBA considerably. For example, the inclusion of the impact a project has on a range of external costs (environmental and health impacts, safety, congestion, etc.) is more or less routine in practice, and standardised approaches to modelling and measuring them are emerging. Standardized procedures for project appraisal are emerging at an international level with, for example, the HEATCO report (Bickel *et al*., 2006) and RailPag (EC-EIB) work in Europe.

A more recent and more controversial development concerns the inclusion of "wider economic impacts" in appraisal. The wider impacts include effects on productivity, agglomeration, competition and labour markets (see Vickerman, 2007, for a discussion). While some of these effects are not very clearly defined and there may be overlap between them, it is widely accepted that the effects are real and sometimes potentially important. There is less agreement, however, on what this means for the practice of appraisal.

The influential Eddington study (Eddington, 2006) argues there is sufficient empirical evidence that agglomeration economies are important for some, typically large, projects and that they should be included in appraisal of these types of project. The Crossrail[2] project in London is a classic example of a case where agglomeration effects should be included – a very large project that will significantly alter access to places of work for thousands of people. Not including these benefits where they are likely to exist tends to understate the benefits of transport projects and creates a risk of underinvestment. It also biases the allocation of funds between transport projects with high and low agglomeration benefits.

Some recent studies (Graham and Van Dender, 2010; Gibbons and Overman, 2009) take a close look at the empirical evidence on agglomeration economies, and conclude that it may not be precise and solid enough for inclusion in *routine transport project appraisal*. These authors argue that the conceptual case for the existence of agglomeration economies is strong and supported by ample evidence but that it is not yet possible to transfer this evidence to the context of a typical transport infrastructure project (which is much smaller than, e.g., Crossrail). This work brings further support to the conclusion of a 2007 ITF Round Table on wider economic impacts of investments in transport

infrastructure (ITF, 2007), that using rules of thumb to account for agglomeration benefits in CBA is not best practice. Investigating the existence and size of agglomeration benefits makes sense for large and very costly projects, but the evidence suggests it would be misguided to treat agglomeration as a general boost to the benefits of transport infrastructure investment, which could be represented by some kind of average mark-up.

CBA, total costs and benefits and their distribution

Even if CBA produces a good approximation to total costs and benefits, this knowledge provides little information on how cost and benefits are ultimately distributed in the economy (project incidence). This is a problem because incidence is relevant to decisionmaking. The evolution described under the previous heading, by which CBA gradually expands its scope and comprehensiveness through add-ons to the core method, does little or nothing to improve the representation of incidence and distributional effects.

In order to determine the full distributional impact of transport projects, it is not enough to establish the direct impact of the project on different user groups, because direct impacts can differ strongly from the ultimate impact after all channels of transfers (and wider impacts) have played out. Tracing the ultimate incidence of project impacts requires a model of the economy that distinguishes at least the main groups that could be affected by that project, for example a spatial general equilibrium model that distinguishes between various types of households and the effects on various locations. Welfare economists have spent considerable effort on establishing methods for considering efficiency and equity impacts simultaneously. In principle, when thought necessary the job can be done[3]. Nevertheless, operational models are not yet routinely available and such assessments remain costly and time-consuming. The consequence is that attempts to describe the likely ultimate incidence of the impacts of transport projects are relatively rare and cannot up to now aspire to a high degree of accuracy.

To summarize, a basic CBA provides a framework for addressing a fairly limited question[4]: what are the likely net benefits from a transport project? This information is useful for supporting decisions on what projects and project options to fund, but it is not sufficient, as it provides no, or very imprecise, information on a range of effects that policy-makers care about. The scope of the appraisal can be broadened and precision can be increased, but this will increase costs and the time taken to produce appraisals, and informational and methodological constraints do impose real limitations on how far the appraisal can be taken. What is possible varies between countries -- some countries have a strong tradition in regional economic data and modelling, others do not. Even if all potentially relevant effects were described as well as possible, it should not be expected that project funding decisions will be made on the basis of appraisal alone. Appraisal informs decisions, but is not a decision rule, as is clear from the gap between the insights from CBA and real decisions. Against this background, the next section discusses the role of CBA in decision-making.

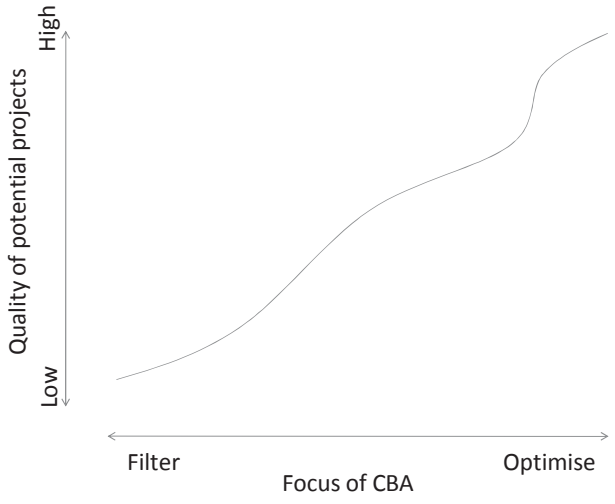
3. THE PRACTICE OF CBA

3.1. Filtering out bad projects or selecting the best ones

We argued in the previous section that in principle CBA is applicable to any project. In the context of transport, CBA can provide insight into the effects of small improvements as well as major changes to a network, and into programming as well as strategic policy choices. Within this broad remit, the way the methodology is implemented needs to be adapted to the context. These remarks abstract from the broad context in which project appraisal takes place, assuming implicitly that this context is receptive to CBA. In practice, however, CBA – if used – has a different function depending on where and when it is used. The weight given to CBA in decisionmaking can be large, small or even zero, depending on the broad culture of decisionmaking that applies. Similarly, the potential contribution of CBA to the quality of decisionmaking depends on the broad policymaking context.

A complete discussion of what determines, or should determine, the exact role of CBA in decisionmaking is outside the scope of this paper. Nevertheless, a comparison of practice in France, Mexico and the UK suggests that the function of CBA partially depends on the characteristics of the portfolio of projects that are subject to CBA[5]. Figure 1 is a stylised representation of this dependence. If the portfolio of potential projects is expected[6] to be of high quality (in the sense of being well-documented, with strong preliminary assessment by the promoters), CBA can help refine final project selection so as to make the best possible use of available funds. With an expectation of a low quality portfolio, the emphasis probably should be on weeding out the worst projects. If CBA acquires a reputation that bad projects are likely to be identified and selected out, then over time it will help raise the average quality of projects submitted. This behavioural role of the appraisal regime is very important.

Figure 1. **The focus of CBA depends on the (expected) quality of the project portfolio**



Many factors determine the quality of the initial portfolio, including the capacity of promoters to carry out project design and the general state of the transport network (with either high or declining marginal returns to investment). To be clear, the notion of quality does not refer here to the likely social rate of return of a project, but to the overall "case" for the investment. In fact, in situations where there are many high-yield projects, the quality of the average project case could be low, as there is an expectation that most projects are beneficial. CBA then can usefully focus on selecting out poor projects that try to game this expectation of high average benefits.

The role of CBA in Mexico is very much to filter out bad projects (Ramirez Sobranis, 2010). It appears that the main purpose of appraisal is to impose discipline on the project selection process through appraisal requirements that are both *rigid* and *narrow*. The requirements are rigid in the sense that they are described in detail and no funding can be obtained without passing the CBA test (obtaining the minimal rate of return of 12%). The need for discipline in an environment with a virtually limitless supply of relatively high-yielding transport spending options is easily appreciated. Rigid appraisal requirements almost certainly outperform the alternative where project selection is essentially random, even if rigidity means a good project is occasionally filtered out.

However, the Mexican appraisal process is also narrow, in the sense that only a limited range of direct impacts is taken into account. The rationale offered for a narrow interpretation of cost and benefits is that broader impacts are increasingly less tangible and their quantification therefore harder and more susceptible to manipulation. This argument is flawed for at least two reasons.

First, omitting certain project impacts from the appraisal implies the risk of introducing systematic bias in project selection. Excluding safety impacts, for example, may induce unduly cheap solutions to capacity expansion that minimise cost by omitting critical safety features. Ignoring environmental impacts can lead to a bias across modes, e.g. favouring transport by car over public transport modes. Broadening the scope of the CBA reduces these problems. While in principle CBA could produce an unbiased comparison of alternative projects, in practice there are difficulties with comparisons between different transport modes and between different types of projects (e.g. those providing access and those expanding capacity). Projects with very different life spans and cost recovery periods can also be difficult to compare. Given these practical limitations to CBA, other criteria or indicators need to be used. Such indicators can be based on strategic policy priorities. Strategic policy choices can also be used to allocate resources to different types of projects (e.g. to metalling rural roads) prior to CBA, using the latter to rank projects within like groups of projects.

Second, not quantifying an impact because it is difficult to quantify implies a judgment that no number is better than an imprecise number. This is sensible in situations where no confidence interval can be associated with an estimate, as in that case the estimate provides no information. In many situations, however, the accuracy of the estimate of an impact can be quantified. Then it is better to use the imprecise number and be explicit about exactly how small or large the confidence interval is. Even with low confidence levels, using ranges of values is useful because they are made explicit. In general, explicitly recognising uncertainty is better than limiting the analysis to areas where uncertainty is low. The final process of project selection then can turn to the appraisal to inform judgments about various uncertain impacts, instead of relying on less formalised criteria to base choices upon (as seems to be the case in the current Mexican process).

Figure 1 suggests that, where the portfolio of projects is of good quality, appraisal should shift its focus toward identifying and hierarchising the best projects and choosing the best technical variants. Where networks are mature, additional investments can be expected to have a lower return on average, justifying closer scrutiny. The main risk now is that projects with low returns do go ahead and displace

alternative (better) ways of spending the money; the main risk is no longer that a project that is much better than alternatives is stopped (which is the main potential error introduced by a rigid and narrow approach). The type of appraisal used in France and in the UK, which accounts for a broader range of impacts and takes a longer run view than in Mexico can be seen as exemplifying this shift in emphasis. Two caveats should be mentioned here though:

Our use of France, Mexico, and the UK as examples reflects the available background material and implies no judgment that network maturity or generally higher economic development levels automatically imply a need for appraisal to focus on the optimisation of resource use. Not all economies with incomes and networks comparable to France and UK rely equally strongly on CBA as France, Mexico, or the UK do. And in some countries the culture of decision-making is such that focussing on CBA as a filter seems more justified, even if networks are well-developed and incomes high.

Figure 1 is normative in the sense that it proposes a role for CBA in project selection where the average submitted project is of high quality. In practice, however, there is a recent tendency to rely less on CBA for funding decisions in countries like France and the UK (see Mackie, 2010, and Quinet, 2010). Some possible reasons for this evolution are discussed in the next section. In general they reflect a judgment that CBA on its own does not perform as well as hoped for in carrying out the proposed role.

3.2. Other uses of CBA

The method underlying CBA is applicable to small or large projects, as well as to programs or to master plans and strategic orientations. Choices on what to emphasize and how much detail to include depends on the object to assess, but in principle the tool is sufficiently versatile. Nevertheless, applying CBA poses some problems where large projects, master plans and strategic orientations are concerned. CBA in its present apparatus is very well-suited for the evaluation of small projects, i.e. projects that have only little impact on overall price levels throughout the economy. In order to be well adapted to the assessment of investment programmes or, more broadly still, the choice of a strategic policy direction that implies ”transformational” choices, the methods need to be extended, moving from a highly partial to a more general framework that allows for changes in relative prices and that extends the time horizon. In such a framework, CBA is able to enlighten decisions on project prioritisation or the timing of implementation. CBA is extremely useful for comparing different ways of solving a well-described and limited problem but provides less precise guidance in terms of strategic policy choices. Although this is a seemingly straightforward observation, CBA is nevertheless used for providing strategic policy guidance and then found wanting. Despite the rather poor understanding of what economic interactions matter and how precisely they can be measured, applying CBA to more comprehensive projects provides very useful insights to the decisionmakers, as has been recently demonstrated by the overall assessment of the current French master plan.

Tensions between the broad policy planning level and the appraisal level can and do arise. What happens, for example, to projects that pass a CBA test but that lead to increased carbon emissions (e.g. extra capacity at severely congested hub airports), when the strategic policy choice is to decarbonise the transport sector? Or to projects that do not pass a CBA test but are thought to contribute to decarbonisation (such as some high-speed rail projects)? It seems unreasonable to halt *every* project that increases CO_2 emissions (in a significant way) even when the broad goal is to reduce the transport sector’s emissions; just as it seems unreasonable to accept all projects that reduce carbon emissions

irrespective of cost. CBA can be extremely useful in quantifying this tension between an individual project's merits and the broad thrust of policy.

3.3. The impact of CBA on decisions

In practice, the impact of CBA on the ultimate decision varies over time and place. At present, both in the UK and in France, CBA weighs less on decisions than it used to, while discretionary strategic policy considerations have moved to the fore (see Mackie, 2010, and Quinet, 2010). The strategic policy considerations relate to sustainability (with a heavy focus on carbon emissions) and to economic growth (so that productivity effects take priority over user benefits). The strongly expressed view of the Round Table participants was that increased attention to broad strategic policy objectives should not reduce the importance of CBA in assessing an individual project's merits in comparison to other projects or in relation to strategic goals.

4. IMPROVING THE PRACTICE OF CBA IN TRANSPORT

The previous sections provided an outline of what CBA aims to achieve and how the role of CBA depends on the decisionmaking environment in which it is embedded. A general observation is that CBA remains controversial everywhere. Sometimes this is related to misunderstandings of what it does, or to disagreements about the value set, and sometimes there are concerns about its misalignment with the broader policy framework. CBA introduces rigour into decisionmaking processes, and while it should not tie decisionmakers hands it does increase transparency, accountability and rationality, and counters subjectivity in decisionmaking. This is its principal objective. How can that objective be pursued more effectively than at present? This section provides some suggestions.

4.1. Improving communication

CBA focuses on direct user benefits because they are a good approximation to total benefits and easier to measure than ultimate benefits, not because of any decision to narrow down the analysis. This point is often not understood and is a perennial issue in communicating the results of appraisal. The direct impact of a project, e.g. time savings, will translate into improved accessibility for various activities (work, school, leisure, shops, etc.) and into increased economic activity. Importantly, these are translations of benefits, not additions, so counting them twice would mean double counting. Whereas current debates focus on expanding the scope of CBA, the earlier concern was to avoid such double counting. For example, Mohring (1961) states:

"Among the benefits of highway investment to which reference is commonly made are those presumed to accrue to property owners. (...) such gains are quite properly labelled "non-user benefits." (...) they are regarded as benefits that must in some way be added to those arising directly from highway use (...). Although widely accepted (particularly among highway planners), this final conclusion is, as it happens, fallacious. That property values increase in the vicinity of highway improvements does reflect the existence of highway benefits. Increases in land value are not in

themselves *net* highway benefits, however. Rather they reflect an actual or potential transfer of benefits derived from highways from one population group to another."

Though measuring direct user benefits does not account for the distribution of benefits and their transformation it does succeed in capturing total overall benefits. In principle the problem could be overcome by detailing the final incidence of impacts. Not only would this alleviate concerns about narrowness, it would also provide much desired policy insight into distributional effects. However, implementing such an approach in practice is not possible on a routine basis unless one is willing to accept a major reduction in the degree of confidence underlying the analysis and/or sizeable increases in time and financial resources.

Stating that communication of the results of CBA needs to be improved is easy and commonplace but providing concrete recommendations on how to do it is not. One suggestion is to spend a bit less energy on pushing the technical boundary of CBA and more on presentation and discussion of results. A clear and succinct presentation of the different components of costs and benefits included in the analysis is key, and probably does more for the credibility of the analysis than fine-tuning the value of some poorly understood parameter. Second, CBA should limit itself to what it can do, and not try to meet requests to include ever more effects of which knowledge is lacking. This does not mean that CBA should ignore concerns about relatively vaguely defined concepts such as sustainability or liveability. Instead, analysts should ask planners to be explicit about what intermediate goals (e.g. urban form) promote sustainability or liveability. They might then use appraisal to help establish what policies work in the desired direction. CBA could become more agile in responding to changing priorities in policymaking without giving up the rigour and internal coherence that characterises it.

4.2. CBA, MCA and strategic policy objectives

Multi-criteria analysis (MCA) is often proposed as an alternative to CBA that is superior because it addresses a broader range of project impacts, speaks more directly to decision-makers' concerns and is open to alternative assessments of the weights that various impacts receive. The opposition of MCA and CBA, however, seems largely artificial and the discussion that follows suggests that in fact there is considerable overlap and synergy between the methods.

MCA usually includes CBA for a project's impacts on economic efficiency and then monetises less tangible impacts to derive an overall quantitative (usually monetary) indicator of the broader net value of the project. MCA remains restrictive in that for some impacts, satisfactorily objective monetisation techniques have so far proved elusive (e.g. for landscape impacts).

One feature of MCA is that it enables different weights to be attached to different aspects of the evaluation. In CBA, the weights (that is, the monetary valuation of physical effects) are determined on the basis of the best available evidence. In MCA, weights can reflect evidence, expert opinion, or maybe even policy preferences. The MCA approach is useful when evidence is poor or absent. However, defining weights on the basis of policy preferences introduces subjectivity into the analysis and in the extreme defies its purpose.

This means that the strength of MCA is also its great potential weakness. Decisions on the weighting criteria employed can be critical in determining outcomes but they tend to be hidden in the detail of the analysis. Although scenarios can be produced on the basis of different weightings to illustrate their impact, it is difficult to present this to decision-makers in a way that is sufficiently concise and transparent.

The response in some countries has been to employ a MCA approach without deriving a single quantitative indicator of net value, in order to avoid pre-empting decision. An example is the UK's use of appraisal summary tables under the New Approach to Appraisal (NATA) introduced in 1998 for road projects. This has since been developed to cover investments in all modes and for multimodal studies and incorporates strategic environmental assessment for large projects. "Guidance on Multi-Modal Studies" was issued in 2000 and introduced the Appraisal Summary Table. This takes the form of a single page designed to highlight information relevant to current economic and other policy objectives. It includes statements of net present value of the project to users and to government and monetary indicators of value in improving safety and accessibility. Environmental impacts are listed in a variety of ways. Noise impacts are recorded by the number of properties affected. Climate change impacts are indicated by tons of CO_2 added or avoided. Other effects are given a simple score depending on whether they are expected to be minor, significant or a major element for consideration. The list of factors covered can be added to according to current government policy priorities and includes impacts on landscapes, heritage sites, biodiversity, physical fitness, reliability, wider economic impacts, severance, transport interchange facility and land use policy. No weighting is applied to the different indicators. The decisionmaker is left to make the trade-offs involved in choosing whether to advance the project.

The focus of more traditional MCA is largely a discussion about what weights to attach to various impacts. The methods of measuring the impacts themselves do not necessarily differ from those used in CBA. Recent evolution in France (see Quinet, 2010), where decisionmakers increasingly favour MCA techniques but appraisal practice still largely follows the techniques developed for CBA, suggests that both approaches can co-exist. The perceived tension between MCA and CBA may partly be a reflection of the (real) tension between CBA and strategic policy analysis, as MCA allows more flexibility in selecting weights to match policy priorities.

Ultimately CBA needs to contribute effectively to the decisionmaking process. How this is best achieved is a matter of tradition, culture, politics and geography. It may be achieved by developing tools such as the UK appraisal summary table. It can also be achieved through institutional financing arrangements. Funds can be distributed to government bodies responsible for different types of project according to overall priorities. For example, funds for development of tertiary roads in remote rural areas might be allocated to regional or local governments to spend on these kinds of projects rather than trying to arbitrate between these investments and projects of a very different nature, for example urban tolled motorways.

4.3. Customisation and compartmentalisation

In an idealised situation where all relevant aspects of a project are included in a CBA[7] and can be evaluated with a reasonable degree of confidence, CBA could be the sole criterion to decide upon the allocation of a given budget across projects. The appraisal method would be identical across all projects and benefit-cost ratios would be used to rank them. In practice, CBA does not live up to that potential, and the pragmatic approach is to customize the appraisal method to different types of projects and to rely on other criteria in addition to benefit-cost ratios to allocate funding.

As an example of introducing other criteria for decision-making, the EIB *de facto* accepts lower rates of return for urban transport projects than for road projects. This contributes to aligning the share of funding that goes to public transport projects with the priorities of the bank's shareholders. While such differential treatment could be criticised in a world of perfect CBA, the practical shortcomings of

CBA make such additional criteria useful. In these circumstances the key requirement is that there is transparency and accountability regarding these additional criteria.

Adapting the appraisal method to the type of project at hand goes one step further than allowing different threshold rates of return (for possibly identical appraisal methods). Discussions revealed broad consensus that such customisation is justified. In practice, CBA is very well suited to comparing projects that concern the same mode, e.g. different road projects. Intermodal comparisons are more problematic. Furthermore, CBA is strong in evaluating road projects, but weaker for other projects. The reason is that key inputs to the analysis, including such basic issues as capacity measurement, are harder to define in non-road modes. It follows that CBA does not provide complete guidance for intermodal comparisons, even if the projects are similar apart from mode.

The scope and the role of CBA hence changes when the decision-set broadens. This becomes even clearer when project contexts are hard to compare. The key impacts to be expected from building a rural road differ strongly from those of projects that expand capacity in an urbanised setting, and the appraisal method should reflect those differences. This highlights the need for additional criteria rather than an inadequacy of the appraisal technique itself and as already noted appropriate indicators can be derived from strategic policy when this is clearly stated.

4.4. Discount rates, benefit-cost ratios, and costs of public funds

The Mexican CBA practice, in line with the approach used by the World Bank, imposes a minimal internal rate of return (12% IRR at present) that projects must attain to be eligible for funding. Internal rate of return (IRR) is calculated as the interest or discount rate at which the net present value of costs and benefits of an investment are equal. Because of the discounting involved in the calculation, requiring a high internal rate of return (such as 12%) disadvantages projects for which the benefits accrue further in the future. It may also give an inappropriate incentive to project promoters as one can expect all projects to take the hurdle, but not necessarily by a large margin. The practice in European countries including the UK and France is to use much lower discount rates (3-6%). The selection of what projects to fund then relies on comparisons of benefit-cost ratios, rather than internal rates of return (which because of the way they are calculated compound the size of benefits relative to costs with the time period in which they occur). The "European" approach avoids a confusion of project selection criteria and appropriate discounting practices. It also allows differences in views on how to compare present and future financial flows to be reflected in differing discount rates[8]. One could argue that requiring a high internal rate of return is more straightforward in a context where there are many immediate problems to solve, but the same results can be obtained by relying on benefit-cost ratios with the additional benefit of improving the comparison of projects with strongly different payoff paths. The discussion in earlier sections suggests there is a move away from rigid criteria, reducing the practical value of thresholds in decisionmaking.

France lowered its discount rate for transport project appraisal from 8% to 4% in 2006 (and to 3% for flows occurring 30 years or more into the future). Shortly thereafter it also started valuing the marginal cost of public funds at 1.3 instead of 1. This means that each Euro used to build infrastructure receives a weight of 1.3 in the CBA, and this is justified because of the efficiency cost of raising the tax revenue needed to fund the infrastructure[9]. These changes can be seen as improving the conceptual rigour of French appraisal. Whereas before the discount rate for appraisal (8%) seemed high in comparison with social discount rates, it is now more in line with common EU values. Using a lower discount rate conceivably increases the number of eligible projects, but this is counteracted by introducing a higher marginal cost of public funds. The conceptual case for the innovation is solid: the

evidence that marginal tax increases carry high marginal efficiency costs in countries where taxes are already high is strong, and using a specific parameter is better than indirectly accounting for the cost of funds through high discount rates[10].

The use of a marginal cost of public funds (MCPF) bigger than 1 reflects a view that using public money raised through distortionary taxation has an efficiency cost that needs to be accounted for in appraisal. Values ranging from 1.2 to 1.5 are typical and are obtained mainly by calculating the marginal efficiency cost of raising revenue through tax on labour, the main and probably the most distortionary source of tax revenue in advanced economies. It is worth noting that the relevant MCPF depends on what source of tax revenue is considered. Non-labour tax revenue can come at a lower or higher cost than labour tax revenue. Tax revenues raised in the transport sector itself, possibly through the project under analysis, may well display a lower efficiency cost, given that a sizeable share of transport flows relates to leisure and not to work activities. Putting source-specific values on tax revenue flows then becomes part of the appraisal, implying that in principle project design and funding structures should be analysed together, not separately. More broadly, the marginal cost of public funds is just one factor in the comparison of various sources of public and private funding and it does not imply that private funds are universally preferable where they are available.

5. CONCLUSION

CBA is and remains a valuable tool for bringing structure, rationality and transparency to infrastructure decisions and strategic policy choices. The tool is not in itself sufficient to make decisions, and current decision-making processes show that decisions do not always follow the recommendations of CBA. Nevertheless, more consistent use of CBA-type appraisal would lead to better decisions overall.

In order to maximize its potential value, CBA needs to be sufficiently broad. Excluding impacts on the grounds they are poorly understood becomes problematic when these impacts are essential to the project. The better approach is to account explicitly for uncertainty. This imposes rigour on how trade-offs between various objectives are handled. It also highlights the need for more research to improve knowledge of the impacts of investments in relation to strategic objectives. CBA is evolving, with a gradual expansion of the scope of the analysis. Coupled with the use of transparent summary tables to present results alongside distributional effects and other indicators critical to political priorities, CBA is well suited to addressing changing strategic policy priorities and emerging demands for project programming.

NOTES

1. Although it is not easy in an absolute sense for reasons of data, model, forecasting and valuation error.

2. *www.crossrail.co.uk/*.

3. Views differ on whether it is necessary to consider the distributional impact of every project. If there is a multitude of projects and other changes to the economy, then focussing on the distributional impacts of a single project is not necessarily useful at the country level, though local public authorities or socio-economic groups can be highly interested in them.

4. Limited but important. One view is that net benefits are all that matter, as accompanying measures can be used to achieve distributional objectives (see Kaplow, 2007, who revises the position from welfare economics that equity and efficiency should not be separated in appraisal, and is careful to point out this holds only under particular separability assumptions for household preferences). Project appraisal then still could usefully include a description of distributional effects, but these effects should not play a role in the decision whether to go ahead with the project or not.

5. Casting the discussion in terms of a portfolio suggests there is a large number of smaller projects under consideration. The principles involved, however, are not limited to small projects: distinguishing basic quality control from quality optimisation is useful for small and large projects as well as for strategic policy principles.

6. We prefer to express the relation in terms of expected quality, as there is no certainty about the quality of individual projects and the expectation can be seen as reflective of the overall decisionmaking culture.

7. Assuming there is consensus on what these impacts are, which is not straightforward with relatively new concerns including reliability, resilience, and security.

8. See Layard and Glaister (2001), Introductory chapter, for a more detailed discussion.

9. The marginal cost of public funds refers to the costs of market distortions caused by taxation and is not related to concepts that concern the financial cost of borrowing.

10. It is not clear if that was the rationale but the practice certainly worked in that direction.

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THE PRACTICE OF COST-BENEFIT ANALYSIS IN TRANSPORT

THE CASE OF FRANCE

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SUMMARY

ABSTRACT 29

1. INTRODUCTION 29

2. ORIGINS OF CHANGES IN THE DOCTRINE 30

   2.1. Progress in economic analysis 30
   2.2. Changes in social organisation 31

3. PROJECT EVALUATION GUIDANCE 32

   3.1. Old cornerstone 32
   3.2. Innovations after 2007 35

4. ASSESSMENTS OF RECENT PROGRAMMES AND PROJECTS 37

   4.1. Grenelle I and II 37
   4.2. National Transport Infrastructure Plan 40

5. OVERALL DECISION ON COST-BENEFIT ANALYSIS *VS.* MULTI-CRITERIA ANALYSIS 43

   5.1. The difficulties and benefits of Multi-Criteria Analysis (MCA) 43
   5.2. Complementarity of CBA and MCA 45

6. SOME IDEAS FOR IMPROVING COST-BENEFIT ANALYSIS 46

   6.1. Methodological problems 46
   6.2. Methods of implementing CBA 47

7. CONCLUSION 50

NOTES 51

BIBLIOGRAPHY 52

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ABSTRACT

We first review the history of CBA in France, emphasizing the change from a strict use of CBA in accordance with the teaching of pure economic analysis, towards an assessment more in line with Multi-Criteria Analysis (MCA). We then show the drawbacks of pure MCA and the limitations of pure CBA, and advocate the combined use of both. We draw conclusions aimed at improving project assessment methods, pointing towards both methodology and the increased involvement of CBA in the decisionmaking process, while taking stock of the characteristics of this current decisionmaking process (negotiations, multiple decisionmakers).

1. INTRODUCTION

The practice of cost-benefit analysis (CBA) has a long tradition in France, dating back to Dupuit (1849), but is still a topical subject. This practice is in fact the result of the combination of economic theory and decision processes regarding project choices. Both of these are constantly changing: advances and progress in the theory mean that the technical methods and tools used are constantly improving, while changes to decision processes and institutional organisations are transforming evaluation requirements. In some countries, the process of constant change has been very fast indeed. This is currently true in France, where major transformations are occurring. We are now leaving a period during which the doctrine was based on the strict application of traditional economic calculation and the pre-eminence of a single criterion predicated on surplus theory, and entering a phase very firmly focused on multi-criteria analysis in which traditional CBA is only one of the assessment factors. These transformations are under way, although not finished yet. However, the situation is already sufficiently clear-cut for this paper to outline the main points and pass judgment on their causes and effects.

The paper will then analyse the causes of the changes that are occurring. Some are attributable to progress in economic analysis. In addition to the still relevant traditional issues such as travel time and its many facets, these mainly concern risk assessment and the effects of investments on productivity and the spatial organisation of activities. Others relate to the institutional framework and are the result of the proliferation of decision-makers, the growing importance assigned to the environment and to consultation and the consequences of liberalisation (competition between operators, private finance).

The paper will then go on to describe the way these changes in the evaluation framework have affected evaluation procedures and how they have resulted in a shift from a single criterion doctrine to a multi-criteria doctrine. This multi-criteria doctrine is not yet finalised, but its aim is to introduce evaluation processes that will enhance projects throughout their lifecycle, introducing dialogues between analysts and stakeholders on decisions concerning the project into the dialectical dynamics.

Although the corresponding guidance is not complete, it does very clearly point in this direction. This is confirmed by information on ongoing studies and research, on which future instructions would normally be expected to be based.

This policy has already been adopted in ongoing programmes and projects and in the way they are evaluated. The third part of this paper will describe its initial manifestations, which will demonstrate the advances but also the limits of the procedures in the making.

It will then be possible to pass judgment on these developments, highlighting their strong and weak points, the problems and challenges that they throw up and the research that needs to be done. The choice between multi-criteria analysis and cost-benefit analysis will be addressed first and it will become clear that these two frequently opposed techniques are in fact broadly complementary. We will then look at the changes and improvements that need to be made to the usual cost-benefit analysis, which should remain the cornerstone of project evaluation.

2. ORIGINS OF CHANGES IN THE DOCTRINE

Major changes have been taking place in the way in which cost-benefit analysis (CBA) is performed for the past ten years or so. These changes are the result of progress in economic analysis allied with changes in society and, such is the synergy between the concerns of the researchers and the policy in the social environment in which they live, it is often hard to identify which of these two factors is the most influential. The way in which each of the factors addressed below will be included in one or other of the two categories is therefore somewhat arbitrary.

2.1. Progress in economic analysis

One factor which will be included on the theoretical analysis side is the continual progress made in assessing the effects of investments on travel times and its components such as reliability, non-adherence to timetables or the linkage between transport and the rest of activities, both at firm level (logistics) and people level (activity programmes). The references on these topics include Mackie *et al.* (2003), Gunn (2007) and Hensher (2011, forthcoming) for passenger transport; Beuthe *et al.* (2008) for freight transport; and Bhat *et al.* (2004) for activity programmes. This progress can also be seen in knowledge of congestion phenomena. These have been studied for a long while now in the field of road transport [after the initial work of Arnott *et al.* (1993)], but are less well known in railway and air transport.

Another factor included here is better knowledge of the interactions between transport and space. The New Economic Geography (NEG) is in the gradual process of developing its applications for project evaluation (Ottaviano, Tabuchi and Thisse, 2002; Venables, 2007). These are also found in the studies on agglomeration effects – productivity gains due to the proximity of agents (firms and individuals) – and the development of methods to quantify them (Graham, 2007). These developments meet – but do not fully satisfy – a constant demand from policymakers wanting to know the consequences of investments on economic development and the attraction of activities, with local

elected representatives regularly hoping that the infrastructure put in place in their region will promote its economic development.

Two forms of uncertainty have also emerged on the economic analysis side. First, there appears to have been a systematic bias in evaluations (Flyvberg, 2009). The United Kingdom guidance has addressed this bias and recommended how to anticipate and avoid it. The French guidance may possibly take the same route, but other avenues are currently being explored, in particular introducing audit systems to reduce if not prevent bias. The second form of uncertainty is more conventional, being the random factors as known and modelled by the financial markets. While particular attention is paid to these issues by the study teams concerned[1], no precise recommendations have yet been issued (apart from the recommendation to pay special attention to this factor…), nor a firm doctrine stated. However, the next guidance is bound to include detailed and clear mention of this factor.

2.2. Changes in social organisation

It is also increasingly clear that our world is full of uncertainties – and the current economic and financial crisis is added proof of that. Risk also assumes greater importance with the development of Public-Private Partnerships (PPPs). These manifest themselves in various forms: privatisation of motorway concession companies; operators of certain airports; franchises for public transport; and fragmentation and liberalisation of certain parts of the activity, as in rail transport. In all these cases, the partners pay considerably more attention to risk than used previously to be the case when public finance was the rule: risk aversion was much lower because the only financial stakeholder was the government.

Risk has also increased as a result of liberalisation. More markets have been opened to competition which is not perfect but takes the form of oligopolies (in the railway or aviation sectors, for example). An unstable market structure results, in which there are many uncertainties as to the outcome of the confrontation between the players (how many entrants, in what niches, how will they compete, by price, quantity, etc.?) and which has serious repercussions on the conditions for performing cost-benefit analysis (Meunier and Quinet, 2010; Sanchez-Borras, 2010). All this contrasts with the relative stability afforded by the previous public monopolies.

Another source of change lies in the importance accorded to the environment. The environment has been a factor in CBAs for a long time now through the process of valuing externalities. Attention continues to focus on environmental aspects. An expert report recently made recommendations for the carbon value to be used in economic calculations (Quinet *et al.*, 2008); similarly, consideration continues to be given to updating the other unit values for externalities.

The environment has become even more radically involved through the political process. The parliamentary majority after the 2007 elections introduced a major change in its policy to respond to environmental concerns. This resulted in what is known as the *"Grenelle de l'Environnement"*, or Grenelle Round Table on the Environment. The use of the term *"Grenelle"* is a reference to the Grenelle Agreements (thus called because the meetings leading up to the agreements were held in Boulevard de Grenelle in Paris) which brought together the Government, employers and the unions to negotiate an end to the May 1968 strikes. Similarly, the Grenelle Environment Round Table (Grenelle website) brought together a number of different stakeholders in French political life: central government, local authorities, firms, trades unions and environmental groups. What emerged was a form of five-way governance (*"gouvernance à 5"*) that proposed environmental measures to the Government and Parliament, which were largely adopted. These measures cover all aspects of social life, including transport infrastructure. The transportation programme places great emphasis on railway

infrastructure and public transport, relegating road infrastructure to the back seat. The transport infrastructure policy is also accompanied by significant administrative reforms, with the merging of the transport and environment authorities. Environmental concerns seem to have come off best in this merger. The Highways Department, which was previously all-powerful within the Ministry of Transport, has been abolished and its personnel spread throughout the Ministry, within a structure designed to promote and improve intermodality.

The five-way governance resulting from the Grenelle Environment Round Table is a sign of the increasing complexity of the decision processes. While that complexity is not new, it does serve to emphasize and signal the changes currently underway.

3. PROJECT EVALUATION GUIDANCE

3.1. Old cornerstone

The old cornerstone for the guidance dates back to 2004 (Framework Instruction of 25 March 2004 on harmonization of evaluation methods for major transport infrastructure projects, and Instruction of 27 May 2005 updating it)[2]. This Instruction modified an Instruction on the same subject dating back nearly ten years, to 1995. It introduced changes to the evaluation of external effects and the unit values of those external effects. It also gave additional practical guidance on the presentation of studies to take account of changes in the decisionmaking context and the development of public discussion. It followed the same doctrinal line, developed in the report by Boiteux *et al.,* on which the corresponding approach was predicated, characterised by the statement that the central core of the evaluation is calculation of the economic cost, as this is an invaluable indicator for locating and ranking in the public decision process. It is even stated that this method of economic calculation is the only one currently allowing costed comparisons between different investment projects. This paper will not go into detail on the methods for performing profitability calculations, as these methods are classic. Suffice to note the emphasis given to the problem of calculating user benefits which arises when wanting to use values of time and associated parameters different from those used for traffic modelling. There is a risk of serious inconsistencies when this happens. This problem arises when the circulars recommend standard values of time, which is generally the case. It is particularly common in France where there are often calls to use reference values of time modified in relation to behaviour values to take account of collective preferences.

However, the 2004 Circular has already introduced some changes to this doctrine. Just after the positive statements in favour of economic calculation, it goes on to state that evaluation of a project must contain many other elements clarifying public choices and that these elements are either quantitative or qualitative. The Circular places particular emphasis on territorial and social equity and on the structuring effects of transport in territorial development. The need to provide decisionmakers with the elements for evaluation is underlined, whether or not they are quantifiable or have a quantifiable monetary value for all the criteria that determine the public choices. Lastly, the developments to the Circular place great importance on project profitability calculations.

The Framework Instruction also stresses the need to carry out sensitivity tests to clearly identify for each project the long-term uncertainties and risks associated with the technical and economic

environment, project implementation times and conditions and the various assumptions and valuations used.

In accordance with these objectives, the Instruction sets out how to perform profitability calculations and gives a standard set of assumptions for macro-economic conditions and the unit values involved. The recommendations given are fully in line with the economic theory and good practice of the period. One innovation that should be mentioned is the recommendations to calculate accessibility indicators as a means of understanding the consequences of the project on spatial organisation. But, apart from this point, the general principles that it highlights for taking structuring effects and equity into account are not accompanied by any tools to put them into practice.

All in all, the 2004 Framework Instruction expresses intentions that go beyond conventional economic calculation but, in terms of the methods proposed, remains within the strict framework of that calculation. This Framework Instruction was followed by an updated Circular in 2005, whose main purpose was to change the discount rate (from 8% to 4%) and introduce the marginal cost of the public funds concept (value set at 1.3). This Instruction should be varied for all modes of transport to take account of the specific features of each. In fact, only one of the Application Circulars concerning roads has been taken to a certain completion point. But it is still at the draft stage and currently applied on a provisional basis without having been formalised. Its main provisions are outlined in Box 1 below:

Box 1. **Main recommendations of the 2007 Draft Circular on the evaluation of road projects**

The Circular sets out the general principles on the concept of project, development scenario and reference scenario. It then indicates the various stages of progression in the design of a project, drawing a distinction between the feasibility study and upstream public engagement – where only the broad brushstrokes of the project are defined (the alignment corridor may vary by several kilometres and there may be several competing corridors) – and the outline design and public inquiries, where the alignment is much more precisely defined (to within tens of metres or a hundred metres). It states that the upstream studies must clarify the modal comparisons, landscape scheme and financial feasibility, and culminate in the definition of a major traffic corridor; and that the downstream studies must choose the alignment alternatives, phasing and priority for the different projects. It also states that each phase must include the evaluation of profitability indicators, calculation of non-monetary elements and financial analysis. However, it gives no precise indication on what it is possible to estimate and the degree of precision to be achieved in each phase.

The Circular gives guidance on traffic studies, specifying the relationships to be used for route choices (these models do not take travel time choices into account) and the rules for factoring in traffic induction. These relationships can be used either "manually" in the simplest cases or incorporated into more elaborate models standardized for large-scale studies. Traffic growth trends are also confined between the upper and lower bounds. In the case of more extensive studies where, for example, reverting to the basic factors would appear necessary, changes in macro-economic parameters such as GDP or oil prices are required.

Evaluations for user and other stakeholder benefits are highly confined by strictly defined numerical values, leaving little room for the analysts to make choices. This is to avoid strategic bias and to facilitate comparison between projects. This is standard practice in Europe, as can be seen in the Heatco Report (Heatco, 2006). The valuations associated with user costs and travel times and comfort conditions are reproduced here, on the basis that similar tables exist for the environment and safety.

3 – TABLE OF UNIT VALUES	**Physical unit**	**Unit value in Euros 2000**
* *Routine maintenance, tyres, lubricants:*		
• Cars	Vehicle x kilometre	0.07
Including VAT		0.0115
• HGVs	Vehicle x kilometre	0.13
* *Vehicle depreciation*		
• Cars	Vehicle x kilometre	0.027
Including VAT		0.0044
• HGVs	Counted in the time value	
* Tolls: to be defined on a case-by-case basis: in the absence of specific information, the average toll in 2000, excluding special structures and disregarding prepaid, was:		
• Cars	Vehicle x kilometre	0.066
Including VAT		0.0108
• HGVs	Vehicle x kilometre	0.149
* *Fuel*		
• Cars (takes account of petrol/diesel split)	€/litre	1.00
Including tax on petroleum products		0.50
Including VAT		0.16
• HGVs	€/litre	0.71
Including tax on petroleum products		0.39
* Standard time for economic calculation		
• Cars (1)		
Distance d < 20 km	time/vehicle	9.88
Distance d 20 to 50 km	time/vehicle	13.41
Distance d 50 to 400 km	time/vehicle	0.0304 d + 15.39
Distance d > 400 km	time/vehicle	34.36
• HGVs and coaches (1)		38.15
* Discomfort penalty (cars only) (1)		
1 – Distinction depending on type of road:		
– 7m ordinary road	Vehicle x kilometre	0.054
– 7m express road	Vehicle x kilometre	0.032
– Trunk road	Vehicle x kilometre	0.023
– Two-lane express dual-carriageway	Vehicle x kilometre	0.007
– Motorway	Vehicle x kilometre	0.000
2 – Functional distinction (these values must not be cumulated with the preceding ones):		
– single lane carriageway	Vehicle x kilometre	0.025
– road with at-grade intersections	Vehicle x kilometre	0.016
– road with non-motorway status	Vehicle x kilometre	0.007
– road with unlimited access.	Vehicle x kilometre	0.007

The discount rate is set at 4% until 2035, then 3.5% until 2054 and 3% thereafter. The indicators to be calculated are discounted profit, calculated on the basis of a 50-year investment lifecycle without residual value, internal rate of return, profit per euro invested and profit per public euro invested. A section is devoted to risk analysis and the favoured method is analysis of possible failures and scenario construction.

Alongside this conventional cost-benefit analysis aspect, non-monetary effects are required to be evaluated. These are specifically named as follows:

- Accessibility effects. A methodology for calculating accessibility indices and their changes linked to implementation of the project.

- The impacts on local or regional economic development. There are two types of impact: first, the employment effects, for which ratios are given corresponding to the direct effects of hiring for construction and operation works. Then, the consequences on economic activity are subject to a very complex procedure based on surveying local and regional economic leaders and analysing local activity statistics. Linking these with the previously calculated accessibility changes, and using the classification rules laid down by the Circular, a qualitative estimate is obtained of the expected consequences on the project on local or regional economic activity.

It should be noted, however, that these analyses of employment and regional development are not complete. They do not take account of macro-economic effects on the corresponding markets. In more concrete and somewhat simplistic terms, they do not say whether the additional employment and economic activity identified are net creations or accompanied by reductions in other regions.

The non-monetary effects contain a third category: evaluation of the discomfort experienced by users in congestion situations: here, service quality levels are defined from this angle. This point reflects the fact that the time values given above poorly reflect the inconveniences associated with congestion and that traffic studies are also ill-suited to assess congestion conditions (they do not take traffic-jam situations explicitly into account).

The Circular ends with requirements for financial evaluation. This evaluation is brief: it identifies the project revenue and compares it with the infrastructure manager's costs, by calculating a Net Present Value, determined using an interest rate based on market conditions. The analysis does not explicitly take account of the financing structure (capital or loan), only including it through the choice of interest rate, which is a sort of WACC. It does not analyse the risks as private finance stakeholders would do, taking no account in particular of Debt Service Cover Ratio coefficients. It limits itself to giving an overview of private finance options.

3.2. Innovations after 2007

The tone and direction were to change completely after 2007 under the impetus of the new Government. As the title of the Circular published on 9 December 2008 (Ministry of Ecology, 2008a) suggests – the "Ministry evaluation reference system" – the thinking behind it is completely different. It concerns all of the Ministry's spheres of decision and not just transport. It proposes an evaluation procedure which is very different from the previous system, where cost-benefit analysis was at the heart of the evaluation. Here, the evaluation starts by defining the project aims and assessing how that project will meet them in comparison with the other possible alternatives. These comparisons are made by analysing the project impacts. These impacts are ranked according to the three pillars of

sustainable development: the economy, the social effects and the environment. An analysis matrix is given and reproduced below.

Table 1. **Project evaluation matrix**
Summary Impact Assessment Table

Field	Nature	Qualitative description of impacts	Valuation of impacts (1)
Environment and Risks	Climate		
	Local air pollution		
	Noise		
	Aquatic environments		
	Bio-diversity		
	Landscapes		
	Soils		
	Safety, Security, Risks		
Social	Employment		
	Vulnerable groups, poverty		
	Redistributive effects		
	Training, human capital		
	Access to essential goods and services		
	Territorial cohesion, social mix		
Economy	Impacts on households		
	Impacts on firms		
	Total cost		
	Cost for public finances and fiscal impacts		
	Competitiveness and additional economic effects (2)		
Other			

(1) Value expressed in monetary or physical units; failing that, scope of the impact: from negligible to extremely high.

(2) Some potentially important effects on the economy could be gradually factored in to the cost-benefit analyses: agglomeration economies, impacts on the markets in imperfect competition situations, impacts on the labour market and their fiscal consequences, etc. Moreover, the impacts mentioned in the table shall specify, for each criterion, the main risks and uncertainties that may have been identified and the main information concerning impact distribution.

It can be seen from this table that the surplus criterion no longer appears in name, but just under the headings of competitiveness and impacts on households and firms.

Emphasis is placed on the educational character of the procedure, which must be designed to produce an improvement in the project throughout its preparation and consultation through public debate. This concern for good project management is demonstrated in another Circular, issued on the same date, on the "Establishment of a Quality Charter for Evaluation in the Ministry" (Ministry of Ecology, 2008b): the evaluation must be impartial, transparent, pluralist and exhaustive; it must be

possible to track the origin of the constituent elements of the evaluation (traceability). It must be geared towards consultation through wide public availability.

The final point to note is that this very short six-page Circular is relatively incomplete. It provides no guidance on how to complete the table, the indicators to be measured and the double-counting to be avoided. These tasks are left to subsequent circulars which will give detailed recommendations for each field and are in the course of preparation.

In parallel with this approach, the Ministry's departments are continuing to improve the procedures for performing economic calculations. They have been working on providing new carbon price evaluations (Quinet, 2008) and this work has been based on the most orthodox economic analysis. Similarly, a report is being finalised on factoring in risk. It is based on the economic theories for financial asset assessment, here too in line with economic orthodoxy.

So, the situation at the moment is that there are two schools of thought and two ways forward: one a multi-criteria approach, based on enumerating and quantifying a large quantity of impacts, and the other, clearly single criterion, based on the surplus theory. These two schools of thought have existed in France for a long time and until now have always conflicted. Oscillations have been witnessed in the past, when the balance has swung from one to the other over different periods of ten or so years. The paradox of the current situation is that, for the time being at least, the trend is more syncretic: the two schools of thought co-exist and are in the process of developing in parallel. The multi-criteria analysis (MCA) recommended by the 2008 Circular is being applied for the first time, on a somewhat experimental basis, in the evaluation of projects arising from the Grenelle Environment Round Table, while those same projects are being subjected to socio-economic evaluations in accordance with the principles of the 2004 Circular. This paper will now look at how these evaluations are linked.

4. ASSESSMENTS OF RECENT PROGRAMMES AND PROJECTS

Since the turning-point of 2007-2008, many decisions have been taken on infrastructure projects. These may be presented and analysed in terms of the decisionmaking level, starting at the beginning of the process and general decision, i.e. long-term planning, and then moving to the end of the process and specific considerations, i.e. the technical specifications for projects that have already been decided.

4.1. Grenelle I and II

The most far-reaching decision taken recently was the enactment of the two bills that will put the decisions that came out of the Grenelle Round Table on the Environment on the statute book. The first of these was Law No. 2009-967 of 3 August 2009, on the timetable for the implementation of the Grenelle Round Table on the Environment (Grenelle I). Along the same lines as the above-mentioned Circular on assessment, this bill, which applies not only to transport but to all activities, first sets out general objectives. For the transport field, the objectives listed are: combating global warming, ensuring sustainable development by means of a reduction in pollution; and restricting destruction of

the countryside. These objectives can be met, for example, through the development of mass transportation (by inland waterway, rail or coastal navigation). General objectives are then listed, for example, for freight transport, aimed at increasing the modal share of non-road freight from 14% to 25% between now and 2022.

These objectives will be achieved by means of a co-ordinated set of measures described in the bill, with the maintenance and efficient use of existing infrastructure, as well as regulatory provisions, topping the list. Investment in infrastructure is just one of the tools available, and is not necessarily the preferred option.

Fairly specific details are given regarding the resources in terms of new infrastructure, at least as far as investment in rail transport is concerned. With regard to freight transport, for example, the bill provides for the construction of three "rail motorways", in order to achieve a targeted reduction in road freight. Improvements to the rail and river connections serving ports, sea motorways and the Seine-North Europe canal are also mentioned and some quantified objectives set in this regard.

In the case of passenger transport, the emphasis is placed on pursuing the programme of new high-speed rail links, with the aim of covering some 2 000 km by 2020, with several lines being listed by name.

Box 2. **New high-speed rail projects under Grenelle I**

- The Southern Europe–Atlantic line, consisting of the central Tours-Bordeaux section and three branch lines, namely, Bordeaux–Toulouse, Bordeaux–Hendaye and Poitiers–Limoges.
- The Brittany–Pays de la Loire line.
- The Mediterranean Arc, including the Nîmes–Montpellier by-pass, the Montpellier–Perpignan line and the Provence–Alpes–Côte d'Azur line.
- The provision of services to eastern France, with the completion of the Paris–Strasbourg line and the three branches of the Rhine–Rhône line.
- The interconnection to the south of the high-speed lines in the Ile-de-France.
- French access to the international tunnel along the Lyon–Turin railway line, which is the subject of a treaty between France and Italy.

An additional 2 500 km are also planned in order to complement the previous network or to substitute for links in the network that might not be ready in time. Reference is also made to a programme to extend local public transport, including measures for public transport on separate lanes in the regions and the Ile-de-France region.

The bill also provides for the drawing up of a National Transport Infrastructure Plan (*Schéma National des Infrastructures de Transports* – SNIT) and lays down the following criteria for determining the choice of transport links that will be included in it:

- The net balance of greenhouse gas emissions produced or avoided by the project in relation to its cost;
- Progress made on other projects and the prospect of saturation on the networks concerned;
- Environmental performance (combating noise pollution, severance effects, biodiversity conservation, etc.);
- Multimodal access, economic development, opening up regions and regional development at the various levels;
- Improvement of the efficiency, safety and cohesion of the existing transport system; and
- Fulfilment of the objectives relating to the provision of access for persons with reduced mobility, provided for under national legislation.

In the bill, emphasis is placed several times on the importance of following up projects and measuring their efficiency. The word "feedback" is not used, but this concept clearly pervades the text. Likewise, in the spirit of the Grenelle Round Table on the Environment, it attaches importance to consultation procedures and public debate, with the expected outcome being precisely the enhancement of the projects and their efficiency. Thus, of the five action areas contained in the bill, an entire section is given over to governance and information.

Law No. 2010-788 of 29 June 2010, on the national commitment to the environment (Grenelle II), does not provide any additional information on investment programmes or choices of infrastructure, but strengthens those measures that are conducive to promoting dialogue in the public debates that will ensue.

Note that the commitments made in these two bills, and particularly those in Grenelle I, were subject to a summary report that was written in accordance with criteria laid down in the bill itself and based on existing data. However, this report did not serve as a guide for the decisions set out in the bills. Dating back to October 2008, the report was instead an *ex post* assessment of the said commitments, while the draft Grenelle I had already been submitted to Parliament in June 2008. Moreover, the authors of the report themselves deemed it to be imperfect since it had been based on very incomplete data:

> "*Nevertheless, this report cannot strictly be called a cost-benefit analysis or cost-advantage analysis, which is the model that all assessment of public policy should eventually aim to follow. In fact, the time-frame within which this report had to be prepared and the status of the planning law rendered this kind of analysis difficult, and even impossible, for some objectives. This is particularly true of certain environmental issues (biodiversity, health-environment, etc.), for which the absence of reference values for their assessment adds an additional layer of difficulty*."

This comment reflects both the inadequacy of the studies conducted prior to the investment provided for in the bill and the difficulties encountered by analysts in performing assessments in accordance with the principles laid down in that bill – which are the same principles as those set out in the Circular of 2008 referred to in the preceding section.

Attention is drawn to the fact that an internal assessment (Study on the impact of the draft Grenelle environment bill) was conducted on the Grenelle commitments, using a cost-benefit analysis method. This assessment was rudimentary since cost-benefit analyses were not available for all of the

projects and measures involved. Nevertheless, it did enable the cost-effectiveness of the measures listed under each objective to be compared. This revealed that several of the measures in question were only cost-effective for implicit valuations that were significantly larger than those usually imputed (notably of the carbon price).

A yearly report is drawn up and submitted to Parliament by the *Commissariat général pour le développement durable* (General Commissariat for Sustainable Development – CGDD, 2009), which gives an update on the implementation of the Grenelle commitments. This report looks at the implementation of the measures rather than at the progress made towards achieving the objectives.

4.2. National Transport Infrastructure Plan

Grenelle II provides for the preparation of a National Transport Infrastructure Plan (*Schéma National des Infrastructures de Transports* – SNIT). A little later than originally scheduled, a draft SNIT was published on 13 July 2010 (Ministry of Ecology, 2010), with a view to organising a public consultation. This involves, *inter alia*, dialogue with the locally-elected representatives concerned, interministerial co-operation, and consideration of the plan by the *Conseil économique, social et environnemental* (Economic, Social and Environmental Council) in its new composition – a wide-reaching public debate followed by a debate in Parliament. The strategy underpinning the plan consists of the following four lines of approach:

- optimising the existing transport system;
- limiting the construction of new infrastructure;
- improving the performance of the transport system serving the regions and energy installations;
- reducing the environmental footprint of transport infrastructure.

Around sixty measures have been decided upon, covering areas such as the maintenance, modernisation or development of infrastructure. As far as infrastructure is concerned, and as part of the policy line described above, emphasis is placed on the objectives set out in Grenelle I to:

- strengthen intermodal transport, in favour of rail transport;
- modernise major sea ports;
- enhance the integration of environmental considerations into existing transport infrastructure;
- shift the focus away from road and air transport; and
- provide support for the development of public transport.

For each of these objectives, a list of items, criteria and indicators is proposed. Table 2 below shows the criteria and indicators for assessing the first objective to develop rail transport.

An examination of the project assessments undertaken shows that the assessment methods used are more in keeping with the previous practices and principles. Firstly, many of the projects included in the Grenelle bills and the SNIT have already been subject to detailed assessments – for example, in the framework of the preliminary public debates or public utility surveys; secondly, the corresponding reports are not structured in the same way; third, they all comprise project impact assessments, in particular on the local economy and the environment; and fourth, they all include a socio-economic analysis undertaken in line with the circulars of 2004 and 2005, giving rise to cost-effectiveness indicators, which, in general, are summed up in the internal rate of return.

Table 2. **Criteria and indicators for assessing the development of rail transport objectives**

Detailed objective	Criteria	Indicators	What is to be assessed?	Infrastructure at stake
Increase the access of large regional agglomerations to high-speed rail. Develop a rail alternative to air and road transport.	Ability of the project to provide an alternative to air transport for areas with an airport that serves short-haul destinations	Amount of air traffic shifted to rail	Estimate the modal shift to rail and the consequences in terms of CO_2 emissions	Rail
		CO_2 equivalent in tonnes avoided		
	Ability of the project to contribute to network effects. Ability of the project to increase the country's high-speed rail coverage	Number of links between regional metropoles with travel times	Assess the time savings between the main hubs of the high-speed rail network	Rail
	Ability of the project to increase access to high-speed rail travel	Number of cities of more than 100 000 inhabitants that become a "TGV city"	Assess the improvement in the access of urban agglomerations to the TGV network	Rail
		Number of cities of more than 100 000 inhabitants with direct access to TGV		
		Agglomerations with a population of more than 100 000 with access to high speed service within less than 20 minutes		
		Cities with more than 100 000 inhabitants saving travel time of more than ½ hour		
	Ability of the project to act as a substitute for non-collective transport	Amount of traffic shifted from road transport	Estimate the modal shift from road to rail and the consequences in terms of CO_2 emissions	Rail
		Amount of CO_2 equivalent in tonnes saved by transfer from road to rail		
Cope with the increase in traffic with a sufficient quality of service by means of upgrading lines, improving operations or building new tracks when necessary.	Ability of the project to reduce congestion	Number of nodes and length of links where congestion has been reduced	Assess the consequences of the project in terms of network congestion	Rail

Detailed objective	Criteria	Indicators	What is to be assessed?	Infrastructure at stake
Improve the interchanges between modes for passengers and freight	Possible market for rail in the framework of an interconnection between rail and road	Amount of traffic possibly transferred from air to rail in the case of an air-rail interconnection. Amount of CO_2 equivalent in tonnes saved in this case. Number of passengers and amount of freight using rail to and from the airport terminal. Characteristics of the regional network from TGV stations (frequency, number of lines, etc.).	Assess the benefits of an air-rail interconnection	Airports, Rail
Increase the interconnections in the Ile-de-France in order to improve the quality of the national network	Quality of public transport from TGV stations	Characteristics of the mass transit network (frequency, length of the network) from TGV stations. Amount of traffic diverted from Paris stations to new stations on outskirts.	Assess the quality and coherence of the public transport system linked to the TGV network	Rail
	Impact of the project on the number of new stations in the Ile-de-France	Number of services between TGV areas.		
Establish a plan for railway stations in Paris in order to cope with the growth in traffic, taking into account the increase in traffic owing to the improvement of intercity routes	Ability of the project to improve the services between the areas of TGV services	Share and volume of long-distance road freight traffic (more than 500 km)	Assess the ability of the project to relieve congestion in Paris stations and to improve the direct services from province to province	Rail
Improve the quality of intermodal transport logistics through rail motorways, combined transport and ordinary rail services	Size and type of market possibly concerned by rail inland waterway and sea transport	Amount of truck traffic which can be diverted towards other modes	Determine where part of the transport demand can be served by rail, inland waterway or sea transport	Rail, sea ports, inland waterways
		Amount of CO_2 tons avoided	Assess the impact of the project on climate change	
		Traffic of sea ports in the area of the project	Assess the impact of the project vis-a-vis the accessibility of sea ports	Rail, road, inland waterways
		Number of ports benefiting from an improvement in reliability		
	Ability of the project to develop the hinterland of sea ports	Travel time savings stemming from the project on a representative O-D	Assess the performance of the project on sea port reliability	Rail, inland waterways, sea ports
		Share of logistic sector employment in the area under consideration	Assess the ability of the project to improve sea port accessibility	Rail, inland waterways, sea ports
	Presence of traffic generation sources in the area	Number of combined transport terminals and multimodal platforms in the area of the project	Assess the ability of the project to improve sea port accessibility	Rail, road, inland waterways, sea ports, airports
			Find areas where interconnections between modes could be improved and estimate the contribution of the project to this improvement	Rail, road, inland waterways, sea ports, airports

5. OVERALL DECISION ON COST-BENEFIT ANALYSIS *VS.* MULTI-CRITERIA ANALYSIS

5.1. The difficulties and benefits of multi-criteria analysis

The change in approach that took place in France has not taken hold. The general guidelines set out in the 2008 Circular have not been transformed into implementation measures. Even the recently published draft SNIT has not yet used the new approach in any assessment, which is testament to just how difficult it is to implement in practice. It is necessary to recognise the ambitious nature of MCA, since it reflects the expectations of decisionmakers and does not take into account the difficulties involved in achieving those goals.

From this perspective, it suffers from two major difficulties.

The first relates to the existence of overlap between the various criteria or objectives listed. The reader is referred to Table 2 above, where it can be seen that, for example, there is overlap between the categories "impacts on human capital" and "impacts on firms", as well as between "access to essential services" and "impacts on households". It is necessary to establish more accurately where each of these impacts starts and ends. The complexity of this task can be gauged by comparing the consequences for firms with those for households. This reveals the time saving achieved in general as a result of investment in infrastructure or changes in accessibility. Current assessment procedures use both types of indicator, but the second set of indicators are simply a translation of the first in aggregate spatial terms. More generally, most of the economic impacts listed in Table 1 have a time-saving impact, but it is necessary to ask whether assessing them in terms of time saving as well as other expected impacts amounts to counting them twice.

The second issue relates to the difficulty of measuring secondary impacts. From this point of view, the assessment form does not provide any added value, but instead contributes to the problem without coming up with a solution. Indeed, there are some impacts that we do not know how to assess: this is undoubtedly the case for impacts like competitiveness. Secondary impacts certainly need to be taken into account, but the difficulty lies in measuring the cause-and-effect relationship between the completion of an infrastructure project and the changes in productivity entailed for firms. In recent years, significant progress has been made on this issue, which has not resulted from the endorsement of MCA over CBA, but from advances in general economic analysis, in particular with the advent of the "new economic geography". If these advances had not been made, MCA would be as powerless as conventional CBA in assessing the impact of competitiveness.

As mentioned previously, employment is another classic case. It is possible to determine with sufficient accuracy how many people are employed in the construction or operation of a new infrastructure project: it is simply a case of observing how similar existing infrastructure projects are run. It is also possible to establish through observation the number of jobs required to manufacture the inputs that the suppliers of public works providers will use. However, this quantitative assessment does not take into account the reactions of the labour market: an increase in the number of jobs offered by public works providers usually leads to an increase in salaries across all or part of the labour market, and thus to a decrease in employment. It is not known if the calculation of the number of jobs

created using the mechanical reasoning currently applied provides an accurate picture of all the impacts that need to be taken into account.

This situation could even descend into charlatanism. Simplistic methods of calculating the number of jobs created, which gloss over secondary impacts that we do not know how to measure, have the benefit of providing results that are easy to understand, can be communicated easily, readily garner support and are held to be the truth. MCA is exempt from the charge often made against CBA that it is the computer, rather than the decisionmaker, that takes the decisions and, moreover, following opaque procedures. However, it does fall into a similar trap: with MCA, decisionmakers appear to be more in charge of decisionmaking, but they may base their decisions on an outcome that they think they understand because it is simple, but which can be fundamentally wrong.

Conversely, MCA enjoys several advantages over standard CBA. Bearing in mind the above-mentioned caveat that simplicity may be deceptive, MCA does tell the decisionmaker more than could a presentation on a rate of return or discounted benefit. Communication is enhanced, which is a major advantage in a public debate situation, where the speakers understandably may not comprehend the subtleties of economic theory or how surplus value is calculated. This argument is even more relevant given that such decisions increasingly involve multiple stakeholders, all with different points of view and between whom it is essential to establish a common language. This is the case for the public debates that large infrastructure projects undergo. However, beyond the official framework of such regulatory public debates, it is well known that decisions on infrastructure are complex and involve multiple actors, none of whom possesses the ultimate power of decision over the remainder.

Although a simplification of what is, in fact, a very variable situation, the following groups can be distinguished:

- Political decisionmakers, of which there are many and who are often in conflict with one another. For example, conflict between central government (which is aiming for a degree of rigour in allotting funds) and local authorities which are trying to attract as many infrastructure projects as possible to their region, and which are concerned moreover with considerations of fairness and distribution of advantage;

- Associations of "active minorities", such as environmental organisations that try to encourage policies and measures in favour of the environment;

- The private sector (equipment manufacturers, public works providers), which fights for developments in the sector of activity concerned;

- Investors, who are looking to deploy the resources at their disposal, under conditions that are most favourable for them; and lastly

- Economists, who generally portray themselves as the champions of efficiency through CBA.

In this context, project assessment can no longer be seen as a tool for use by a kind of enlightened despot to calmly impose an order of priority on projects submitted in line with the public interest. This view might have served in the distant past as a simplistic, but convenient representation of reality, but it is no longer justified today. In fact, CBA and other methods for assessing projects should be considered as resources in the discussions that develop between these actors, whereby all parties make use of them, exploiting the room for manoeuvre afforded by their high margin of uncertainty. In this regard, MCA is more enlightening, since it provides each group with an array of resources for

identifying which of the impacts will most affect them, whereas conventional CBA simply provides an overall indicator.

In a similar vein, it is probably easier to modify a project that has been assessed using MCA since it distinguishes more readily than CBA between different types of performance and points to those that are less satisfactory, for example, by comparing them with similar projects.

5.2. Complementarity of CBA and MCA

This should not make us lose sight, however, of the advantages of CBA, which are in some sense complementary to those of MCA. Firstly, it provides a consistent general framework in which the impacts taken into account flow from general assumptions regarding the functioning of the economy and, provided that these assumptions are broad-based, avoids double counting, as demonstrated by the fact that the impacts that it calculates can be summed to obtain the overall impact. Next, since in its most commonly used version it values goods at market prices – subject to corrections for externalities that are also taken into account on the basis of actors' willingness to pay – it is in a sense democratic, since it incorporates and respects actors' choices.

Lastly, it makes it possible to take into account different valuations, which are easily incorporated into the calculation. When a decisionmaker attributes a value other than the market value of a specific good, it is possible both to calculate the rate of return of the project with this new value and to determine the extent to which this new value changes the choices available. Lastly, a CBA can be used, with respect to a decision based on multiple criteria, to determine the implicit value given by the decisionmaker to these criteria. For example, as was indicated above, the *ex post* analysis of the decisions of the Grenelle Round Table on the Environment with regard to climate change showed that these included measures that were only justified for very high carbon values, significantly higher than those generally presented in the literature at this time. Similarly, CBA can, as will be seen later, be adapted to take into account redistribution concerns, an effect often stressed by the proponents of MCA.

In all, while admittedly there are areas where a MCA and CBA conflict, they also complement each other, and while attention is frequently drawn to the areas where they conflict, the complementary aspect is probably not emphasized enough, even though it becomes readily apparent when both methods are conducted in a properly co-ordinated manner. It would feasible to devise a procedure in which a CBA is performed alongside a presentation of the basic impacts. The CBA provides a framework which ensures that the impact assessment is consistent and automatically eliminates double counting. It provides results expressed in monetary units with specific monetary valuations – e.g. for individual actors' willingness to pay – that can easily be changed if, for some reason, the decisionmakers wish to do so. It makes it possible, with respect to a decision based on the analysis of non-monetarised impacts, to determine the underlying implicit unit value.

In cases where effects of interest to decisionmakers are not taken into account in the CBA, it is generally because their impact is poorly known, and in this case it is important is to learn more about them. In such cases, to introduce them in the form of indicators that have not been confirmed by scientific analysis in a multi-criteria analysis is only a stopgap measure that must be used cautiously since its scientific validity is uncertain. If these are known but have not been identified by the ordinary CBA, then the procedures being used in the CBA must be updated. With these considerations in mind, in this composite perspective, an analysis will now be made of the problems presented by traditional CBA and the adjustments that need to be made to enable it to play its role better.

The analysis will also include the well-known arguments that MCA used in isolation opens the way to arbitrary and subjective judgements, and that CBA alone all too often functions like an incomprehensible black box, while combining them eliminates both of these shortcomings.

6. SOME IDEAS FOR IMPROVING COST-BENEFIT ANALYSIS

These ideas for improvement can be grouped into two partially overlapping categories. The first will consist of ideas concerning the inadequacies of economic knowledge and the second of the ideas on how cost-benefit analysis fits into the decisionmaking process.

6.1. Methodological problems

Many of these problems are related to two of the key characteristics of CBA that stem from the fact that it is based, as currently practised, on a partial equilibrium analysis, which means that it is only valid if the entire economy is in a first-best situation in which all companies price at the marginal cost – which occurs naturally if markets are in a state of perfect competition. This also means that CBA only provides the total surplus, without giving any valid indication regarding its composition, for example, regarding those who will benefit or suffer because of the project. The fact is that these two characteristics are very ill-adapted to the current conditions of economic activity and the decision-making process.

There are a number of factors in the light of which the currently prevailing situations are far removed from situations of perfect competition. Firstly, there are externalities such as environmental externalities, which CBA has long since taken into account.

More important and more difficult to address are the situations of imperfect competition, such as a monopoly or duopoly maximising their profits, which are increasingly frequent in the transport sector. This is the case in air transport in Europe, in which markets are mostly oligopolistic; it is also the case in the rail sector in Europe in which rail competition in most markets has led to the emergence of a small number of competitors, who are also in an oligopolistic situation. In such situations, the usual practices of CBA need to be changed, but it is then necessary to analyse the nature of the competition and its impact on the prices charged by operators, which differs according to market structure (Meunier and Quinet, 2010, Nash *et al.*, 2010). In this case, traffic studies also need to be revised by considering that operators' prices are endogenous and are the result of market equilibrium. Variations in the profits of companies need to be taken into account when calculating surpluses.

There are other imperfections in sectors besides transport, which are generally observed to have positive Lerner indices, indicating a certain degree of market power (Laird *et al.*, 2005; Vickerman 2007).

Lastly, nearly all taxes lead to economic losses. These losses can be incorporated by taking into account the cost coefficients of public funds. Some references on the corresponding theoretical problems are Calthrop, de Borger and Proost (2009) and Mayeres and Proost (1997).

These effects can be analysed on an individual basis by using correcting factors for traditional CBA. CBA in partial equilibrium can also be replaced with an analysis using general equilibrium models (GEM). This latter option has the advantage of providing not only an overall indicator of the rate of return of the operation and the collective surplus that it generates, but also a distribution of this surplus according to its beneficiaries (Brocker, 2005). This provides a rigorous response to a frequent demand on the part of decision-makers, who wish to know the distributive effects of projects. Analysis using general equilibrium models is also the only way to introduce weightings into individual utilities, making it possible to highlight a given population category and thereby calculate an overall indicator that respects collective choices regarding income distribution.

A specific difficulty of CBA that is rarely mentioned arises in the case of countries of small size for which the transport flows and the beneficiaries of the investments are largely foreign to the country in which the infrastructure is located, as is the case in many European countries. In such cases, in order to assess the national interest of a project, it would be necessary to distinguish between national and foreign actors, both for the beneficiaries and the payers. This is rarely done, and it is easy to imagine the difficulties involved, but it is also clear that this can have a major impact on the results of the CBA. Here too, only procedures that take into account the entire economy, i.e. that go beyond partial analysis, can address this problem.

A special aspect of the demand from decision-makers concerns spatial effects. Economic analysis has recently made great progress in this field. With regard to modeling calculations, Land-Use-Transport-Integrated (LUTI) models[3] have been developed and provide, as a sort of extension of general equilibrium models, the spatial distribution of activities and the changes in this regard that will be generated the project being examined. In terms of theoretical analysis, the new economic geography (NEG) has shed new light on the development processes of agglomerations and on agglomeration externalities.

Obviously, all of these discrepancies from the assumptions of a first-best economy are far from being perfectly understood. But more generally, all the parameters and mechanisms used in CBA need to be continually improved. Topics such as time and congestion are inexhaustible and any progress made opens the way to further progress. If the most urgent issues for research programmes in these fields had to be identified, two can be highlighted, other than the need for more in-depth study of spatial effects. Firstly, knowledge of congestion in public transport, which lags very significantly behind the field of road traffic, and the lack of information in this regard undermines the assessment of rail and airport projects. Secondly, the dynamic analysis of users' decisionmaking: a basic investigation of how users make decisions shows that changing their schedules is the first adjustment that they think of when supply conditions change, although most models are essentially static and do not take the corresponding mechanisms into account.

6.2. Methods of implementing CBA

Alongside these issues that concern economic analysis, its shortcomings and the areas in which it needs to be improved, other ideas for possible progress can be grouped according to how the CBA is implemented and incorporated into decision-making processes. In this regard, two aspects will be addressed: firstly, the uncertainties and imprecision involved, which can enable the various players to manipulate the decisionmaking process, and, secondly, imperfect use of the method.

The uncertainties and imprecision of the results of CBA are many and well known. Firstly, there are the risks that emerge as investment projects are implemented and brought into service, such as uncertainties about costs and traffic. There are those that result from the fact that traffic studies, like

cost studies, use complex models that – beyond the general principles which underlie them (for example, a traffic model of the nested logit type, or a cable-stayed bridge of a given span) – entail a great deal of uncertain data, multiple relationships, secondary assumptions and also many parameters that are often derived subjectively through expert estimates. These uncertainties are clearly addressed by economic theory and can be taken into account in a variety of ways; the simplest procedures are based on the law of probability for the random variables involved and the degree of risk-aversion of the actor concerned. This factor is becoming more important because of the fact that, with the development of private financing, the actors involved are the most risk-adverse. Another type of risk is one that emerges gradually, and that can be treated using methods of the capital asset pricing model **(**CAPM**)** type. These methods are well known in many applications such as finance and operational research and it would be desirable and not too complicated to incorporate them into cost-benefit analysis. The theoretical analysis of risk situations has developed considerably and it is odd that the results obtained have scarcely been incorporated into CBA.

In the preceding paragraph, we have assumed that the variables were centred and with mean zero. Another source of uncertainty lies[22] in the fact that the calculations of rate of return are in general biased. The costs are underestimated and the traffic and rate of return are overestimated to a varying but often significant degree. A number of authors have provided ample documentation in this regard, in particular Flyvberg (2009). Their analysis and observations examine the different sources of bias which, according to Flyvberg (2009), can be classified as technical, psychological and political-economic reasons. The most important are generally considered to be the political-economic reasons, since the actors who present a project and want to see it implemented are tempted to manipulate the many areas of imprecision and uncertainty contained in the calculations so as to support their arguments. What can be done to protect against this bias? This is probably the most important and difficult issue to address in the practice of cost-benefit analysis.

A number of procedures can be envisaged in this regard. Firstly, there is the systematic use of *ex-post* studies, which make it possible to exercise an influence, if only a moral one, on future evaluations. These *ex-post* studies can be used to establish comparisons by reference class, making it possible to compare the estimated costs of a given project with the average cost and with the distribution of the costs of a project of the same nature. Another method is to conduct an expert examination of studies. This can be done in a variety of ways, i.e. by calling upon a panel of experts that would audit all studies in a given sector, or by designating a group to examine each study. In these situations, the problem is to ensure the independence and quality of the expert examination, in a narrow field where there are few experts, who know each other and have often had contacts, sometimes as service providers, with the bodies promoting projects. The recent debates surrounding the IPCC show how difficult it is to preserve this independence. It must also be borne in mind that the expert examination of the study of a project is a long and costly matter, requiring a vast amount of information to verify the smallest details, for the "devil is in the details". Another approach consists of acting upon the methods used to produce studies and on the relations between the actors involved in the project. In this regard, the growing participation of private actors in the context of public-private financing is a key development. This entails risks, since private investors have important interests that they wish to further. They use their power of influence, which is the result, firstly, of information asymmetries in their favour and, secondly, of contractual arrangements regarding their intervention. On this latter point, Flyvberg (2009) proposes that the promoters of a project preserve a minimum capital commitment in a project for a specific period of time. Similarly, the conclusion of contracts between promoters and financers can provide an opportunity for the project to be assessed by actors who have both the ability to conduct an expert examination and an interest in this examination[4]. However, the expert examination will then be viewed from a financial standpoint and rather than from that of its collective rate of return.

Projects, and especially major international projects, frequently span multiple jurisdictions, for example a region level, a national level and often an international level (in Europe, the European Union). Each jurisdiction participates in decision-making, expects to derive a surplus from the project and does not want to contribute beyond this surplus. In this case, the decision-making project is a negotiation between these different organisations, even when there is a certain top-down relationship between them. For example, the regions have responsibilities over which the central government has no control. The usual process is for the regions to propose projects for central government financing, with a view to sharing the costs. The resulting contract is subjected to the usual effort incentive and information asymmetry mechanisms, with the lower level normally being the best informed. This situation has been analysed by a number of authors. Florio (2007) proposes a contract based on an *ex-post* verification of the project's rate of return. Caillaud *et al.* (1996) have also explored the interest of multiple jurisdictions through a revelation mechanism and they show the conditions in which decentralisation can be beneficial.

The last point to be discussed resides in the functions given to CBA. These are currently very limited. They are generally confined to verifying that if each project were realised today, it would have an acceptable rate of return or discounted cash flow. In this regard, it should be pointed out that the methods used to calculate the rate of return or the discounted cash flow are not very satisfactory since the lifetime of the calculation is clearly lower than that of the planned investment. For example, in France the lifetime set by the guidelines in force is 50 years, although transport investments have much longer lifetimes, and their impact on economic life, through land use for example, lasts even longer; what is more, no residual value is taken into account.

This has a number of consequences. Firstly, as they stand now, the procedures are not suitable for establishing a schedule of investments or for choosing between variants, since this would require determining the optimum dates for putting the operations into service, which is impossible given the limitations of the indicator calculated. Programming is therefore impossible, except in a very approximate way. Better outcomes can be obtained from the tool used, since the methods for achieving these results and finding the optimum programming do exist (Maurice *et al.*, 2008) and their implementation shows that the usual indicators (internal rate of return, benefit per Euro invested) are of poor quality. But to obtain them, it is necessary to take into account the fact that the benefit differs depending on the year of entry into service and to avoid the inconsistencies that would result from comparing operations put into service at different dates but with a lifetime limited to 50 years without any residual value, which does not correspond to any real situation.

What is more, by limiting the lifetime to 50 years, this approach overlooks long-term consequences that are far from negligible, especially with relatively low discount rates (4% in France with a decrease beyond 30 years, 3% in the United Kingdom, again with a decrease in the long term) and low market interest rates. However, the long term is a vital concern, as is shown by the debates on global warming and the concern over the impact of infrastructure on land use patterns. However, to extend the economic calculation to the long term, for example to 100 years and beyond, a number of elements need to be taken into account; firstly, relative prices may change very significantly, and to incorporate these changes the model needs to take interactions into account in a general way. Partial analysis that neglects income effects must be replaced by a general equilibrium model. Behaviour can also change, as can utility functions; for this reason, analysis over the long term must incorporate, in the interest of risk analysis, breaks in parameters. Little information is available about these factors, but if we are convinced that they play a role, it is better to take them into account explicitly rather than to ignore them (or include them in an arbitrarily chosen residual value). Simulations conducted by taking, for example, the price of carbon, one of the goods of which the cost is likely to vary the most strongly in a distant future, show that extending the horizon and taking relative price variations into account in a macroeconomic framework has a major impact on the choices to be made; for equivalent

immediate rates of return, low-carbon infrastructure programmes have an enormous advantage in the long term over carbon-intensive ones, but this only becomes apparent if lifetimes of a magnitude of one hundred years or more are taken into account, i.e. much higher than is currently the case (Quinet 2010).

Lastly, on a more practical level, most instructions for carrying out cost-benefit analyses remain very theoretical since they do not distinguish how the analysis should be conducted depending on the stage of the project. However, the questions asked and the information available differ significantly depending on whether one is viewing them from the standpoint of master plans or from that of the choice of technical variants for the same project. Normally, it is at the upstream level of master plans that the choices have the greatest impact, since they determine the entire future of the project; unfortunately, it is at this level that cost-benefit analysis is currently used the least. Steps should be taken to provide methods for adapting it to this stage of decision-making. These methods should respond to many challenges, and in particular make it possible to:

- Achieve quantified results at a stage when generally little is known about the project.
- Make long-term projections, which means taking relative prices into account by linking the transport sector to the rest of the economy, but through modelling that is necessarily approximate over the long term.
- Analyse a wide range of scenarios covering the possible developments that may emerge in the distant future.

7. CONCLUSION

In response to the changes that have taken place in society and the progress made in economic analysis, the approach to the assessment of projects in France has radically changed in recent years. Starting from an initial situation in 2004-2005 in which the approach was clearly focused on applying the economic theory of surpluses and single-criterion analysis, by 2007-2008 a very clearly multi-criteria approach had prevailed. However, the specific methods used for this approach are being implemented very slowly. This is partly due to the method of governance introduced by the Grenelle Roundtable on the Environment, consisting of five-party governance based on trial and error, experiences and feedback. But it is also due to the fact that establishing criteria that are not redundant and cover all aspects of interest to decisionmakers is no easy task. If the strengths and weaknesses of these two types of assessment are examined, it becomes clear that both procedures are as much complementary as they are rivals; cost-benefit analysis provides a rigorous framework for presenting multi-criteria analysis and makes it possible to better measure the cause-and-effect relationships between the project and the impacts being measured. This is a reason for focusing on the progress that can be made in cost-benefit analysis which was analysed in the last section. This progress is of various kinds. First of all, it concerns methodological aspects, for the analysis should go beyond the partial framework and be incorporated into general equilibrium models; this would make it possible to take into account the effects of spatial distribution, imperfect competition and distribution of benefits, which are constant concerns of policymakers. To do so, we must improve our fund of knowledge on these issues, while continuing to investigate traditional subjects, such as the value of time and dynamic

models. Lastly, cost-benefit analysis should be used better and differently; it is too limited to verifying the rate of return of a given project and does not focus sufficiently on the long term; the methods that it uses are well adapted to analysing the variants of a project already chosen, but they cannot be implemented completely in the upstream stages, where decisionmakers have the greatest need for guidance. Progress in these two areas will require the implementation of new methods, incorporating the impact of projects on the economy as a whole through general models that go beyond the usual partial equilibrium assumptions.

NOTES

1. Note, in particular, in the field of risk, the forthcoming expert report putting the emphasis on risk assessment methods modelled on those for evaluating financial assets.

2. For a more detailed description of the doctrine prior to 2007, see for example, Quinet (2007).

3. See Wegener (2004) and Wegener (2009).

4. If it is poorly designed, it can lead to greater deviation, for example, if the expert assessment of the project and its rate of return is provided to a poorly informed and divided public.

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THE PRACTICE OF COST-BENEFIT ANALYSIS IN THE TRANSPORT SECTOR THE PERSPECTIVE OF MEXICO

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SUMMARY

ABSTRACT 59

1. INTRODUCTION 59

2. INSTITUTIONAL FRAMEWORK (STAGES OF THE PUBLIC INVESTMENT PROCESS) 60

2.1. Planning 61
2.2. Cost-benefit analysis 61
2.3. Prioritization 62
2.4. Programming and budgeting 62
2.5. Monitoring and *ex-post* evaluation 62

3. THE ROLE OF COST-BENEFIT ANALYSIS IN THE DECISIONMAKING PROCESS 63

4. KEY ELEMENTS OF COST-BENEFIT ANALYSIS 65

4.1. Which costs and benefits are taken into account? 66
4.2. Structure of the cost-benefit analysis 67
4.3. Specific methodologies 67

5. POTENTIAL DEVELOPMENT OF PROJECT ASSESSMENT PROCEDURES 69

5.1. Gateway process 69
5.2. Eligibility index of PPPs 70

6. CONCLUSION 72

NOTES 73

Mexico City, October 2010

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ABSTRACT

Mexico's public investment process is strengthen by an institutional framework that ensures that projects with a high social return are given preference. The *Federal Law of Budget and Financial Responsibility* establishes as a prerequisite for federal investments the obligation to present a Cost-Benefit Analysis (CBA), and to obtain the Investment Unit's approval. This paper describes the use of CBA for the social and economic evaluation of transport infrastructure in Mexico and is made from the point of view of the role of the Ministry of Finance's Investment Unit in the appraisal process.

1. INTRODUCTION

Mexico has an institutional framework that seeks to strengthen the process of planning, selection and prioritization of investment projects. At the beginning of the process many actors participate, including the Ministry of Finance (SHCP), the Ministry of Transport (SCT), the Infrastructure National Fund (FNI), the National Development Bank for Public Works and Services (BANOBRAS), private actors and the Congress, which gives final approval for the Federal Expenditure Budget (PEF).

This process ensures that investment projects with a high social return are given preference. The Federal Law of Budget and Financial Responsibility (LFPRH) establishes the following criteria as prerequisites for federal investment:

1. The presentation of a planning document to the SHCP, where federal bodies identify and prioritize their investment needs for the next six years;

2. The presentation of a cost-benefit analysis to the SHCP (the SHCP may request that such an analysis is judged by an independent expert);

3. Obtain approval of the project through SHCP's Investment Portfolio System;

4. The Interministerial Commission for Financing and Expenditure (CIGFD) will analyse and determine the project's level of priority for inclusion in the draft budget for expenditure, taking into consideration, *inter alia,* the following criteria: social profitability, regional development and synergies.

A key element in the process of project selection is the obligation, by law, to present a cost-benefit analysis (CBA) in order to demonstrate its profitability and to access public funding. If a project's social internal rate of return does not exceed the minimum required (12%) it will not have

access to public funds and may not be executed. This instrument will enable the financing of socially worthwhile projects.

The Investment Unit (UI) of the Ministry of Finance plays a fundamental role in this process. It is responsible for integrating and managing the Investment Portfolio System and reviewing and approving the CBA. Each time a project proves to be socially worthwhile, the UI assigns a registration code which identifies the project and makes it possible to receive public funding, either through the Federal Expenditure Budget or the National Infrastructure Fund.

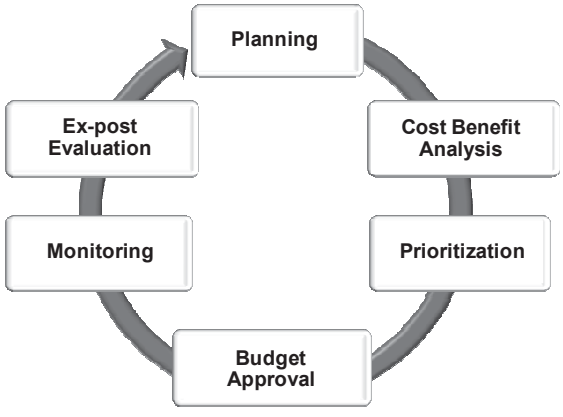
This document describes the use of cost-benefit analysis for the social and economic evaluation of transport infrastructure. The description is made from the point of view of the role of the UI in the investment process. It does not consider internal evaluations within SCT and other federal bodies involved in the definition, selection, evaluation and financing of projects.

Mexico is currently endeavouring to improve the quality of its public investments. In this process the UI will play a more active role, from the conception of alternative solutions to a transport problem to the definition of the project and its evaluation. It will examine risk analysis in depth as well as the determination of the most appropriate financing scheme, either through pure federal expenditure or through Public-Private Partnerships (PPPs).

2. INSTITUTIONAL FRAMEWORK (STAGES OF THE PUBLIC INVESTMENT PROCESS)

Cost-benefit analysis in Mexico is not an isolated practice but rather part of an integral process that seeks to influence the preparation, selection, evaluation, financing and monitoring of an investment project.

Currently, Mexico has an institutional framework that gives support to the National Public Investment System. This institutional framework can be explained by the different stages of the investment cycle, which are described in the following paragraphs.



2.1. Planning

In order to guide the actions and efforts involved in infrastructure development, certain planning tools can identify and define those priority projects that should be developed at any particular moment. This stage is considered crucial since it depends on the correct identification of public investment needs, the analysis of feasible alternatives and the depth of studies needed to reduce the uncertainty of a project. The expected outcome at this stage is a strong investment expenditure plan (multi-annual investment planning). In the specific case of transport projects, these tools are:

- *National Development Plan* (6 years). It establishes the general objectives that the Government plans to achieve concerning the transport sector.
- *National Infrastructure Program* (6 years). Defines in a more precise way the strategies and lines of action to follow concerning the transport sector. It also defines in a quantitative manner the goals to be achieved (e.g. kilometres, ports and airports to construct) and the main projects to boost, as well as defining their source of funding.
- *Planning Document* (updated every year). In order to establish the needs for investment in the medium term, the SCT must elaborate a plan which identifies and prioritizes their investment requirements for the next six years.

2.2. Cost-benefit analysis

By law, all federal projects have the obligation to present a cost-benefit analysis in order to demonstrate their social profitability and to access public funding. It is important to note that the elements that help homogenise criteria and promote transparency and certainty in the process are:

- *Clear guidelines and parameters for the evaluation of costs and benefits.* In order to promote the same process for all projects, there is a general methodology that helps in the evaluation and selection of projects with a high social return. There are specific methodologies for highways, rural roads, massive transport, etc.
- *An independent expert opinion*. New projects for which the investment is greater than 500 million pesos[1] have an obligation to present an independent expert analysis before initiating construction. The analysis deals with the technical, economic and environmental feasibility. This only applies for the energy, water and transport sectors.
- *Training Center for the Preparation and Evaluation of Projects* (CEPEP). This is the think-tank of the UI. The CEPEP helps in the development of new methodologies, assists in the analysis of complex projects and provides training in these methodologies to federal entities and local governments.
- *Investment Portfolio System.* A bank of projects that, through a cost-benefit analysis, demonstrates a high social return. If a project is socially worthwhile the UI assigns a registration code. This code (which shows UI approval) is a prerequisite for inclusion in the draft budget and for access to public funding.
- *Transparency.* With the purpose of giving greater transparency in the use of public funding for projects, the Investment Portfolio System is available on the SHCP web page and can be consulted through this link:
  http://www.apartados.hacienda.gob.mx/sistema_cartera_inversion/index.html

2.3. Prioritization

Programmes and projects registered in the Investment Portfolio System will be analysed by the Interministerial Commission for Financing and Expenditure (CIGFD), which will determine the priority for inclusion in the Federal Expenditure Budget Draft, as well as the order of execution. This process is intended to establish an order in all the programmes and projects, and maximize the impact they may have to increase the social benefit, primarily observing the following criteria:

a) Social-economic profitability;
b) Extreme poverty reduction;
c) Regional development; and
d) Synergies with other programmes and investment projects.

2.4. Programming and budgeting

Since it is a prerequisite to have a registration code in the Investment Portfolio System in order to receive public funds, the Federal Expenditure Budget and the Investment Portfolio System are linked at this stage.

- The Draft Federal Expenditure Budget that the President sends to the Deputies' Chamber only incorporates investment programmes and projects which have a registration code; in other words, that have a CBA and meet with the established profitability parameters;
- Once the Federal Expenditure Budget is approved, new projects that are incorporated must present a CBA and have UI approval.

2.5. Monitoring and *ex-post* evaluation

At this stage the project's development is monitored, checking that *ex ante* estimated benefits are actually attained. The following instruments are used:

- Monitoring the physical and financial progress provides information about investment outlays and construction progress;
- Profitability monitoring reviews the behaviour of the profitability indicators at the operational stage;
- *Ex-post* evaluation compares the observed benefits of the project, once it is in operation, against the planned benefits.

3. THE ROLE OF COST-BENEFIT ANALYSIS IN THE DECISIONMAKING PROCESS

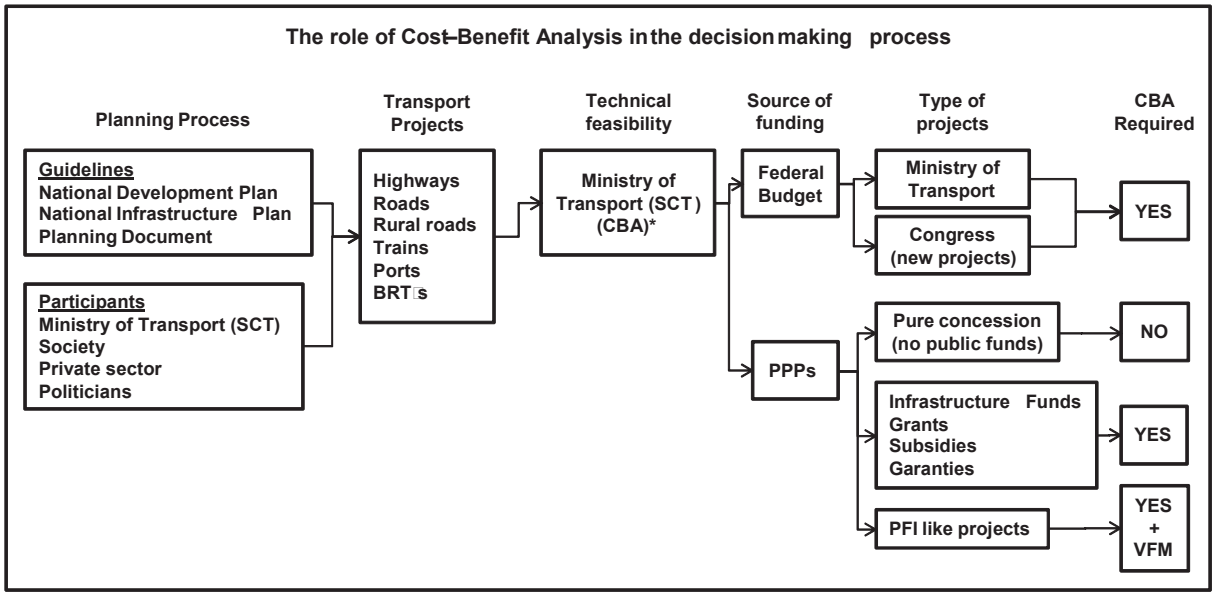
In Mexico, as in many other countries, there are multiple needs for transport and very few resources to attain them. In addition, transport projects are the subject of important political debate, as they have a huge impact on the Federal Expenditure Budget.

In this respect, the cost-benefit analysis is the most important instrument in the decisionmaking process. The principle behind the CBA is to seek the best possible way to use available public resources to finance any project.

As this process involves many actors, both within and outside government, the CBA can establish criteria in order to identify, quantify and value costs and benefits for the lifetime of a project in a uniform, clear and transparent way.

By law, investment projects which depend on public financing must:

- present a cost-benefit analysis;
- obtain the Investment Unit's approval (registration code); and
- be part of the investment portfolio.



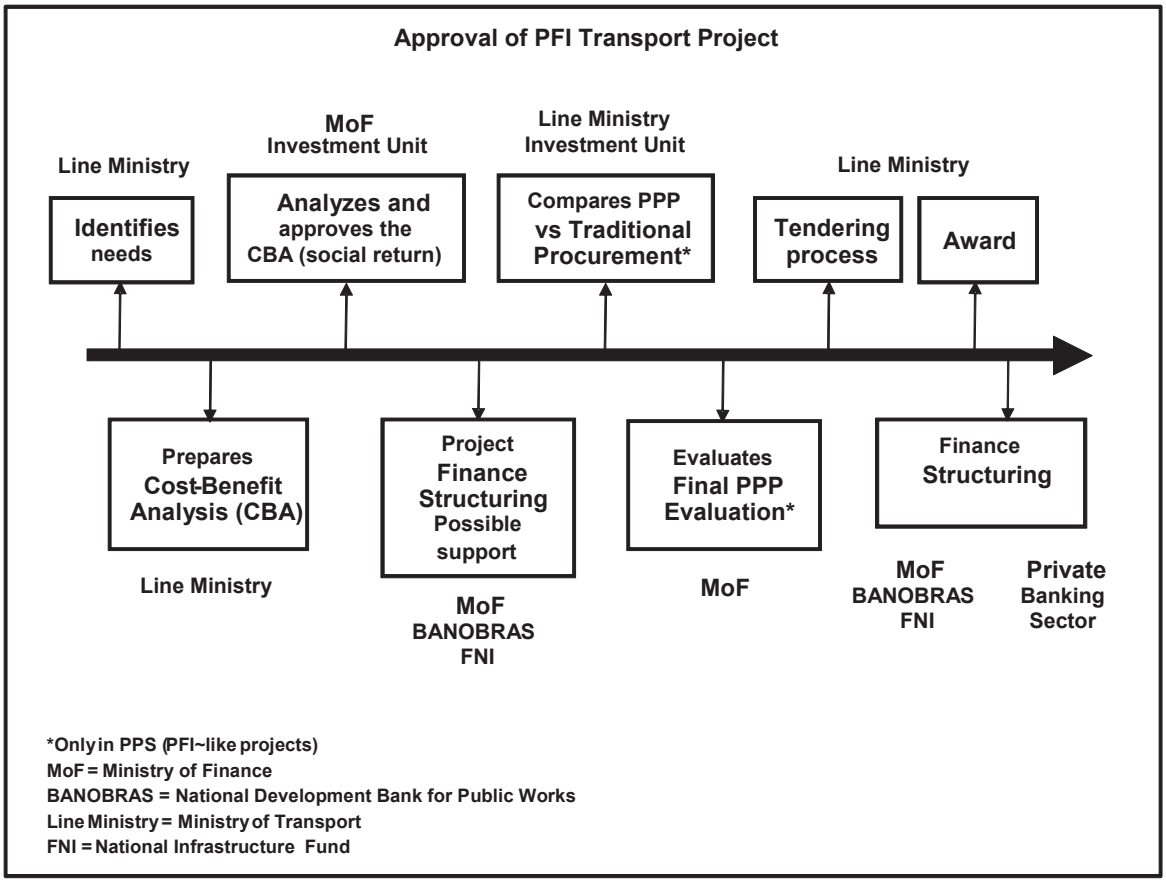
**/ The Ministry of Transport reviews the technical feasibility of the project and elaborates a CBA.*

CBA is a prerequisite to acquiring UI approval and for public funding.

In this way, to be able to execute a project it is necessary to demonstrate through a CBA that this project has a high social return; otherwise the project cannot be undertaken. This is regulated through the Federal Law of Budget and Financial Responsibility (LFPRH). This institutional framework looks both at projects that do not originally belong to the National Infrastructure Plan, and those that are included in it but which must prove (through a CBA) their social profitability in order to accede to infrastructure funds.

Thus, infrastructure projects that apply for federal funding, or those realised through a PPP needing support and subsidies from the Government (through the National Infrastructure Fund), must submit a CBA and receive authorisation from the Investment Unit in order to initiate construction.

Services provision contracts exist in the Mexican transport sector which are similar to PFI projects. In this PPP scheme, a CBA and UI approval are the prerequisites before the value-for-money analysis.



4. KEY ELEMENTS OF COST-BENEFIT ANALYSIS

The cost-benefit analysis aims to prove, from the Net Present Value (NPV) and the Internal Rate of Return (IRR) assessment, that a project generates net benefits to society. Depending on the investment amount, the depth of analysis changes according to the size and type of the project; however, all information must be supported by reliable and precise data which allows for the addition of a detailed monetary costs and benefits assessment.

The depth of the analysis depends on the type and size of the project.

Type of CBA Millions of Mexican Dollars (MD)			
Type	**Technical notes** (Idea and project definition level)	**CBA** (Pre-feasibility level)	**CBA** (Feasibility level)
Infrastructure project	< 5 MD	< 50 MD	> 50 MD
Maintenance project	< 15 MD	< 50 MD	> 50 MD

The steps in the CBA process are as follows:

- Identify the transport need or problem. If this is not clearly defined, the CBA is sent back to SCT;
- Review whether it is possible to "optimize" the current situation, looking for actions that could be taken if the project is not accepted (e.g. upgrading of the existing infrastructure or administrative measures to improve the current situation);
- Analysis of the proposed alternatives, examining each one and demonstrating why the one chosen is the most appropriate;
- The project's costs and benefits have to be identified and quantified, and the profitability indicators calculated (NPV, IRR);
- Finally, the project's behaviour is faced with stress scenarios.



There are some key issues to be addressed in the CBA structure:

- What is the problem/need to be solved?
- Is the project the best alternative? What other alternatives have been considered to solve the need?
- Is it technically, economically and environmentally viable? Are the rights of way available?
- What are the components of the project? Does it require complementary public works?
- When is the optimal time to start the project?
- What is the optimal size and scale?
- What are the main risks and how can they be controlled?
- What is the impact on the transport network? Is there a programme to replace/or reorder the transport operators routes?

4.1. Which costs and benefits are taken into account?

In some cases there is much pressure to deliver results for projects that are not necessarily the best solution. In order to solve this issue, the CBA tries to include only those variables that are the most objective, so the costs and benefits are well known and there is no controversy about them. The costs and benefits are as far as possible quantified and expressed in monetary terms. For example, comfort and safety conditions, accidents, service quality level are considered as non-monetary benefits and are not taken into account. In the case of rural roads and other interregional transport projects, the impacts on local or regional economic development are considered as non-monetary benefits too. The CBA only considers social benefits, therefore it is not a financial evaluation.

In general terms, the costs and benefits are:

Costs

- Investment;
- Maintenance;
- Operation;
- Re-investment;
- Disruption costs.

Benefits

The main benefit is the reduction in transport costs (generalised cost of travel). This applies for direct users and in some cases for indirect users whose benefit comes from a release of capacity in the transport network, which helps to alleviate congestion and reduce the transport cost.

- Travel time savings[2];
- Vehicle operating cost savings[3];
- Operation and maintenance savings;
- Emissions cost savings;
- Salvage value.

4.2. Structure of the cost-benefit analysis

The general structure of a CBA is as follows:

1. Executive Summary. Gives a global vision of the project and describes the main components and characteristics.

2. The "no-project scenario" analysis and alternatives. Defines the problem that needs resolution, evaluates the proposed alternatives. Analyses what happens to transport costs if the project is not undertaken. It must consider measures to optimize the no-project situation. This scenario must be properly defined before using it as the base case from which to measure incremental cost and benefits.

3. Project description. The project is broadly defined to include its purpose, components, scale and scope.

4. Project scenario. The optimized "no-project" situation is compared with the "project situation" to calculate the incremental benefits and costs.

5. Project evaluation. Identifies the costs and benefits that are only associated with the project (and exclude those that would exist without the project being undertaken). Measures the impact of cost and benefit streams on an incremental basis. Calculates the Social Net Present Value (NPV) and the Social Internal Rate of Return (IRR), using 12% as the social discount rate.

6. Sensitivity and risk analysis. Measures the impact of changes in the main variables on NPV and IRR. It answers the question, what are the main risks and how can they be managed?

7. Recommendations.

4.3. Specific methodologies

Specific methodologies exist to facilitate and promote transparency and uniform criteria to evaluate the costs and benefits of each type of transport mode.

Highways

- Construction;
- Modernisation;
- Road by-passes;
- Road junctions.

Rural roads

- Productive roads;
- Connecting roads.

Railway projects

- Rail by-passes;
- Rail terminal reallocation.

Massive transport projects

- BRT Bus Rapid Transit;
- Light rail train;
- Interurban train.

The main elements analysed in the methodology for massive transport systems (BRT, light rail train, interurban railroad) are as follows:

Supply (Characteristics of the current transport system):

- Operating hours;
- Number and total capacity of all transport modes;
- Age of vehicle fleet, and its costs of operation and maintenance;
- Existing routes that provide the service (distance, number of lanes, etc.);
- Travel time by route, and traffic light system description;
- Route section;
- Number of stops, their location and the distance between them (preferably present a diagram);
- Frequency of transport by congestion schedule (high, medium and low).

Demand:

- Origin and destination of passengers;
- Classification of passengers by travel motivation;
- Amount of user's time;
- Estimated average number of passengers daily and distance travelled by time of congestion (high, medium and low);
- Average occupancy rate of each transport mode by congestion schedule.

Supply and demand interaction (What is the problem?):

- Higher transport costs due to the low speed of transport, meaning more hours of transportation;
- High operation and maintenance costs of public passenger transportation;
- Inefficient transport system operation (stopping in prohibited places, forbidden use of lanes, poor road signs), causing an increase in the transport cost of private vehicles.

Benefit identification:

- Benefits of a shorter travel time spent by passengers carried by public transport;
- Benefits to the environment from the reduction in pollutant emissions (intangible);
- Reduced operating and maintenance costs through using more efficient technologies with higher capacities;

- Benefits of shorter travel time, and lower operating and maintenance costs for vehicles on routes that have been decongested by the project;
- Earnings per release of resources, through salvage value of obsolete inputs;
- Salvage value at the end of the project evaluation horizon.

5. POTENTIAL DEVELOPMENT OF PROJECT ASSESSMENT PROCEDURES

Mexico is currently endeavouring to improve the quality of public investment. In this process the UI will play a more active role, starting with the conception of alternatives for resolving a transport problem up to the definition of the project and its evaluation. It will delve deeply into risk analysis and the determination of the best financing scheme, either through pure federal expenditure or public-private partnerships.

This effort seeks to strengthen the role of the UI by:

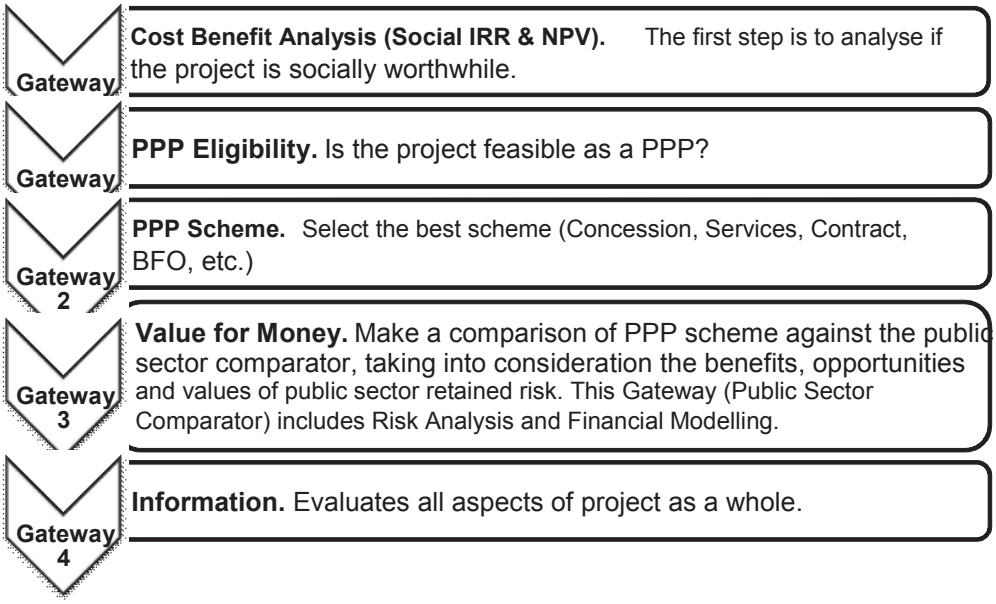
- Forming specialised teams;
- Following the projects' evolution;
- Helping to define the scope and size of major projects in the early stages;
- Focusing attention on major projects;
- Carrying out more in-depth risk analysis.

To consolidate these efforts, the UI is formulating and working on three new approaches to evaluate a PPP project:

a) Gateway process review;
b) Eligibility index for PPPs;
c) A new methodology for the whole investment cycle (not shown here).

5.1. Gateway process

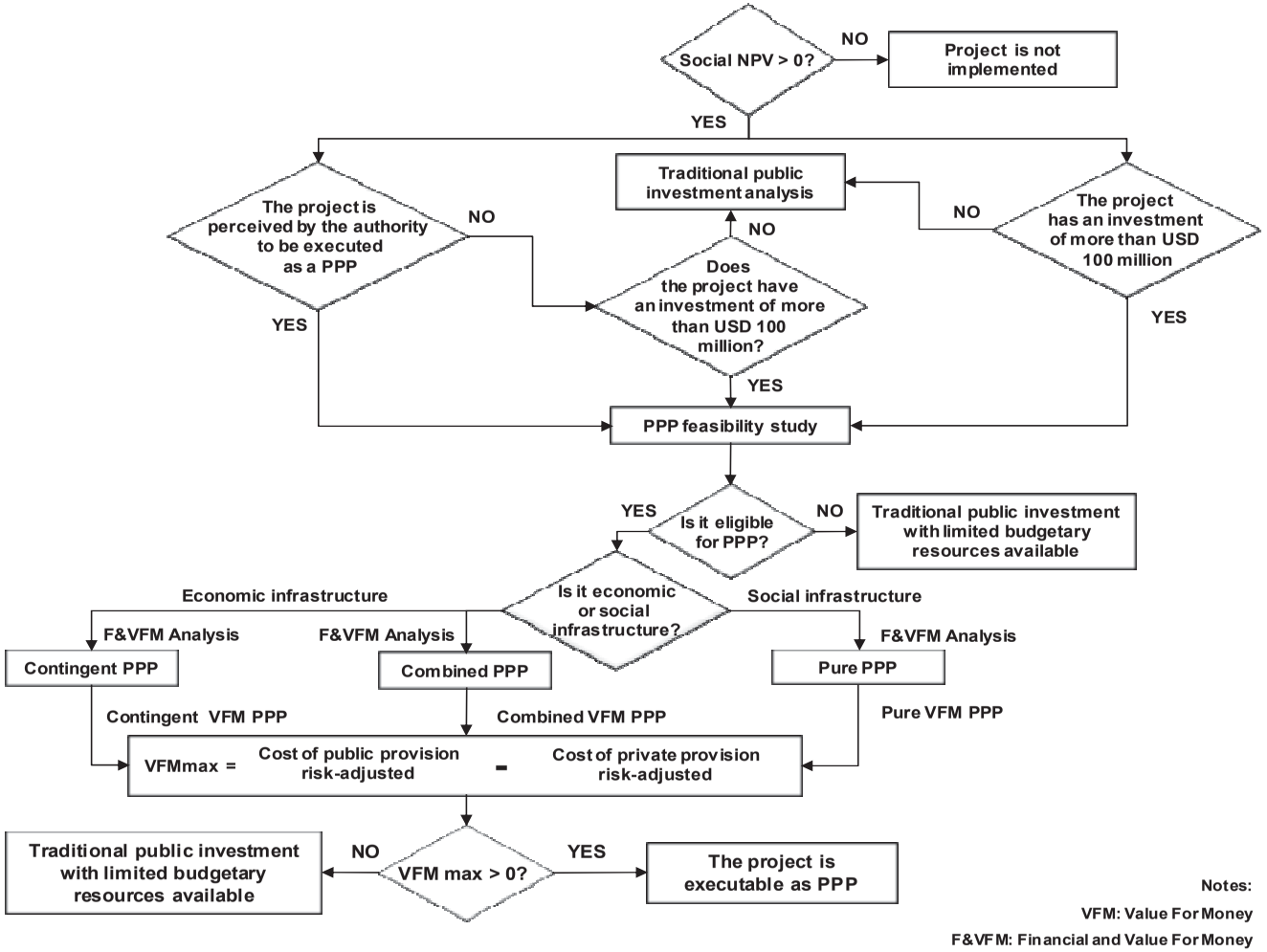
There is plenty of room to improve the PPP analysis through a gateway process review. Through all these gateways the UI will seek to get the best value for money for PPP projects.



Preliminary version.

5.2. Eligibility index of PPPs

The UI is working on a new methodology to strengthen the identification and selection process of PPP projects. The first requisite is the preparation of a CBA and identification of the project as being socially worthwhile.



(Preliminary version)

6. CONCLUSION

In recent years, Mexico has strengthened its institutional framework and the ordering of the different stages in the investment cycle through the following changes in legislation:

- The obligation, under the Federal Law of Budget and Financial Responsibility (LFPRH), to seek and obtain UI approval of cost-benefit analysis as a prerequisite to accessing public funding.

- Project prioritization decided by the Interministerial Commission for Financing and Expenditure (CIGFD), for inclusion in the Draft Budget for Expenditure, taking into account social profitability, regional development and synergies, among other criteria.

- The constitution was amended to include the possibility of multi-annual investment outlays for bigger infrastructure projects.

- The implementation of the Investment Portfolio System (every request for CBA approval is submitted via Internet; no paperwork is necessary).

- Clear guidelines and parameters for the evaluation of costs and benefits for the different transport sectors.

- A Law on PPPs.

There is room for improvement in the use and role of CBA in decisionmaking for transport infrastructure, mainly by fostering its use in the early phase (planning stages). The big challenge is to involve more key actors in the use of CBA in this process.

NOTES

1. Approximately 50 million dollars.

2. To calculate time travel savings there are different values of time depending on the purpose of travel (business, leisure, freight, etc).

3. The World Bank's Vehicle Operating Cost Model is used to calculate these savings.

COST-BENEFIT ANALYSIS IN TRANSPORT: A UK PERSPECTIVE

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SUMMARY

ABSTRACT 79

1. INTRODUCTION 79

2. THE ROLE OF TRANSPORT APPRAISAL 80

   2.1. The appraisal context 80
   2.2. The applicability of appraisal 82
   2.3. The scope of appraisal 83
   2.4. The perspective of appraisal 84

3. TRANSPORT CBA IN THE UK 84

4. CRITIQUES OF UK TRANSPORT APPRAISAL 87

   4.1. The policy critique 87
   4.2. The planners' critique 88
   4.3. Technical critiques 89

5. TRANSPORT AND THE ECONOMY 92

6. CONCLUDING THOUGHTS 96

BIBLIOGRAPHY 98

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ABSTRACT

The economic appraisal of transport projects in the UK is now celebrating its fiftieth birthday. There is strong experience of using a framework approach, that is, cost-benefit analysis of the direct transport impacts plus assessment of the environmental and planning impacts. This is codified in the "New Approach to Appraisal" (NATA) and "WebTAG". It is essential to recognise that the framework approach is an input to decisionmaking, which is a broader social and political process. Various policy, planners' and technical critiques of transport cost-benefit analysis are discussed in the paper, including the adequacy of treatment of the linkages between transport and the economy. While transport appraisal is broadly defended, the need is identified for appraisal to address the forward policy challenges of reliability, resilience and sustainable economic development.

1. INTRODUCTION

Economic appraisal of transport projects in the UK, if dated from the studies of Coburn, Beesley and Reynolds (1960) and Foster and Beesley (1963), is now celebrating its fiftieth birthday.

It has always been a controversial tool, generating accusations of unacceptable principle, improper application, inadequate evidence base and bias. One early application was to the appraisal of the proposed third London Airport where a critic labelled the project appraisal as "nonsense on stilts" and the method was defended against accusations of being "bastard science and/or insidious poison in the body politick" (Self, 1970; Williams, 1973). Since that time, appraisal has found itself at the centre of public disputes about the road planning system, the treatment of environmental impacts, the so-called "roads generate traffic" issue and the relationship between transport and the economy. The Government established a special independent committee, SACTRA, to advise it. The 1997 Government undertook a review which led to the so-called New Approach to Appraisal, and in 2009 revisited and "refreshed" the NATA, see the link - http://tinyurl.com/natacons.

But the pages of the magazine, *Local Transport Today,* show that transport appraisal remains as controversial as ever, and the new Coalition Government is believed to be considering whether yet further change is required.

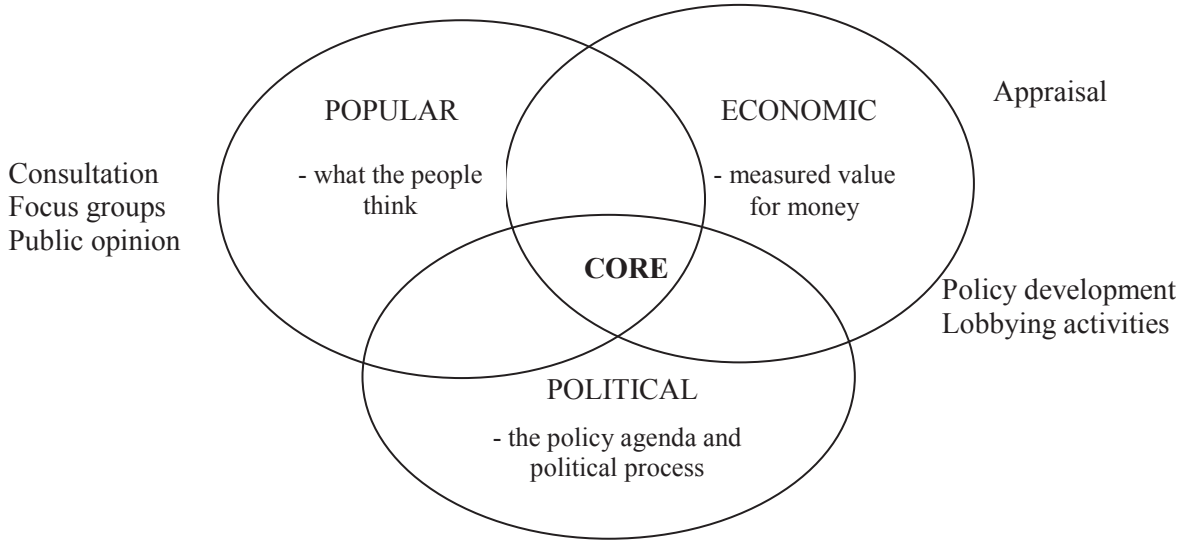
So, transport appraisal in the UK is a hotly contested space, and the idea that transport CBA in the UK is somehow a stable, agreed concept is not true. What is true, however, is that there is a well codified history and development of practice which is discussed below. Before that, though, we review some features of CBA which help to explain its controversial nature and its role in contributing to decision-making.

2. THE ROLE OF TRANSPORT APPRAISAL

The reason that appraisal is controversial is that there is disagreement on the role which it should play in decision-making. Since this is a value-laden question, agreement is unlikely to be achieved by reference to logic or rationality. A lot depends on the social, economic and legal framework within which decisions are made.

2.1. The appraisal context

In a country such as the UK, the context can be presented in the following form:

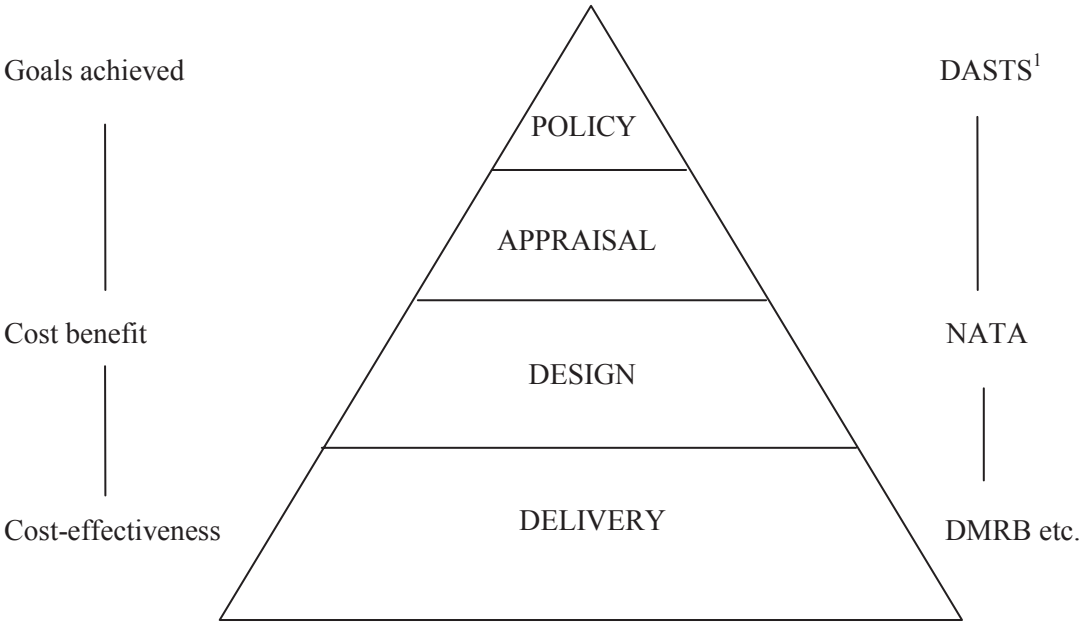


Here is the space within which transport planning decisions happen. There is a political space where governments decide their goals and aspirations for transport. There is a social space in which interested parties are consulted, give their views. There is the economic space in which technical studies of an engineering economic kind reside. The three spaces are brought together and are mediated within a planning system which naturally looks for solutions which can satisfy all three spaces.

The construction of the diagram assumes that there is a balance of forces which can be resolved within an overlapping core. Sometimes it may be acceptable to move outside the core, but this can cause trouble. For example, both the UK and the Netherlands have found that road user charging may pass the engineering economic test but not be acceptable socially or politically. Note that in some

countries the balance of forces may be different. For example, external funding may be required, in which case the goals, criteria and assessment of the external funding agency come into the picture.

A slightly different way of conceptualising transport appraisal is in a hierarchical way:



A point which is frequently made by critics of CBA in the UK is that it is generally not used in other government sectors. So, for example, schools construction requires a building programme budget and a design manual with some indicators to determine priorities. The argument in transport is that schemes are complex, heterogeneous, have a range of impacts across jurisdictions and that something is needed to bind together strategy and design. Also, traditionally in the UK, transport strategy has been quite weak and the planning level quite strong – this may be different in other countries such as France.

In any transport scheme proposal, the decision is played out among a number of parties – the planning system, the scheme promoter, the objectors, the lobbyists, the transport operators, the funders and so on. The appraisal can be seen as an important part of the rules of engagement within which the interests of these parties are considered and resolved. The appraisal rules are in the ownership of the Department of Transport, in its role as chief transport planner. In formulating the rules, the Department relies on academic and consulting studies, and consults with a wide range of interests. The rules should themselves have a strong foundation and credibility, and the Department is often nervous when the rules themselves come under attack, as they do from time to time. This is a healthy feature of the system.

The position of appraisal in the British system gives rise to a number of tensions and conflicts:

– The need for consistency with the overall appraisal guidance of the Treasury in the Green Book;

- The need to distinguish between the DfT's role as guardian of the appraisal rules and as a scheme promoter in its own right;

- The need to define exactly what appraisal rules apply to: publicly funded projects?; projects which require planning permission? Do they apply to revenue as well as capital expenditures? Are they a DfT programme budgeting tool? This is not entirely transparent, especially in relation to airport and port projects, where traditionally CBA has played a lesser role than in the road and rail sectors;

- The consistency of the appraisal regime with policy objectives and targets set by government. For example, should all transport projects be at least carbon neutral or can there be trading across projects within an overall transport carbon budget ceiling?;

- The need to define research requirements to help develop the appraisal by expanding the value set, updating existing values and so on. The valuation of travel time has been through three generations of study and a fourth is under consideration at the moment;

- The need for maintenance of WebTAG itself.

So, within any decision system, who owns the appraisal regime itself, how that sits within the overall decision process, and what status it has are important questions for the political economy of transport.

2.2. The applicability of appraisal

It follows from the previous section that formal appraisal is more suitable in some contexts than in others. So, where policy initiatives are large, irreversible, and have a range of impacts over space and time, affecting a range of social groups (travellers, residents, businesses, etc.), some form of cost-benefit analysis is likely to be useful. This is especially the case if there is a quasi-judicial planning process in which the promoter puts the case and objectors put their case before an inspector. In that context, the appraisal provides a useful reference point around which to organise the material for consideration. In this context, a significant issue is the use of appraisal as a control mechanism – in the modelling and appraisal, is a particular scheme context compliant with good practice as set out in relevant user manuals? Does the promoter's case have credibility? Actually, one of the strongest technical and analytical cases for some form of appraisal according to rules with the possibility of independent challenge is to consider the counterfactual in which appraisal does not exist. Our conjecture is that political decisionmaking without the checks and balances of decision support tends to produce worse results. This is seen whenever projects acquire prior political commitment and become extremely difficult to stop, however poor the economic case (Mackie and Preston, 1998).

Where transport initiatives involve recurrent expenditure or are reversible or can be developed incrementally, the case for social appraisal, though still theoretically valid, is in practice weakened. So fares policy, bus and rail service levels, public transport subsidies and highway maintenance are not generally subjected to the same sort of appraisal as capital projects. But also, appraisal is significantly influenced by the asset ownership and regulatory regime; road and rail projects will generally be seen as in the public domain, so that social appraisal has legitimacy, whereas airport and port projects may be more commercial in nature and be considered as quasi-commercial projects with social implications.

2.3. The scope of appraisal

There is not just one concept called cost-benefit analysis. There is really a family of concepts which involve differences of practice in different countries. A fundamental distinction may be drawn between those who see cost-benefit analysis as an extended form of commercial appraisal and those who use it as applied welfare economics *à la* Bergson.

Both groups would agree that where markets are incomplete (public goods, externalities) or where prices are administered or regulated, commercial appraisal can give poor estimates of the social value of investment. Benefits may accrue to travellers which are not captured by a pricing scheme. Safety and environmental impacts fall upon users and non-users but are not internalised by market processes. It is right that a more comprehensive assessment procedure is devised to capture those impacts in the appraisal. Whether they are all valued in money terms or quantified physically (noise, emissions) or simply written down as impacts – loss of historic or natural assets, for example – is a level below the proposition that there should be a comprehensive account of the forecast impacts.

The difference lies in the view taken of transport investment as a tool of social policy. According to one view, transport is a quasi-private sector activity with certain externalities attached and some pricing issues. From this viewpoint, the Kaldor-Hicks criterion is seen as a sufficient test of project worth – "can the gainers compensate the losers and still retain some gains?"; and CBA as an extended economic efficiency calculation to assign an efficiency value to projects, but viewed from a social rather than a simple agency, commercial perspective. Issues relating to distribution and equity are, with this view, best dealt with through the taxation and social welfare systems and not through sector budgets such as transport, water or energy. Authors such as Harberger and Sugden (1999) broadly take this view. The implication at the technical level is that the task is to find the willingness-to-pay values for the impacts on travellers and non-travellers which are not represented in the revenue and cost streams of the project. Behavioural values are what count and should be carried through into appraisal at whatever level of disaggregation is considered practical.

The alternative view is that CBA is a form of social calculus, in which distributive as well as efficiency considerations are relevant (Pearce and Nash, 1981; Galvez and Jara Diaz, 1998). With this view, except in the extreme case where the marginal utility of income is equal at all income levels, some reweighting of the costs and benefits is required, depending upon which social group they accrue to. This raises practical difficulties, since it is considerably more difficult to discover the distribution of beneficiaries by income class. Again, a true appraisal would need to consider the distributive effects of land price and displacement effects, which might be ignored as transfers in an efficiency analysis, that the distributive effects of impacts on intermediate goods sectors like logistics and distribution are problematic, and so on.

Therefore, in practice, proxies are used, such as standard average values – for example, non-working time savings and safety benefits, in which values are not allowed to vary with the income level of the recipient. This is equivalent to assuming unit elastic marginal utility of income across income groups.

2.4. The perspective of appraisal

Cost-benefit analysis is a neoclassical comparative static framework. It relies on comparing a stable baseline case against one or more stable do-something cases. A strength of this approach is that it ties together equilibrium modelling, represented in matrix estimation and assignment routines, with user benefit calculations based on the "rule of half", codified by Neuburger (1971) and others.

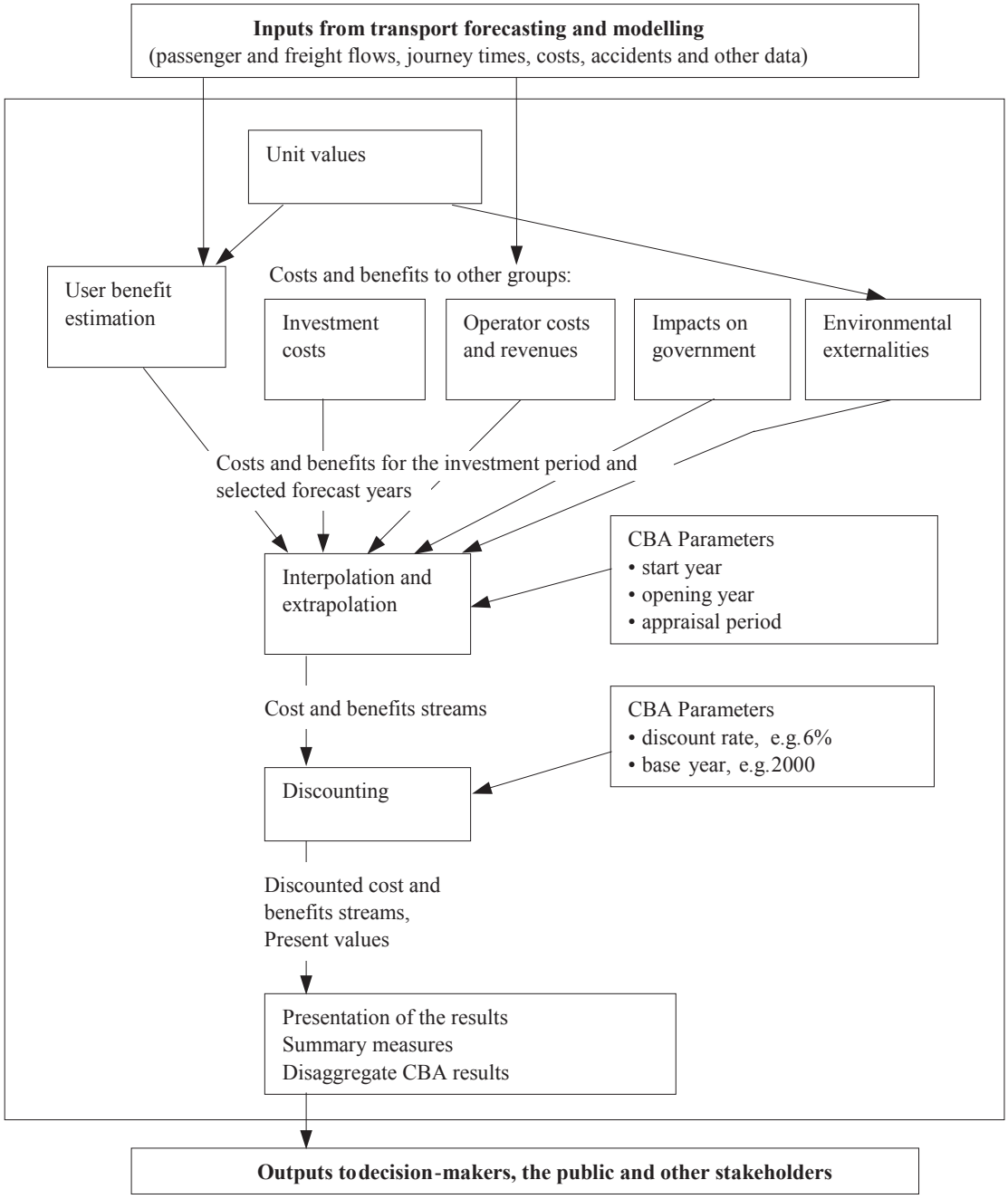
But the approach can be criticised as limiting. Paradigms such as prospect theory offer alternatives to utility maximisation, but have not yet been operationalised for practical appraisal. Another critique is the failure to consider disequilibrium dynamics and paths to equilibrium. Transport projects cause shocks to the economic systems – household change location; firms entering the market in location A and other firms exiting in location B; and forces are unleashed which play out in real time. CBA is strong for assessing marginal changes to an established network (marginal in terms of the scale of the changes to generalised cost, not the size of the project), weaker for paradigm – altering investments which impact on the macroeconomy at regional or national level. However, the discipline of appraisal clearly linked to scheme modelling and forecasting is essential as a check on unsubstantiated claims, especially by those who are not funding the project.

3. TRANSPORT CBA IN THE UK

A useful starting point is a general schema for transport CBA, which underpins various appraisal work in which ITS Leeds has been involved – see, for example, work for the World Bank at www.its.leeds.ac.uk/projects/WBtoolkit and for UNECE (2003).

The following figure describes certain key features of transport CBA.

- CBA relies on inputs from transport models and forecasts and in that sense is only as good as the model quality and forecast assumptions which feed it;
- It requires a set of values which are either standard values or, at the minimum, common principles for devising local values;
- Costs and benefits need to be estimated over the life of the scheme or in practice for a limited number of forecast years, with interpolation and extrapolation;
- The results need to be discounted to an equivalent present value within Ministry of Finance rules;
- The results need to be presented in suitable form to the decisionmakers, the public and other stakeholders.


Inputs from transport forecasting and modelling
(passenger and freight flows, journey times, costs, accidents and other data)
Unit values
User benefit estimation
Costs and benefits to other groups:
Investment costs
Operator costs and revenues
Impacts on government
Environmental externalities
Costs and benefits for the investment period and selected forecast years
CBA Parameters
• start year
• opening year
• appraisal period
Interpolation and extrapolation
Cost and benefits streams
CBA Parameters
• discount rate, e.g.6%
• base year, e.g.2000
Discounting
Discounted cost and benefits streams, Present values
Presentation of the results
Summary measures
Disaggregate CBA results
Outputs to decision-makers, the public and other stakeholders

A key feature is that, in an ideal world, we would like to measure, model and value all the impacts on society of a project or policy measure. The point of view should be an overall, societal one. Typically, the project impacts might fall on a range of stakeholders, as in Table 1.

Table 1. **Impacts by stakeholder on a transport project**

Stakeholder group	**Impacts (changes in)**
Transport users	Time Reliability Fares/costs Journey quality Perceived accident costs Option value
Transport operators/ Infrastructure providers	Revenues Operating costs Capital costs
Non-users	External accident costs Environmental impact
Rest of economy outside transport	Agglomeration Competitiveness Labour markets
Government	Subsidies Taxes Charges Grants

Some entries in the table will appear twice – for example, increases in operator revenue will be positive for operators and negative for transport users. The fundamental theorem is that, suitably discounted,

Present Value of Net Social Benefit (**NPV**)

= (1) Consumer Surplus (CS)

+ (2) Revenues to transport operators

+ (3) Environmental and Safety externalities

+ (4) Option and Non-use values

+ (5) Wider Economic Impact

- (6) Costs,

and a simple indicator of Benefit : Cost Ratio (BCR), if required, is:

[(1) + (2) + (3) +(4) + (5)] / (6).

Although in an ideal world, all items of cost and benefit might be valued in monetary terms, practice falls short of this. The evidence base is lacking for some environmental impacts, and "unique", natural and heritage assets pose ethical as well as practical problems for valuation. In practice, therefore, the framework table is likely to be partly in money, partly in physical impacts and partly in descriptive terms. The final table is likely to be a summary of lengthy documentation. So, summary measures such as NPV and BCR are in practice indicators of a subset of the full table and need to be interpreted accordingly.

The purpose of the framework table is to estimate the net social gain from doing something relative to the reference case. Therefore, it is essential to avoid double counting. So, for example, if a transport improvement is reflected in an increase in transport user benefit (ΔCS) which is then partly transmitted into a change in land rents, which is then transmitted again into a change in prices and wages in the rest of the economy, the project must not be credited with the same benefit as the three different stages of the economic transmission system (Mohring, 1993). Conceptually, either the analysis should capture the *final* economic system benefits or it should measure the transport sector benefits *plus* the *additional* wider economic benefits. This second approach is the current UK one; we return to some issues with it below.

The UK appraisal regime is codified in a publicly available internet resource, WebTAG. All transport projects requiring an input of public capital expenditure, apart from small schemes, are required to undergo an appraisal of the form described above, using the value set and methods set out in WebTAG. So, a significant rule of transport appraisal in the UK is to operate as a control tool to provide value-for-money indicators on a consistent basis as an input to the decisionmaking process. It should be stressed that appraisal is one input to a decision process and NOT the process itself; we have studied the degree to which the decision outcomes on national roads can be modelled and explained by their performance in the Framework, and similar analysis has been carried out in Sweden (Nellthorp and Mackie, 2000; Eliasson and Lundberg, 2010). The chapter index to the WebTAG site is at www.dft.gov.uk/webtag/documents/index.php

4. CRITIQUES OF UK TRANSPORT APPRAISAL

There are a number of critiques of transport appraisal as practised in the UK, which should be treated with some degree of seriousness. The issue of how transport links to the wider economy is deferred to the next section as the most significant source of concern with appraisal practice.

4.1. The policy critique

There are various arguments that appraisal is not adequately aligned to policy, or is inconsistent in certain respects with policy objectives, or is not in practice used across the full range of policy analysis. It is true that in UK practice, there is a lot more experience of using appraisal at the "plan" level than at the "strategy" level, and there is not a great deal of open discussion of the relative value-for-money of spending public money across government sub-programmes. Still less is the overt use of common appraisal methods to compare across-sector boundaries – for example, to assess the relative performance of transport, health education, regeneration, etc., in city policy. One disadvantage

of CBA in particular is that it is not widely used outside the transport sector and so does not naturally provide metrics for comparison between transport and other sectors. There is a suspicion that this may have led to relative underfunding of transport capital, especially at the local and regional level. Another similar point is the absence of points of comparison within the transport budget between small and large and, in particular, between capital and revenue spending. Some of the conclusions from such a study might be uncomfortable for central government.

Should appraisal be aligned to policy? In a sense, the answer must be "yes", but policy is often rather crude, setting out, say, five goals of transport policy without a detailed study of the costs, effects and trade-offs involved in practical choices. Appraisal is about informing those choices, and a degree of independence rooted in good-quality evidence on consumer and social values is no bad thing. In some countries such as Sweden, the guardians of transport appraisal are independent of government. In Britain, a middle way is taken, whereby transport appraisal is within government but at arm's length from the parts of the DfT which are concerned with particular schemes (responsibility for which, in any case, is now mainly outsourced to agencies). This can cause tensions. Two of the new government transport ministers have expressed reservations about aspects of the appraisal regime, and it will be interesting to see how these are handled.

A different policy critique is that transport appraisal is not particularly agile. It is a set piece with strong internal coherence, and designed to address a subset of policy questions, but not to be easily adaptable to new questions which come along. In a way this is understandable – because one of its strengths is its reliance on a good evidence base, it takes time to develop the new evidence required to support analysis of new policy needs.

One of the most disliked attributes of travel is unreliability, defined as some measure of the variance of travel time from which may be derived the safety margin required in order to be on time at the destination on x% of occasions. Where the activity at the destination is a job interview, an opera performance, a flight to Mexico, or simply the need to open the shop on time, this becomes important. It is one of the big arguments behind reserved track and priorities for buses and trams in cities, and one of the big arguments in how much to spend on managed motorways. But it is a difficult problem for appraisal and an even more difficult problem for modelling.

Another example is resilience. In Britain we need to invest in the transport system so as to insure against various external risks. There are weather risks, such as high winds and storms associated with global warming, there are peak oil risks implying a need for fuel diversity beyond what the private sector would plan for, and there are security risks. Conventional appraisal is not well set up to address policy needs and forward programmes of this kind.

4.2. The planners' critique

The planners' critique of transport appraisal is that it is not set up in a way which tells society what it needs to know or even what will happen. This relates to the whole question of induced traffic and, more broadly, induced change associated with transport investment.

The basic ethos of transport engineering economics is that one starts from a base trip matrix and assignment, and then estimates the changes in travel cost associated with a change in the network. For many years, until the mid-1990s, it was standard practice to use a fixed trip matrix in which all behaviours except route choice were assumed to be fixed. Following SACTRA (1994), variable matrix approaches replaced the fixed matrix, but normally with constraints such as fixed land use.

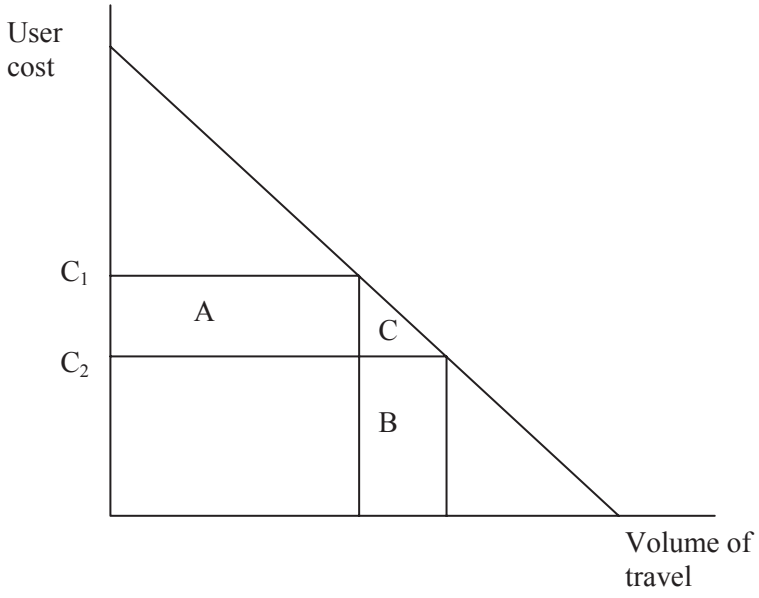


Figure 1 illustrates the difference in approach. Engineering economics teaches us to focus on A (or A plus C) as the measure of user benefit arising from a change to the transport system. Planners, on the other hand, argue that in a congested network environment, the difference between C1 and C2 is unstable and will very rapidly be eroded over time, as people take out the benefit of improved accessibility by travelling further. The apparent constancy of travel time budgets is one supporting proposition. Moreover, planners argue that the real interest is in area B – what happens to induced land-use change, employment and economic activity as transport improves? How does the extra capacity impact on the spatial economy? While it is possible for conventional appraisal to dodge these questions by assuming perfect competition, planners are apt to point out correctly that perfect competition is not generally consistent with a spatially separated economy, which is the very reason why transport exists! There is, therefore, a significant issue of how and whether appraisal can be adapted to deal with this issue – see the next section.

4.3. Technical critiques

At another level, there are arguments about the value set which is deployed in British practice. While there are some who are philosophically opposed to monetary valuation *per se*, more common are objections to particulars.

4.3.1 Travel time savings – employers' business

The Value of Travel Time Savings (VTTS) on employers' business is important and difficult to study. Although employers' business car traffic in Britain is only around one-sixth of total traffic, the high values used for this traffic mean that it typically accounts for half the travel time benefits for cars. The cost-saving approach is used. This says that in a competitive labour and product market, firms hire labour to the point at which the value of the marginal product is equal to the wage rate; thus the value of a travel time saving is equal to the marginal gross cost of labour including labour-related overheads. This requires a number of assumptions to be fulfilled:

- All released time goes into work, not leisure;
- Travel time is 0% productive in terms of work; no work can be undertaken while travelling;
- The marginal value of working and the marginal value of travel to the individual are zero (or have equal and opposite value);
- The competitive labour market theorem holds; w = vmpl;
- No indivisibilities in the use of time for production, so every minute is equally valuable.

A reasonable conjecture is that these assumptions taken together are approximately true for manual workers travelling in the course of their work duties. So, for example, in the case of professional truck drivers or coach drivers, the cost-saving theory remains valid. However, it is more doubtful for other business travel in the course of work.

Empirically, a number of authors have cast doubts on whether VTTS for employers' business varies proportionately with the wage rate, as would be implied by the cost-saving approach (for example, Hensher and Goodwin, 2004). In a meta-analysis of 77 studies from 30 countries, de Jong and Shires (2006) found a cross-sectional elasticity of the VTTS to income of between 0.4 and 0.5 for employers' business purposes. This result could be consistent with higher income, "white-collar" workers partly substituting leisure rather than work for travel and/or being able to use travel time for partially productive work. The world of mobile communications has clearly made this more plausible over time. It is a concern that EB values of time for passengers (as opposed to freight) may on average be too high.

4.3.2 Travel time savings – other issues

Many transport projects give use to a high proportion of relatively small time savings – say, five minutes or less. Welch and Williams (1997) showed in an urban case study that between 25% and 50% of time-saving benefits from fairly major schemes could be attributed to these small time savings. So, two questions legitimately arise:

How statistically robust are the traffic assignment models which generate the time difference estimates? For most schemes, we are dealing with relatively small absolute and proportionate differences accruing to very large numbers of travellers over a very long period of time, which sum to give a large aggregate value. So the security of the model predictions is an important issue.

Can the constant unit value assumption be relied upon? Most countries use the CUV assumption, and there are reasonable logical defences for it, but it is a weakness that stated-preference and similar choice models rely on extrapolation from larger time savings. Direct empirical support for CUV assumption is therefore lacking.

A second issue concerns the relationship between VTTS and trip distance/duration. In British practice, the value of time per minute is assumed constant over all trip lengths. But evidence from other countries tends to support increasing VTTS with trip length, and arguments about driver fatigue, boredom, and time requirements at the destination are consistent with that. This is a weak point which could affect the relative performance of different sorts of scheme.

If VTTS does vary with distance, a related question is whether the average values are calculated from a pattern of journeys which are representative. The author conjectures that in value-of-time

studies, certain sorts of journey – such as very short trips to the shops or to school; long-distance leisure journeys on holiday; and trips by foreign drivers on British roads – tend to be systematically under-represented.

Finally, there is the well-known question of whether VTTS derived from stated-preference exercises yield values which relate to the driver's personal value or to the value for the driver and other occupants of the vehicle. This is not easy to be sure of, yet it makes a significant difference whether the values are interpreted as "per person" or "per car".

4.3.3 Transport taxation

Another point of controversy in British appraisal practice is the treatment of transport taxes. In a world of uniform taxes on all goods and services, such as a single rate of value added tax, this would be a non-issue. But in practice, road traffic pays a fuel tax, rather high by international standards, equivalent to around 1 USD per litre, while public transport, bus and train, is zero rated for VAT and pays little or no fuel tax. This causes complications for appraisal and is the source of arguments that appraisal practice is inconsistent with policy.

Suppose a new road is proposed which induces additional traffic relative to the base case. This road traffic is willing to pay the generalised time and money costs associated with the additional travel. They gain to the extent of the triangle of benefit (area C in Figure 1). But the figure is drawn on the presumption that the cost the user pays for the marginal trip is wholly a resource cost. That is true of the time cost and the resource cost of extracting fuel from the ground, refining it, distributing it and retailing it. However, the fuel tax element in the final price to the user is not a real resource cost but a transfer payment. CBA principles say this element should appear twice in the appraisal, once as a cost to the user and once as an equal and offsetting gain to government. Providing the marginal track and environmental costs of use are accounted for elsewhere in the appraisal, this approach is correct. However, it is frequently criticised for appearing to treat as a benefit additional consumption of fuel and carbon emissions which the Government is otherwise targeting or trying to reduce. This is said to be sending mixed messages.

This issue is less about the treatment of fuel tax in the appraisal and more about the appropriate shadow price of carbon. If the fuel tax was set equal to the full marginal external cost of road use, including the economy-wide shadow price of carbon, then the issue would not arise. Here is an example of a case where appraisal rules and transport economics can come into conflict with transport politics.

4.3.4 The Benefit : Cost Ratio (BCR)

Another issue which has occupied many hours of debate in the NATA Refresh is the definition of the Benefit : Cost Ratio. Returning to Table 1, where the elements of cost and benefit were defined, it may be noted that whereas, given the values for the elements, the Net Present Value (NVP) of a project is a unique quantity, the value of the BCR depends on exactly what is counted in the numerator and denominator of the ratio. For example, should increases in revenues to transport operators be treated as a producer surplus to be added to the consumer surplus in the numerator or an offsetting item to the cost in the denominator? Should a contribution to the capital cost of a scheme from a private developer be counted as a benefit item or as an offset to the cost, or both? For certain kinds of scheme, especially where toll revenue or road user charging revenue is involved, it makes a huge difference to the BCR what definition is used.

It is therefore worth asking why, given that the Net Present Value gives a unique result, it is worth bothering with a BCR with all the problems of defining a ratio. In an unconstrained world, in which there was enough funding to undertake all schemes with a positive NPV, the BCR would be redundant. It is in the presence of a constrained budget, a rationed resource, where the problem arises. One solution would be to raise the discount rate to the point at which the supply and demand for funds was equalised. But this would distort the relative social values of present and future benefits and destroy the case for long-term infrastructure projects. A minimum cut-off BCR is therefore needed as a rationing device or hurdle ratio which the project should be required to jump over.

The denominator, therefore, should be the unit of constrained resource, and the question is how to define it. Suggestions have included public capital costs, net public expenditure, and the net public cost to the Department of Transport and its agencies. The NATA Refresh opted for this last concept. This places fuel tax effects on the numerator of the ratio, since these are effects which, in the British public budget system, accrue to the government budget as a whole and not to the transport sector budget. This exemplifies the need for appraisal practice to have clearly defined rules in order to operate consistently across applications.

Whatever definition of the BCR is used, however, one criticism remains. The BCR is a summary descriptor of the monetised elements of the overall appraisal. By definition, it does not capture the non-monetised elements. While this is widely recognised, it is all too easy to use the BCR alone as an indicator of relative social value for money. This is fraught with danger if the non-monetised elements in the overall appraisal are variable across the scheme.

5. TRANSPORT AND THE ECONOMY

The interaction between transport and the wider economy, and its treatment in appraisal, is one of the most lively current topics. Historically, there are different traditions – for example, the German approach has been to view transport infrastructure as a tool of regional planning and to pay relatively little attention to transport CBA in favour of a broader regional impact approach. This is perhaps associated with the strong regional governments in the German political system.

The tradition in the UK has been to rely on transport CBA and to assume that the direct transport benefits are a good proxy for the total economic system benefits. In the last decade, following the impetus of the SACTRA Report of 1999, the approach has come in for reassessment. In part, this is technically driven – enhanced computing power makes tools such as Spatial Computable General Equilibrium more practically usable than before, giving a framework in which transport-economy linkages can be represented (see, for example, Elhorst and Oosterhaven, 2008). But mainly they are politically driven by the desire to demonstrate to decisionmakers the impact of transport infrastructure on the final economy. Time savings are the base metal of the system but impact on GDP is the gold.

It would obviously be more convincing to decisiontakers if the impact of a piece of infrastructure on the final economy could be modelled and estimated within the appraisal. But this is problematic because transport appraisal is effectively a reduced-form means of aggregating the demand curves of thousands of different users, representing all stages of the economic process, from primary products to final consumption. Except in very simple situations, such as feeder roads to serve agriculture or access

roads to mines and quarries, it is impossible to estimate directly the final impact on GDP. There is a question mark, in any case, over whether GDP is the correct metric by which to value transport schemes, since it gives no weight to leisure time, or most safety and environmental impacts.

For many years, UK appraisal practice relied on a theorem proved by several authors (Mohring, 1976, for example), that in an all-round, perfectly competitive economy, the correctly measured, direct transport benefits are equal to the final economic system benefits. A judgement was made that it was too difficult to try to discover the size, and even the sign, of the divergence between the two in particular cases. On this account, transport impacts would be mediated through effects on accessibility and land development into changes in the pattern of final output, wages and prices, but except in unusual cases it would be reasonable to assume "no additionality" to the primary transport benefits.

Following the 1999 SACTRA Report, this assumption has been revisited by the Department for Transport, which has identified three sources of additional wider-economy impacts (conceptually, "additional" may be positive or negative). These are:

- Agglomeration economies – external economies of access to economic mass not captured by individual firms or transport users;
- Imperfect competition benefits, due to output effects in markets where prices diverge from marginal costs;
- Labour supply effects and the tax-wedge benefits of induced labour market behaviours.

We now review very briefly the state of play on each of these potential sources of additionality.

Agglomeration economies are said to exist when the spatial concentration of economic activity gives rise to increasing returns. These increasing returns arise from labour market pooling, knowledge spillovers, specialisation and the sharing of inputs and outputs. These considerations explain why head offices of corporations, banks and other enterprises are located in major cities and not in small towns. One way in which the spatial scale of an economy can be effectively increased is through a reduction in the generalised cost of travel. Essentially the argument is as follows. If there are increasing returns to economic mass, and if transport in part determines the level of access to economic mass experienced by firms, then investments in transport which serve to increase accessibility can induce some shift in the productivity of firms via economies of agglomeration. These are external economies and, therefore, are additional to the transport user benefits.

Quantifying the relationships is a testing task, but significant recent work has been carried out by Dan Graham of Imperial College, London. The main points we draw from Graham's work are as follows.

The principal difficulties in estimating elasticities to economic mass are those of causality and confounding. The causality issue is that accessibility in/to large agglomerations may be high, because that is where demand is highest rather than because the higher accessibility has created the agglomeration. Confounding problems arise as the variables of interest are often heavily intercorrelated.

Urbanisation economies are larger than localisation economies. Urbanisation economies relate to proximity to economic mass in general while localisation economies relate to proximity to the economic mass of a particular sector (e.g. textiles).

The UK's current appraisal guidance is centred around urbanisation elasticities. The guidance, based on Graham, Gibbons and Martin (2009), quotes an overall agglomeration elasticity of 0.04 across all sectors of the economy (doubling city size increases productivity by 4%), with 0.02 for manufacturing and consumer services, 0.03 for construction and 0.08 for business services.

Returns to agglomeration vary not only by sector but with city size. With an accessibility measure based on generalised cost of travel, Graham (2007) found that returns vary across sectors, increasing particularly in banking, finance, insurance, business services and public services. So composition of economic activity in a city of a given size could be significant.

There remain questions around the causal effect of transport infrastructure on productivity. Graham and Van Dender (2009) find that variations in productivity between agglomerations may be entirely attributable to differing qualities of labour between locations.

In a spatial economy with regionalised production of goods and services, a reduction in transport costs normally increases competition and reduces market deadweight losses due to imperfect competition and spatial monopoly. These can be measured as the price/marginal cost mark-up applied to the increment of output resulting from the transport improvement.

As with agglomeration, the issues associated with measuring this welfare gain are practical rather than theoretical:

- Estimating relevant market output elasticities and mark-ups; different authors from the SACTRA Report (1999) produced results ranging from 4% to 20% of the transport benefit;

- Ensuring that net rather than gross estimates are used. For example, if a road scheme improves the market position of firms inside the study area at the expense of other firms outside the study area, there is a difference between the gross effect on the study area and the net effect on the economy as a whole.

The comparative static approach does not allow for dynamic interactions between transport infrastructure and market structures. It is not implausible that the number of firms in sectors like brewing, fuel oil retailing or supermarket retailing, and hence the mark-ups, might vary with the quality of the transport infrastructure.

The third wider impact is also related to the changes in the wider economy induced by a transport improvement. Suppose that the result is either an increase in employment to supply additional output or a reshuffling in the labour market with a more efficient match of people to jobs. People will be making their choices based on their net of tax wage, but the marginal value of their output will be their gross of tax wage. There is a tax-wedge benefit, equal to the difference between gross and net, which is not counted in transport CBA.

As with the imperfect competition effect, there are practical issues in computation:

- The relevant elasticities and the extent to which changes in transport costs are reflected in prices and wages;

- The need to consider this effect not only in the transport-using sectors but in the transport sector itself. Increased transport productivity through higher speeds will, in the end, result in a smaller labour force required to carry out the base transport activity, and the tax-wedge effects in the transport sector need to be included in the appraisal.

Beyond these points, the tax-wedge argument raises questions about the definition of the numeraire in transport CBA. If it is "one dollar's worth of resources in the hands of the government", then CBA should be about the value of spending that dollar in different ways. It may be that transport expenditure has *exceptional tax*-wedge effects relative to other forms of spending, but conceptually we should be counting the *net tax*-wedge effects, not the gross.

To summarize, some progress has been made in the UK towards extending transport CBA to cover the wider economy impacts. However, in parallel with that, there are alternative developments in progress which demonstrate that appraisal methods are linked to the political environment within which transport schemes and policies are developed.

While the Department for Transport's approach has been to modify transport CBA for the three sources of additional benefit, there is renewed interest in alternative methods of estimating the impact of transport investment on city region economies. These are driven by several considerations: the desire to incorporate land development and induced economic activity and employment in the appraisal effects just discussed; and, most important of all, the changes in the UK transport budget context. The UK has a tradition of strong central government budgetary control and funding, even for local transport projects, so that the position has been quite different from the French "*versement transport*" arrangements for its major cities. Now, however, since the credit crunch and public funding crisis, there will be much less central funding of local transport capital schemes, and the balance of power will swing towards local economic partnerships. In that context, the question of interest is the value for money *to the city region* of transport infrastructure relative to housing, regeneration, and other budget headings for which the city is responsible. So the question the city fathers will ask is: what is the effect of a transport scheme on output and employment at city level?

Unfortunately, transport CBA is not well placed to answer this question and therefore other approaches have been used to estimate additional activity measured by Gross Value Added (GVA) (LSE, 2009; KPMG, 2009 a, b). These approaches are cousins to CBA, but focus on:

- The impact of transport improvements on accessibility;
- The relationship between accessibility, real wages and employment at area level – both displacement from other areas and net generation;
- The further relationship to agglomeration in the city region.

Compared with the micro approach of CBA, this is a more meso-economic approach, of the kind discussed in previous Round Tables (ITF/OECD, 2007; 2008).

It clearly depends crucially on the stability of a few key economic relationships, which are themselves problematic for the reasons of causality and confounding mentioned earlier. For Britain, with no great tradition of regional accounting and regional economic modelling, this could be a significant step. However, these approaches are best seen as complementary to CBA: whenever national funding or a national value-for-money perspective is required, the NATA remains the mandatory toolbox.

6. CONCLUDING THOUGHTS

It is comparatively easy to trace the development of transport appraisal in the UK over the last fifty years. Starting from a narrow model, in which time and operating costs are traded against capital and maintenance cost, appraisal progressively developed through:

- *refining* the values of user benefits and also safety impacts;
- *incorporation* of behavioural responses, represented as fare and generalised cost elasticities, with feedbacks to congestion (car) and overcrowding (public transport);
- *extension* of the user benefit theorem to cover environmental externalities and wider economic impacts;
- *application* across transport modes and to policy/investment packages;
- *creating a climate of opinion* within government and the profession, in which the appraisal regime has a certain independence and results are taken seriously as inputs to decisionmaking, without supplanting the decisiontakers' role.

As a result, it has probably been reasonable to claim that the UK has been one of the leading European countries in transport modelling and appraisal, and that the qualities of independence and analytical capability have served UK consultants well in international markets.

And yet, it would be difficult to assert that the transport sector is the crowning glory of the British economy. This is partly due to history and geography, which created particular challenges for the UK. But it is also a reminder that transport policy is shaped mainly by politics – central and local government structures, the planning system, the availability of public finance, policy towards tolls, fares and charges or sources of sector revenue, attitudes to public transport revenue support, privatisation and regulation. Appraisal is a useful tool within an overall policy context, but no more than that.

The strength of transport cost-benefit analysis is its link with modelling and basic traffic data which, provided growth scenarios are credible, maintains a strong sense of realism in the assessment. However, the current low discount rate (3.5%) and lengthy appraisal period (sixty years) create major intellectual problems in coping with capacity limits in future years. The weakness is the upward link to regional economic planning and forward strategy. The British have always had a resistance to the top-down master planning approach, preferring bottom-up incremental development.

In the context of very scarce public finance, peak oil, and seriously difficult targets for carbon emissions, the content of transport policy is likely to change in the next period – towards policies relating to reliability and resilience, towards electricity and away from fossil fuel dependence, towards the city regions and away from the national network, and towards a more integrated economic development approach. Transport appraisal will need to evolve in order to serve these changing needs. This is the next challenge for those involved in transport appraisal.

NOTE

1. Delivering a Sustainable Transport Strategy; New Approach to Appraisal; Design Manual for Roads and Bridges.

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