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The importance of stakeholder analysis in freight transport

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Abstract

In this paper the multi actor, multi criteria analysis method or in short the MAMCA method is presented for the evaluation of transport project. In this method stakeholders are explicitly taken into account which is very important in the freight transport sector. Starting from an overview of evaluation methods, the paper comes to the integrated MAMCA approach. Several applications of this method are discussed.

Keywords: Freight transport; Evaluation methods; Multi criteria analysis.

1. Introduction

The evaluation of transport projects has become increasingly complex. Different aspects have to be taken into account and the consequences of the projects are usually far reaching and the different policy alternatives are numerous and difficult to predict. Several pressure or action groups have also emerged causing an even more complex decision making process. The use of multi criteria analysis for the evaluation of transport projects has increased due to this increasing complexity of the problem situation. The eclectic multi criteria analysis method developed by De Brucker (2000) for example enables to integrate different types of analysis tools used in transport project evaluation, such as the Environmental effect analysis, safety effects, economic impact analysis, etc.

At the same time, the importance of stakeholders within this evaluation process is been recognised. Research on transport projects is generally carried out to provide information to policymakers that have to operate within restrictive parameters (political, economical, social, etc…). Researchers should therefore take greater account of the different priorities of stakeholders such as policymakers, private enterprises and households (Van Ham and van Wee, 2003). These stakeholders should be incorporated explicitly in the evaluation process.

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The concept of stakeholders was first introduced in the management literature, where stakeholders have to be taken into account once a company or organisations has adopted the idea of corporate social responsibility (Donaldson and Preston, 1995 and Buysse and Verbeke, 2003). The broadest definition of the concept is found in the work of Freeman (1984) where a "stakeholder is by definition any individual or group of individuals that can influence or are influenced by the achievement of the organisation's objectives". In the context of transport policy this definition can be transformed in: stakeholders are those people who have a vested interest in a problem by affecting it or/and being affected by it (Banville et al., 1998).

Depending on the situation a more participatory process can be followed where the stakeholders can participate in the policy process (such as proposed by Rotmans and Van Asselt, 2000). The level of participation will depend on the resources and time devoted to the project, as it takes time and money to involve the stakeholders in the process. Also, not all stakeholders will be able or ready to participate in the policy analysis process and their participation might not even always be desired by the analyst. The participation of the stakeholders is however necessary if the quality of the decision can not be guaranteed by the analyst alone (because he or she has not the necessary information or if the problem is ill-structured). Consultation of the stakeholders or participation is then necessary. Another category of necessary stakeholder participation occurs when the decision is highly controversial and the acceptance rate low (Vroom, 1974). The most important is to identify them and to be aware of their stake and objectives. If the interests of the stakeholders are not taken into account the study or analysis will be ignored by policymakers or be attacked by the stakeholders (Walker, 2000).

In the next section the possible introduction of the concept of stakeholders in the existing evaluation tools for transport projects will be discussed. In section 3 a multi stakeholder, multi-criteria analysis methodology will be developed for decisions in the transport sector. Section 4 illustrates this methodology by applying it to some case studies.

2. Methods used for the evaluation of transport projects

Several evaluation methods can be employed for the evaluation of transport related projects. In this section an overview of these methods will be given and the adaptability of them to include the necessary multi-criteria, multi-stakeholder approach (as argued above) will be discussed. Five common used evaluation methods can be identified, namely the private investment analysis, the cost-effectiveness analysis (CEA), economic-effects analysis (EEA), the social cost benefit analysis (SKBA) and the multi criteria decision analysis (MCDA).

The private investment analysis (PIA) or private cost-benefit analysis, the cost-effectiveness analysis (CEA) and economic-effects analysis (EEA) are applied in specific cases. These three methods are however not interesting if we want to include stakeholders into the analysis. The Private cost-benefit analysis takes the pure financial cost and benefits of the project into account. It is being executed from the point of view of the private or public investor and does not take more broad objectives into account. The Cost-effectiveness analysis (CEA) looks at the effectiveness of the measure in terms of the costs that government puts in. The CEA has thus a uni-criterion, uni-actor perspective. It looks at the effectivity with regard to one specific goal. The economic-effect analysis (EEA) or Regional Economic impact study (REIS) looks at the projects' impact on added value, employment and fiscal revenue. Input-output tables are used and indirect effects are captured through the use of multiplicators. The EEA is specifically designed for the government perspective and takes only three criteria of this stakeholder into account (De Brucker et al., 1998).

The SCBA is grounded in welfare theory. It takes a wider societal perspective and in this sense it can also include the external costs of transport into the analysis. It is usually used when there are only a few possible alternatives to be examined. A discount rate is used to calculate the net present value and the internal rate of return of the project. All the costs and benefits have to be expressed in monetary terms. In some countries such as the UK, the social cost benefit analysis has been the only authorised evaluation model for transport projects. The aim is to come to a more comparable basis for different transport projects and to define to a framework of similar discount rates and appraisal methods. The monetarisation of all the effects however still remains a problem. Some of the external effects of transport are difficult to assess and translate in monetary terms (Button, 1993; Kreutzberger, Macharis and Woxenius, 2004). The SCBA is based on the compensation criterion. The introduction of a stakeholder analysis in a SCBA is in principle possible if the costs and benefits are structured according to the stakeholders. So for each stakeholder the costs and benefits would be listed and calculated. However, in the end of the process the costs of one stakeholder can be compensated by the benefits of another. The redistribution effects are not clearly coming out of such an analysis. This problem can be avoided by creating an end table per stakeholder so as to get a cost-benefit analysis of the project per stakeholder. The problem of monetarisation will however exclude many more subjective or qualitative costs or benefits from the analysis.

Multi criteria decision analysis (MCDA) provides a framework to evaluate different transport options on several criteria[1]. The idea of incorporating several decision makers in a multi criteria decision analysis is not new. Many methods have extended their methods and software for Group Decision support systems (GDSS). The PROMETHEE method for example has been extended in Macharis, Brans and Mareschal (1998); the Analytical hierarchy process (AHP) method in Saaty (1989), ELECTRE in Leyva-López and Fernández-González (2003). However the concept of stakeholders was not clearly defined in these extensions. The decision makers were referred to as players, parties or participants. The concept of stakeholders was first introduced in MCDA by Banville et al. (1998). As denoted by Banville et al. (1998) multi criteria analysis is useful for the introduction of the stakeholder concept. In their paper, a first framework for the introduction of the concept of stakeholders is introduced. They argue that certainly in the first three stages of a multi criteria analysis the concept of stakeholders can enrich the analysis, but they do not include the stakeholders within the methodology further on. In this paper a multi-stakeholder, multi-criteria analysis is proposed. It has been successfully applied in several projects for the evaluation of transport related strategic decisions.

[1] Some hundred methods exists for the aggregation of the evaluation (see Vincke, 1992 for an overview).

3. The multi-stakeholder, multi-criteria analysis evaluation framework

The methodology consists of 7 steps. The first step is the definition of the problem and the identification of the alternatives (step 1). The various relevant stakeholders are then identified as well as their key objectives (step 2). Second, these objectives are translated into criteria and then given a relative importance (weights) (step 3). For each criterion, one or more indicators are constructed (e.g., direct quantitative indicators such as money spent, number of lives saved, reductions in CO2 emissions achieved, etc. or scores on an ordinal indicator such as high/medium/low for criteria with values that are difficult to express in quantitative terms, etc.) (step 4). The measurement method for each indicator is also made explicit (e.g. willingness to pay, quantitative scores based on macroscopic computer simulation, etc.). This permits the measurement of each alternative performance in terms of its contribution to the objectives of specific stakeholder groups. Steps 1 to 4 can be considered as mainly analytical, and they precede the "overall analysis", which takes into account the objectives of all stakeholder groups simultaneously and is more "synthetic" in nature. Here, an evaluation matrix is constructed aggregating each alternative contribution to the objectives of all stakeholders (step 5). The MCDA yields a ranking of the various alternatives and gives the strong and weak points of the proposed alternatives (step 6). The stability of this ranking can be assessed through a sensitivity analysis. The last stage of the methodology (step 7) includes the actual implementation. The various phases are discussed in more detail below.

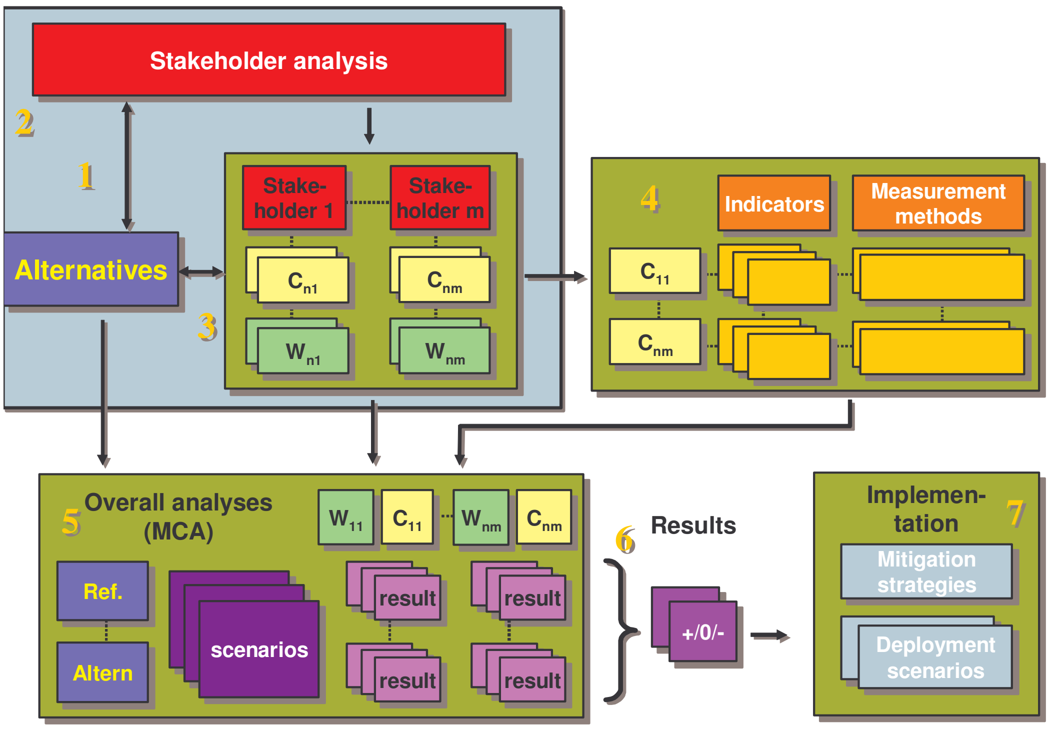

Fig. 1: Methodology for a multi-stakeholder, multi-criteria analysis (MAMCA).
Source: own set-up.

Step 1: Define alternatives

The first stage of the methodology consists of identifying and classifying the possible alternatives submitted for evaluation. These alternatives can take different forms according to the problem situation. They can be different technological solutions, possible future scenario's together with a base scenario, different policy measures, long term strategic options, etc. There should be minimum 2 alternatives to be compared. If not, a social-cost benefit analysis might prove to be a better method for the problem. In section 4 different examples are given.

Step 2: Stakeholder analysis

In the stakeholder analysis the stakeholders are identified. Stakeholders are people who have an interest, financial or otherwise, in the consequences of any decisions taken. An in-depth understanding of each stakeholder group's objectives is critical in order to appropriately assess the different alternatives. Stakeholder analysis should be viewed as an aid to properly identify the range of stakeholders to be consulted and whose views should be taken into account in the evaluation process. Once identified they might also give new ideas on the alternatives that have to be taken into account.

Step 3: Define criteria and weights

The choice and definition of evaluation criteria are based primarily on the identified stakeholder objectives and the purposes of the alternatives considered. A hierarchical decision tree can be set up (see section 4 for examples).

Several methods for determining the weights have been developed. The weights of each criterion represent the importance that the stakeholder allocates to the considered criterion. A description of these methods is given in Nijkamp et al. (1990) and Eckenrode (1965). In practice the pair-wise comparison procedure proves to be very interesting for this purpose. The relative priorities of each element in the hierarchy are determined by comparing all the elements of the lower level in pairs against the criteria with which a causal relationship exists. This pairwise comparison is done on a 1 to 9 scale.

In Table 1 several criteria (gj) are compared to each other in terms of their importance to the overall goal or focus F. PF(gj,gj') represents the preference intensity for a specific pair of criteria (gj, gj') in terms of the higher level element (c.q., the focus F). This preference intensity is measured on a scale from 1 to 9 as illustrated in Table 2.

Table 1: Pair-wise comparison matrix in the AHP.

F	g_1	…	…	$g_{j'}$	…	g_n
g_1	1					
…		[1]				
g_j			[1]	$P_F(g_j,g_{j'})$		
…				[1]		
…					[1]	
g_m						1

Source: Saaty (1988).

Table 2: Pair-wise comparison scale in the AHP.

Intensity of importance $Pg_j(a_i,a_{i'})$	Definition	Explanation
1	Both elements have equal importance	Both elements contribute equally to the criterion considered
3	Moderately higher importance of row elem. (RE) as compared to column elem. (CE)	Experience and judgment reveal a slight preference of RE over CE
5	Higher importance of RE as compared to CE	Experience and judgment reveal a strong preference of RE over CE
7	Much higher importance of RE as compared to CE	RE is very strongly favoured over CE, and its domin. has been demonstrated in pract.
9	Complete dominance in terms of importance of RE over CE	The evidence favouring RE over CE is of the highest possible order of affirmation
2, 4, 6, 8 (Intermediate values)		An intermediate position between two assessments
1/2, 1/3, 1/4, ... 1/9 (reciprocals)		When CE is compared with RE, it receives the reciprocal value of the RE/CE comp.
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining *n* numerical values to span the matrix
1.1-1.9	For tied activities	RE and CE are nearly indistinguishable; moderate is 1.3 and extreme is 1.9

Source: Saaty (1988).

The applied multi criteria-analysis method and software (see step 6) allow an interactive process with the stakeholders in order to perform sensitivity analysis.

Step 4: Criteria, indicators and measurement methods

In this stage, the previously identified stakeholder criteria are "operationalised" by constructing indicators (also called metrics or variables) that can be used to measure whether, or to what extent, an alternative contributes to each individual criterion. Indicators provide a "scale" against which a project's contribution to the criteria can be judged. Indicators are usually, but not always, quantitative in nature. More than one indicator may be required to measure a project's contribution to a criterion and indicators themselves may measure contributions to multiple criteria.

Step 5: Overall analysis and ranking

The MCDA method used to assess the different strategic alternatives can be any MCDA-method. Most of the cases discussed below are analysed with the Analytical Hierarchical Process (AHP). This method, described by Saaty (1982, 1988), allows to built a hierarchical tree and to work with pairwise comparisons. The consistency of the different pair-wise comparisons as well as the overall consistency of the whole decision procedure can easily be tested in the AHP that can handle both quantitative and qualitative data, the latter being very important for transport evaluations. Certain criteria in transport concern ecological impact or road safety issues. These criteria are difficult to quantify. Moreover, the method is relatively simple and transparent to decision makers and to the public. The method does not act like a black box since the decision makers and the stakeholders can easily trace the way in which a synthesis was achieved. The AHP is supported by a user friendly software package (EXPERT CHOICE), which makes it possible to determine not only the overall priorities of the alternatives studied but also to investigate the sensitivity of the final ranking.

It is also possible to work via profile charts if the pairwise comparison proves too difficult to manage (see Dooms and Macharis, 2004).

Step 6: Results

The multi criteria analysis developed in the previous step eventually leads to a classification of the proposed alternatives. A sensitivity analysis is in this stage performed in order to see if the result changes when the weights are changed. More important than the ranking, the multi criteria analysis allows to reveal the critical stakeholders and their criteria. The multi-actor, multi criteria analysis provides a comparison of different strategic alternatives, and supports the decision-maker in making his final decision by pointing out for each stakeholder which elements have a clearly positive or a clearly negative impact on the sustainability of the considered alternatives.

Step 7: Implementation

When the decision is taken, steps have to be taken to implement the chosen alternative by creating deployment schemes. This implementation process can be complemented by cost-benefit analysis for well-defined projects.

4. Case studies

The methodology can be applied in a very broad range of applications. In the area of transport it can be used for the evaluation of transport policy measures (such as the evaluation of mobility rights (Crals et al., 2004), infrastructure projects or the evaluation of transport technologies (such as the evaluation of advanced driver assistance systems, see Macharis et al., 2004). In this section, several recent applications of the methodology will be discussed in the area of freight transportation.

The methodology was first applied to evaluate the location of intermodal terminals (Macharis, 2000 and Macharis, 2004). The so called LAMBIT-model (Location Analysis Model for Belgian Intermodal Terminals) provided the framework for the decision-making process on the location of new intermodal terminals. In a preliminary phase the traffic potential of the terminal projects is determined. In order to have a sustainable terminal, the traffic potential in the surrounding area of the terminal must be large enough to support it. Furthermore, the impact of the new projects on the market area of the existing terminals must be analysed. A network model allowed the determination of the traffic potential and the impact on the existing terminals. In the risk analysis, the proposed locations were screened according to pre-determined standards (large enough for an intermodal terminal, grants by the local district, ability to get permissions, etc.). In the next phase a more comprehensive evaluation of a discrete set of terminal projects was applied. The criteria used in this evaluation represent the aims of the parties involved, namely the users of the terminal, the operators/investors and the community as a whole. The results of the analysis of the affected parties are brought together in order to get a global ranking of the projects. A sensitivity analysis closes the procedure.

In Figure 2 the decision tree is given. This tree shows the three stakeholders with their respective criteria and sub-criteria. For every criterion and subcriterion used in the model indicators have to be chosen that makes it possible to evaluate the alternatives on these criteria.

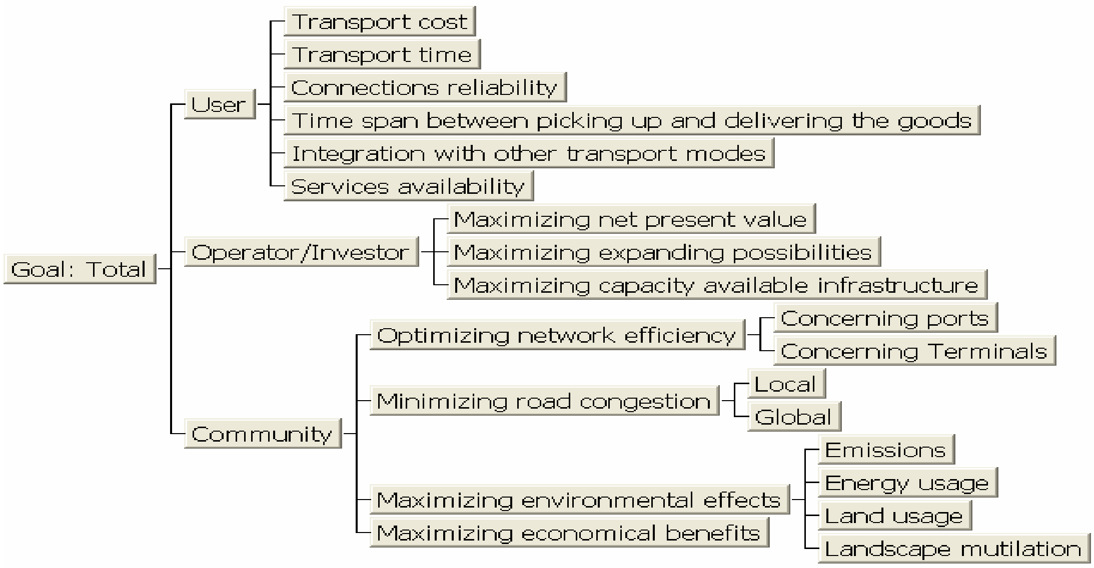

Fig. 2: Decision Tree in the LAMBIT-model.
Source: Own set up.

For the criteria of the operator/investor and more in particular the maximization of the net present value a cost-benefit analysis was used. The possible combination of multi-criteria with a cost-benefit analysis is very useful and expands the analysis. This combination of multi-criteria analysis, was also performed in the BRUGARWAT case study (Brussels Garbage by water), were the possible modal shift of waste transport in the Brussels region was analysed (Macharis and Boel, 2004). A social-cost benefit analysis was done in iteration with a multi-criteria analysis.

The social cost-benefit analysis made it possible to get an idea of the social desirability of the project, while the multi criteria analysis was used for the choice between the several possible types of package units that can be used. The alternatives were the ISO 20', 30' and 40' containers that compact the waste, ISO 40' open top containers and MSTS containers (multi service transport system) or bulk transport. For the Garbage operator (Net Brussel) the operational results (containers, ships, terminals, savings compared to road transport). For the local community the effects on visual intrusion, noise, smell and congestion are important. For the community as a whole the impact of the modal shift on accidents, global congestion, global noise, pollution and climate change were taken into account.

In the framework of the Masterplan of the Port of Brussels (Dooms, Macharis and Verbeke, 2004) the methodology was used in two types of applications. A first type of application was for a location analysis and planning for a separate port site (i.e. the site of Carcoke and Béco). In the Minimasterplan Carcoke for example the possible destinations of the site were compared to each other. The strategic alternatives were here an European distribution centre (EDC), value added logistics (VAL) or Recycling.

The second type of application was for the long-term strategic planning for the whole port area. For each port area the possible strategic development options were compared. This consisted of a pro-active and a status-quo scenario. Depending on the area different stakeholders were included in the analysis. Four main stakeholders are important in the context of port planning: government, local community, port authority and potential port users. A main stakeholder can be unbundled in several sub-categories with their own specific criteria (e.g. local community can be unbundled in tourists, residents, adjacent non-port firms and organisations) if the characteristics of a zone necessitate this approach. The definition of criteria for each stakeholder follows the approach followed for the definition of stakeholders: the criteria depend on the purpose, i.e. on the characteristics of each zone. This is very relevant for stakeholders, such as government and the local community, as their objectives often change throughout the port area. For example, in some port zones government objectives will be oriented towards economic development, whereas other port zones will be considered suitable for housing development and recreation. The objectives of the port authority and the port companies are much more stable, although there can be variations depending on port zone, but not as intense as for government or local community stakeholders. Another reason for this difference is that the port authority can be considered as 'identical' or 'univocal' over the whole port area, whereas the identity of local community stakeholders and sometimes even government (e.g. municipalities) can change depending on the considered port zone. The last step of the methodology consisted here in checking if the different strategic options proposed in each port zone were consistent with each other.

In Figure 3 the hierarchical decision tree is provided.

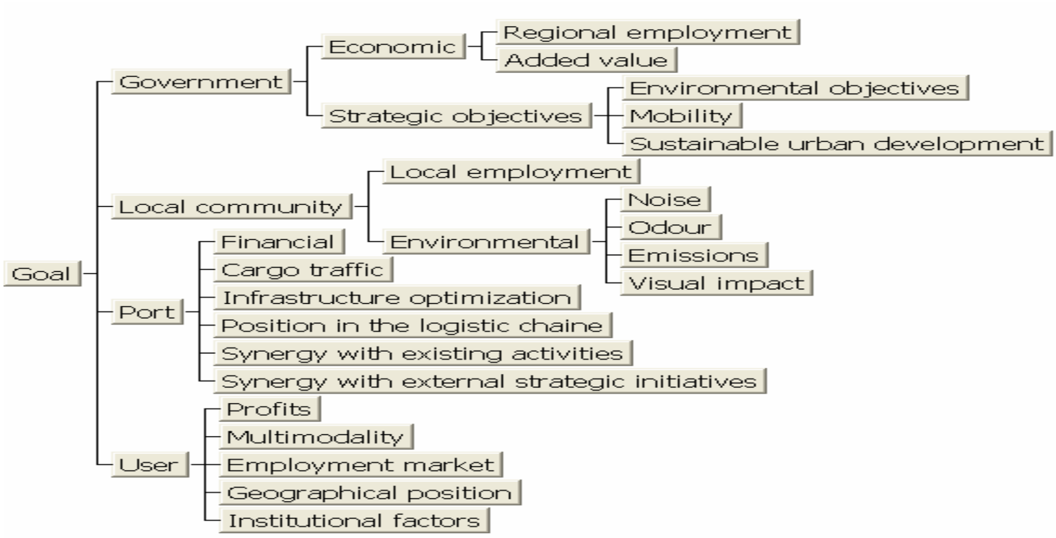

Fig. 3: Hierarchical tree for the Masterplan of Brussels (Béco dock).
Source: Dooms, Macharis and Verbeke, 2004.

The introduction of a new HST-terminal in Brussels (Macharis, Meeus and Dooms, 2004) was analysed according to the same methodology. Seven possible alternatives were proposed and compared. The stakeholders here were the railway operator NMBS, the government, the local community and the users. In Figure 4 the criteria for these stakeholders are given.

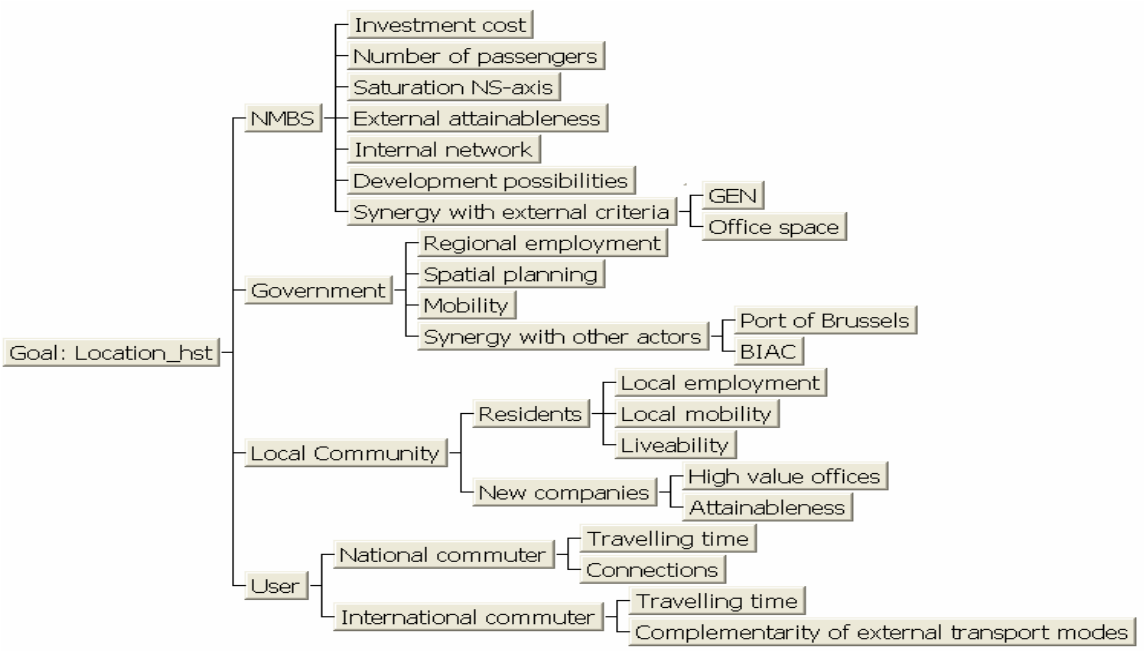

Fig. 4: Hierarchical decision tree for the evaluation of a new HST-terminal.
Source: Meeus, Macharis and Dooms, 2004.

A last and very interesting case was the evaluation of the possible extension of DHL at Zaventem International Airport (Verbeke, Dooms, Macharis and S'Jegers, 2004). This case has been reported extensively in the Belgian press during September and October 2004. The decision consisted in choosing between a pan-European consolidation strategy with Zaventem as superhub, a West-European expansion strategy with Zaventem as one of the multihubs or the further development of DHL in an external superhub, for example in Leipzig. The stakeholders in this case were DHL, BIAC the airport operator, the Government and the local community. Interesting in this case from a methodological point of view–next to the fact that the methodology highlighted very well the difficult decision making the government was involved in-was the introduction of time horizons into the analysis. With a 2012 time horizon (see Figure 5), the global preference was for the multihub expansion whereas when the time horizon moved to 2023 the global preference changed to the superhub (see Figure 6). This is due to the constraints of BIAC and also DHL itself to quickly grow in terms of capacity. In a longer timeframe, this does not pose any problems anymore.

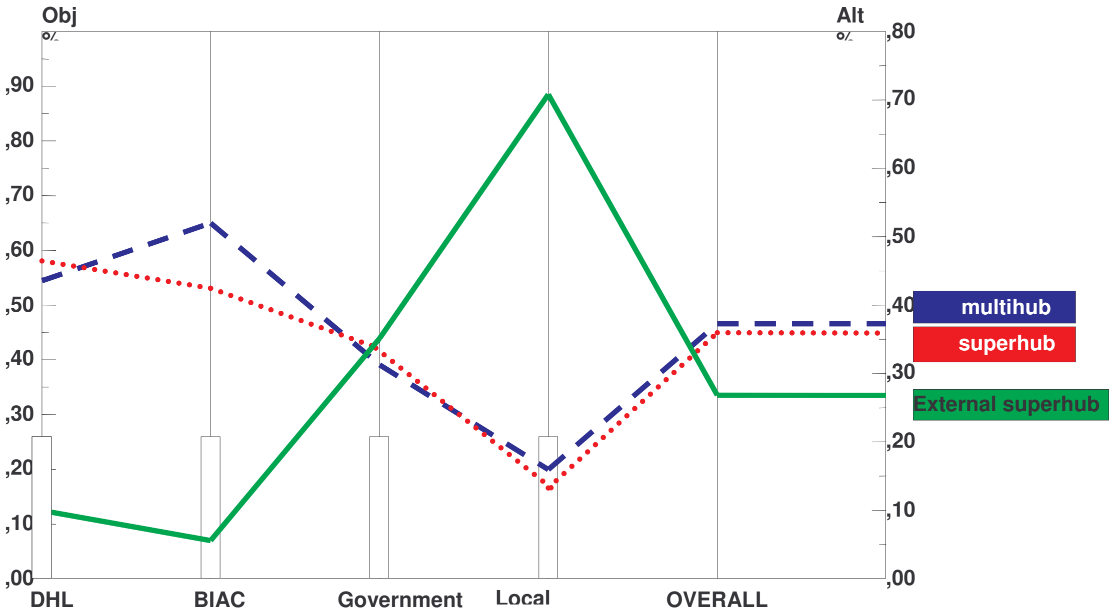

Fig. 5: The DHL case: time horizon 2012.

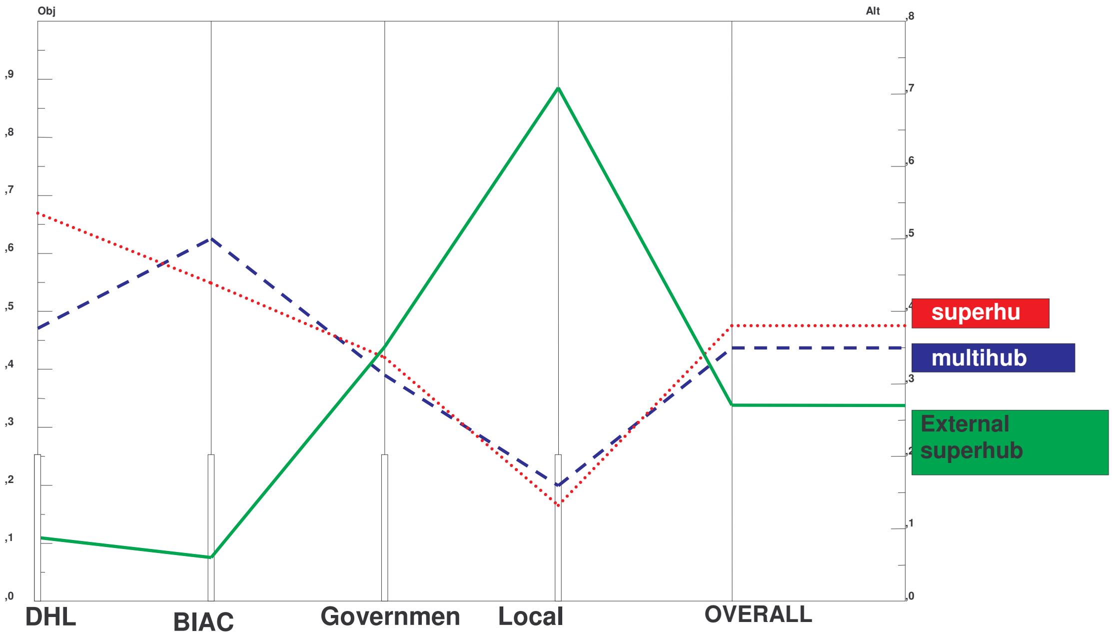

Fig. 6: The DHL case: time horizon 2023.
Source: Verbeke, Macharis, Dooms and S'Jegers, 2004.

The government had to provide a legal-institutional framework with horizon 2023 that could secure a long-term growth of the activity, especially after 2012. If not, the hub-activities of DHL would be relocated to another airport. In the short run, towards 2012, the multi criteria analysis showed that Zaventem had to be protected as a node in a multi-hub network of the company DHL.

5. Conclusion

For the evaluation of transport projects several stakeholders are involved and several criteria have to be included. The proposed methodology allows to incorporate these points of view and several criteria in the analysis. The methodology has been applied in a variety of projects, ranging from the evaluation of infrastructure projects to the evaluation of new technologies. Including stakeholders into the analysis takes more time in the beginning, but improve the likelihood of acceptance of the proposed solution will be higher in the end.

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