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R. Joumard, Jp Nicolas

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Transport project assessment methodology within the framework of sustainable development

Robert JOUMARD* & Jean-Pierre NICOLAS**

* INRETS, Laboratoire Transports Environnement, case 24, 69675 Bron cedex, France, joumard@inrets.fr

** Laboratoire d'Économie des Transports, ENTPE, 1 rue M. Audin, 69518 Vaulx-en-Velin, France, nicolas@entpe.fr

Summary

Faced with a choice of different transport projects, such as road or rail infrastructure projects, which project is the most sustainable? We suggest a relatively simple and transparent evaluation method for such projects. First, transport issues within the sustainable development framework must be addressed, bearing in mind the strong meaning of the term, which is the only concept allowing environmental issues to be taken seriously into account. It also means linking local and global aspects, long and short terms, and thus to specify the time and geographical scales of projects and their impacts. Secondly, we put forward these main principles as evaluation criteria enabling the sustainable development concept to be made operational. We suggest three economic criteria, four social criteria and eleven environmental criteria, in addition to an aggregation method for these criteria integrating the social or political preferences of decision-makers or their representatives. A concern that is often significant in transport projects is the future of traffic mobility, whose main parameters we have analysed in order to put forward probable scenarios, which form the basis for applying the criteria listed above.

Key-words: evaluation, project, transport, sustainable development, indicator, aggregation.

Introduction

Faced with different options in a transport project, such as a road or rail infrastructure project, which one is the most sustainable? We suggest a relatively simple and transparent evaluation method to help choose from a sustainable development angle.

In 1992, the United Nations conference on the environment and development of Rio de Janeiro (UNCED, Agenda 21, chapter 40-4, 1992) already proposed that "Indicators of sustainable development need to be developed to provide solid bases for decision-making at all levels and to contribute to a self-regulating sustainability of integrated environment and development systems". Research has led to the proposal of general indicator systems in socioeconomic (Hardi and Muyatwa, 2000; Sharpe, 2004), or environmental fields (OECD, 2002a).

As in other fields, environmental indicators are often used to focus on transport sustainability (Gudmundsson, 2003), such as, for instance, the European indicator system TERM (EEA, 2008). Transport infrastructures, transport policies or mobility behaviour can be assessed by considering energy consumption only (Saunders *et al.*, 2008; Mathiesen *et al.*, 2008), together with some atmospheric pollutant emissions (Gallez *et al.*, 1998). Amekudzi and Khisty (2008) present the concepts of the sustainability footprint and sustainability footprint management as tools to take into account the environmental

impacts in infrastructure decision-making. The life cycle impact assessment can also take into account many environmental impacts (Goedkoop and Spriensma, 2001) and has been used to compare, for instance, different fossil and biofuels (Zah *et al.*, 2007).

However, the literature reviews show that there is quite a wide consensus on the three pillars of sustainable development, i.e. economic development, environmental protection, and social justice (Jeon and Amekudzi, 2005; Verry and Nicolas, 2005).

Another conclusion of these reviews is that the indicators can be divided into three categories according to their objectives: to help in the understanding of the running of the transport system, to provide data for managing this system (evaluation, performance, control), or finally to aid decision-making by ranking possible options. According to the aim, the indicators can differ and are not combined in the same way. Thirdly, continent, country or agglomeration levels are commonly taken into account, but not the microscopic level of an infrastructure, where most of the transport investment decisions occur.

Therefore, although more global assessments are useful for providing guidance to public policies, we focus on a methodology for assessing transport infrastructure projects for decision-makers in the framework of sustainable development. This research was made in the framework of the evaluation of different options of the development plan of road infrastructures in the western part of the Lyon agglomeration. The authors were approached to design the method by the working group of representatives and experts, which met regularly in the second semester, 2006. Nevertheless, the method is not developed specifically for road transport and can therefore be used to compare different modes of transport, as sustainable development often implies that an evaluation of transport projects should include modes of transport other than roads.

The first part presents the concept of sustainable development underlying the thought. The second part presents the proposed evaluation methodology. This leads on to a general methodological discussion.

1. Addressing transport issues within the framework of sustainable development

Our approach of sustainable development has to be quite consensual to be usable by the local stakeholders. It takes into account the economic, environmental and social dimensions inherent to each project. It insists also on the necessary link between short and long terms on the one hand, and on the other hand between local and global levels. As shown in the two next sections, this framework allows us to propose a coherent system of indicators. It remains open and transparent because the weight of each item is up to each user, but has to be explicit.

1.1. The three dimensions of sustainable development

Although simultaneously taking into account the three pillars of sustainability is commonly accepted today, without succumbing to radical ecology, it is nevertheless necessary to reverse the hierarchy still often implicit in evaluation practices with a priority on economic development rather than social and environmental concerns. With such an approach, the problems raised over these two dimensions are revised and corrected at best afterwards, once the decision has been taken.

In the long term, harmonious economic development can only be guaranteed if, first, the environmental and social priorities of public projects are respected. Should hierarchical links be drawn for these three spheres, the economic aspect, which is placed within the other two, would have to respect the constraints of the social and environmental aspects (Boulding, 1966; Costanza *et al.*, 1997). Passet (1979) symbolized this idea with three

circles included one inside another (See Fig. 1). Nowadays, the European legislation does include this priority by demanding that a strategic environmental evaluation procedure be included prior to any decision concerning projects likely to impact the environment (EC, 2001b).

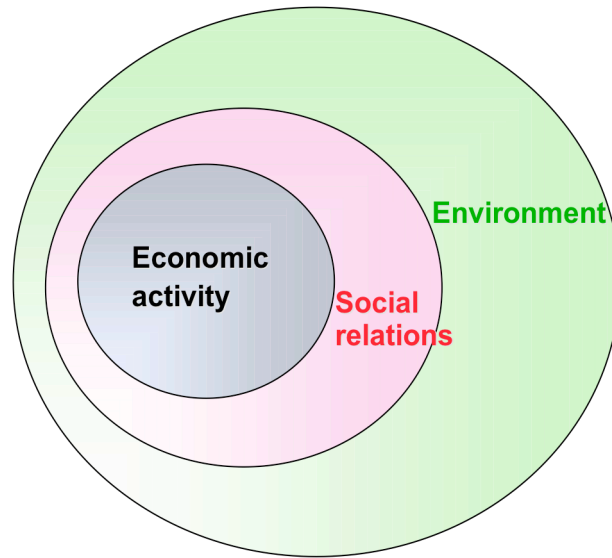


Figure 1: Hierarchy of economic, social and environmental spheres according to Passet (1979).

Thus, if we consider the current distinction between weak and strong sustainability (O'Connor, 1998), our research clearly belongs to the second approach.

1.2. Linking local and global considerations, the short and long term

In addition, an approach in terms of sustainable development must necessarily link correctly the time and spatial scales of the positive and negative impacts of the projects evaluated (Zuindeau, 2006; see Jourmard *et al.*, 2008 for the scales of the environmental impacts).

Geographical scales

Three scales are important: i) the local level with the proximity issues; ii) the urban regional level, and the coherence of the project with the transport and urbanism conurbation policy; iii) the global level with the impacts of the project on the national or even European network traffic on the one hand, and on the non-renewable resource and the greenhouse gas emissions on the other hand.

These different spatial scales also mean that expected complementary projects must be taken into account both at the conurbation level and at the global level. The coherence with other projects must be assessed from an environmental point of view to take into account cumulative impact.

Time scales

Traditionally, the connection between short and long term appears in the socio-economic evaluation of projects by a 30-year simulation of the expected traffic, especially within a high and low bracket evolution forecast of the GNP. Three points should be highlighted:

- Taking into account only variations of the GNP, as if we could still reason as we did during the *Glorious Thirty*, strikes us as being excessively reductive. It is absolutely necessary to make a determined prospective effort to design different future

possibilities and to assess the ability of the projects under consideration to adapt to these different contexts.

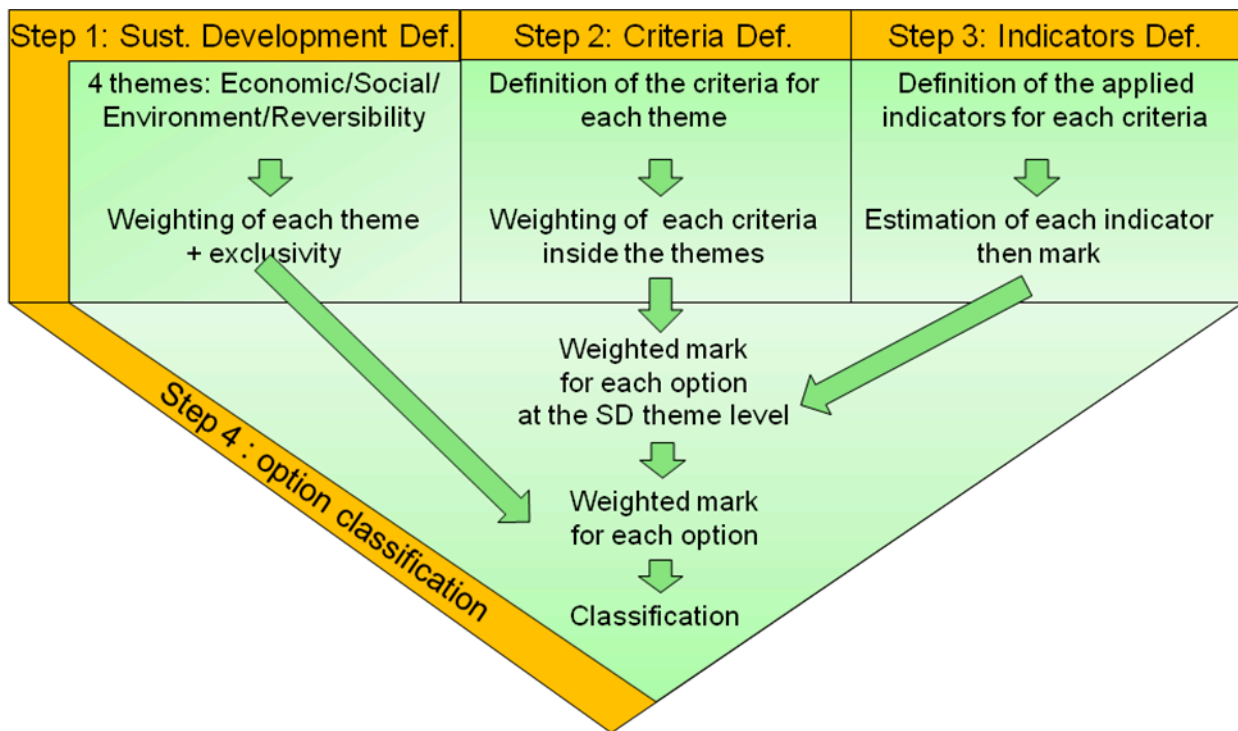
- A 30-year time scale seems quite satisfactory for the economic and social dimensions, since beyond that we are unable to imagine and represent forthcoming evolutions. However, it would be interesting to underline the very long-term environmental impacts of an infrastructure and existing possibilities to prevent them.
- Irreversibility: the theoretical infinite horizon would allow the irreversible nature of an impact to be taken into account, emphasized by the notion of sustainable development. An impact, however minor, can in fact become extremely penalizing if it is irreversible, especially when it concerns species rather than individuals.

2. Evaluating transport projects: what indicators for what methodology?

The major principles put forward in the first part have now to be transformed to make the concept of sustainable development operational. The importance of the sustainable development justifies the design of pertinent indicators and the collection of new data if necessary, though "in the name of pragmatism, the exercise consists often to reorganize existing information rather than to build systems allowing collecting really new data" (Boisvert, 2005: 167). Therefore we try to design a set of criteria and then of indicators representing in a synthetic way the different issues of sustainable development, whose structure or aggregation method illustrates the concept itself.

The proposed evaluation method is based on several works, either in the framework of a programme so-called "Prospective and indicators of environment", especially dealing with indicator aggregation (Adolphe *et al.*, 2006), on indicators of sustainable mobility (Nicolas *et al.*, 2003), or, more specifically, of the European actions COST 350 (www.rws.nl/rws/dww/home/cost350) and 356 (<http://cost356.inrets.fr>) on the environmental impacts of transport, and on the consultation dynamics put forward by the Canadian research team for different Tunisian economic projects eligible for the Mechanism for Clean Development (Baastel *et al.*, 2004). This method uses a formal procedure in four steps, each of them based on explicit collective choices (see Fig. 2):

- The first step concerns the definition of sustainability, where four dimensions are finally held: economic, social, environmental and reversibility to take into account the time dimension. All these dimensions are equally considered (same weighting), and therefore cannot affect each other (an improvement in one dimension is not compensated by a deterioration in another). For each family of criteria the impact on territorial planning, urban development and local demography, including urban spread, must be taken into consideration.
- The definition of the criteria to consider within each dimension, with a weighting of each criterion. The criteria must be clearly and thoroughly identified, not be redundant and correctly classified into one of the four dimensions, to be transparent.
- The definition of the indicator(s) to be used for each criterion to be selected for their representativeness. They may be quantitative or even qualitative. This step can be done by experts, but also within a research activity; the output is a grading of each indicator into five levels, from -2 (high degradation) to +2 (high improvement).
- Finally, the fourth step provides a synthesis of the previous ones.



Adapted from Baastel *et al.*, 2004

Figure 2: A four-step procedure to assess the options

2.1. Economic criteria

The traditional cost/advantage analysis, used in most European countries to assess transport projects (OECD, 2002b; Grant-Muller *et al.*, 2001), remains a pertinent tool if criticisms from social and environmental fields are taken into account, especially when the economic surplus is divided into major types of stakeholders:

- (eco 1) The *global surplus* corresponds to the discounted sum (based on the official discount rate) of the annual costs and advantages of the project calculated over a 30-year span starting with the opening of the infrastructure. It provides a synthetic figure which indicates whether the project is interesting or not for the community from an economic point of view. The environmental impacts should be assessed monetarily to be included in the result. But as they are considered in the environmental criteria, we suggest they should not appear here in order to avoid double counting. A common criticism of the discounting method is that the way economics takes into account the long term (Arrow *et al.*, 1996) is not adapted to environmental time scales (Heal, 1993, Nicolas *et al.*, 2005). We solve this problem within the environmental dimension with the irreversibility criterion (see below).
- (eco 2) Another criticism of the global surplus approach is that, on the one hand, it does not differentiate between the winners and the losers by aggregating economic losses and benefits (Banister, 1994), and on the other hand, the money unit used has a different value for stakeholders, especially because of different income (Arnsperger *et al.* Van Parijs, 2003). We answer the first point by differentiating the positive and negative surplus for different sub-groups (Faivre d'Arcier, 2004). Such a division distinguishes between road users, users of other modes, the State, local authorities, private investors involved and any other actors concerned in the project. The surplus variations according to stakeholder income correspond to the social dimension and are accordingly taken into account later.
- (eco 3) The *evolution of employment (including the farming sector)*, directly or

indirectly linked to the project, is often taken into account in evaluations. This must be done with caution as this criterion is already included in both previous indicators: the advantages generated by the project, and especially the induced traffic and time gain do already measure the expected economic dynamism from the "transport" angle. However, this criterion highlights a significant concern in times of high unemployment through the jobs created by the construction of the infrastructure (bound to disappear afterwards), those caused by the expected economic activity surplus, as well as the possible agricultural jobs lost due to land occupation.

2.2. Social criteria

- (soc 1 and soc 2) *Accessibility*: What is, specifically, access *to employment* (soc 1) on the one hand and *to major public services* (hospitals, administrative services ...) on the other (soc 2), measured either in terms of the number of opportunities reached in a given time using a private car or public transport, or in the necessary time to reach a given number of opportunities (Caubel, 2004)?
- (soc 3) *Environmental equity*: Who is exposed to local pollution, to noise and to the impact of habitat fragmentation?
- (soc 4) *Mobility cost*: The idea here is to measure the share of household revenue dedicated to daily mobility, according to income group and distance from the centre, and to see what the impact of the project might be, especially in the long term, if it causes localization changes (cf. for the Lyon area: Nicolas *et al.*, 2003; Vanco and Verry, 2009).

All of these social criteria should be assessed according to household type, and classified according to income group and geographical zone, the objective being to appreciate the degree of equity introduced for each potential scheme.

2.3. The environmental criteria

The discussion about theoretical criteria for addressing an environmentally sustainable evaluation refers to the common practices of Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA), as defined respectively by the European directives 85/337, modified by 97/11 and 2003/35 (EC, 2003), and 2001/42 (EC, 2001a). The first one considers the effects of projects on the environment; the second one stipulates that plans and programmes which are liable to have significant effects on the environment must be subject to an environmental assessment prior to their adoption. In the directives, SEA and EIA differ not by their methods, but by their application field (plans and programmes for SEA, projects for EIA, without covering policies). The directive 2001/42 does not refer expressly to the *strategic* evaluation, and does not describe the process of the *strategic* environmental assessment. The national transpositions of the directive 2001/42 show that the strategic aspect of the evaluation is usually not indicated, except for German and partially Irish legislations. The directive does not describe the methodological aspects but gives only a list of mixed targets and impacts, including the interrelationship between them and "secondary, cumulative, synergistic, short, medium and long-term, permanent and temporary, positive and negative effects".

The environmental criteria (Adolphe *et al.*, 2006; Goger, 2006) suggest taking into account the different kinds of impact on the environment, by favouring for each type of impact the homogeneity of the process leading from the source to the final impacts and the non-redundancy, whilst linking and incorporating the criteria together. On the basis of international research, and especially the actions COST 350 and 356, we will further detail these criteria hereafter, by giving their spatio-temporal scales, or even by providing an operational indicator:

- (env 1) *Local air quality*: This concerns sensitive pollution (smells and smoke), and direct sanitary impacts. Its main specificity is to be directly linked to the emission of pollutants, called primary, and not to secondary pollutants formed from primary pollutants. The geographic scale is the kilometre; the time scale is the hour as regards the impact on air quality, and is extremely variable with regard to the final impact, notably on health (from a second to a 50-year time scale). An indicator could take into account emissions of polyaromatic hydrocarbons, PAH, of benzene, of nitrogen dioxide, NO₂, and of fine particles, as well as exposure to air pollution (concentration x number of people exposed).
- (env 2) *Regional air quality* (photochemical smog): It is due to secondary pollutants. Its spatial scale is thousands of kilometres, and its time scale is the day. An indicator could take into account emissions of volatile organic compounds, VOC, and NO_x.
- (env 3) *Water quality, use and regime*: The spatial scale is the kilometre for the water quality itself, but is much more global concerning final impacts. One of the indicators could be the presence of a catchment area. The water system concerns the lowest water level, flooding, and piezometry.
- (env 4) *Natural and technological risks*: The spatial scale is multiple, taking into account on one hand the direct impacts of a catastrophe, which may appear on different scales (upstream and downstream flooding impact, for instance), but on the other hand chain catastrophes. An initial indicator is the presence of Seveso zones classed Z1 and Z2, and the presence of natural risk zones.
- (env 5) *Maintaining biodiversity and respecting protected sectors*: The spatial scale is the kilometre. The functionality of protected zones involves maintaining biological corridors to avoid isolating them by cutting them off from the rest of the ecosystem. An indicator could be the respect of the protected zone map at the regional level. The fragmentation criterion can be reached quite simply by means of cartographic analysis exploiting a geographical information system.
- (env 6) *Greenhouse gas emissions*: Its spatial scale is the terrestrial globe; its time scale is the century. Its indicator is the global warming potential, which balances the emissions of six pollutants, principally CO₂.
- (env 7) *Acoustic disturbance and light pollution*: Its spatial scale is the kilometre, the time scale being extremely short. Acoustic disturbance has two dimensions: on one hand high noise levels, typically in an urban zone (number of individuals subjected to a given level), and on the other hand the disappearance of calm zones in little-urbanized zones.
- (env 8) *Site, landscape and man-made heritage*: This refers to the habitat fragmentation, and the quality of the landscape, of the environment and the built heritage. Habitat fragmentation reduces the areas accessible to animals and to man. Furthermore, an infrastructure alters the landscape, especially when the latter is considered to be of high quality. Discretion and non-visibility of the infrastructure are then sought-after qualities unless the infrastructure may itself be an element of the landscape considered to be positive, a sort of monument. The spatial scale is the kilometre.
- (env 9) *Space consumption*: The land surface neutralized per type of usage may here be taken into consideration, the land occupation of the infrastructure and the waterproof surface. The spatial scale is the kilometre.

- (env 10) *Consumption of non-renewable raw materials, including fossil fuels*: We will first consider here the volume of primary hydrocarbons corresponding to the traffic generated, and secondly, the other aspects of the infrastructure's life cycle.
- (env 11) *Safety of residents and users*: The impact is short-term and short-distance. Three indicators may be used to measure it: the numbers of deaths, serious injuries and light injuries. It is necessary to avoid taking this criterion into account twice. Indeed, calculation techniques for the economic cost of the transport infrastructure generally include safety.

The indirect effects caused by the infrastructure (agricultural and forest land planning, urban spread, mushrooming of housing estates, increase of trips ...), must be taken into consideration as much as direct effects. These indirect effects are especially significant, even essential, for safety and for sectors where the natural environment, water and landscapes are high stakes. In the case of landscapes, referring to the scale used for land planning, the scale to be taken into account is 20 to 30 times the land occupation of the infrastructure.

2.4. Reversibility as a fourth pillar

In addition to its three traditional pillars, other themes often listed in relation to sustainable development have to be discussed.

Functional and strategic criteria are possible, such as the project's adaptability, the coherence with urban development policies, with other projects and existing projects. This should especially concern the combination of environmental impacts with possible synergies. These strategic criteria, however, must be secondary compared to the three sustainable development criteria mentioned above, to avoid making the sustainable development approach meaningless. The risk of such coherence criteria would indeed be that a prior policy implemented yesterday with non-sustainable principles would block any effort made today to adopt more sustainable policies. In addition, these criteria are already taken into account through economic or environmental criteria. We will therefore not be presenting them.

The decision-making mechanisms are also a main dimension of the sustainability. This concerns citizen information, respect of democratic principles, and citizen participation in the elaboration of the project. These criteria are an integral part of the method we put forward and enable social or collective preferences to be taken into account for the aggregation of criteria in a transparent way. They do not need to be taken into account as a new dimension.

Finally, we consider that the sustainable development in practical terms is part of the space and the territories on one side, of the time frame on the other side. The criteria presented above are largely able to take into account both these dimensions, except the uncertainty linked in essence to the future. To take into account this question of risk and uncertainty, two ways are proposed in the evaluation procedure: i) to build contrasted scenarios of the context evolution, taking into account not only the traditional GDP forecasts, but also forecasts for fuel prices or local socio-demographic variations, ii) to favour the project adaptability and the ability to easily come back if heavy and unforeseen impacts happen. For that, an additional criterion may be taken into account transversally:

- (dec 1) *Reversibility of the project*: This concerns the possibility of re-orienting, or cancelling the project once finished, according to future choices.

2.5. Implementing criteria

As shown by Turnhout *et al.* (2007), the development of indicators is an activity at the science policy interface. The aggregation or the weighting of criteria indicators is either arbitrary (when made by someone without legitimacy to do), or political/social (when made by a political representative or the citizens), but never scientific (i.e. made from knowledge in biology, ecology, physics ...). When so-called scientific hypotheses are made, for instance in the definition of ecological indicators or of the external costs, they express underlying political choices or are purely arbitrary: "Ecological indicators are shaped by political preferences and considerations to protect certain species, certain types of nature, etc. [...] [They] are therefore an expression of values" (Turnhout *et al.*, 2007: 218, 221). In the case of the external costs, international synthesis highlights wide divergence between countries, with very variable official values and environmental taxes, from less than 1% to more than 4% of the GNP depending on the OECD country (Nicolas *et al.*, 2005).

We suggest that within each of the four classes of criteria, each criterion should be balanced with a sum of weighting equal to 100. We thus obtain four grades corresponding to four classes. The implementation of these weighting coefficients may, for example, according to the means, require a survey of the population, as made for the Personal Security Index designed by the Canadian Council on Social Development (Tsoukalas and MacKenzie, 2003) or in the French case for environmental issues (Lambert and Philipps-Bertin, 2007), or require a report by experts. This weighting must be transparent and clearly posted. Weighting coefficients, for example, can balance the quality of local air, of regional air, noise, greenhouse effect ... according to the focus placed on each of these impacts. This focus is likely to evolve in the medium and long term. We can thus suppose that biodiversity, global warming and the consumption of fossil fuels will be far more pressing social and political preoccupations in 20 years time than they are now. We will therefore be able to evaluate projects in the light of present and future concerns.

The weighting of the criteria, within the three major economic, social and environmental classes may correspond to several logics. The weight of criteria is only meaningful when debated collectively by those involved in the evaluation. It is the prerogative of the political decider to choose his weighting, thus assessing on one hand the risks identified by experts and on the other hand citizens' preferences, which may not coincide, whilst stating his own choices as a responsible person according to the context. Taking into account our own sensitivity and the perception of environmental stakes by the French population, we suggest, as an indication, the weighting elements as shown in Table 1.

Next, we have to combine or synthesize these four classes of criteria. A first possibility would be to weigh each family of criteria to reach a final combined and unique indicator. However, this would mean considering high substitution ability in space and/or time between economic, social and especially environmental aspects. Any degradation of the environment could, for example, be compensated by an improvement of the economic sphere.

In these conditions, sustainable development is not tied to any ecological constraint. Hence, in view of what was indicated in the first part, it seems to us more sound to consider that a "sustainable" project must improve all economic, social and environmental aspects. Some even consider that, within the environment, each criterion must be improved independently of the others. For example, it would not be acceptable to compensate for the destruction of natural habitat with an improvement of the acoustic environment, and vice versa. We suggest more modestly that irreversible impacts (greenhouse effect, biodiversity) should not be combined with other impacts on the environment, but should be considered independently, environmental impacts having three notes: one linked to the greenhouse effect, one to biodiversity and a third to other impacts.

The five notes calculated (economics, social impact, greenhouse effect, biodiversity, other environmental impacts) must then systematically be higher or equal to their initial values. In other words, in relation to the current situation, any project which would globally deteriorate the economic wealth, social equity, the greenhouse effect, biodiversity, or other environmental aspects, would not be acceptable. If several projects or policies confirm this requirement for durability, we will then be able to compare these projects by applying the first weighting method.

However, in order to take full account of the priority given to irreversible environmental impacts, only the requirement of greenhouse and biodiversity improvement could be kept. To avoid major and irreversible effects on the environment, deterioration in the economic area, indeed in the social area or concerning reversible environmental impacts, could be accepted.

criteria			weighting		
eco 1		Global surplus	40	100	
eco 2		Variation in surplus of the economic actors	40		
eco 3		Employment evolution	20		
soc 1		Accessibility to (40)	employment	100	
soc 2			major public services		15
soc 3		Environmental equity	20		
soc 4		Mobility costs	40		
env 5		Biodiversity and protected sectors	isolated then 15		
env 6		Greenhouse gas emissions	isolated then 23		
Reversible Impacts	env 1	Local air quality	10	100	
	env 2	Regional air quality (smog)	10		
	env 3	Water quality, use and regime	10		
	env 4	Natural and technological risks	10		
	env 7	Acoustic and light disturbance	15		
	env 8	Site, landscape and man-made heritage	10		
	env 9	Space consumption	10		
	env 10	Consumption of non-renewable materials, energy	10		
	env 11	Safety	15		
dec 1		Reversibility of the project	100		

Table 1: First proposal of the weighting of criteria.

3. Discussion and conclusion

Because of lack of means, the working group on the western bypass of the Lyon agglomeration was not able to apply the method to the different options envisaged (DRE, 2007). Nevertheless, the method has been partially applied in the university by a group of students with local and detailed data. A unique option has been tested with a unique prospective scenario.

If the present commitments are honoured, i.e. very few interchanges in order that the infrastructure does not induce an urban spread and a new design of the town centre network (which today receives the transit traffic), especially including a capacity restriction to avoid new local trips, the first results show:

- From an environmental point of view, the impacts on the greenhouse effect are nil, and the impacts on biodiversity can be avoided by specific means. Locally, air pollution and noise on the bypass are compensated by improvements in the town centre.

- There is no real social impact, due to no noticeable change in local accessibilities and no induced urban spreading which could weaken some modest households, more exposed to gas price variations.
- Finally, from an economic point of view, the project seems acceptable, thanks to timesaving for bypass traffic. Therefore, its rate of return can vary greatly with the final choices to protect the local environment.

More generally, this text should be seen as a methodological tool for the strategic evaluation of transport projects or schemes. It is obvious that for major projects, the accurate development of the tool and its application to real planned cases is a relatively heavy task, which, in fact, corresponds to the challenges of sustainable development. Despite a lack of necessary means, a qualitative evaluation is still possible. It seems that it is best to qualitatively evaluate projects with approximate operational criteria and approximate aggregation mode, but respecting the principles put forward in this paper, rather than evaluating quantitatively and precisely only a few criteria. Indeed, the contribution of the concept of sustainable development is to take into account a set of extremely heterogeneous questions but synthesized in a systemic approach. To forget it is to forget sustainable development.

Finally, a subject bound to forecast difficulties and the development of higher transport demands inferred by transport projects has to be discussed in this conclusion, to remove any ambiguity concerning this question, to underline the lack of knowledge on transport and location interactions which limit any attempt of assessment, and to insist on the necessity of always integrating, upstream, the transport dimension into a wider planning approach of development.

From the economic point of view, a new infrastructure improves economic and social wealth, not only by way of gains for the former users but also by providing new opportunities of exchange, and thus new traffic. The traditional economic approach supplies here a solid theoretical framework to measure quantified pros and cons of the project. An explicit consideration of the other pillars of sustainable development enables its limits to be dealt with, for instance by integrating the measurement of environmental impact and the consideration of social disparities.

On the other hand, this new infrastructure is also going to have long-term effects, which are inadequately forecast, while the negative impacts should also be taken into account, for instance urban spreading generated by the increase of speed in the transport system during the 20th century. Therefore, discussion on the assessment method proposed in this article has to take account of two points:

- Research on the transport and location interactions constitutes an important stake and, more particularly in the case of our evaluative approach, the modelling works in this domain (Wegener and Fürst, 1999; Simmonds *et al.*, 1999; Hunt *et al.*, 2005).
- Any project to improve accessibility should not be reduced to the "transport" alternatives only: city and regional planning have here an important role to play, to which our assessment methodology, if widened in scope, could be applied.

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