New trends in cost-benefit assessment of public investments in France and Germany

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Abstract

Cost benefit assessment of investments is an ongoing preoccupation for public authorities in France and Germany, as in many other countries.

In Germany, the regular review and set-up of the Federal Transport Infrastructure Plan (FTIP) is based on assessment methodologies for which the state of art is updated regularly. The most recent update will be finalised soon.

In France, the requirement for cost benefit assessment has long been enshrined in the legislation concerning transportation, and it has been quite recently extended by the law to all public investment in civil investments.

The paper reviews the recent methodological updates and compares the main methodological choices made in each national approach, reflecting the different political and administrative requirements.

Introduction

In 2005 the HEATCO-project (Developing Harmonised Approaches for Transport Costing and Project Assessment) gave an overview on current practice in project appraisal in Europe, showing considerable variation between national practices. The project aimed at proposing harmonised guidelines for project assessment for trans-national projects like the TEN-T corridors.

Nevertheless national assessment guidelines are often bound to a national development path, incorporating national specifics like the geographic structure or the political system. Still today quite different assessment procedures can be examined in European countries. Mackie, Worsley et al. (2013) picked up some European countries and added the US, New Zeeland, and New South Wales (Australia) to the selection of countries to be compared. Finally they stated, that the framework of economic appraisal in transport is well established practice in all countries considered and the results provide input into the decision process on whether to realize a project idea or not. But not in all countries the steps and calculation procedures of the assessment are fully transparent.

A general guideline to cost benefit assessment (CBA) of investment projects is given by the EC with the "Economic appraisal tool for cohesion policy 2014-2020" as update of the previous version dated 2008. The main objective of the guideline is to illustrate common principles and rules for application of the CBA approach into the practice of civil servants, beneficiaries and consultants preparing project appraisals. Transport is one sector of interest beside environment, energy, broadband as well as research and development. For the transport sector topics of overriding importance like target system, demand forecast, definition of indicators and economic analysis are addressed, but calculation formula for certain indicators are not presented.

We present in this paper an in depth analysis of two different appraisal procedures in France and Germany, whereat especially France does not belong to the portfolio of the Mackie and Worsley study. This comparison briefly describes the historical development of appraisal practice and puts emphasis on recent developments, mainly in CBA national guidelines. The comparison exercise is developed on these recent evolutions and enlarged in order to include some other key - although recently unmodified - methodological elements. The bi-national contribution is completed by a discussion on the influence that national governance framework and national public thematic focuses regarding transport infrastructures may have on scope, logics, and enhancement of CBA guidelines.

1 CBA framework in France: recent changes

Beginning with the seminal works of Jules Dupuit (1844), France has a long tradition of infrastructure project appraisal. Assessment studies are structured by national methodologies, which are defined according to guidelines set by ad hoc commissions and apply to all transport projects of national level, whatever the mode. These commissions are established under the aegis of the Prime Minister's offices in charge of mid- and long-term strategies; their conclusions are then transformed into official guidelines by the administrations directly concerned. Up to 2014, these guidelines were based on the recommendations of two commissions both chaired, the first one in 1994 (Boiteux 1994) and the second one in 2001 (Boiteux 2001). Their general recommendations were complemented on specific points by other Commissions dealing with the collective value of carbon (Quinet A., 2008), and on risk issues in project appraisal (Gollier, 2011).

In 2014, after the recommendations of a new Commission, those guidelines were deeply modified, and the purpose of this section is to explain the reasons of these changes, their nature, and their consequences on project appraisal. A first sub-section will briefly summarise the content of the previous guidelines and explain the reasons why a new Commission was set up. The second one will present its recommendations as regards socio-economic assessment methodologies, reference values and governance. The third sub-section will describe how these recommendations have been implemented in the new guidelines and document changes in projects' net present value (NPV) and its components induced by the adaptations of the former guidelines.

1.1 The previous guidelines

The previous guidelines dated back to 2004. They were based on the classical partial analysis limited to transport: the main ingredient was the travel time savings, monetized through the value of time (distinguished according to the mode, to the trip purpose and increasing with distance). This value of time was multiplied by ad-hoc coefficients to take into account, rather coarsely, comfort and reliability. Established environmental costs were also monetized: air pollution, noise, CO_2 emissions. An opportunity cost of public funds was fixed at 1.3. Those ingredients were embedded in popular indicators such as the Net Present Value, the Benefit per Cost unit, the Internal Rate of Return, using a standardized discount rate of 4%. This discount rate was supposed to be risk free, implying that a risk premium could be added to it. But this part of the procedure has never been implemented, and risk analysis was undertaken by defining scenarios. The different assumptions of scenarios made it impossible to compare project results belonging to different scenarios.

Several reasons suggested to update these guidelines, both from the technical point of view and from the governance point of view.

From the technical point of view, the last guidelines (Ministère de l'équipement 2005) dating back to almost ten years required the revision of numerical values (many of them are valid for about a decade) and to take into account developments in our society as well as current expectations. The modalities for using the data must also be specified, to make them more consistent and to adapt them to new developments. Finally, the traditional cost benefit assessment should benefit from advances in economic theory in several domains where decision makers have particularly strong expectations, such as industrial economics, risk analysis or spatial economics.

The assessment methods should also take proper account of the changes in the general situation of the present period. Our times are marked by two major transitions which we are committed to: energy and ecology, with the rising level of risk attached to this situation. This makes it both more difficult and more imperative to develop a long-term strategy which cannot take the shape of extrapolation, as it was the case, at least implicitly, in the past. The situation is also, especially in France, marked by the limitation of public budgets and the loss of competitiveness of our economy.

Yet, despite these arguments which should support an expanded application of cost benefit assessment, it appears that its use is limited. Experience shows that in France this assessment is used with wide variations in its implementation, thus making comparisons between projects difficult. The results also lack transparency and clarity, and are therefore ill-suited to advise decision makers and inform the public. As a result, decision-making processes rarely use these calculations, as vividly demonstrated during public debates. As stated in the explanatory memorandum to the law which, among other things, changed the governance of project assessment (LPPFP of 31 December 2012): "Public investment is a key factor driving growth and competitiveness. Because it is also a guarantee of high-quality public service, decisions concerning public investment must be made with attention to reconciling development with the control of public finances. Investment choices today are insufficiently justified. The evaluation and decision-making procedures do not always make it possible to prioritise projects and retain the ones that will be most useful to the community."

1.2 The recent Commission and its recommendations

These reasons explain why a new Commission was appointed in 2012 to revise the procedures of project assessment. As it was the case for the previous ones, the new Commission was composed of the main stakeholders: public servants, transport operators, environmental associations, as well as public decision-makers. It delivered a report in 2013 (Quinet 2013) and reached unanimous agreement on almost all of its recommendations, which concerned both the technical processes and the governance of project assessment. The report concerns all types of public investment, and the transport guidelines issued in 2014 apply not only to transport infrastructure projects but also possibly to projects such as, for example, new traffic regulation systems.

1.2.1 Recommendations on technical issues

Unit values[1], comfort, reliability

We will not present here all the detailed unit values, but just insist on key elements, beginning with values of time. These values of time have been derived from a survey of stated and revealed preference studies and traffic models outputs, mainly from French sources. This progress gave new values that tend to be a bit lower than the “Boiteux II” - set in 1994, updated 2010 - values, about 10% lower. What explanations could be offered for this decrease? Besides more informed and improved knowledge on the value of time, it could be interpreted as a result of the fact that travellers are now able to better manage their travel time, especially using new information and communication technologies.

Besides, the values of time have become more differentiated for travellers, distinguishing between trip purposes both for urban and interurban trips, and varying – normally increasing - with the interurban distance range, all this for each mode. Specific (higher) urban values are given for the Parisian region. Waiting time and connecting times are taken into account, and all these values of time are supposed to evolve as GDP per capita with an elasticity of 0.7. Furthermore, the values are differentiated

[1] This part builds heavily on Meunier et al. 2014

according to the comfort level in public transport, and to the reliability of travel time for both public transport and passenger cars.

More precisely, public transport comfort is taken into account depending on the density of persons standing up in the vehicle, which corresponds to multiplication factors applied to travel time in the vehicle and used for generalized cost computations. Reliability is treated also in time equivalents, depending on the magnitude of delays and the probability of delay for public transport and on an aggregate indicator of travel time dispersion for passenger cars. The values are transferring the probability of delay (for delays exceeding 6 minutes and delays exceeding 16 minutes for urban and suburban transport; for delays above 10 minutes for interurban transport) into a number of equivalent minutes lost. The values used for public transport comfort and reliability have been derived from data gathered by the main operators in France. For passenger car travel time reliability, the indicator taken into account is the difference between 90th percentile and median travel time, divided by the median (as in Markowitch 2009), which applies to a "reliability penalty" (2.5 times the value of time for constrained trip purposes, i.e. professional or commuting trips; one time the value of time for other purposes).

The value of statistical life and value of life year have been sharply increased, from around 1.9 to 3.0 Million Euro (2010 values). This increase is due to the results of new surveys (especially the OECD 2012 survey). It means approximately a 50% increase for transport fatalities and a more specific increase of 120% for road fatalities, for which a reduced unit value was applied previously. As another result, the values of environmental effects per vehicle linked to health issues such as local air pollution and noise increase by about 30%. This lower percentage comes from the decreasing emissions per vehicle due to technical progress. Similar counteracting evolutions are observed for road safety impacts, due to the very sharp decrease in road fatalities observed over the last twelve years: fatalities where approximately divided by two, which leads as a whole to a small net increase of the value of road safety external cost per vehicle-km .

Among other environmental unit values, noise and CO_2 emissions should be mentioned. For noise nuisances, two methods are given, the first one gives values per decibel (dB) per person-year exposed, depending on noise levels. It may be used when project design is precise enough and noise studies are available. For more preliminary stages, approximate values are given per vehicle-km, differentiated according to local conditions (time of day, traffic and population densities). For CO_2 a sequence of values is defined, beginning in 2010 with 32€/t, reaching 100€/t in 2030, applying from then on a Hotelling-like rule, with a 4.5 % geometric annual increase.

Extending the coverage of effects

Another set of recommendations concerns the extension of the scope captured by appraisal. Besides comfort and reliability effects which are directly experienced by users, there are several effects which are important issues for decision-makers, and which the classical CBA does not address. Many attempts are made in various countries to take them into account, see for instance the wider economic effects in the UK. The commission selected four topics: effects on macroeconomics (growth, employment), effects on market power and competition, spatial consequences, and redistribution and equity consequences.

Recommendations concerning macro-economic effects such as effects on employment or economic growth are rather limited, and are mainly composed of caveats about those effects, which are not firmly established. In the short run, the main effects are of a Keynesian type, dubious in case of full employment; in the long run, the inter-sectoral relationships and the way which public money has been raised through (taxation, debt increase...) comes into picture. Are these effects larger than what stems from the gain of productivity and competitiveness induced by the abatement of transport costs due to the investment, as estimated through classical CBA?

In fact, classical CBA basically estimates savings in transport costs under the assumption of perfect markets. It presents results as if these transport cost savings were integrally transmitted to other agents. Within such a framework, at the end of the day, these cost gains are translated into productivity gains accruing to the final consumers, as well as gains in intangibles such as external effects or non-marketable goods. However, this equivalence between transport costs savings and gains in productivity or intangibles is challenged in presence of market imperfections. That is why these phenomena need to be carefully addressed.

For market power, the recommendations are that it is necessary to analyse them, take them into account and assess the changes that the project may induce in this field. The report insists on the importance of the potential consequences of market power within the transport sector (pricing, market segmentation, frequency and level of service, etc.). Illustrative simulations of order and magnitude of pricing effects are given for the competition between air transport and high speed rail services. As regards market power effects downstream of transport, no systematic correction is introduced, but a sensitivity analysis is highly recommended.

The most elaborated recommendations are those which deal with spatial effects; they first suggest, for the major projects, to use land-use and transport interaction (LUTI) models in order to at least visualise the spatial consequences of the projects. They also give qualitative indications on the effects of both urban and interurban investments on the spatial repartition of populations and employment. They recommend to estimate the agglomeration externalities and to add them to the welfare calculation. For this purpose they give precise rules (the elasticity of productivity vis-à-vis the density of employment is 2.4 %, as estimated from thorough econometric studies).

For the redistribution issue, an indicative index is proposed in order to take into account distributive effects on user's surplus. New feedback from research and studies will be needed in the future for designing more precise methodologies.

The extension of environmental effects has also been considered. As regards biodiversity, although studies are increasing in number, variety and quality, it was not judged possible at this stage to include general unit values. Still, as for all environmental effects, the report insists on a proper inclusion of the cost of avoidance, reduction or compensation measures within the project's cost estimates. Concerning upstream and downstream pollution effects, it has been possible to issue recommendations on unit values only for upstream energy production impacts ("from well to tank"), following CE-Delft (2008) and (2011).

Risk and uncertainty

An important part of the commission's report aims at adapting the appraisal to the situation of modern economies and societies. It deals mainly with risks analysis and long-term considerations. We will first summarise the recommendations on risk analysis. The successive systemic crisis we have seen in the last decades has made clearer, that risks, at all scales, are an increasingly important issue for our societies. The report insists on this point; it reminds of the importance of estimation biases and recommends several counter-measures, which rely on expertise and organised feedbacks.

A review of risk sources, combined with sensitivity analyses may help to estimate expected values of costs and advantages. Using the expected value is valid for risks which are not correlated with macro-economic evolutions, such as errors in input data, parameter calibration, geological risks, etc. But the newest contribution brought by the report regarding risks in transport CBA, is that we should take into account carefully the systemic risk, the risk resulting from the more or less strong links between the benefits of an investment and the economic growth. Schematically, imagine an investment which advantages are positively correlated with GDP: in 20 years from now, if by chance the economic situation is good, the investment will have made the community even better-off, but if it has turned bad, the investment won't bring in as much as in the first situation. Conversely, if the investment is negatively correlated with GDP, it will play a role similar to an insurance for hard times, and therefore should be more valued for that role in appraisal.

The systemic risk may be estimated using two kinds of methods. One consists in valuing risk by correcting the value of each monetised component (e.g. time gains, safety, pollution, etc.) for their risk premiums, which will increase the project's value if the advantage component is negatively correlated to GDP, reduce it if the correlation is positive, and let it unchanged if there is no correlation. These corrected components remain discounted with a single "no risk" discount rate. The other method consists in keeping the mean value of each of the components as in usual CBA, but having it discounted with a rate adjusted accordingly to the project's risk characteristics. The discount rate will be increased if the investment's advantages are positively correlated with GDP or, otherwise, decreased.

Each method has its advantages and drawbacks. The first one may give rich information to decision-makers and stakeholders as regards the distribution of outcomes, but needs much information and a thorough definition of scenarios. The second method is a lot easier to implement, the difficulty residing in the choice of an appropriate correction for the discount rate. We will detail it a little: to put it simply, using an approach which presents formal analogies with financial asset valuation, the discount rate that gives the present value of a future item exposed to risk is the sum of the risk-free rate and a risk premium. Following analyses of real market rates and perspectives of economic growth, combined with theoretical analyses for the long term, the risk-free rate ρ was set at 2.5% (then 1.5% after 2070). The risk premium is the product of a specific coefficient (the "β-value", which should be chosen consistently with the correlation between the investment's effects and the economic growth) and the general risk premium of the economy, ϕ, set at 2% in the report (3% after 2070). Hence, the risk-adjusted rate follows: $r = \rho + \beta\, \phi$.

Accordingly, a project will have its net present value computed with a discount rate which will be lower, higher, or equal to the risk free discount rate, depending it shows respectively negative, positive, or no correlation.

For investment programming, the rule of decision is now similar to deciding when to exercise an option, corresponding in financial technique to calculating a stopping time. Such a calculus has complex formulations and very often has to go through mathematical simulations[2] : we cannot develop here this important issue. Besides risk, and not independently from it, another key issue is how to deal with long term aspects.

Long term issues

Infrastructure projects are costly long-term investments and their effects are largely irreversible. They modify existing infrastructure networks and contribute to structuring during several decades, possibly several centuries, the territories, the economic competitiveness and the quality of environment. In the last decades, the attention given to long term issues has increased; technically also, this has translated into reduced discount rates for project appraisal. Therefore it is not possible any more to disregard, in project appraisal, what happens between, say, 50 to 100 years of infrastructure operation.

In order to meet both natural resources limits - especially energy resources - and environmental requirements such as greenhouse gases (GHG) emissions reduction objectives or the stopping of land

[2] When outcomes are not uncertain, the decision rule is simple: under quite general assumptions (mainly: advantages independent from the date the infrastructure is put into operation, advantages growing with time), the infrastructure is to be built when the first year's advantage divided by the cost equals the discount rate - as long as NPV in this situation is positive.

take and sealing, major strategic changes will be required in a closer future, about two or three decades from now. These new strategies imply changes in modal split, more or less rapid development of innovative transport services, technological mutations, or changes in urban development logics. The various sets of measures that will be chosen for implementing these strategies may highly and differently impact costs, externalities or advantages of transport projects. We must therefore place project appraisal within a frame of scenarios which need prospective analysis and political choices.

Technically, monetising the effects of a project over its appraisal period presupposes having made assumptions on the long-term evolution of diverse kinds of key parameters, which are interdependent (see Fig. 1), such as:

- General socio-economic indicators (GDP, population, petrol price, etc.);
- average growth of demand;
- relative prices of unit components of NPV;
- “Performance ratios” used for estimating impacts, such as unit vehicle emissions or road fatality rates.

Besides, it is necessary to make assumptions on network evolution. This should lead to the definition of an explicit scenario at the national level (e.g. a list of projects and main regulatory measures), common for all projects subject to individual appraisal.

Public expenses and surplus calculation

The report addresses also the issue of the marginal cost of public funds. Building on a literature review and a specific study commissioned by the Department of Ecology, it suggests the value of 1.2 (multiplying each public Euro), while the previous value was 1.3. It also raises the question of methodologies for investment selection in the case of fund shortage, for example public budget shortage. Built on works by Maurice, Sauvant and Quinet (2007), the report recommends a procedure of linear programming in order to optimise the NPV of the programme under the constraints of budget for each year of the programming exercise. It comes out that this procedure boils down to adding to each invested Euro another shadow price, named “scarcity cost of public funds” which is reckoned to be approximately 1.05 in the present French situation. In programming exercises, this factor adds to the marginal cost of public funds, which is linked to the structure and the level of the taxes, while the scarcity cost is linked to the global amount of public money that the Government intends to allocate to the investments in the sector concerned.

Now leaving aside the question of public expenses, surplus variations are, in practice, not as easy to compute and straightforward as in a basic theoretical exercise. At the individual scale, in the simple case where the project implies no major behaviour change, surplus variation may be captured by simple generalized cost variations, given the accurate sources of surplus are taken into account, with correct values. The improvements in this regard deal naturally with making the coverage of surplus sources more complete (see for instance above, reliability and comfort) and differentiating the unit values for these surpluses (see above values of time or environmental values).

But progress has to be made for capturing more accurately surplus variations when more important behaviour changes are at stake. When the individual changes mode for instance, specific unobserved sources of surplus which influence the modal choice become a problem (this problem is related to the “modal constants” used by traffic models, see below). Other problems may arise; for instance, using reference “average” values of time without precautions may end up, for some users, in computing negative surplus variations in contradiction with their behaviour choice.

When more major changes are at stake, e.g. changes in trip origin or destination, or, even more, changes in the number of trips, which leads us to the question of induced traffic, we should consider the final utility of the trips also, because it may differ. These difficulties have been discussed and the recommendations issued are certainly not "the final best solutions" but rather practical advices which are hopefully not too much subject to bias risk. It would be too lengthy here to state them in detail, but their main orientations are to use as much as possible the information given by traffic models, to correct generalized costs when it is needed for a better approximation of consumer surplus variation (e.g. using "modal constants" which are often used in multimodal traffic models, and may be interpreted as a kind of average differential utility of modes). An impetus is also given in view of improving the economic consistency of traffic models so that surplus calculations using the model's utility functions may be made and compared with the application of CBA rules for consumer surplus. In any case, this often neglected complex issue would need more attention from applied research.

The recommendations consider not only consumer surplus, but also producer surplus in case of imperfect competition, advising to consider strategic reactions of transport competitors, infrastructure managers as operators, and to make a sensitivity analysis by adding 10% of all trips linked to professional activities including freight transport.

Recommendations on governance

A first set of recommendations aims at improving integration of appraisal with decision making on infrastructure projects. The report proposes a series of measures intended to reduce these defaults. Since they are tightly linked to specific decision processes and judicial rules valid in France, we will not go through them. We will only indicate that the report advocates for more transparency and accountability, so that decision makers should be able to understand the aims and scope of each model and to have a clear view of their level of reliability. An external audit is recommended for all important projects. Furthermore, ex post studies, which are regularly implemented in France, should be made more comparable and more comprehensive, and aimed at providing useful conclusions for the improvement of CBA methodology.

Other recommendations concern the need to:

- enhance ex-post analyses and structure the governance so that they be followed by correcting actions,
- organise methodological updating in a more continuous process
- consider deciding on the precise ranking of projects in the framework of medium term programs rather than project by project, contrarily to the frequent result of the political decision making process. This is recommended because projects' consequences are often not independent, i.e. building such or such other project may increase or decrease the assessed project's net present value, making then a purely individual assessment inaccurate when the inter-relation is not negligible.

1.3 The implementation of the recommendations

1.3.1 Technical implementation

In 2014 new guidelines were issued (Ministère de l'écologie 2014), which endorsed almost all the technical recommendations of the report. The totally of new valuations were made official. Risk assessment did not fully follow the recommendations, as the most preferred option taken by the directive was the use of scenarios, which are now fully standardized, allowing for a better comparability between projects. Also, sensitivity checks are introduced which, in case they conclude that the project's sensitivity to economic growth fluctuations is low, allow to use a simpler risk-adjusted discount rate of 4.5%. The process of setting long term common perspectives is going on. As for the use of models such as LUTI models or General Equilibrium models, the directive is prudent, as no such model exists and is operational in France at present. Let us mention the on-going studies made in the framework of the “Grand Paris” project, where three LUTI models are in an on-going process of calibration and comparison.

The new directives have been implemented for several projects. In general, the increase in environmental unit values induces an increase in the proportion of environment in the advantages. This effect is enhanced by the decrease in the unit values of time. Two points have conflicting effects: the increase in the horizon of estimation is counter-balanced by the frequent increase in the discount rate (in the new framework, the discount rate is specific to each project, and is quite generally above the common discount rate of the previous directives, which was set at 4%, slowly diminishing on the long term).

On the whole, the Net Present Value may come out a bit lower or a bit higher than under the previous directives, depending on the project's specific characteristics and impacts. The IRR may also come out higher or lower, but its definition itself is problematic in this representation of risk, and its meaning becomes quite unclear, because under the risk assessment method used here, the discount rate has to correspond precisely to the project's risk characteristics. Another point deserves some comments: the introduction of new effects such as the agglomeration externalities. In the case of a public transport project inducing an increase in density, the statistically induced increase in productivity can represent a non-negligible item. This can be seen in the following table, showing the differences in results for the project of automated metro ring in Ile de France, the “Grand Paris Express”. These results are in line with the estimations made in the UK for the CrossRail project. This kind of effects is not to be expected in the case of an interurban motorway project. It appears that in such an investment, the decrease in time savings valuation is partially counter-balanced by the increase in value of life.

Advantages in Euro Discounted in 2010	According to the present directives	According to the new recommendations
Time savings	27,6	21,8
Reliability Comfort	-	3,1
Pollution	0,3	-0.9
Safety	0,5	1
Carbon emissions	2,9	6,5
Noise	0	0,2
Urban effects	-	5,7
Agglomeration externalities	-	10
Total	31,3	48,4

Table 1: Break-down of estimated advantages provided by the “Grand Paris Express” (source: Quinet 2014)

1.3.2 Governance recommendations

Since they are tightly linked to specific decision processes and judicial rules valid in France, we will not go through them. We will only indicate a few points:

- One of the main recommendations of the report, relative to the audit of project assessments, has been enforced through a law (LPPFP 2012) which makes such audit by independent experts compulsory for projects over 100 million Euros.
- The recommendation that methodological updating should be implemented in a more continuous process has been translated in practice through permanent working groups aiming

at monitoring the research, bridging the gap between research and practice, and building especially on ex-post analysis of already implemented projects.

2 CBA framework in Germany: recent changes

Germany has a long tradition in developing appraisal procedures for possible transport infrastructure investments. The Federal Ministry for Transport and Digital Infrastructure (BMVI) is currently finalizing the FTIP for the year 2015. On one hand, basics like the traffic demand forecast were adapted to the assumed frame conditions of the year 2030 as horizon for FTIP 2015. On the other hand, it was considered to be essential to check and optimize the methodology of the decision-making process. The development includes all aspects of decision-making: firstly, the target system in regard of the prioritizing strategy was assimilated to the social and political developments. Secondly, the evaluation methodology was aligned with respect to international standards, progress in research, extended knowledge, and the efficiency of its application. In this context the BMVI commissioned research projects concerning several topics.

2.1 Overall process

In FTIP 2015, four evaluation modules are used for evaluating and assessing the impacts of considered projects (see Fig. 1). As far as possible, all monetisable effects need to be captured in the cost benefit analysis (CBA) (Module A). As a result, it provides an economic benefit-cost-ratio (BCR), which reflects the profitability of the used financial means.

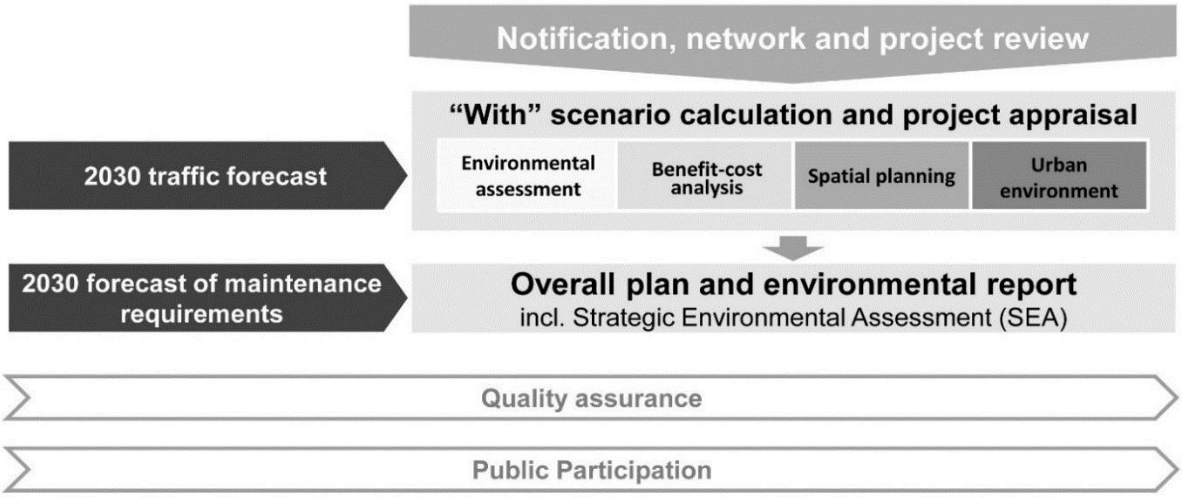

Figure 1: Overall process of the FTIP 2015 (own illustration on the basis of BMVI 2014)

However, some targets and their range of achievement can still not be depicted within CBA. To these cases belong the additional environmental effects, spatial impacts and urban development. These indicators and impacts are considered in further assessment modules (environmental and nature-focused evaluation (Module B), spatial impact assessment (Module C) and urban development evaluation (Module D)).

During the preparation of the FTIP 2015 several research projects were initiated by the BMVI in order to review and improve assessment procedures of all four modules. Although this paper mainly deals with improvements of CBA, the basic assessment approaches of modules B to D are also described.

2.2 General review of CBA

The indicators "reliability" and "life cycle emissions of greenhouse gases during the construction and operation of transport infrastructure" were freshly added to the set of relevant indicators. Moreover, in the future benefits from transport time savings in freight transport (for example due to reduced capital binding costs) will be considered as well. Furthermore induced and diverted traffic and their impacts on benefits will be taken much better into account, following the internationally applied approach of consumer's and producer's surplus. Some indicators out of the FTIP 2003 could be abandoned. In particular the consideration of employment endowing effects has been dropped, since the scenario for the transport demand forecast 2030 already assumes full employment.

The mentioned improvements are influencing the numerator of the cost-benefit-ratio. To enhance the quality of this final criterion, the denominator has to be calculated as precisely as possible. Therefore a procedure to check the plausibility of investment costs has been added to the CBA approach. This procedure is mainly based on reference values of completed transport infrastructure projects. In addition, it includes estimates on the impact of planned safety and environmental regulations on investment cost.

2.2.1 Development of new benefit component "reliability" and integration into the concept of CBA

For some years, the term "reliability" in transport or reliable transport system has been being discussed regularly and accordingly claims towards political stakeholders have been being made to take action for more reliable transport systems. In this respect, it was essential to consider this topic during the revision of the methodology for the FTIP. Reliability is usually defined as the deviation from an expected mean of the travel or transport time, or the deviation from an expected arrival time, whereby both delays and early arrivals have to be considered. Deviations from the expected travel time can be mathematically described by a distribution of travel times or arrival times.

For specific transport carriers as well as for the differentiation between passenger and freight transport the different characteristics of reliability have to be adapted, too. Unreliability in traffic systems affects at a first level the means of transportation, e.g. cars, trains etc. Passenger and freight carried by these means of transport are affected at a second level. During the conception of the methodology for the new FTIP, only the effects on the second level are to be assessed, meaning that a focus is set on the effects on passenger and freight by the unreliability of the chosen means of transport. For example, a train operated relation with major time variations has not a relevant impact on the indicator "unreliability", if the trains serving this relation only feature low occupancy rates. Additionally it is important to mention that in the course of the evaluation process for the FTIP only improvements of reliability due to infrastructure measures are allowed to be considered. This is especially problematic in the railway sector, since unreliability often occurs due to problems with the rolling stock, through deficiencies in the existing technical infrastructure or through delays on "upstream" sectors.

In general, three approaches for measuring and assessing reliability or unreliability, respectively, for one route can be used (Significance, Goudappel, Nea, page 14 and following):

- Standard deviation of travel time distribution (or other aggregate indicator of travel time distribution)
- (Anticipated) buffer times to avoid delays
- Deviations from contracted arrival times in schedule bound systems (schedule delay) in frequency (percentage of arrivals) and extent (delays measured by e.g. minutes).

The applied approach of FTIP 2015 for the transport carrier road is based on the first alternative. It uses a functional determination of the standard deviation for travel times as indicator of reliability. A RP-/SP-survey provided reference values for one hour standard deviation for different trip purposes.

For rail passenger or freight transport, the third alternative is not easy to implement, since the FTIP rail network 2030 does not contain a schedule. For that reason, the modelling of reliability can only be realised by an artificial schedule for passenger transport and an endogenous train line system between marshalling yards for freight transport. Then, the number of delayed arrivals and the mean of the delays are gathered. De facto, the transport industry uses buffer times for transport planning. Buffer times transform delay risks - meaning possibly arising time losses - into certain time losses compared to an undisrupted journey/transport. These are the costs of the risk reduction. The buffer times are calculated in such a way that - together with the mean travel time - they cover the travel and transport time distribution up to a very small quantile, i.e. arrivals after the scheduled time should remain exceptional (see Fig. 2).

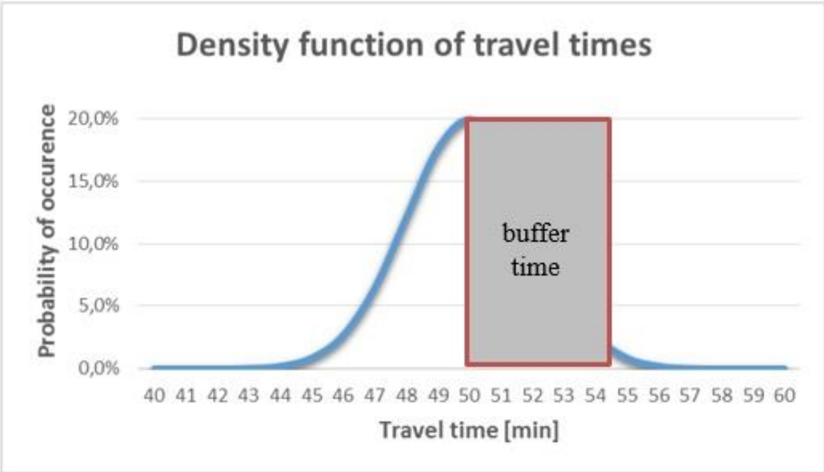

Figure 2: Buffer time overlapping the density function of travel time

For the transport carrier inland waterway, reliability is only defined by the water level fluctuations. There are special transport insurances which pay for alternative transports (road or rail) in case of low water level. A high number of low water level-incidents may reduce the profit of insurances. These costs are already considered within the CBA as part of the operational costs. Therefore, there is no need for considering reliability for inland waterways.

2.2.2 Enhanced consideration of induced traffic and modal shift into the concept of CBA

CBA approaches are based on the concept of welfare change. On the international level this concept is put into practice by measuring changes in the consumer's and producer's surplus due to new or modified transport infrastructures. These changes represent the benefits of the respective transport infrastructure and are brought into relation to the construction and maintenance costs. Within this concept impacts of induced and diverted traffic are considered by applying the so-called rule of half. For the time being the FTIP considered diverted and induced traffic and their impacts on benefits only roughly. Regionally differentiated factors were statistically derived to cover additional resource consumption of the "switched to-mode" and the induced traffic. During the general examination of the FTIP methodology it became clear that improvements on this issue were necessary to catch up with international standards. As baseline German FTIP measures welfare changes by changes in resource consumption. Therefore benefits of transport infrastructure are measured by changes in the consumption of money, clean air, time and others. Due to this conceptual difference the rule of half cannot be applied directly to the CBA of FTIP. Therefore a new approach[3] has been developed by introducing a new benefit component "difference of implicit benefits" which allows to keep the current assessment concept of resource consumption. This adjustment results in conformity of CBA approach of FTIP 2015 and international assessment standards.

[3] Nagel et al. (2012)

The “difference of implicit benefit” and its meaning can be explained with a simple example as follows. An accelerated rail connection (option b) still remains slower than the competing road connection (option a). Travel times[4] (or more generally: generalized user costs) of option b decrease from t_0^b (GC_0^b) to t_1^b (GC_1^b) due to the acceleration whereas all user prices and operational costs are assumed to remain constant.

Nevertheless one can observe (and predict by models) some users (Δx) switching from road to rail. It is plausible to assume that these behavioral changes are caused by a difference in generalized user costs which are not part of travel times and user prices. These generalized user costs are unobserved, implicit costs of the rail and road connections. According to Nagel et al. (2012) implicit costs can easily be calculated for switching users. Figure 3 shows the situation. Corresponding to the assumptions underlying the rule of half-concept, the demand curve for option b between $x_0$and $x_1$is assumed to be linear. It is obvious that travel time costs plus user prices for option b are higher then those for option a for all users, including the marginal users between x_0 and x_1. However these users would only switch from option a to b in case the generalized user costs of both options are equal or costs of option b are less than those of option a. This is only the case if implicit costs or rather their difference is taken into account. In Figure 3 the difference of these implicit costs are shown on the left hand site both for the marginal user at x_0 and x_1.

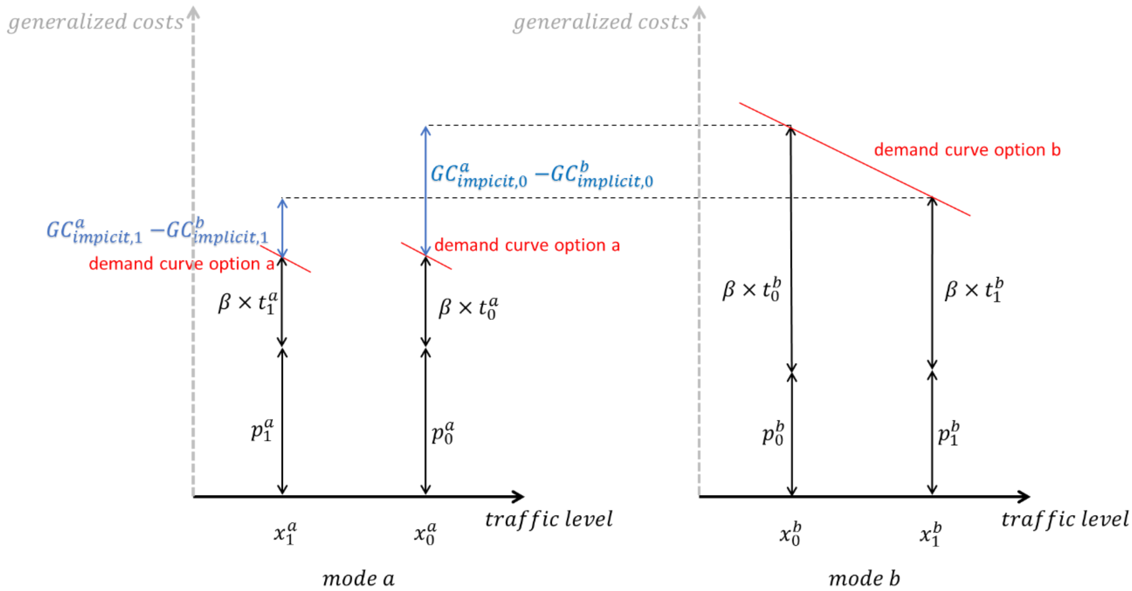

Figure 3: Demand curves and user costs for option a and b for the marginal users at x_0 and x_1 (own illustration on the basis of Intraplan, Planco, TU Berlin, 2014)

According to Figure 3 the generalized user costs can be described as follows for the average switching user between $x_0$and x_1:

$$p^a + \beta \times t^a + \left(GC^a_{implicit} - \overline{GC^b_{implicit}}\right) = \overline{p^b} + \beta \times \overline{t^b} \qquad (1)$$

being

p^a user price for option a

$\overline{p^b}$ average user price for option b, $\overline{p^b} = \frac{1}{2} \times \left(p_0^b + p_1^b\right)$

[4] To simplify the explanation, an average value of time, weighted across all distances and trip purposes, is used. Mean VOT are provided by TNS Infratest & IVT (ETH Zürich), 2014.

t^a travel time for option a

$\overline{t^b}$ average travel time for option b, $\overline{t^b} = \frac{1}{2} \times \left(t_0^b + t_1^b\right)$

β value of time

$GC_{implicit}^a$ implicit generalized costs for option a

$\overline{GC_{implicit}^b}$ average implicit generalized costs for option b,

$$\overline{GC_{implicit}^b} = \frac{1}{2} \times \left(GC_{implicit,0}^b + GC_{implicit,1}^b\right)$$

From this, equitation (1), we get

$$\overline{GC_{implicit}^b} - GC_{implicit}^a = (p^a + \beta \times t^a) - \left(\overline{p^b} + \beta \times \overline{t^b}\right) \quad (2)$$

Switching from implicit user costs of the average switching user to implicit benefits of all switching users, equation (2) becomes - being Δx the number of switching users:

$$\Delta U_{imlicit,total} = \left(\overline{U_{implicit}^b} - U_{implicit}^a\right) \times \Delta x = \left[\left(\overline{p^b} + \beta \times \overline{t^b}\right) - (p^a + \beta \times t^a)\right] \times \Delta x \quad (3)$$

As developed in appendix 1, this difference of implicit benefits is added to those benefits which have already been considered by the methodology of FTIP before: i.e. benefits arising from differences of resource consumption. The sum of both benefits produce the same result as the calculation based on consumers' and producers' surplus. Following this example, changes in consumers' and producers' surplus depend on demand changes, induced by changes in travel time costs as the chosen example refers to the acceleration of a rail connection. Generally spoken, the total benefits of a project can be calculated by considering changes of generalized costs with respect either to the concept of consumers' and producers' surplus or to the concept of resource consumption with its additional component "difference of implicit benefits".

2.2.3 Valuation of travel time savings (VTTS) for passenger and freight transport

Within the scope of the new FTIP methodology, two research projects for the determination of valuation approaches for travel or transport times and reliability were initiated. One study focused on passenger, the other on freight transport. In both studies, revealed (RP) and stated preferences (SP) surveys were conducted. In the passenger transport survey about 3.200 people and in the freight transport survey about 450 companies participated.

The studies have submitted tentative results, which are momentarily being validated. In accordance to this exercise in passenger transport, the Value of Time (VOT) will from now on be determined as a function of the travel distance (see Fig. 4). With increasing travel distance between origin and destination the valuation for time savings increases. This applies to all trip purposes in passenger transport. The results of the study suggest that time rates for student transport are lower than average; therefore in FTIP 2015 a differentiation for trip purposes is aimed at. Because of the usually short student transport distances the sample only supports distances of <70 km for a separate travel time value.

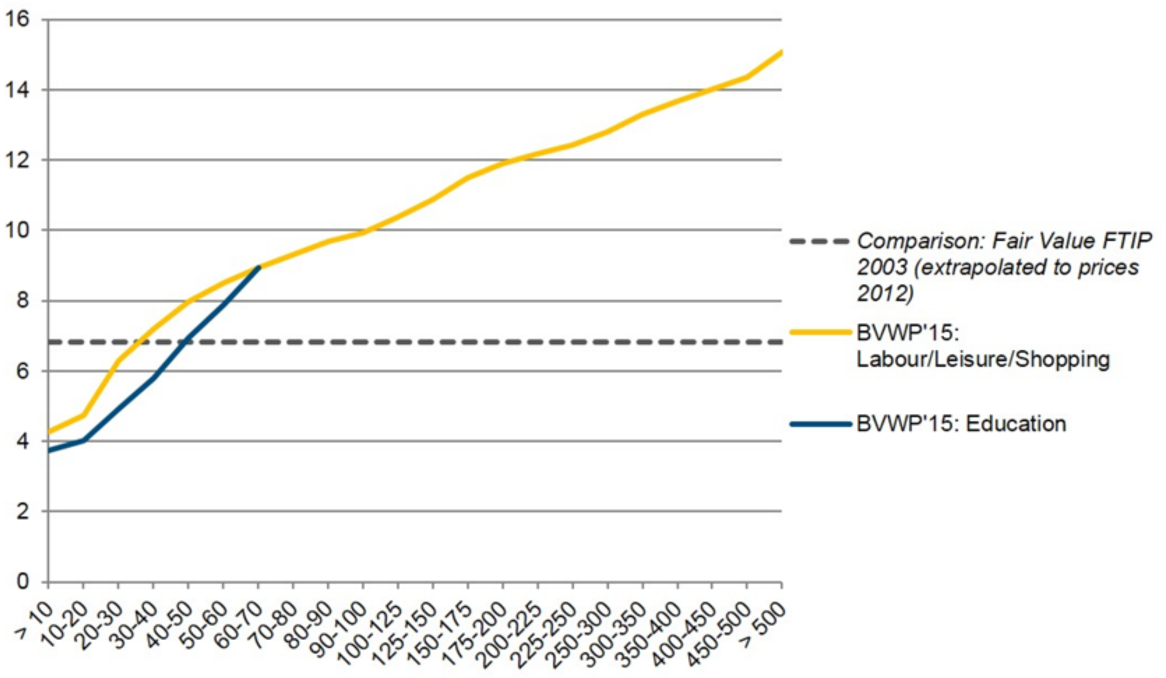

Figure 4: Distance-dependent time values of non-economic passenger transport(tentative results on the basis of TNS Infratest & IVT, 2014)

Furthermore it was found out that travel time values depend on the household income (see Fig. 5). The calculation of travel times in sections or corridors does not allow to make use of this progress, as the income distribution of the drivers passing this section is not known. Therefore in FTIP 2015 this correlation will not be considered.

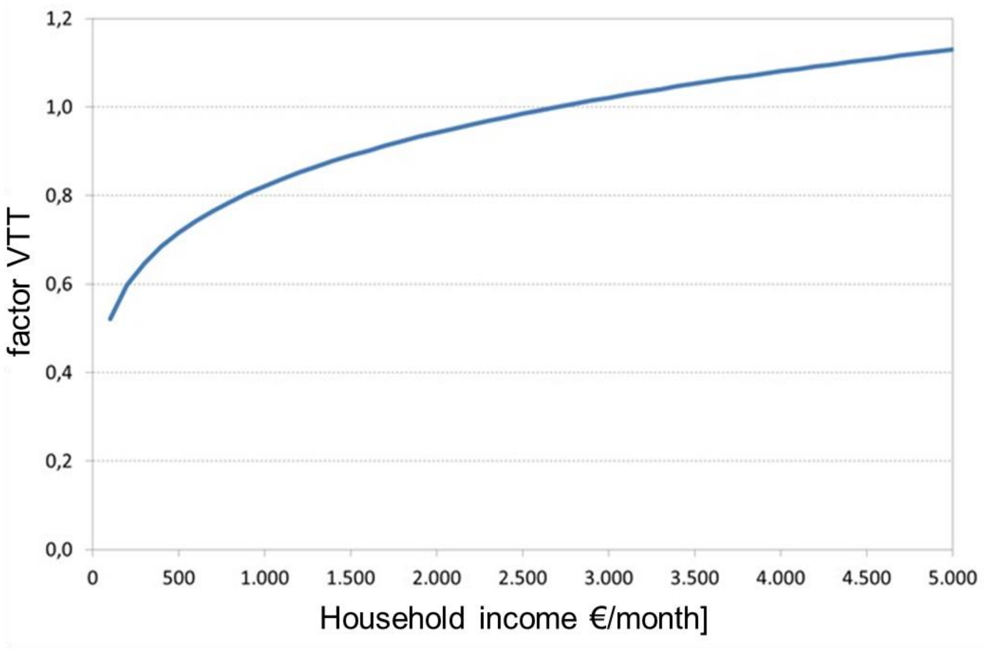

Figure 5: Income-dependent factor for time values (TNS Infratest & IVT, 2014)

FTIP 2015 will for the first time include a VOT for transported goods. Until now only the potential cost savings for vehicles and staff in case of transport time savings were considered. From now on decreased capital costs and logistic advantages on the receiver's side because of transport time savings are also considered. The VOT in freight transport depends on the travel distance and the category of goods.

2.3 Further evaluation modules

2.3.1 Environmental and nature-focused evaluation

The environmental and nature-focused evaluation (Module B according to Figure 1) focuses on the assessment of additional environmental effects. Furthermore this evaluation module fulfils the requirement of the EU-Directive 2001/42/EC for Strategic Environmental Assessments aiming to ensure that environmental and possibly other sustainability aspects are considered effectively in policy, plan and programme making. In order to set up corresponding reports environmental assessments are carried out on both project and programme level. Within module B several indicators like the impairment of non-fragmented regions or nature conservation areas are considered.

2.3.2 Spatial impact assessment

The third evaluation module covering the spatial impact assessment (Module C) includes the quality of accessibility and connectivity for different regions. In this process, the deficiencies in the connection between regional centres and metropolitan centres are measured. Furthermore, the accessibility of regions with regard to the closest infrastructure access (motorway junction, airport, long distance traffic train station etc.) is evaluated. In contrast to CBA, which acquires the economic network-wide sum of the accessibility improvements in terms of time savings (allowance advantage), the spatial impact assessment considers aspects belonging to the distribution theory like the question of minimal accessibilities to regions (distributive advantage).

2.3.3 Urban development evaluation

The fourth and last module is the urban development evaluation (Module D) of transport infrastructure projects. Therein specified is the aim to relieve developed areas and people living within them, specifically through road bypass projects. The urban development evaluation considers several indicators like effects on the utilisation of released road spaces.

2.4 Decision making

The new general guidelines for the FTIP 2015 provide prioritizing rules for the allocation of the available budget to the positively assessed projects (see Fig. 6):

1. Determination of necessary financial means for maintenance and replacement:
   The condition of the Federal transport network shows significant deficiencies. Accordingly it was determined that maintenance and replacement of infrastructure have priority over expansion and new construction projects. Therefore the maintenance and replacement requirements and their financial needs until 2030 have been assessed based on forecasts of the current situation. These financial needs are subtracted from the overall budget of the FTIP 2015. The remaining funds are available for expanding the network. The following prioritizing steps deal with the distribution of these remaining funds on all projects in the context of network expansion and new constructions. As far as project works have not been started yet projects will be examined again within FTIP 2015 even if they have already been nominated for implementation within FTIP 2003.

2. Distribution of the remaining financial means to the different transport modes follows superordinate targets like bottleneck avoidance, CO_2-reduction, and energy efficiency. For the latter the political intention is decreasing, since the main target of a transport infrastructure plan is to enable mobility, whereas negative impacts on nature have to be kept at minimum. The purpose of this second prioritizing step is to determine the resource allocation for expansion and new construction projects for the three transport carriers: road, railway, and waterway, considering the political targets for FTIP 2015 and the strategic investment scenarios that are deduced from these targets. A strategic investment scenario can be defined for example by the fact that it favours the most economical solution and only orientates itself

on the cost-benefit analysis. Within the budget left after maintenance investments, a combination of projects of all three transport carriers can be found, which mostly achieve the target set. In case of a focus on other targets (e.g. bottleneck avoidance) other financial distributions can arise. Interactions between road projects are checked mainly for close-by located projects. For the rail sector corridor studies complement the individual project assessment. The final decision on the second step of prioritization is based on single project evaluations but cross-checked by the benefit of the overall plan.

3. Urgency classification of projects for each transport mode follows mainly the results of CBA but also takes into account the relevance for dissolving bottlenecks or preserving the nature. On the third prioritizing step the urgency sequence for each transport carrier is determined (see Fig. 6). The CBA-module includes the major part of the project effects. For that reason BCR serves as the central criterion for the distinction between "urgent needs" (VB) and "additional needs" (WB). The other evaluation modules allow deviation from the efficiency criterion in individual cases. Projects with critical environmental and nature conservation assessment results or with outstanding spatial impact can be correspondingly down- or upgraded. Projects contributing essentially to the elimination of bottlenecks with impacts on main parts of the network are further candidates for an upgrade.
4. Significantly urgent projects of the first category VB will be labelled accordingly (urgent need plus - VB+) and should be realized at the first possibility.

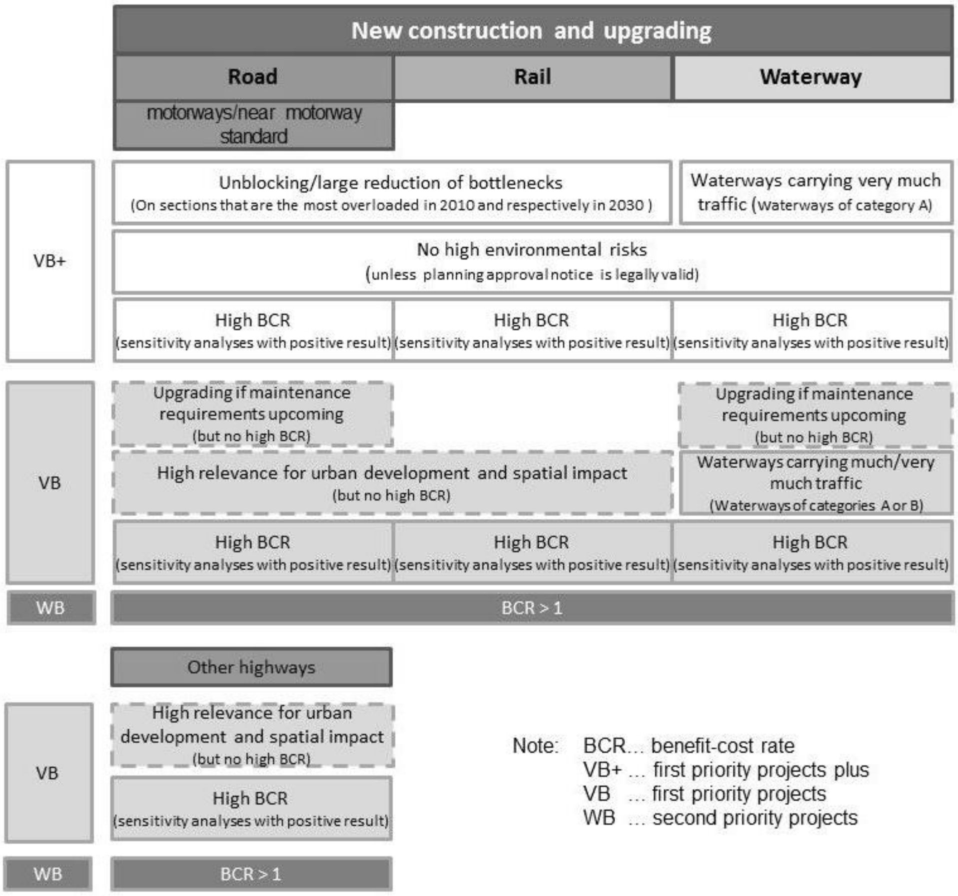

Figure 6: Classification of urgency according to of the third prioritizing step (BMVI 2014)

The prioritizing scheme uses all evaluation modules in a comprehensible process, while avoiding complex regulations or weighting factors. The decision-finding is based on a small set of prioritizing rules, which can be easily validated and adjusted if necessary. To emphasize the transparency of the process, it is standard to display the results of each single indicator for all considered projects in its original unit and thus to provide a multi-criteria analysis.

3 Comparisons and conclusion

We will now comment on the main convergences and differences between the two approaches, including some key topics kept unchanged in the national guidelines and therefore not appearing in the previous part.

3.1 General aspects

3.1.1 Discount rate

In several German appraisal methods for transport infrastructure investments the discount rate has been fixed to 3 %. During the improvement of CBA recent developments on financial markets and methodological backgrounds for the determination of a discount rate have been discussed, especially approaches based on opportunity costs and social time preference rates. For Germany empirical analyses for both approaches show, that discount rates between 1.0% and 2.0% are plausible. Based on these discussions the discount rate for FTIP 2015 has been reduced significantly to 1.7%.

As mentioned in the previous part, in France the risk-free discount rate is similarly low (2.5% for years up to 2070, 1.5% afterwards) and the methods for dealing with risks may impact the final discount rate used (see below).

3.1.2 Treatment of risk/uncertainty

In Germany, risks and uncertainties in terms of the forecasted impacts of projects are handled by sensitivity analyses. Sensitivity analyses are carried out on

- input data for the traffic forecast like rate of economic growth and demographic development (running CBA with “low” scenario - concerning demand forecast - for all projects),
- the discount rate for investment costs (higher value for calculations of net present values of investment costs for all projects),
- demographic development of structurally weak areas.

Furthermore a new approach is applied for ensuring the range of investment costs of projects. This approach provides plausibility checks of investment costs. Therefore additional sensitivity checks of investment costs are not deemed necessary.

In French guidelines, as exposed above, methods for taking account of risks and uncertainties are given based on recent theories, expertise and lessons learned from ex-post analyses. Adjusted discount rates are used in Germany only for infrastructure costs’ and sensitivity analyses , whereas French guidelines are somewhat more complex than in Germany, due to the special attention they pay to systemic risks i.e. to the correlation between project risks and macro-economic evolutions. Both national approaches are methodologically similar when scenarios and sensitivity analyses[5] are used instead of risk-adjusted discount rates. Nevertheless, when using highly contrasted “extreme” scenarios or risk-adjusted discount rates as in the French guidelines, the risk issues may have a much more discriminating role.

3.1.3 Time span, long term and residual values

In German guidelines, the time span starts for all projects in 2015. It consists of the planning period, construction period and operating period. As far as there are no individual specifications for planning and construction period the FTIP provides tabulated values. The operating period is separately calculated for each project. It is based on the average lifetime and the investment costs of the

[5] The Guide to Cost-Benefit-Analysis of Investment Projects, European Commission (2014), also distinguishes between a financial and economical discount rate.

components of the project (without consideration of land acquisition costs). Therefore residual values must only be considered for land values.

Within the planning, construction and operating period, costs and benefits for each year are determined and discounted on 2015 prices. This approach leads to a wide range of operating periods. Especially technically ambitious and costly projects often have long operating periods, as their dominant components (e.g. tunnels and bridges) show long lifetimes. Therefore, these projects generate benefits over a longer operating period.

French guidelines put more stress on long term issues, their relation to key public policies and to the treatment of risks in CBA. They consider quite long economic lives for transport infrastructures, since the assessment period is extended to 2070 and includes a residual value computed over 70 additional years. This is also meant to compare projects on more homogeneous grounds, although these reference periods are of course to be reduced, would the physical lifetime or the operation period of the infrastructure be shorter.

3.1.4 Treatment of surplus / traffic shifts and induced traffic

As regards surplus calculations, both national guidelines have identified the complexity and inconsistency problems of simple generalized cost calculations. The corrective measures have common features too:

- enlarging the sources of surplus encompassed by CBA (reliability, comfort,…),
- increasing the accuracy of surplus calculations: besides updating previous values, both guidelines tend to increase the differentiation of these values (value of time by trip distance for instance).

It should be also noted that the developments introduced in CBA guidelines need accurate traffic modelling design and output refinement.

Inconsistency problems occur when the traffic model predicts a modal shift, but CBA estimates an increase of generalized cost for users switching from mode a to b. German former guidelines (FTIP 2003) introduced corrective factors for this situation. The 2015 update integrates approaches which are based on the concept of producers' and consumers' surpluses (see above and appendix 1). This rule should solve many inconsistencies. But this calculation raises the question of the choice of value of time to be taken when modal differentiation is adopted. It also supposes that traffic models properly take into account all the surplus sources so that the number of shifting users is correctly estimated.

French guidelines consider the mode-specific values of time but do not propose a simple corrective measure for inconsistency problems, but practical advices depending on the information given by the traffic model so as to make the best use of it, in a case by case approach. They also consider a mid-term measure consisting in a convergent improvement of CBA rules and of traffic models - which should become more consistent from an economic point of view.

In any case, both guidelines need that traffic models properly take into account all the meaningful surplus sources so that the shifting and the induced traffic are correctly estimated. The impression emerging from all these developments is that applied research and feedback on practical surplus estimation should be developed, so as to reduce the risks of bias in surplus estimations.

3.1.5 Partial equilibrium analysis and wider effects

In Germany, following Anglo-Saxon practices, costs of public funds are not considered within the FTIP. There are mainly two arguments leading to this approach: At first there are uncertainties about the scale of welfare impacts resulting out of costs of public funds. At second the relative advantageousness of investment projects - which is the main focus of the FTIP - is not influenced by the question whether impacts of costs of public funds are considered or not, at least when the key indicator used for decision making is a benefit / net public cost ratio.

In France, cost of public funds is considered, building on a recent thorough study on the scale of welfare impacts. The Quinet report advocates for an approach where, ideally, the net present value of a program of projects should be maximised under constraints (introducing thus a budget-scarcity component to the purely economic cost of public funds).

Wider economic effects – like productivity increases or reduction of imperfect competition - are more discussed in the French guidelines - e.g. introducing for the first time agglomeration effects and trying to delimitate the cases where they could appear. These effects are not ignored by the German guidelines, but as full employment 2030 is an assumption of the base scenario for FTIP-calculations, impacts of new infrastructure on the labour market can't occur. However, indirect economic effects may appear, when accurate, through the multi-disciplinary studies and assessment modules. For instance, spatial and urban effects on the mid-term and long-term, when significant, do not appear in German CBA but they do in other assessment modules of the FTIP-methodology, whereas in France a progressive method using notably LUTI models is exposed in the Quinet report for identifying and in some relevant cases integrating some of their economic consequences in the project's net present value.

3.2 *Comparison of details*

3.2.1 Value of travel time savings

Both guidelines introduce or extend a differentiation of values of time, according to distance and trip purpose. The positive relationship between value of time and revenue level is acknowledged in both approaches but does not lead to explicit differentiation, due to limits of traffic modelling precision and probably as well to equity considerations. Nevertheless, some differentiations may partially and indirectly capture this kind of effect: French values include a higher urban value for the Parisian region, and the modal differentiation of values of time captures auto-selection phenomena which have to do with revenue levels.

3.2.2 Reliability and comfort

Reliability in passenger travel time is introduced in both guidelines, with similar but different methodological choices. For passenger cars, aggregate indicators of travel time distribution are used and multiplied by specific values differentiated by trip purposes: standard time deviation for Germany and a delay distribution indicator time for France. For public transport, the German guidelines consider the number of delayed arrivals and the mean of delays, whereas the French ones use the magnitude of delays and their probabilities.

Comfort is taken into account explicitly only in the French guidelines, using time multipliers depending on the comfort level, but it can be argued that German guidelines may partially and indirectly capture them too, only for traffic shifts and induced traffic, when using the surplus corrective term (see 2.2.2 and 3.1.4).

3.2.3 Externalities (CO_2, environment, safety)

Both approaches consider externalities resulting out of accidents as well as emissions of greenhouse gases, air pollutants and noise. In the following reference values applied for assessing accidents and CO_2-emissions are compared exemplarily.

In Germany accidents cost rates include replacement costs, costs due to loss of resources and components for considering immaterial damages. In contrast to other European countries the latter component was not considered in any CBA approach for assessing transport infrastructure projects in Germany until FTIP 2015. This circumstance may result out of the German history of the twentieth century and the resulting ethical doubts concerning the valuation of human lives. For FTIP 2015 this component was determined by assessing the willingness to pay of users for reducing the risk being harmed by accidents (themselves or rather relatives and friends). Due to the additional consideration of this component accident cost rates raise significantly by above 100% and more depending on the degree of injury. Accordingly the cost rate applied for assessing fatalities is about 2.48 Million Euros (2012 values). Nevertheless the German cost rates are below the French ones. These differences may result out of the fact, that the German approach and its component for considering immaterial damages are based on values of the HEATCO-project whereas the French guidelines consider results of new surveys (OECD 2012 survey).

In terms of CO_2-emissions French value decreases from 32 to 100 €/ton in 2030 whereas in Germany a constant cost rate, 145 €/ton, is applied. The German value is determined for 2030 but should be used for the entire assessment period. Having the large range of issued values in mind, it can be said, that the German and French value for 2030 are very close to each other[6].

Beside the above mentioned externalities each approach considers additional impacts which are not part of the other one. In case of the French guidelines up- and downstream effects belong to these additional impacts whereas the German FTIP additionally considers separating effects of transport infrastructure inside urban areas and CO_2-emissions resulting out of the constructing, operating and deconstructing of transport infrastructures.

3.3 Governance, integration of CBA guidelines/studies with decision-process (planning procedures) and stakeholder consultation

3.3.1 Evaluation across all transport modes or assessment of single transport modes

The FTIP evaluates transport infrastructure investment across the transport modes road, railway and inland waterways. Therefore the assessment approaches for all three transport modes are similar or even identical.

French guidelines are also common to all modes, with some specificities.

3.3.2 CBA focus or integration of further evaluation modules

Both guidelines consider the relation between the diverse types of assessment studies but with different focuses. In Germany this is developed for the decision process, with explicit decision rules (see Fig. 6) whereas the Quinet report and French guidelines rather develop some methodological and practical coordination issues (see chapters 2.1, 2.3 and 2.4).

3.3.3 Place of CBA in the national decision process with its specificities

The FTIP forms the basis for the development and upgrading of transport infrastructure. It is prepared by the Federal Ministry of Transport and Digital Infrastructure (BMVI) and is adopted by the Federal Cabinet. Thereby it is a non-legislative act of intent and not a funding plan or program. Usually the FTIP is valid for 10 to 15 years or until a new federal transport infrastructure plan is published. Within this period the FTIP is reviewed usually every five years. The parliament decides about the FTIP by passing bills for the extension of the federal transport network. These extension acts are the basis for further administrative and more detailed planning steps.

In parallel the parliament decides about the general medium-term financial planning and the annual budget of the federal government. The medium-term financial planning includes an investment framework plan for the federal transport network and the next five years. Both annual budget and investment framework plan are the basis for the annual construction planning which is of course also influenced by the planning status and the prioritization of the projects.

[6] CE Delft-INFRAS (2011)

France had such a national planning process, every five years, for about fifty years beginning after the Second World War. The mandate of the Quinet report did not include the definition of official decision rules. In practice, the five year plans were accompanied from time to time by national infrastructure schemes (modal, then intermodal), issued by the State. More recently a national Commission was set up for proposing a more selective program of projects, taking in account the crisis and the related stringent budget constraints. But, since about 1990, there is no regularity in the timing of these infrastructure schemes, nor regular medium term plans. As a matter of consequence, the French guidelines provide no indication on how to prioritize the projects inside a comprehensive plan (apart from the recommendation to maximize the Net Present Value of the program), while the German guidelines provide recommendations for setting medium and long term programmes.

Official procedures are found at the individual project's level, beginning with public debates focusing on a project's opportunity or, rarely, more broadly on a transport problem (e.g. Vallée du Rhône transports, development and congestion), then developing all studies, stakeholder and public discussions, and public enquiries. What is specific to France is the compulsory ex-post studies made a few years after the project is implemented; results of these studies were quite useful for the Quinet report. The role of Parliament may be seen rather as budgetary regulation but they do not endorse lists of projects. A recent development, still underway, is the reflection on "participative democracy" which should improve stakeholder participation, upstream and in a more continuous way during the project's life.

Conclusion

As a whole, we see that the scope of CBA guidelines depends on the national decision framework and on the themes public debates are focused on. But the methodological issues addressed prove to be quite convergent, and confirm the needs for research on traditional topics such as externalities and value of time differentiation. They also show renewed interest on topics like the treatment of risks and uncertainties, or like the often disregarded issues of surplus calculation. Another feature is that CBA is not anymore considered in isolation but in interaction with other kinds of studies, and that its long relationship with traffic modelling is evolving, in search for better global consistency. Finally, the variety of choices made for some of the methodological issues, after trying to make out what is due to national specificities and what is not, may offer quite interesting food for thoughts in the methodological debate.

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APPENDIX 1 German guidelines - Details on the corrective term for modal shift or induced traffic (difference of implicit benefit)

From equitation (1) (see chapter 2.2) we get

$$\overline{GC^b_{implicit}} - GC^a_{implicit} = (p^a + \beta \times t^a) - \left(\overline{p^b} + \beta \times \overline{t^b}\right) \quad (2)$$

Switching from implicit user costs of the average switching user to implicit benefits of all switching users, equation (2) becomes

$$\Delta U_{imlicit,total} = \left(\overline{U^b_{implicit}} - U^a_{implicit}\right) \times \Delta x = \left[\left(\overline{p^b} + \beta \times \overline{t^b}\right) - (p^a + \beta \times t^a)\right] \times \Delta x \quad (3)$$

being

$\Delta U_{implicit,total}$ difference of implicit benefits of all switching users

$U^a_{implicit}$ implicit benefit of option a and the average switching user

$\overline{U^b_{implicit}}$ average implicit benefit of option b and the average switching user

Δx number of switching users.

This difference of implicit benefits is added to those benefits which have already been considered by the methodology of FTIP before. These benefits consist of differences of operational costs and travel time costs:

$$U_{operational} + U_{travel\ time} = \left(rk^a - rk^b\right) \times \Delta x + (\beta \times t^a - \beta \times t^b_1) \times \Delta x \quad (4)$$

$U_{operational}$ Benefits from operational cost savings

$U_{travel\ time}$ Benefits from travel time savings

rk^a specific operational costs of option a

rk^b specific operational costs of option b

t^b_1 travel time of option b after implementation of infrastructural investment

Therefore the total benefits U_{total} become

$$U_{total} = \Delta U_{implicit,total} + U_{operational} + U_{travel\ time}$$

$$U_{total} = \left[\left(rk^a - rk^b\right) + \left(\beta \times t^a - \beta \times t^b_1\right) + \left(\overline{p^b} + \beta \times \overline{t^b}\right) - (p^a + \beta \times t^a)\right] \times \Delta x \quad (5)$$

$$U_{total} = \left[\beta \times \left(\overline{t^b} - t^b_1\right) + \left(\overline{p^b} - rk^b\right) - (p^a - rk^a)\right] \times \Delta x \quad (6)$$

This is exactly the calculation resulting out of the welfare concept:

$$U_{total} = \Delta CS + \Delta PS$$

$$\Delta CS = \beta \times \left(\overline{t^b} - t^b_1\right) \times \Delta x = \beta \times \left(t^b_0 - t^b_1\right) \times {}^1/_2 \times \Delta x$$

$$\Delta PS = \left[\left(\overline{p^b} - rk^b\right) - (p^a - rk^a)\right] \times \Delta x$$

being:

U_{total} total benefits of infrastructural investment

ΔCS Change in consumer surplus due to the infrastructural investment

ΔPS Change in producer surplus due to the infrastructural investment