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Evolutions of the reference values used in transport CBA national guidelines of 3 countries and what they reveal

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Abstract

The paper presents, analyses and compares the evolution of reference values used in national guidelines issued for cost-benefit analysis of transport infrastructure projects, over the last fifty years, in France, UK and Germany.

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Keywords: cost-benefit analysis; reference values; guidelines; transport projects

1. Introduction

Socio-economic analysis of public investment projects has been made for more than fifty years in the USA and some European countries, usually beginning with transport projects. These analyses use reference values to account for the main effects of the projects, and values for externalities have been introduced progressively. This paper presents the evolution of reference values used in national guidelines issued for cost-benefit analysis of transport infrastructure projects, in three countries: France, UK and Germany.

Looking back over the last fifty years, we analyze the evolution of the main unit values, considering their nature and also the dynamics of their unit amounts. The results shed light on the evolution of collective preferences and

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economic knowledge during the last decades, as revealed by transport CBA guidelines. Each country is treated within a specific section, followed by section 4 devoted to the comparisons. But how do these thematic observations actually translate in the end at the level of a transport project? Section 5 presents simulations indicating how the same project would have been assessed using former guidelines, revealing how the diversity of valuation rules has or not a noticeable impact in CBA results. More precisely, we test two benchmark road projects and complete these simulations with a more in-depth analysis of CO2, before coming to the conclusive section.

2. Evolution of unit values in France

Since the 1950s, economics engineers of the French Ministry in charge of Transportation tried to assess economic value of projects by comparing the benefits of an operation with its costs. This method was first an administration tool for analyzing projects or project options. Then it was gradually used to justify choices made by public authorities when projects are submitted to public inquiry.

The French 1982 transportation law systematized and standardized a practice that had been widespread for nearly 20 years. It required an economic and social appraisal prior to any major transportation infrastructure project.

National guidelines for socio-economic assessment of transport infrastructure projects have been issued every 5 to 10 years during the last fifty years. The first ones were devoted to road projects; they encompassed all transport modes as of 1995. Over the last 20 years or so, they have been founded on the work of national commissions set up by the Commissariat du Plan and its successors, now France Stratégie: reports Boiteux I (1994), Boiteux II (2001), Quinet (2013) and thematic reports on CO2, biodiversity, etc.

2.1. Appearance and progressive differentiation of unit values

Monetisation of externalities was progressive; their chronological order of appearance is: value of time, operational and fuel costs, comfort, safety, then environmental externalities (CO2, pollution, noise, upstream impacts). Table 1 shows the evolution of these criteria's monetisation (a X in this table indicates that the criterion becomes monetised in the corresponding guideline). It must be noted that all these externalities, except climate change, were already mentioned in the first guidelines 50 years ago, even though they could not be monetised at that time due to the state of the art's limits.

The comparison of values over such a long time span is difficult because the indicators and units used for measuring the criteria may have changed. Similarly, differentiations are introduced progressively, for instance depending on transport modes and on the type of areas the infrastructures are built in. As an example, for noise impacts, both the computation method and the measure unit were modified, and the number of differentiation cases has grown a lot. Therefore it has not been possible to analyse the evolution of noise values other than qualitatively.

Table 1: Summary of the main differentiations introduced by each guideline

Guidelines (year)	1962	1964	1986	1995	2004/05	2014
Value of time	X			mode	Urban: purpose ; IdF Interurban: mode x distance	Interurban : purpose
Safety	X		Heavy/light injuries			
Road comfort		X				
Public transport comfort						X
CO2				X		
Reliability						X
Air pollution				X	Diffuse/dense urban	Very dense / intermediate urban
Noise				X		Traffic level x local density
Upstream/downstream effects						X

In this table: "IdF" means differentiated urban values for the Parisian region (Ile de France); "density" means: differentiation according to population density levels; "Mode, distance, purpose" mean differentiation by transport mode / trip distance / trip purpose. We will now compare the unit values defined or extrapolated for 2010 by each guideline, presented in the order they appeared in the guidelines.

2.2. Values given to these criteria and their evolution rules

In order to have a common reference for comparing the guidelines, values are considered for the comparison year 2010, expressed in euros 2010 and referring to the most similar differentiation cases.

Using a common reference year makes necessary to use the projection rules defined in each guideline over the assessment periods considered at that time, extended if need be up to 2010. When these evolution rules referred to observable variables, such as GDP per inhabitant, we applied the rule to the observed values for these variables in the meantime. Similarly, in order to get homogeneous and comparable values we used the information obtained between the guideline's year and 2010 (example: for the vehicles' occupancy ratio).

2.2.1. Value(s) of time

We will illustrate value of time using the case of personal road vehicle for an interurban trip. First, we observe that this value of time did not change much between 1961 and 2014. On Fig.1 we also see the effect of the differentiation introduced as of 2004, according to parameters such as distance or trip purpose: the dotted curves show the extreme values resulting from the most outward cases, the continuous curve giving the evolution of the "average representative case".

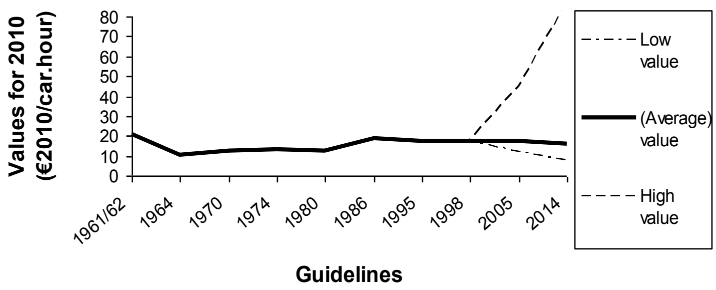


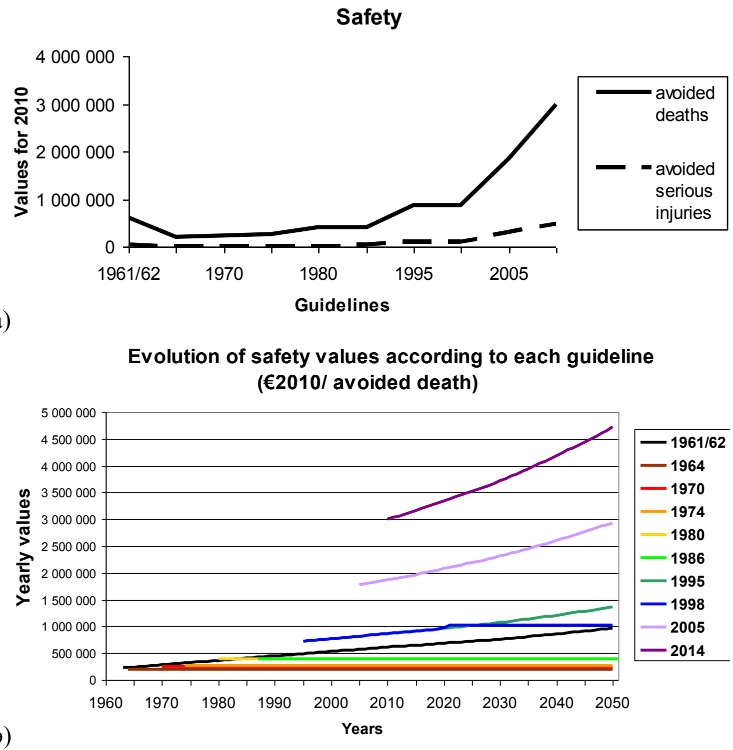
Fig.1 Personal vehicle value of time, interurban trip (veh.hr)

2.2.2. Operational and fuel costs

Operational costs include all mileage-related costs. Fuel costs are presented separately. They are supposed to be constant in all guidelines, except in 2014 guidelines. In the last guidelines, the values for operational costs have become non mandatory meaning it is up to the user to choose the value and its evolution rule. This new rule has been applied because of the volatility of these values that should be updated regularly but do not necessarily require to be agreed upon by a group of experts. Also, no evolution rule is mandatory for the evolution of fuel efficiency of cars and trucks. The evolution of operational and fuel costs has been quite stable over time compared to external costs values in Euro2010 except for the increase in fuel costs for trucks which is not as remarkable for cars since about 70% of cars in France use gasoline which is not as volatile as gasoil.

2.2.3. Safety

The evolution of safety values shows a completely different picture: the increasing trend is very clear, and accelerating in the last periods.



(a)

(b)

Fig.2. Safety unitary values (Euros2010) and their projections to 2050, according to different French guidelines.

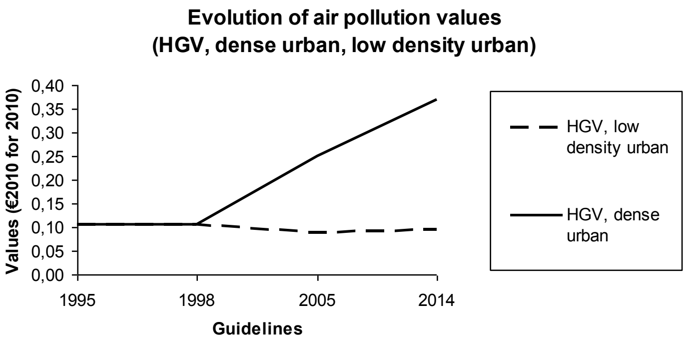
Since most of reference values are not considered to be constant prices, they are set jointly with evolution rules. Fig.2 and Fig.3b do illustrate how these rules changed and how they may impact over the project's long assessment period since the relative valuation of each impact changes over time in recent guidelines when they were constant until 1995.

2.2.4. Environmental externalities

Urban pollution values, introduced in 1995, became differentiated ten years later depending on local population density, with higher values for denser areas and an increasing trend (see Fig.3).

The last guidelines, in 2014, introduced some new environmental externalities: upstream and downstream effects and noise values in euro per vehicle-kilometer. Recommendations on upstream and downstream effects only include unit values for upstream energy production impacts ("from well to tank"). Concerning noise, the 2005 guidelines provided values based on hedonic prices which have not been used because they needed very precise data on local housing and their levels of exposure to noise. Providing noise values in euro per vehicle-kilometer, the new guidelines make the calculation of noise costs easier and noise impacts valuation has become mandatory.

CO2 values seem to be mildly increasing after their introduction in 1995 (+30% in 20 years). However, in the next section we check the influence of other CBA rules.



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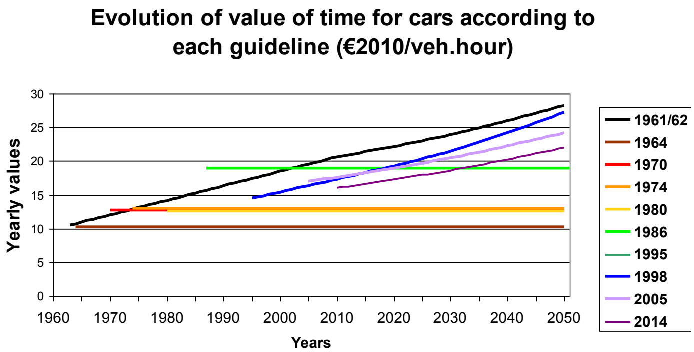

(b)

Fig.3. Values for air pollution (Euro2010) and value-of-time projections to 2050, according to different French guidelines.

2.3. Influence of other CBA rules

If using constant prices, fixed evaluation period duration and constant discount rate, the average discounted value of CO2 or any other reference value in assessment studies would be simply proportional to its 2010 value. But all these items evolved in the French guidelines, and for some values, CO2 being the more prominent, the impact on their weight in NPV is quite important, as Table 2 (expressed in Euro2000/tonne of carbon) shows.

Table 2: Illustration of the influence of CBA rules besides the base value

Guidelines (year)	1995	2004	2014
1ton carbon is worth, if spared in 2010 :	74Euro2000	100Euro2000 ; after 2010,+3 %/year	100Euro2000 +5,8 %/year from 2010 to 2030, then Hoteling-like
1 ton carbon/each year, all over the guideline's assessment period, is worth an investment of :	910 Euro	3 900 Euro	17 600 Euro

3. Evolution of unit values in Germany

In Germany budget legislation stipulates that economic assessments have to be carried out for larger investments on transport infrastructure. Therefore three approaches for cost benefit analysis on transport infrastructures have been developed since the early seventies. These approaches are:

1. Guidelines for economic analyses on road infrastructures since 1971 (applicable for road projects)
2. Federal transport infrastructure plan (FTIP) since 1973 (applicable for road, railway and inland waterway)

3. Standardized assessment procedure for investments on public transport infrastructure since 1976

This paper focuses on the first two approaches.

The FTIP forms the basis for the development and upgrading of federal transport infrastructure. It is prepared by the Federal Ministry of Transport and Digital Infrastructure (BMVI) and is adopted by the Federal Cabinet. It includes assessments for all projects which are under discussion at the time of FTIP´s preparation. For these projects construction works have not yet started. 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. The first FTIP was launched in 1973. As documentations about FTIP 1973 were not available the authors of this paper started their analysis with FTIP 1980.

The guidelines for economic analyses on road infrastructures are published by the Road and Transportation Research Association (FGSV). The FGSV publishes guidelines in order to support transport planners in their daily work. The guidelines for economic analyses on road infrastructures should mainly be applied for variant analyses of road projects. It includes a detailed description of the methodology which should be applied by practitioners, including all formulas, parameters and appraisal values. The guideline is updated irregularly.

Updates of both approaches benefit mutually although approaches are more or less independent from each other.

3.1. Appearance and progressive differentiation of unit values

The chronological order of consideration of major indicators within these two approaches is as follows:

- Value of time and operational costs of vehicles including all mileage-rated vehicle costs except fuel consumption
- Fuel consumption and safety
- Air pollution and noise
- CO_2-emissions

Besides these major indicators both approaches consider further impacts, e.g. separating effects of transport infrastructure in urban areas and CO_2-emissions resulting out of the constructing, operating and deconstructing of transport infrastructures. The following explanations concentrate on value of time, operational costs, fuel consumption, safety and CO_2-emissions. This restriction has been made due to the fact that units and approaches used for measuring air pollution and noise have changed several times and differentiations of their dimensions have been increased.

3.2. Values given to these criteria and their evolution rules

In general German approaches for assessing investment in transport infrastructures are based on the concept of real prices along the assessment period. Therefore appraisal values must not be projected along the assessment period when evaluating investments in transport infrastructure. Nevertheless the appraisal values are stated in prices of different years and they were determined based on data of these different years (e.g. oil prices of the respective years). Therefore they must be adapted in order to be comparable with each other. For this purpose values must be stated in 2010 prices (see section 2.2).

Furthermore values must refer to similar differentiation and identical dimensions. For example, VTTS must be specified for all kinds of passenger transport in the unit [Euro/vehicle-h]. In order to meet both requirements appraisal values were adopted in terms of prices, differentiation and dimensions. The following sub sections show results as well as descriptions of the calculations.

3.2.1. Value(s) of time

In Fig. 4 VTTS for passenger transport related to passenger cars is stated in the unit [Euro/vehicle-h]. The differences result from the diversity of the approaches applied for deriving these values. VTTS of some guidelines are based on the assumption that time gains would fully be spent towards productive uses, either directly or indirectly. However, values applied for other guidelines are based on the willingness-to-pay-approach for private trips and measured labor costs for business trips. Furthermore some of those approaches containing VTTS for business trips based on labor costs show large differences in terms of the percentage share of business trips.

In addition, some of the analyzed approaches distinguish between person-related VTTS and vehicle-related VTTS. Vehicle-related values have been transferred by vehicles' occupancy ratios stated in the respective approaches. Fig. 4 shows average values for all trip purposes and driving distances. The appraisal values have been converted into 2010 prices based on observed GDP growth rates.

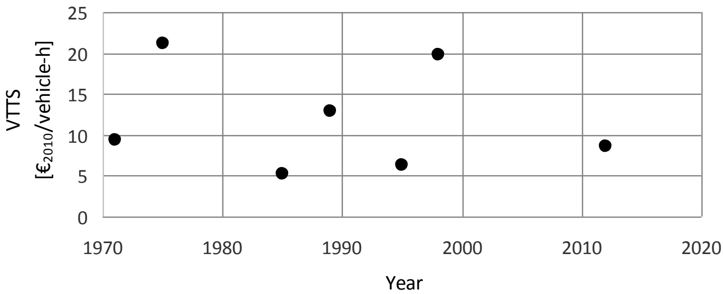

Fig. 4. Evolution of VTTS

3.2.2. Operational costs

Operational costs include all mileage-related costs. In general they do not include fuel costs. The only exception is the appraisal value for 1971, where fuel costs were integrated. Fig.5 shows average values for passenger cars for all kinds of trip purposes, road types and types of propulsion systems. Once again observed GDP growth rates have been applied for converting all values into 2010 prices. As observed for French values, operational costs have been quite stable over time.

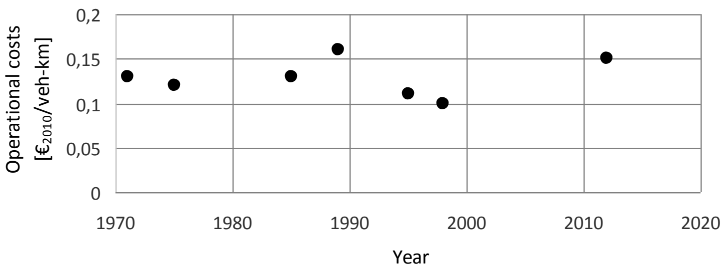

Fig. 5. Evolution of operational costs (without fuel consumption, except for 1971)

3.2.3. Fuel costs

Although all assessment approaches are based on the concept of constant prices, it is quite obvious, that the development of fuel prices underlies specific circumstances. Therefore forecasts of fuel prices were carried out when setting-up the methodological framework of the different assessment approaches. These fuel prices were or rather are used as average values along the assessment period without further adjustments.

Fig.6 shows diesel fuel costs of the different assessment approaches from 1986 until today. Fuel costs are always stated excluding taxes. The large differences of the values (especially between the value for 2000 and others) result out of the fact, that this value was worked out during the second oil crisis when oil prices increased up to 40 $/barrel at 1980 prices (whereas in the nineties oil price was below 20 $/barrel). Values have been converted into 2010 prices by observed and predicted growth rates of the oil price.

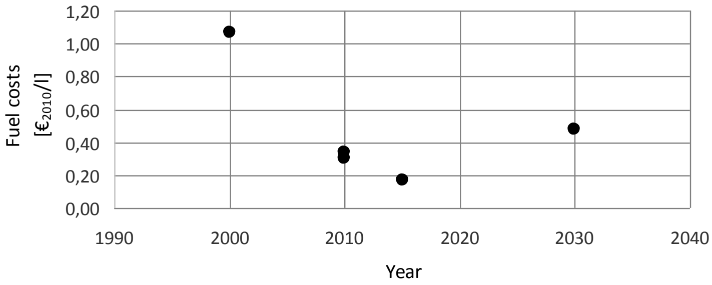

Fig. 6. Evolution of fuel costs

3.2.4. Safety

In terms of safety German assessment approaches evaluate impacts in terms of casualties and property damage. Up to FTIP 2015 appraisal values for casualties were based on costs resulting out of reproduction (e.g. health costs) and loss of resources. Costs resulting out of human suffering were not or only partly considered. Following international standards these aspects were taken into account when deriving appraisal values for FTIP 2015. Therefore it is not surprising that appraisal values for FTIP 2015 are significantly higher than those applied in former approaches.

The appraisal values given in Fig. 7 show the value of statistical life. They are converted into 2010 prices by observed GDP growth rates. This approach is based on the knowledge that costs resulting out of loss of resources are one of the decisive factors for the amount of the appraisal values.

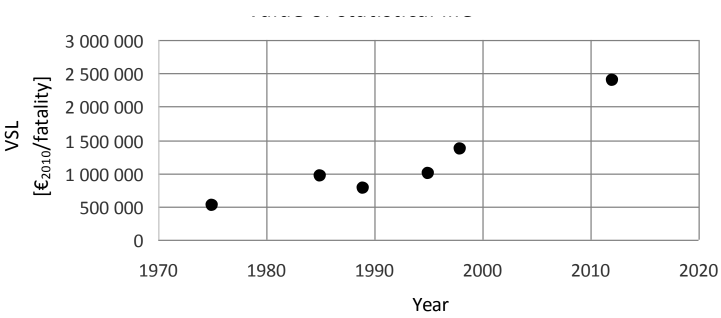

Fig. 7. Evolution of value of statistical life

3.2.5. CO_2-emissions

CO2-emissions were not considered until the middle of the nineties. Up to now there are several methodological approaches for quantifying these appraisal values. Therefore, it is not surprising that appraisal values for CO2-emissions show a wider variety than values for other indicators. Although FTIP 2015 is generally also based on the concept of constant prices, it was assumed, that damage costs due to CO2-emissions will increase strongly over the next years. Therefore, an appraisal value for 2030 has been derived in FTIP 2015. The values shown in Fig. 8 are converted into 2010 prices on the basis of observed and predicted GDP growth rates.

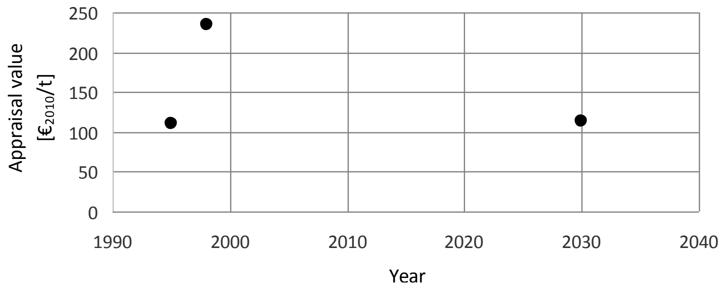

Fig. 8. Evolution of appraisal value for CO2-emissions

4. Evolution of unit values in United Kingdom

Table 3 shows the value of travel time savings as used in UK transport appraisal since 1970. The 1970 values were based on a revealed preference study of the choices made by a sample of travelers, while the 1988 study was one of the first in the UK to exploit the use of stated preference surveys as a method which would overcome some of the well-known deficiencies of revealed preference as a means of determining the value transport users place on saving travel time. The values currently in use are set out in the Department for Transport's WebTAG guidance (UK Government Department for Transport WebTAG Databook November 2014) and date from the 2003 study. A new study, to be published shortly, will revise these 2003 based values. Note that the values are quoted in 2010 values, in pounds per hour and, in brackets, in Euros per hour using the 2010 exchange rate.

Values of time for commuting and leisure trips do not differ between modes. The value of time savings for trips made in the course of work is based on the 'Cost Savings Approach', which uses data on the distance travelled by mode and average hourly earnings, plus a mark-up to allow for other costs of employment. Separate values are provided for professional drivers, including the drivers of buses, heavy and light commercial vehicle drivers.

Table 3: UK Values of Time from different research studies in use for project appraisal 1970-2015 in 2010 values and prices £ per hour (Euros per hour at 2010 exchange rate of 0.85)

Year of implementation of research findings	1970	1988	2003
Working time average across all modes	22.1 (Euro 26.0)	22.0 (Euro 25.7)	27.1 (Euro 31.8)
Non-working time average	5.52 (Euros 6.4)	9.5 (Euros 11.2)	
Non-working time commuting			6.8 (Euros 8.0)
Non-working time leisure			6.0 (Euros 7.1)

Values of time savings are updated from time to time to a new price base. This is done to make sure that the current values take account of actual growth in GDP per capita in place of the forecast value which is used to predict the future growth in the value of time and the growth of other appraisal values, such as the cost of accidents.

While most appraisal values, such as those used for accident costs and for noise nuisance, are assumed to rise in line with GDP per capita, carbon values and fuel costs are exceptions. The forecast change in carbon values is shown in the UK Government's Department for Transport's WebTAG Databook November 2014 table A 3.4. The fuel cost element of vehicle operating costs is derived from the forecasts made by the Department of Energy and Climate Change, together with assumptions about changes in vehicle efficiency and policies on fuel taxation. No 'ready reckoner' for vehicle operating costs is published. Instead, a U shaped cost function is used which provides a direct estimate of the value of changes in speeds (hence in costs), a change varying according to the characteristics of the road network and the level of congestion in the 'do-minimum' and 'with scheme' alternative options.

Values are also updated to take account of more recent data on transport users and transport costs. For example, the value of time for transport users travelling in the course of work (business travelers) is derived from an annual travel survey from which it is possible to derive an estimate of the mileage weighted incomes of people who travel for business purposes. If, after a few years of new data, the survey shows a change in the average incomes of those who travel in the course of business, then the base year value is revised. Similar considerations apply to the non-fuel element of vehicle operating costs.

New research studies have been commissioned every fifteen years or so to take account of possible changes in transport users' perception of time savings – as noted in Table 3, the findings from such studies were implemented in 1970, 1988 and 2003, with further revision to the values anticipated within the next few months following recently completed research. Values for accidents are based largely on studies carried out in the 1980s. These have been updated using studies carried out in the health sector. Values of air quality also depend upon research carried out by the Department for Health and are revised as and when new studies provide evidence for making a change to the values. Carbon values are the responsibility of the Department for Climate Change.

5. Comparisons

5.1. Comparison of criteria and differentiation

The main criteria for which reference values are defined at the national level are quite similar for the 3 countries although the process of editing guidelines and evaluating projects and infrastructure plans is quite different from one country to another.

Guidelines tend to evolve towards an increased differentiation of the reference values, so as to become more appropriate to the high diversity of the nature and specificity of the projects.

However, differentiation differs from one country to another. For instance in France, values of time become more differentiated than environmental values, which are still based on Euro per vehicle-km for air and noise pollution contrary to the German approach which works with thousands of emission factors, given in g per vehicle-km and corresponding appraisal values in Euro per ton.

One of the differentiation drivers is linked to the generalization of the geo-referencing capabilities of the traffic models.

Finally, all guidelines become confronted with problems linked with a high degree of differentiation: do the traffic models meet the technical refinement requirements which become necessary (do they take into account the influence of the differentiation criteria or not? In a consistent way with CBA?), Are the data sources adapted to the increased needs? Should the practical surplus calculations may be adapted and how?

The multiplication of criteria may cause problems too, for instance comfort or reliability depending on how they are treated in the traffic models. Also, criteria introduced for capturing WEBs raise the issue of risk of double counting or systematic biases; this is not a new problem, and it has already been discussed from a theoretical perspective, but it is increased in practice by the necessary use of traffic models and LUTI or other models: are they all consistent?

5.2. Comparisons of values and influence of other CBA rules

Values are remarkably close from one country to another, although differentiation and types of externalities might vary. Some environmental French values are mostly based on European studies and then modified for France in order to account for its specificity in terms of urbanization, GDP, types of cars, etc. However, since values are based on European studies and on a benchmark of values in similar countries, it is not surprising that values are of the same order of magnitude.

We will not focus on methodological comparisons in this paper, but we observe that the common approach is to start from actual observation of data or behaviors, then interpret it with such or such methodological tool before inferring the unit values. As a whole, French values tend to favor the use of revealed preferences methods and international benchmarks, whereas UK switched to stated preferences 30 years ago for values of time, and Germany has several methods as explained in section 3. For environmental externalities, the general evolution is towards a "bottom-up" approach covering more and more impacts (for instance, health impact of particles emitted, including morbidity), generally in terms of damage costs with exception such as abatement costs considered in the UK guidelines for NOx and in the French for CO2. Highly detailed bottom-up approaches, as mentioned above, lead some countries to use values expressed in terms of environmental pressure (e.g. number of tons of substance emitted) rather than with an average cost per vehicle.km.

As a whole we observe an increase in valuation of environmental impacts. For safety values, the general trend is also increasing in all countries. But for all 3 countries, values of time show a relative stability: over the last 50 years, they have been increasing slightly in France, it is rather the case also for UK, while German approaches show no definite trend on the evolution of value of time, with methodological changes which may have also had an impact.

Now besides the initial unit values, their evolution rules, defined in the guidelines for projecting them along the assessment period, can be very different. Thus, values on the long range might differ significantly from one country to another, since French or UK values generally increase over time while German values remain constant.

The influence of other rules in the guidelines may also be important for some components of NPV. Table4 shows the evolution of discount rates. Although discount rates tend to decrease in all countries, German discount rates have been lower than French ones, and this difference is increasing since French discount rates will increase for projects positively sensitive to macroeconomic variations (in GDP). Nevertheless, the fixed components of the most recent discount rates, as interpreted from the Ramsey formula, are quite close: 2,5% decreasing to 1,5% for France, 1,5% for UK and 1,7% for Germany. What differs seems to be the ”macro-economic premium” (0% for Germany versus 2% or 3% for UK and France).

Table 4: Discount rates adopted in successive national guidelines

	France	Germany		UK	
1961/62	7 %				
1964	7 %			1967	8%
1970	10 %	RWS 1971	7 %	1969	10%
1974	9 %				
1980	8 %	Bundesverkehrswegeplanung 1980	3 %	1978	7%
1986	8 %	RAS-W 1986	3 %	Green Book 1982	5%
		Bundesverkehrswegeplanung 1992	3 %	1989 then Green Book 1991	6%
1995/98	8 %	EWS 1997	3 %		
2005	4 % down to 3 %	Bundesverkehrswegeplanung 2003	3 %	Green Book 2003	3,5%
2014	4.5 % or risk-adjusted	Bundesverkehrswegeplanung2015	1.7 %		

For CO2, using as benchmark the value of 1 ton in 2030, we observe that the discounted value is 52Euro in 2015 for France, 108Euro in Germany and 51Euro in the UK. If we consider 1 ton of CO2 saved each year from 2020 until 2050, the nationally discounted value in 2015 is about 1600Euro for France, 3100 Euro for Germany and 2000Euro in the UK. This shows that using purely present reference values may be misleading for assessing the final weight given by the guidelines to the criteria under study, in actual project assessments.

5.3. Illustration on two types of road projects

In this sub-section we illustrate the quantitative impact that the combined evolution of unit values described above may have on road projects. We use here simplified projects, which may amplify the impact of some effects, these examples are purely illustrative and are not necessarily representative.

In each country, we illustrate how the same present project would have been assessed using former guidelines, revealing how the evolution of valuation rules has or has not that much of a noticeable impact in CBA results, depending on whether the reference values are high relative to costs and whether the relative values between each benefit varies or not over time. We tried also to compare between countries.

Still, what is meaningful here is not comparing the NPVs, but comparing the final picture (is the project judged to be good? bad? intermediate?) and comparing the relative weight of the criteria for which reference values are given. We express them as a percentage of the project’s cost, again in order to get stable comparison bases. Also, the comparisons are made with the values of each country but here CBA rules are the same for each evaluation: we keep the same discount rate and time horizon for all countries in order to analyze the specific impact of external values.

However, these rules can have a significant impact on valuation of each benefit. For instance, in France, Hotelling rule is applied to CO2 emissions and since other benefits are considered constant in the long run, CO2 benefits tend to prevail in the long run.

Since the historical evolution of unit values is less easily available in UK, uncertainty on the values actually used in the past was high and we could not include UK the project tests. Note also that air pollution was included only for French CBA tests since methods used in UK and Germany are more complex and would have needed highly detailed model data.

The two projects tested are rather different:

- the first one is an onsite improvement of a 32 km long two lanes road into a 4 lanes road,
- the second project is a 10 km long bypass project.

The onsite improvement project main benefits are the reduction of congestion and accidents whereas the bypass project reduces congestion in the town centre but also reduces air pollution and noise impacts on humans since the effects are moved to a less populated area.

We will now present the results of the tests, once again stating that they are not necessarily representative of average or most frequent cases, but mere illustrations of two common types of projects. First of all, both projects tend to be judged "mildly good" by the tests performed. Had we chosen a highly good or a quite bad project in terms of technical performances (time gains, safety,etc.), the test would have been less meaningful, having a less discriminating power. Here, except for a few guidelines which presented lower values of time (French guidelines from 1964 to 1980) or quite higher (German BVWP 1980) the general judgment of the projects tested is quite stable. The link with the value of time comes directly from the high weight of time gains observed for all the guidelines; still, this share tends to decrease as externalities' share increases. Please note also that the net share is not always representative of the potential weight of externalities, since some externalities may often go in opposite directions: for instance, a bypass may reduce noise and pollution in urban areas while increasing fuel consumption and CO2 emissions. Indeed, when computing the relative share of the sum of absolute values of externalities over the valuation of time gains, the last guidelines end up with high scores (about 40% for the onsite improvement test and 15% for the bypass test).

The boost of externalities' valuation is quite noticeable in the last decade (see Fig. 9). More precisely, safety valuation emerged first; in practice, its weight evolved depending on to conflicting trends: reduction of accidents rates and severity, versus high increase of unit values (in the tests, only the last trend is taken into account since all quantitative "physical" impacts are kept the same for all guideline tests). CO2 emerges as the major environmental externality (in quantitative terms) in CBA in the very last period. All these observations are common to both national guidelines although the precise figures may differ slightly.

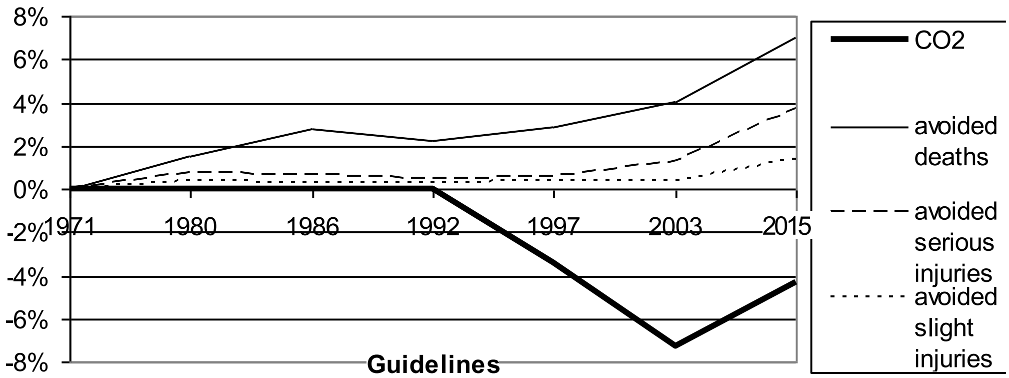

Fig.9. Evolution in German guidelines of the % of externalities over total investment cost, for a bypass project.

The tests' results also confirm the mild increase of values of time (except for the German car value of time which shows a more blurred picture, due to varying methodological choices concerning non-working trips and the percentage share of business trips), and sharp increases of safety and environmental values.

Another observation is that the relative evolution of values may also be important (Fig. 10): the high time gains of the 1961/62 guideline compared to the 1964 guideline in France, and the relatively high time gains as from 1986 come from a good part from the use of evolution rules (linked to GDP) along the assessment period in the guidelines concerned.

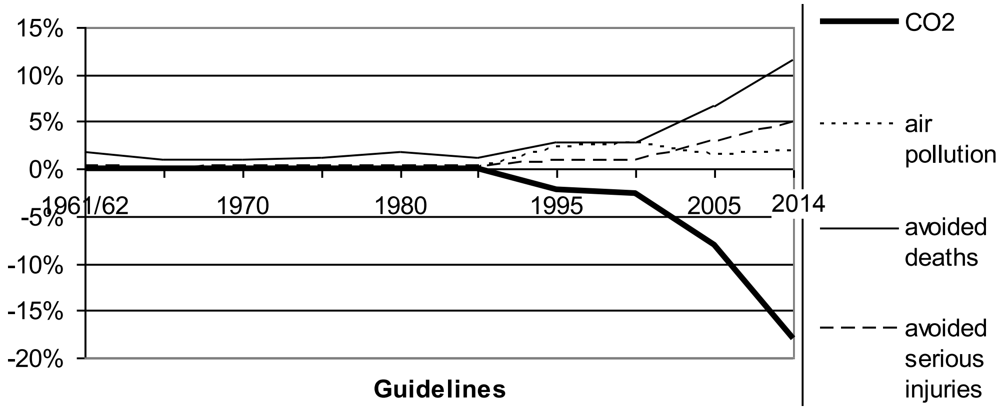

Fig.10. Evolution in French guidelines of the % of externalities over time benefits, for an on-site improvement project (from 2 to 4 lanes)

6. Conclusion

The nature of unit values used in transport CBA has evolved step by step, starting from classical items such as value of time and safety and evolving towards a more and more precise assessment of environmental externalities (noise, air pollution, ..) and even more global externalities (greenhouse gases). Within each nature of value, an increasing degree of differentiation of the values has also been observed. One of the more recent differentiation drivers is linked to the generalization of the geo-referencing capabilities of the traffic models and to their ability to estimate refined impacts such as pollution level at a very detailed scale, depending on traffic level and composition, population density or other local characteristics or variables. These refinements also induce an increased complexity which in turn, besides making benchmark comparisons highly difficult or impossible, makes also models and CBA results less easily explainable and understandable.

Finally, all guidelines become confronted with technical problems linked with a high degree of differentiation: do the traffic models meet the technical refinement requirements which become necessary (do they take into account the influence of the differentiation criteria or not? In a consistent way with CBA?)? Are the data sources adapted to the increased needs? Should the practical surplus calculations be adapted and how?

The multiplication of differentiation criteria may cause problems too, for instance for potentially related criteria like comfort and reliability in public transport, depending on how their reference values are estimated and how they are treated in the traffic models. Also, criteria introduced for capturing wider economic benefits raise the issue of risks of double counting or systematic biases. This is not a new problem, it has already been discussed from a theoretical perspective, but it is increased in practice by the necessary use of traffic models and LUTI or others: are they all consistent?

Looking back over the last fifty years, we have analyzed the evolution of the main unit values, which reveal how the prism of transport CBA has taken account of the evolution of collective preferences, together with technical breakthroughs and updates stemming from the observation of economic agents' behaviors. For the 3 countries, values of time are found to be quite stable in the average, compared to safety values or environmental values, which show much sharper increases, leading to an increasing weight of externalities relatively to time gains. More precisely, values of time tend to increase slightly except when methodological choices induce high variability, especially concerning non working trips, and CO2 emerges as the major environmental externality in the last period, while the potential weight of externalities is not anymore minor compared to time gains.

Since transport projects have long term effects, the guidelines often included evolution rules for the unit values in order to project them for all years included in the evaluation period, except for Germany. The combination of unit value updates and evolution rules updates shows interesting features which are emphasized when comparing impacts on a similar project. Simulating these evolution rules and values on two project examples has shown that the relative evolution of values is also important in order to assess the impact of new reference values.

Besides the factual observations and comparisons outlined above, a more methodological conclusion is that observing only the evolution of unit externality values does not necessarily give an accurate idea of the evolution of the importance given to this externality in each country, nor of the relative importance given comparatively in each country. It is necessary to take account of the evolution rules which are issued together with the updating of these unit values, and also to take account of specific CBA rules used for project evaluation, especially discount rates and the length of the evaluation period.

References

Boiteux, M., 1994. Transports : pour un meilleur choix des investissements: rapport du Commissariat général du Plan. La Documentation Française, Paris, France.

Boiteux, M., 2001. Transports - choix des investissements et coût des nuisances: rapport du Commissariat général du Plan. La Documentation Française, Paris, France.

Bundesministerium für Verkehr (publisher), 1980. Gesamtwirtschaftliche Bewertung von Verkehrswegeinvestitionen – Bewertungsverfahren für den Bundesverkehrswegeplan 1980. Bonn, Germany.

Bundesministerium für Verkehr (publisher), 1993. Gesamtwirtschaftliche Bewertung von Verkehrswegeinvestitionen – Bewertungsverfahren für den Bundesverkehrswegeplan 1992. Essen-Bonn, Germany.

Bundesministerium für Verkehr, Bau und Wohnungswesen (publisher), 2005. Die gesamtwirtschaftliche Bewertungsmethodik – Bundesverkehrswegeplan 2003. Berlin, Germany.

Chevassus-au-Louis, B., 2009. L'approche économique de la biodiversité et des services liés aux écosystèmes: rapport du Centre d'analyse stratégique. La Documentation française, Paris, France.

Forschungsgesellschaft für Straßenwesen (publisher), 1971. Richtlinien für wirtschaftliche Vergleichsrechnungen im Straßenwesen, Köln, Germany.

Forschungsgesellschaft für Straßen- und Verkehrswesen (publisher), 1986. Richtlinien für die Anlage von Straßen – Teil : Wirtschaftlichkeitsuntersuchungen. Köln, Germany.

Forschungsgesellschaft für Straßen- und Verkehrswesen (publisher), 1987. Kommentar zu den Richtlinien für die Anlage von Straßen – Teil : Wirtschaftlichkeitsuntersuchungen. Köln, Germany.

Forschungsgesellschaft für Straßen- und Verkehrswesen (publisher), 1997. Entwurf Empfehlungen für Wirtschaftlichkeituntersuchungen an Straßen. Köln, Germany.

Forschungsgesellschaft für Straßen- und Verkehrswesen (publisher), 1997. Kommentar zum Entwurf Empfehlungen für Wirtschaftlichkeituntersuchungen an Straßen. Köln, Germany.

Gollier, C., 2011. Calcul du risque dans les investissements publics: rapport du Centre d'analyse stratégique. La Documentation Française, Paris, France.

HM Treasury "White papers" and "Greenbooks", 1967, 1978, 1980,1982, 2003. HM Treasury, London, United Kingdom.

Lebègue, D., 2005. Le prix du temps et la décision publique : rapport du Commissariat général du Plan. La Documentation Française, Paris, France.

Le Maître, H., Meunier, D., 2014. L'évolution des valeurs d'externalités dans les projets de transport, in « Etudes § Documents » n°126. Commissariat Général au Développement Durable, La Défense, France.

Ministries in charge of transport for France, 1961 – 2014. Guidelines for CBA of transport projects. Paris, France.

Quinet, A., 2008. La valeur tutélaire du carbone: rapport du Centre d'analyse stratégique. La Documentation Française, Paris, France.

Quinet, E., 2013. L'évaluation socio-économique des investissements publics: rapport du Commissariat Général à la Stratégie et à la Prospective. La Documentation Française, Paris, France.

Rieken, P., Trosky, F., Goldmann, K., Mann, H.-U., Pohl, M., Nagel, K., Beckers, T., Liedtke, G., Winter, M., Kickhöfer, B., 2015. Grundsätzliche Überprüfung und Weiterentwicklung der Nutzen-Kosten-Analyse im Bewertungsverfahren der Bundesverkehrswegeplanung. Essen, Berlin, München, Germany.

Spackman, M., 2013. Government time discounting and required rates of return: UK history and current issues. Economic Affairs 33/2, 190-206.

Swales, K., 1997. A cost-benefit approach to the evaluation of Regional Selective Assistance. Fiscal Studies 18/1, 73-85.

UK Government Department for Transport - Transport Analysis Guidance: WebTAG, 2003-2015. London, United Kingdom.