Ranking the substantive problems in the Dutch Cost-Benefit Analysis practice

Abstract:

This paper investigates the perceptions of key participants in the Dutch Cost-Benefit Analysis (CBA) practice regarding substantive problems when appraising spatial-infrastructure projects with CBA. Two research methods were applied. Firstly, 86 key participants in the Dutch CBA practice were interviewed in-depth in order to obtain an overview and a ranking of perceived substantive problems with CBA in the Netherlands. Secondly, the people interviewed were also asked to fill in a written questionnaire in which they were asked to rank the substantive problems once again, in order to improve the validity of the ranking; 74 of the participants completed this questionnaire. The most important conclusions of this paper are, firstly, that key participants in the Dutch CBA practice consider 'problems with the estimation of the non-monetized project effects' as the most important substantive problem cluster and 'problems with monetizing project effects' as the second most important substantive problem cluster. Secondly, key participants in the Dutch CBA practice consider the 'problem analysis' in a CBA to be a very important substantive problem. Thirdly, there is, in a broad sense, consensus among the different groups in the Dutch CBA practice concerning their perception of the seriousness of problem clusters and the way they rank the problem clusters. Fourthly, a large part of the substantive problems mentioned by the key participants in the Dutch CBA practice are non-specific CBA problems.

1. Introduction

In most western countries (Social) Cost-Benefit Analysis (CBA) is a widely used ex-ante evaluation tool used to support the decision making process in transport (e.g. Grant Muller et al., 2001; Hayashi and Morisugi, 2000; Odgaard et al., 2005; Vickerman, 2007). Nevertheless, many process and content related problems with the use of CBA in the decision making process can still be found in scientific literature (see section 2). To the best of the authors' knowledge, a systematic empirical analysis concerning the perceptions of different participants in a CBA practice on content related problems has not been carried out. A study of participants' perceptions can clarify whether substantive problems discussed in the scientific literature are actually experienced in practice.

In this paper we investigate the perceptions of 86 key participants in the Dutch CBA practice concerning substantive problems that arise when appraising spatial-infrastructure projects using CBA. We define the way welfare effects are estimated and the way the estimations are presented in the CBA reports as substantive problems. We attempt to identify which substantive problems key participants experience and what the relative order of importance of substantive problems is according to 86 key participants. Moreover, we aim to identify the extent to which perceived substantive problems are specific CBA problems or just problems related to any ex-ante policy evaluation tool. Finally, we aim to analyze to which extent different groups in the Dutch CBA practice (e.g. consultants, scientists, policy makers) perceive substantive problems differently. Our empirical results can be used as inspiration for CBA research agendas. When researchers take into account the perceptions of key practitioners by the determination of a CBA research agenda, this might enhance the acceptance of the use of the instrument in the decision making process.

The remainder of this contribution is organized as follows. Section 2 positions this paper in CBA-related transport literature. Section 3 discusses the research methodology. Section 4 presents the quantitative results regarding the ranking of substantive problems in the Dutch CBA practice. Section 5 discusses the perceived substantive problems in more detail. Section 6 analyzes the extent to which different groups in the Dutch CBA practice perceive the substantive problems differently. Finally, section 7 concludes and discusses the results.

2 Transport CBAs: an overview of literature

This section describes seven categories of transport-related CBA literature that we identified in some of the main transport-related journals (section 2.1). In section 2.2 we use this literature for clustering the empirical results with regard to the perceptions of key participants in the Dutch CBA practice on substantive problems (see section 3.3) and discuss the literature on (solutions for) substantive problems in more detail.

2.1 Seven categories of transport-related CBA literature

CBA is a popular research topic in transport literature. In general seven types of CBA literature can be identified. First, some contributions present a CBA of an (innovative) transport project (e.g. Cardell 1980; Nguyen-Hoang and Yeung, 2010; Rotaris et al., 2010; Saelensminde, 2004). A second category of transport-related CBA literature studies the impact of CBA results on decision making (e.g. Eliasson and Lundberg et al., 2011; Odeck et al., 1996; Sager and Ravlum et al., 2005). Third, some contributions reflect on the merits of CBA compared to other ex-ante evaluation methods (e.g. Sayers et al., 2003; Tsamboulas, 2009; Tudela et al., 2006). A fourth category of transport-related CBA literature compares different CBA practices (e.g. Bristow and Nellthorp, 2000; Hayashi and Morisugi, 2000; Odgaard et al., 2005) or describes a CBA practice (e.g. Lee, 2000; Quinet, 2000; Rothengatter, 2000). A fifth group of transport-related CBA literature reflects on the CBA process itself (Beukers et al., 2012; Damart and Roy, 2009; Gao et al., 2011). Sixth, some contributions discuss general theoretical problems of the CBA method (e.g. Ackerman and Heinzerling, 2002; Hansson, 2007; Hyard, 2012; Naess, 2006; Sen, 2000; Wee, 2012). Seventh, and finally, there is a wealth of literature on (solutions for) substantive problems.

2.2 Literature on (solutions for) substantive problems

Below, we discuss this seventh category of transport-related CBA literature in more detail. We selected transport-related CBA literature from the period 1995-2012 appearing in some of the main transport-related journals. In addition, contributions published before 1995 that were cited frequently are taken into account in our selection. It is beyond the scope of this paper to provide an exhaustive study of the transport-related CBA literature on (solutions for) substantive problems. Table 1 shows a brief overview of CBA related literature on (solutions for) substantive problems. Table 1 does not present the frequency of the studies that cover a category of substantive problems because the only aim of this overview is to identify which categories of substantive problems are studied in the literature and not which category of substantive problems is studied most frequently.

Table 1: Overview of categories of literature on (solutions for) substantive problems in some main transport-related journals.

Substantive problem categories	Example papers that study (solutions for) substantive problems
Reference case	Damart and Roy (2009); Mackie and Preston (1998); Quinet (2000)
Project alternatives	Quinet (2000)
Estimating non-monetized effects in general	Damart and Roy (2009); Grant-Muller et al. (2001)
Estimating non-monetized transport effects	Damart and Roy (2009); Flyvbjerg (2005); Flyvbjerg et al. (2005); Grant-Muller et al. (2001); Hayashi and Morisugi (2000); Holz-Rau and Scheiner (2011); Lee (2000); Mackie and Preston (1998); Morisugi (2000); Salling and Banister (2009); Ševcíková et al. (2011); Vickerman (2000); Van Wee (2007)
Estimating costs	Salling and Banister (2009); Van Wee (2007)
Indirect effects	Annema et al. (2007); Bristow and Nellthorp (2000); Grant-Muller et al. (2001); Morisugi (2000); Quinet (2000); Rothengatter (2000); Vickerman (2007)
External benefits	Brahten and Hervik (1997); Grant-Muller et al. (2001); Hayashi and Morisugi (2000); Quinet (2000); Rietveld (1994); Vickerman (2000); Vickerman (2007)
External costs	Forkenbrock (2001); Grant-Muller et al. (2001); Mandell (2011); Morisugi (2000); Quinet (2000); Rothengather (2000); Verhoef (1994); Vickerman (2007); Willis et al. (1998)
Monetizing in general	Annema et al. (2007); Damart and Roy (2009); Grant-Muller et al. (2001); Hyard (2012)
Value of time	Borjesson (2012); Brahten and Hervik (1997); Fosgerau (2007); Grant-Muller et al. (2001); Hayashi and Morisugi (2000); Hensher (2006); Holz-Rau and Scheiner (2011); Mackie and Preston (1998); Morisugi (2000); Lee (2000)
Value of statistical life	Grant-Muller et al. (2001); Hauer (1994); Holz-Rau & Scheiner (2011); Verhoef (1994)
Value of reliability	Hollander (2006); Peer et al. (2012)
Presentation	Annema et al. (2007); Damart and Roy (2009); Grant-Muller et al. (2001); Quinet (2000); Van Wee (2007)
Discounting	Annema et al. (2007); Grant-Muller et al. (2001); Weitzman (1998)
Distribution	Annema et al. (2007); Bristow and Nellthorp (2000); Hyard (2012); Lee (2000); Quinet (2000); Rothengather (2000)
Uncertainty in CBA	Annema et al. (2007); Damert and Roy (2009); Flyvbjerg et al. (2005); Grant-Muller et al. (2001); Holz-Rau and Scheiner (2011); Salling and Banister (2009); Ševcíková et al. (2011); Van Wee (2007); Weitzman (1998)

Table 1 shows that most contributions study (solutions for) a specific substantive problem. A few studies (e.g. Annema et al., 2007; Damart and Roy, 2009; Grant-Muller et al., 2001; van Wee, 2007) describe (solutions for) multiple substantive problems. Most studies base the analysis of (solutions for) substantive problems on analytical thinking or the authors' own experience in a CBA practice. We did not find a study with the same aim as this paper: empirically investigating perceptions of key participants in a CBA practice concerning substantive CBA problems.

3. Research methodology

This paper presents the perceptions of key participants in the Dutch CBA practice with regard to substantive problems. We have chosen the Netherlands for two reasons. First, the Dutch CBA practice is state-of-the-art and can be regarded as representative for many countries that use CBA as an ex-ante evaluation tool in the decision making process for infrastructure projects. Second, it is argued by Odgaard et al. (2005) that, within the European Union, the Dutch CBA practice is – together with the Danish CBA practice – the CBA practice that takes the highest variety of effects into account when constructing a CBA for infrastructure projects.

Two research methods are combined to study the perceptions. Firstly, 86 key participants in the Dutch CBA practice were interviewed in-depth in order to obtain an overview and a ranking of perceived substantive CBA problems in the Netherlands. Secondly, we sent a questionnaire to these 86 key participants, in which they were asked to rank the substantive problems once again in order

to improve the validity of the ranking of the substantive problems based on the interviews, which 74 participants completed. Below we present the methods in more detail.

3.1 Selection of respondents

In order to investigate perceptions from Dutch key participants of the substantive problems with the appraisal of spatial-infrastructure projects using CBA, the aim of the research was to interview the entire population of key participants in the Dutch CBA practice in the last decade. All individuals that had an explicit and recognizable role in the Dutch CBA practice in the last decade are included in this population[1]. First, we interviewed 10 consultants that carried out a number of important CBAs, 10 scientists/employees of assessment bureaus that reflected on important CBAs and 10 policymakers that actually use the CBA results. All 30 people were willing to participate.

The rest of the population of key participants in the Dutch CBA practice was detected and approached for an interview in two steps. First, the 30 respondents were asked which people, in their view – besides the people that were already interviewed – were paramount in order to be certain that the Dutch population of key CBA participants was interviewed for this research. The 30 respondents mentioned 51 people. 42 of these 51 people were interviewed. Next, the list of the 72 interviewed respondents was presented to four respondents that were often mentioned as key participants in the Dutch CBA process during the interviews. These respondents were asked to add to the list the names of the people that needed to be interviewed in order to make sure that all of the key participants in the Dutch CBA practice were interviewed. According to the four respondents, 20 people had to be interviewed to attain this objective. Finally, 14 out of these 20 respondents were interviewed.

In order to determine to what extent different groups in the Dutch CBA practice perceive the substantive problems differently, in the written questionnaire the respondents were asked to express their main specialization regarding CBA (economics, spatial-planning or ecology[2], transportation), main profession regarding CBA (consultant, scientist or researcher, policy maker or lobbyist[3]) and their most important role in the Dutch CBA practice over the last decade (initiator of a plan or lobbyist[4], someone who reviews and advises on funding applications, CBA practitioner, CBA reviewer, academic who studies CBA, developer of CBA guidelines). Because two of the three authors of this paper have extensive experience in the Dutch CBA practice it was possible to classify the 12 respondents who did not fill in the questionnaire. Table 2 classifies the respondents in relation to their main specialization, main profession and most important role.

Table 2: Respondents classified in relation to their specialization, profession and most important role.

[1] The second and the third authors of this contribution are part of this population; however they were not interviewed in order to avoid bias.

[2] From now on this group of respondents is labeled as ‘spatial planning’.

[3] (‘policy maker’).

[4] (‘initiator of a plan’).

Specialization	Profession	Initiator	Reviewer funding application	CBA practitioner	CBA tester	Academic study	Developer of CBA guidelines
Economics (44)	Consultant	1	0	8	1	0	3
	Scientist / Researcher	2	0	6	5	6	5
	Policy maker	0	5	0	1	0	1
Spatial Planning (17)	Consultant	0	0	0	0	1	0
	Scientist / Researcher	1	1	0	0	3	0
	Policy maker	6	3	1	0	1	0
Transportation (25)	Consultant	1	0	3	1	0	0
	Scientist / Researcher	0	0	1	0	3	4
	Policy maker	6	2	1	1	0	2
Total		17	11	20	9	14	15

Table 2 shows, for instance, that three respondents consider 'economics' as their main specialization, 'consultant' as their main profession and 'developer of CBA guidelines' as their most important role in the Dutch CBA practice over the last decade (second row down, last column).

3.2 Structure of the interviews

The interviews were qualitative, semi-structured, in-depth interviews (approximately one hour long). The interviews consisted of two parts. Firstly, the respondents were asked to mention the five most important substantive problems they experience with CBA. Secondly, we asked clarifying questions (e.g. What is, in your view, the exact problem? Why do you think this is a problem? Could you give an example of a CBA where the problem occurred?). In the second part of the interview the interviewer (first author of this paper) tried to challenge the statements the respondent made, in order to sharpen the arguments that the respondent used for the substantive problems he experiences; for instance, by confronting the respondent with contradicting statements made by other respondents.

3.3 Analysis of the interviews

Soon after the interview (within 24 hours where possible), the interviewer processed a report which then constituted textual data for analysis. The method used to analyze the data was content analysis. Content analysis has been defined as a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding and categorizing (Weber, 1990). To make the coding process transparent and replicable, we developed a 'coding and categorizing protocol' (42 pages long) in which the rules for coding are described. The content

analysis in this paper was carried out in two steps. The first step of the content analysis for this study was coding the substantive problems that were mentioned by the respondents in the interviews.

Because the aim of this paper is to inspire scientific research regarding solutions for substantive CBA problems, we are only interested in perceptions on (theoretically) solvable negative aspects of CBA. Hence, an important aim of the coding protocol was to clarify whether a respondent's perception on a negative aspect of the CBA could be defined as a (theoretically) solvable negative aspect or a (theoretically) insolvable negative aspect. In this paper, we label the (theoretically) solvable negative aspects as 'substantive problems' and the (theoretically) insolvable negative aspects as 'disadvantages'. For instance, when a respondent states that it is inherently impossible to take all welfare effects of a project into account in a CBA, this is characterized as a disadvantage of CBA and not as a substantive problem.

The second step of the content analysis in this study was the clustering of perceptions on substantive problems into problem clusters. First, the perceptions of substantive problems were classified into problem categories. The different problem categories were based on the literature (see section 2) and Dutch CBA guidelines (e.g. Eijgenraam et al., 2000). The demarcation of the different problem categories was described in the 'coding and categorizing protocol'. Next, the problem categories were grouped into problem clusters in accordance with the 'coding and categorizing protocol'. Having completed the two steps of the content analysis, it was then possible to determine which substantive problems are perceived by the Dutch CBA practice. Moreover, it was possible to rank the problem clusters by analyzing the number of times the respondents mentioned a substantive problem that could be categorized into a problem cluster.

The two steps of the content analysis were carried out by the first author (first coder). In some cases the first author was not sure whether a respondent mentioned a substantive problem, in other cases he was not sure in which cluster a substantive problem should be placed. In either of these cases the first author discussed the issue with the second author (second coder) until an agreement was reached.

3.4 Intercoder reliability

The intercoder reliability of the content analysis of the interviews was tested by an independent coder (third coder). The independent coder has some knowledge of CBA but is not a participant in the Dutch CBA practice nor has any involvement in this research. In accordance with the literature (e.g. Lombard et al., 2004) more than 10% of the body of content was tested by the independent coder (10 randomly selected out of the 86 interviews). More specifically, the third coder coded the perceptions of substantive problems in the 10 interviews and grouped them into problem clusters in accordance with the 'coding and categorizing protocol'. As a consequence, the reliability of both steps of the content analysis was tested. We think that it is important to test the reliability of the first step of the content analysis because this paper aims to provide an overview of perceptions of substantive problems. Moreover, we think that it is important to test the reliability of the second step of the content analysis because problem clusters are ranked in this paper by the number of times the respondents mentioned a substantive problem that could be categorized into a problem cluster.

We used Holsti's coefficient to assess the intercoder reliability of the first step of the content analysis (Holsti, 1969). The intercoder reliability of the second step of the content analysis is assessed

using Krippendorff's Alpha. We used Krippendorff's Alpha for two reasons. First, this agreement measure considers the possibility that coders cluster a substantive problem into the same problem cluster by chance. Second, Krippendorff's Alpha adjusts – in contrast to Scott's Pi, for instance – for small sample bias (Krippendorff, 2004; Riffe et al., 2005).

3.5 Written questionnaire used as validation

From the content analysis of the interviews, one can see which substantive problem clusters Dutch practice considers to be the most important with regard to the appraisal of spatial-infrastructure projects using CBA. As a form of triangulation (Erlandson et al., 1993), in order to improve the validity of this ranking, the respondents were asked to rank the problem clusters in the written questionnaire. 74 of the 86 respondents filled in the written questionnaire. The respondents were asked to choose the most important substantive problem cluster, the second most important problem cluster and the third most important problem cluster out of the problem clusters (Top 3 Analysis).

In addition, the respondents were asked – in the written questionnaire – to evaluate the quality of each problem cluster on a 5 point Likert scale. The respondents could state that they thought that the quality of the problem cluster was 'problematically low', that they were 'very satisfied' with the quality of the problem cluster, or something between these extremes.

4 Results: ranking substantive problems in Dutch CBA practice

4.1 Nine problem clusters

The coding of the 86 interviews resulted in 636 unique perceptions of substantive problems. As described in section 3.3 the different codes were grouped into problem categories. The 636 codes were categorized into 92 problem categories. Subsequently, it was possible to cluster the 92 problem categories into 9 problem clusters. These problem clusters are related to the so called seven 'CBA-steps' (figure 1).

The seven CBA steps start with the problem analysis (step 1). After that, one has to construct the reference case (step 2) and the project alternatives (step 3). By comparing the project alternatives with the reference case, one can estimate the non-monetized project effects of the project alternatives (step 4). In order to make the analysis a Cost-Benefit Analysis, the non-monetized project effects have to be transferred as far as possible into monetary terms (step 5) and the cash flows have to be discounted to one base year (step 6). Finally, the results are presented in the CBA report (step 7).

The eighth problem cluster is 'problems with distributional effects'. In a pure CBA, distributional effects are not (necessarily) taken into account. Nevertheless, some respondents think that it is important to have insight into these distributional effects for political reasons. When a respondent thinks that it is a problem that the CBA report does not pay enough attention to the distributional effects, the problem is assigned to this problem cluster. The ninth problem cluster is 'problems with uncertainty in CBAs'. The participants who make a CBA have to deal with uncertainty in different 'CBA steps'. The reference case, estimations of non-monetized effects and the discount

rate are uncertain. Some respondents experience problems with the way present Dutch CBAs deal with uncertainty. These perceptions are assigned to this ninth problem cluster.

4.2 Ranking substantive problems in the interviews

Figure 1 presents – for each problem cluster – the frequencies of substantive problems mentioned by the respondents that could be categorized into a problem cluster. Moreover, figure 1 presents (in *italics*) – for each problem cluster – how many respondents mentioned a substantive problem that could be categorized into a problem cluster.

Figure 1: number of codes / respondents per problem cluster

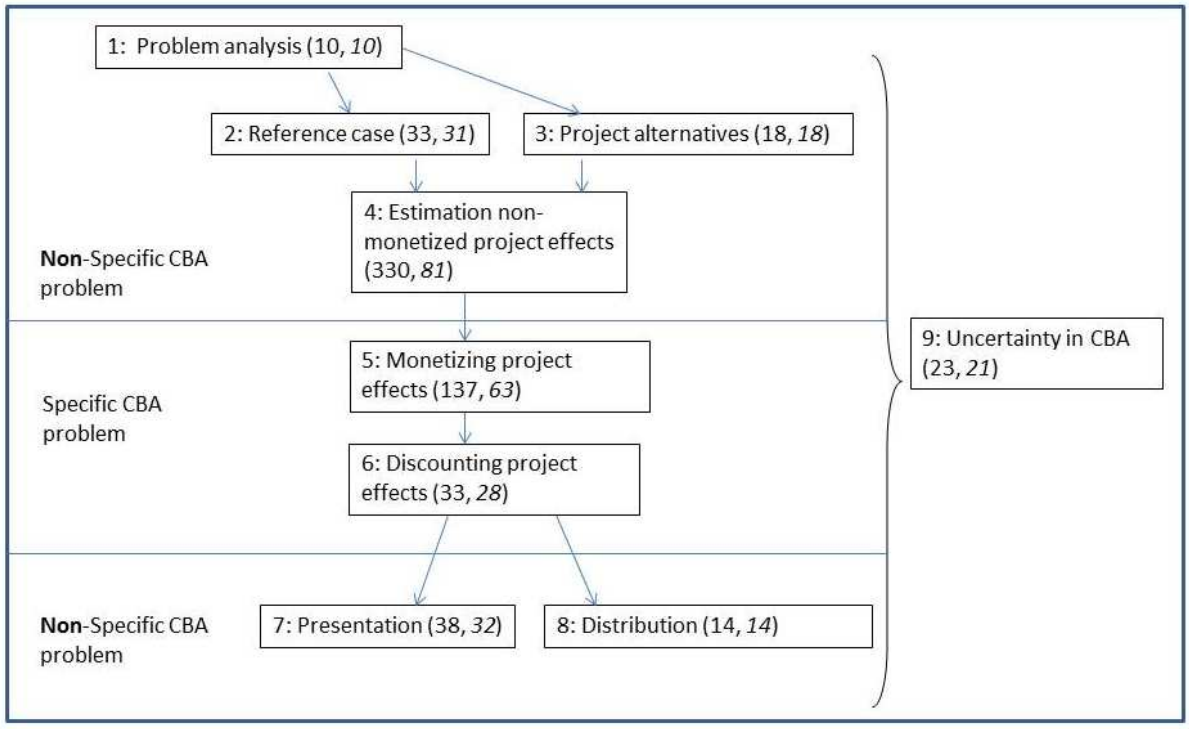

Figure 1 shows that most substantive problems mentioned by the respondents are clustered into the problem cluster 'problems with the estimation of the non-monetized project effects' (52%). Moreover, 22% of the substantive problems mentioned are clustered into the problem cluster 'monetizing of project effects'. 27% of the substantive problems mentioned by the respondents are specific CBA problems: monetizing of projects effects, discounting of project effects. A characteristic of a CBA in comparison to other ex-ante impact evaluation studies (e.g. multi-criteria analysis, cost-effectiveness analysis, environmental impact analysis) is that a CBA aspires to monetize and discount effects. The other ex-ante impact methods have to face the other seven problem clusters as well.

4.3 Results of the intercoder reliability test

The intercoder reliability of the results given in section 4.2 is tested in this study. The results of the intercoder reliability test are presented in figure 2.

Figure 2: results of the intercoder reliability test

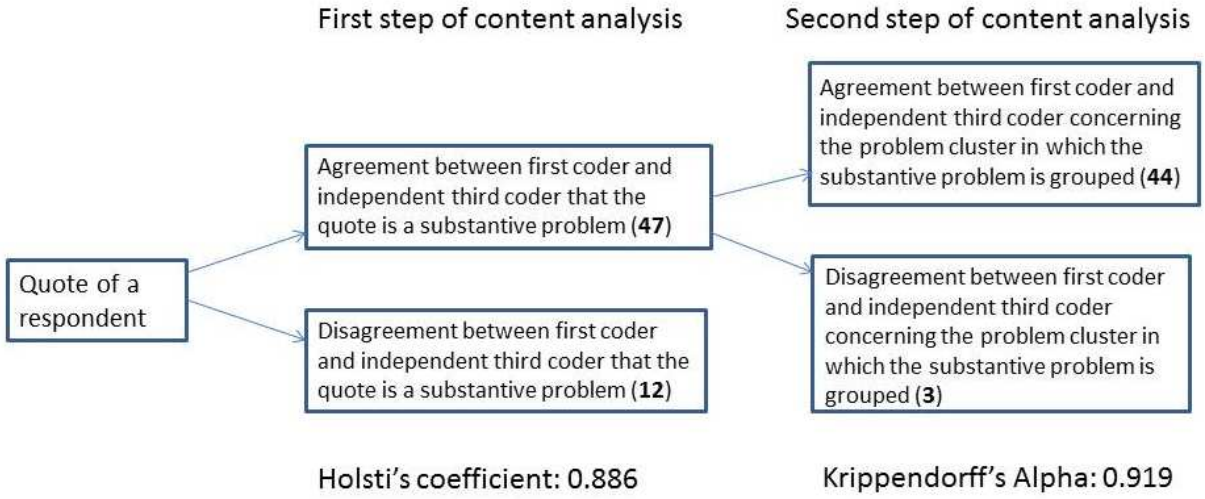

Figure 2 shows that the first coder and the independent third coder agreed 47 times that a respondent's quote must be qualified as a substantive problem and 12 times they disagreed. This results in a Holsti's coefficient of 0.886. For four of the twelve times that the coders disagreed, one of the two coders coded a quote of a respondent as a substantive problem, whilst the other coder coded the quote as a disadvantage. The first coder coded a quote of a respondent as a substantive problem 7 (presentation) five times, whereas the independent third coder did not code the quote. Moreover, figure 2 shows that Krippendorff's Alpha is 0.919 for the agreement of the two coders concerning which problem cluster a substantive problem should be grouped under.

The next question is whether or not it can be determined that the coefficients of 0.886 (Holsti's coefficient) and 0.919 (Krippendorff's Alpha) should lead us to the conclusion that the content analysis in this study is reliable. Lombard et al. (2002) state that there is no established standard for determining an acceptable level of reliability. Neuendorf (2002, p.145) reviews 'rules of thumb' set out by several methodologists and concludes that 'coefficients of 0.90 or greater would be acceptable to all, 0.80 or greater would be acceptable in most situations and below that, there exists great disagreement.' We conclude that the results of section 4.2 are highly reliable and not the result of a purely subjective process. However, there are reliability problems with the number of times problem cluster number 7 (presentation, see figure 1) is coded by the first coder. As a consequence the frequencies of substantive problems that are grouped into problem cluster 7 should be interpreted with caution.

4.4 Ranking substantive problems in the questionnaires

To check the validity of the results in section 4.2, the respondents were asked – in the written questionnaire – to select the most important substantive problem cluster out of the nine problem clusters, the second most important problem cluster and the third most important problem cluster (Top 3 Analysis). 73 respondents completed this question in the questionnaire. Figure 3 presents the results of this 'Top 3 Analysis'.

Figure 3: number of respondents that select the problem clusters as a 'top 3 problem cluster'

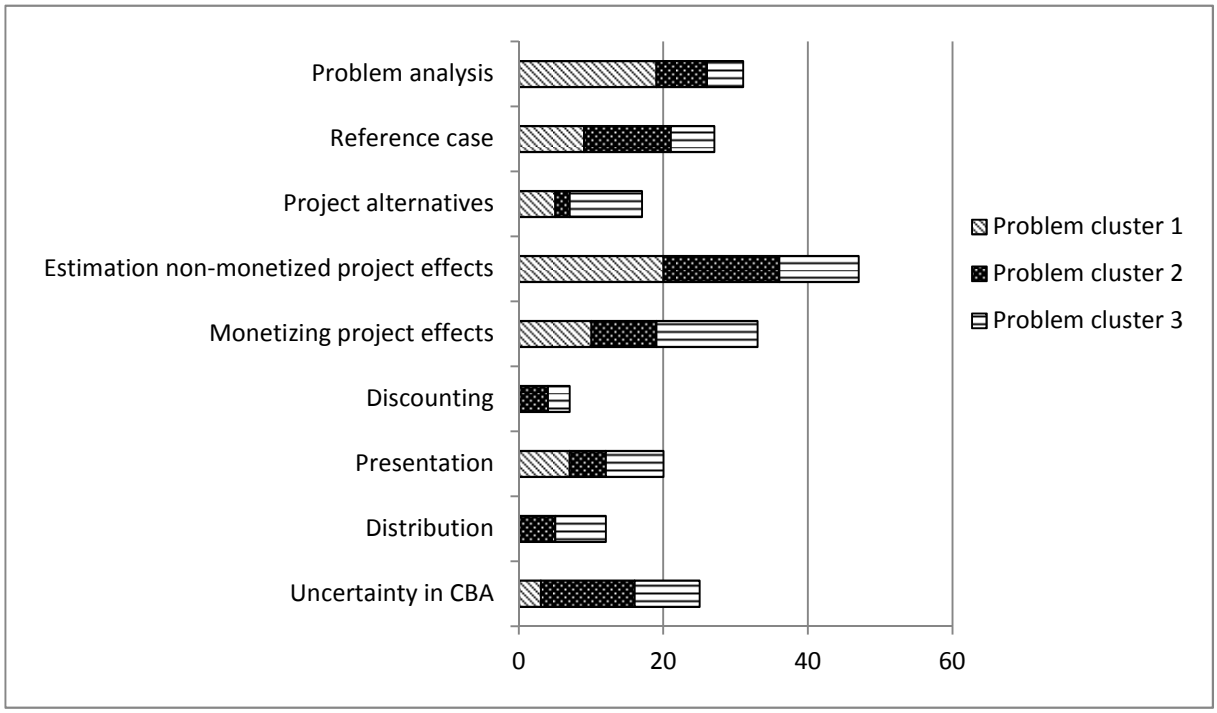

Figure 3 shows that 47 out of 73 respondents (64%) state that 'problems with the estimation of the non-monetized project effects' is a 'top 3 problem cluster'. 33 out of 73 respondents (45%) think that 'monetizing of project effects' is a 'top 3 problem cluster'. A comparison of the interview and questionnaire results reveals that the respondents select the same problem clusters as 'important problem clusters'. Likewise, the respondents rank the other problem clusters in approximately the same way in the interviews as in the written questionnaires (Kendall's tau 0.389). The 'problem analysis' problem cluster is the only cluster that is ranked significantly differently in the interviews and in the questionnaires. 'Problem analysis' is the least mentioned problem cluster in the interviews and is ranked as 'problem cluster number 3' in the 'Top 3 Analysis'. 19 respondents even select this problem cluster as the 'most important problem cluster'.

5 Interesting concrete sub-categories of problems clusters

To start up research that aspires to solve the substantive problems identified in this study it is necessary to have a deeper insight into the exact perceptions of substantive problems. Hence, this section decomposes the nine problem clusters (figure 3) into concrete sub-categories of substantive problems and discusses these sub-categories in brief. It is impossible to discuss all the 636 individual substantive problems in detail in this paper hence, we only discuss the most interesting sub-categories of the problems mentioned. These are the categories which were often mentioned or, in contrast, categories which were mentioned by an unexpectedly few amount of key participants in relation to the attention these sub-categories of problems receive in the scientific literature.

5.1 Problem analysis, reference case and project alternatives

In relation to the 'problem analysis' problem cluster, the problem sub-category that is mentioned by far the most is that practitioners simply miss a high quality independent problem analysis being carried out in both the CBA and the decision making process concerning spatial-infrastructure projects. Key participants mentioned two causes for this absence. Firstly, they state that most clients of CBAs do not see the absence of a problem analysis in project proposals as worrisome, because clients often perceive that they already carried out an appropriate problem analysis themselves. Secondly, it is – according to the interviewed respondents – not clear what makes a problem analysis a 'high quality' problem analysis. The importance of carrying out an independent problem analysis was already explained 40 years ago by Williams (1972, p. 204): *'over and over again one hears of cases where the problem the clients thought they had, turned out not to be the problem they actually had, and any operations research or cost-benefit analysis practitioner who accepts the client's initial formulation of the problem uncritically is heading for disaster'.*

Most of the key participants interviewed that mentioned 'reference case' as a substantive problem (21 out of 31) stated that the construction of reference cases is especially problematic when a project includes a large spatial development such as the development of a new residential area. According to these key participants it is – for example, because of the absence of a housing market model – extremely difficult to decide what *'the world without the spatial elements (in this example, the new residential area) of the spatial-infrastructure project*' (the reference case) would look like in these cases. According to the people in practice, the lack of suitable spatial models results frequently in controversies among the participants in a decision making process concerning the reference case that should be used in the CBA.

Looking at the 'project alternatives' problem cluster, five key participants in the Dutch CBA practice mention that they see as a problem the fact that, in their view, far too often the project alternatives evaluated in a CBA are very suboptimal. Moreover, three respondents state that spatial project alternatives especially are often not articulated to an extent that it is feasible to estimate their effects in a CBA.

5.2 Problems with the estimation of non-monetized project effects

Based on the content analysis of the interviews, this large problem cluster (which, therefore, deserves a separate sub-paragraph) can be subdivided into two problem sub-categories: 'general problems with the estimation of non-monetized effects' and 'problems with the estimation of non-monetized specific effects'. Figure 4 illustrates that the sub-category 'problems with the estimation of specific effects' relates to four specific effects: 'direct effects', 'indirect effects[5]', 'external effects' and 'synergy effects'. Figure 4 presents the frequencies of the problems mentioned by the respondents. For the most disaggregated sub-categories not only these frequencies are given (a

[5] The CBA literature does not demarcate direct, indirect and external effects in an unambiguous way. This paper bases the demarcation between these effects on the Dutch CBA guideline (Eijgenraam et al., 2000): direct effects are effects on the transport market, indirect effects are effects on markets other than the transport market (for instance, the labor market or the real estate market) and external effects are non-market effects.

single number) but also the frequency of the nature of the problems is given. Three main categories exist: a) 'the effect is not (sufficiently) taken into account'; b) 'the effect is taken into account in a contestable way'; c) other. These three categories are depicted between brackets in figure 4. For instance, zero respondents perceive that the nature of 'problems with estimation of costs' is that this effect is not taken into account sufficiently in the CBA, ten respondents state that cost estimations are contestable and four respondents mention other problems with cost estimations.

Figure 4: problem cluster 'problems with the estimation of non-monetized project effects', sub-divided

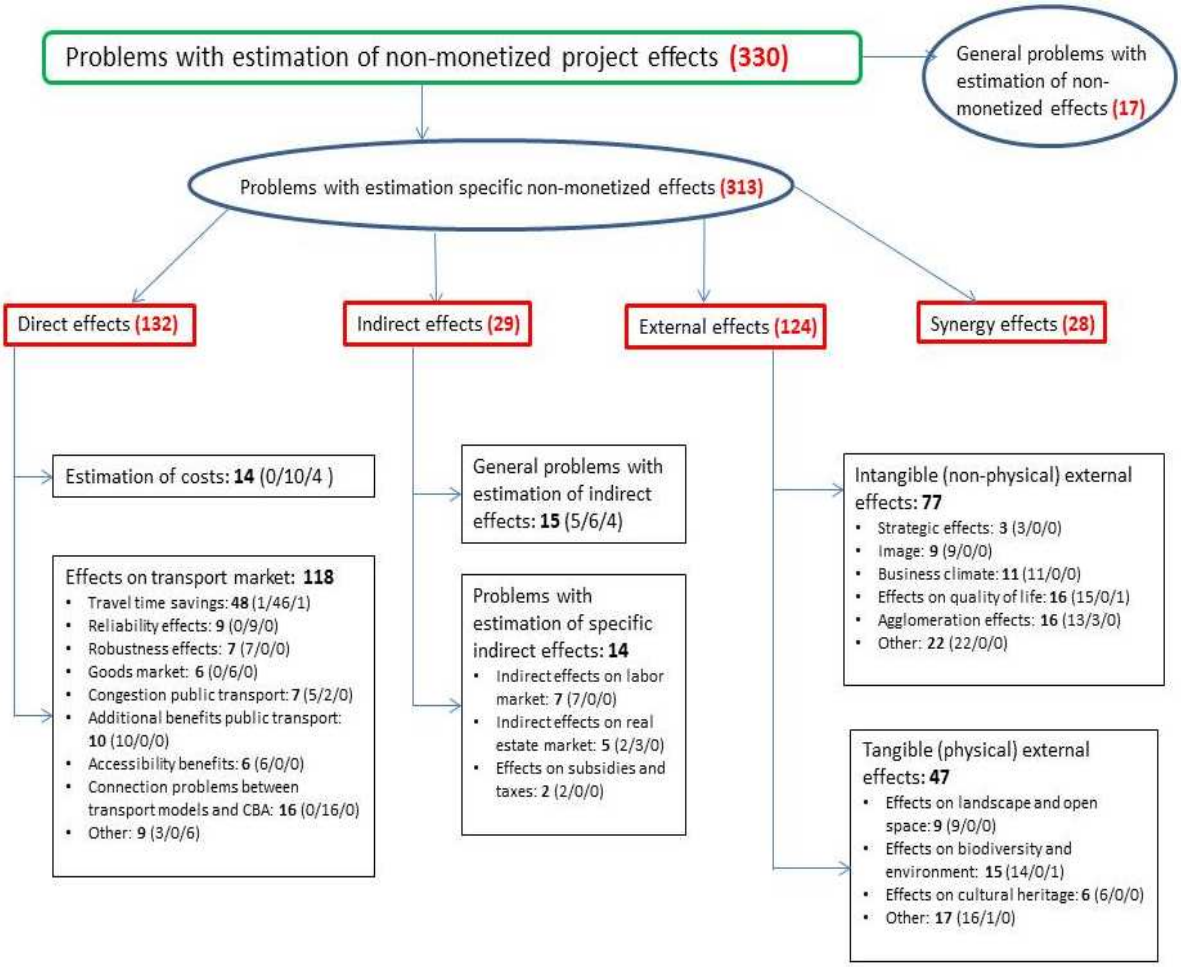

Figure 4 shows that key participants in the Dutch CBA practice experience many problems with the estimation of direct effects. In particular, respondents perceive problems with the estimation of travel time savings (48 respondents). Respondents mentioned for instance, the following three problems:

- Too often you see that the estimations of travel time savings by transport models are unexplainable and CBA guidelines do not prescribe how to deal with these unexplainable mistakes that the transport models make (10 respondents);
- The estimations of project effects on the transport market are frequently based on one future year and subsequently, the transport effects for the other years in the future are extrapolated from this one future year, which they think is highly contestable (6 respondents);

- Transport models are developed to estimate the intensity / capacity ratio on highways and not travel time savings as a result of a new highway. Hence, transport models perform poorly when it comes to the estimation of travel time savings (5 respondents).

Respondents state that, as a result of these three problems, the estimations of travel time savings for project alternatives are contestable to an extent that it can severely influence the outcome of a CBA and the ranking of project alternatives.

Figure 4 also shows that key participants in the Dutch CBA practice experience many problems with the estimation of external effects and in particular intangible (non-physical) effects[6]. In most cases (73 out of 77 times) the nature of the problem with intangible effects is that the effect is – in the view of the respondents – not or not sufficiently taken into account. Some respondents state that in most cases the underlying problem with the estimation of intangible effects is that the effects are more often based on the wishful thinking of project initiators rather than on sound research. On the other hand, some project initiators interviewed for this study state that it is very difficult, if not impossible, to 'prove' these effects.

5.3 Problems with monetizing project effects

Table 3 presents – for each sub-category of the other large problem cluster, 'problems with monetizing project effects' – the frequencies of substantive problems mentioned by the respondents. Moreover, table 3 subdivides the perceptions of these substantive problems according to their nature (top row).

Table 3: problem cluster 'problems with monetizing project effects', subdivided.

[6] We define intangible effects as non-physical effects, which are therefore difficult to concretely estimate both 'ex ante' and 'ex post'. To the contrary, tangible effects are physical and hence, relatively easy to determine.

Nature	Do not monetize for ethical reasons	Do not monetize for pragmatic reasons	It is difficult to monetize because of the lack of an adequate valuation method	Because we currently do not know which is the **best** way to estimate a valuation, every method we use is contestable	Because we currently use an incorrect valuation method, we use the incorrect monetized effects in CBAs	Valuation is possible, we only have to do more research to find the right valuation	Other	Total
General problems with monetizing project effects	4	2	3	3	0	1	1	14
Valuation with standard numbers / benefit transfers	0	0	0	0	9	0	5	14
Valuation method Stated Preference	0	0	0	0	9	0	0	9
Valuation method Hedonic Pricing	0	0	0	0	4	0	0	4
Choice of a valuation method	0	0	0	2	0	0	0	2
Valuation method Revealed Preference	0	0	0	0	1	0	0	1
Netherlands Bureau of Economic Policy Analysis (CPB) is too strict with allowing valuation methods	0	0	0	0	0	0	8	8
Monetizing value of time	2	0	0	0	14	0	5	21
Monetizing effects on landscape and open space	0	2	9	0	0	2	2	15
Monetizing effects on biodiversity	1	1	4	0	3	1	0	10
Monetizing effects on the housing market	0	0	8	0	0	0	0	8
Monetizing value of reliability	0	0	1	0	2	2	0	5
Monetizing effects on urban quality	0	0	3	0	1	1	0	5
Monetizing value of a statistical life	3	0	0	2	0	0	0	5
Monetizing effects on air pollution	0	0	1	0	2	0	1	4
Monetizing effects on cultural heritage	0	1	1	0	0	1	0	3
Monetizing effects on aesthetic quality	0	0	2	0	0	1	0	3
Monetizing effects on comfort in traffic	0	0	2	0	0	0	0	2
Monetizing effects on recreation	0	0	0	0	1	1	0	2
Monetizing effects on archaeological excavations	0	0	0	0	0	1	0	1
Monetizing effects on noise pollution	0	0	0	0	1	0	0	1
Total	10 (*9)**	6 (*6*)	34 *(27)*	7 *(7)*	47 *(36)*	11 *(8)*	22 *(22*)	137

* In *italics:* the number of respondents that mentioned the nature of a monetizing problem. For instance, 14 respondents mention 16 substantive problems with the nature 'do not monetize for ethical / pragmatic reasons.'

We make the following observations:

- The problem sub-category most mentioned is 'monetizing value of time' (21 times). Respondents experience different problems in regard to monetizing travel time savings with

the value of time. Two problems were mentioned by more than three respondents. Firstly, five respondents state that small travel time savings, which are hardly observed by travelers (less than five minutes) and larger time savings (more than five minutes) are taken into account in an equal (linear) way in the Dutch CBA practice. These key participants state that, as a result, the effects on the transport market of projects that chiefly lead to small travel time savings are overestimated. Secondly, three respondents see a problem in the fact that the value of time used in transport models to estimate travel time savings, and the value of time that is used to monetize travel time savings, are inconsistent;

- It is remarkable that although there is an abundance of literature on substantive problems with the value of a statistical life (e.g. Grant-Muller et al., 2001; Hauer., 1994; Verhoef., 1994) only five respondents feel that this valuation is an important substantive problem;
- Key participants interviewed mentioned *'because we currently use an incorrect valuation method, we use incorrect monetized effects'* most frequently as the nature of substantive problems with monetizing project effects (47 times). Nine respondents criticize the standard numbers / benefit transfer method. Respondents claim that applying this method leads to incorrect valuations in specific contexts. Furthermore, respondents state that standard numbers do not take diminishing marginal returns sufficiently into account. Nine respondents criticize the application of the Stated Preference method. The main issue respondents mentioned was that this method does not take the free-ridership and strategic behavior of respondents into account sufficiently;
- It is remarkable that although there is an abundance of literature on ethical problems with applying CBA (e.g., Hansson., 2007; Sen., 2000; van Wee., 2012) only nine key participants experience this as an important substantive problem.

5.4 Problems with presentation, distributional effects and uncertainty

Thirty two key participants stated in their interviews that the quality of the presentation of CBA reports is problematic and should be enhanced. The four most mentioned sub-categories of problems in the 'presentation' cluster are:

- Too much jargon is used in the texts of CBA reports (15 respondents);
- Conclusions in CBA reports are stated as *'false certainties'*. As a result readers of CBA reports are insufficiently aware of the contestability of conclusions (12 respondents);
- CBA reports do not sufficiently make clear which effects are and are not taken into account (4 respondents);
- It is not possible to check the way effects are computed in the CBA reports because the reports do not elaborate in detail on computations (4 respondents).

Eleven respondents state it is a problem that CBA reports do not pay enough attention to distributional effects. Moreover, three key participants interviewed claim that (academic) research should focus on improving methods to estimate distributional effects because they think it is currently very difficult to predict distributional effects. As an example, one of the key participants mentioned that it is very difficult to estimate how an investment project in one Dutch port affects other Dutch ports (distributional effects).

Twenty one key participants experience problems with the way current Dutch CBA reports deal with uncertainty. Dutch CBA guidelines (Eijgenraam et al., 2000) prescribe to handle future uncertainty in CBAs with scenarios and sensitivity analyses. Eighteen respondents mentioned three different problems with the way Dutch CBAs deal with the uncertainty of the future.

- Scenarios used in the Dutch practice are often incorrect scenarios for the future and they do not relate to the context of the specific project alternatives under scrutiny in the CBA (10 respondents);
- Too often we see that effects are estimated using different scenarios yet only the outcomes of the middle scenario are presented in the summary of the CBA report, whereas the outcomes of other scenarios are only discussed in the appendix (5 respondents);
- It is a problem that some CBAs only use one scenario to estimate the project effects (3 respondents).

As well as the respondents that criticized the way CBAs deal with uncertainty of the future, three other respondents stated that they experience problems with the way CBAs deal with uncertainty within the scenarios as a result of a lack of knowledge.

6. How do different groups in the Dutch CBA practice evaluate the problem clusters

This section explores the extent to which results differ for each of the categories of key participants as presented in table 2. Because the respondents can be considered to be the entire population of key participants in the Dutch CBA practice, it is not necessary to test whether or not a difference between groups is significant using methods of statistical analyses. However, 15 people were not able to or were not interested in participating in the research. On the one hand we could consider these 15 people as non-responsive and conclude that the 86 people that were interviewed represent the population of key participants. On the other hand it is possible to conclude that we did not manage to interview the entire population and the 86 respondents must be considered as a sample of the entire population of key participants. As a precautionary measure we tested the significance of the results that followed out of the 'Top 3 analysis' and the 'Likert scale analysis' with logistic regressions under the assumption that the 86 respondents are a random sample of the entire population of key participants in the Dutch CBA practice. All the results are significant ($p < 0.05$). Hence, we conclude that the results of section 6 are applicable for the entire Dutch population of key participants, when the 86 respondents are considered to be a random sample of key participants in the Dutch CBA practice.

The main finding of this exercise is that there is, in a broad sense, consensus among the different groups in the Dutch CBA practice in their perception of the quality of problem clusters and the way they rank the problem clusters. Below we will elaborate on four findings regarding differences in perception on substantive problems between groups in the Dutch CBA practice. First, economists (55%) select the 'problems with the estimation of the non-monetized project effects' problem cluster as a 'top 3 problem cluster' less often than spatial planners (77%) and transport researchers (75%). Moreover, economists evaluate the quality of this problem cluster more positively than spatial planners and transport researchers in the 'Likert scale analysis'. Second, economists evaluate the quality of the 'monetizing project effects' problem cluster more positively than spatial planners and transport researchers in the 'Likert scale analysis'. Third, policy makers (30%) select the

'problem analysis' problem cluster as a 'top 3 problem cluster' less often than consultants (56%) and scientists/researchers (44%). Moreover, policy makers evaluate the quality of this problem cluster more positively than consultants and scientists/researchers in the 'Likert scale analysis'. As opposed to scientists/researchers and consultants, none of the 19 policy makers perceive the quality of the 'problem analysis' problem cluster as problematic. Fourth, the respondents in the CBA practice who focus on finding solutions for (fundamental) problems with CBA (academics that study CBA and developers of CBA guidelines/manuals') rank the problem clusters differently in the 'Top 3 Analysis' when compared to the respondents who apply the CBA (initiators of a plan, reviewers of funding applications, CBA practitioners and CBA testers). Table 4 compares the way 'academics' and 'developers of guidelines/manuals' rank the nine problem clusters compared to 'CBA appliers'.

Table 4: ranking problem clusters: respondents with the role of 'academic study' and 'developers of guidelines' compared to 'appliers'

CBA Appliers (47)	Academic study (14)	Developer of CBA guidelines (12)
1. Estimation non-monetized project effects	Estimation non-monetized project effects	**Problems with uncertainty in CBA**
2. Reference case	Monetizing project effects	Monetizing project effects
3. Problem analysis	Problem analysis	Problem analysis
4. Monetizing project effects	**Distribution**	Reference case
5. Presentation	Problems with uncertainty in CBA	**Estimation non-monetized project effects** / Project alternatives
6. Problems with uncertainty in CBA	Presentation	
7. Project alternatives	**Discounting**	Presentation
8. Distribution	Project alternatives	Discounting
9. Discounting	**Reference case**	Distribution

Table 4 shows that 'academics that study CBAs' rank the problem clusters of 'distribution' and 'discounting' higher and the 'reference case' problem cluster lower than the appliers of CBA. Moreover, Table 4 demonstrates that 'developers of CBA guidelines/manuals' rank the 'problems with uncertainty in CBAs' problem cluster higher and the 'problems with the estimation of the non-monetized project effects' problem cluster lower than the CBA appliers.

7. Conclusions and discussion

Large variety

Firstly, we can conclude that key participants in the Dutch CBA practice experience a large variety of substantive problems regarding the appraisal of spatial-infrastructure projects using CBA. The 86 key participants interviewed mentioned 636 substantive problems that were categorized in 92 problem categories. Subsequently, it was possible to cluster the 92 problem categories into 9 problem clusters.

Estimation of the non-monetized project effects as the most important problem cluster

A second main conclusion is that key participants in the Dutch CBA practice consider 'problems with the estimation of the non-monetized project effects' as the most important substantive problem cluster. One might argue that this result is not very surprising because CBA is about estimating project effects. However, one might also argue that research related to ex-ante estimating transport project effects has been on-going for a long time, which makes it remarkable

that the estimation of non-monetized project effects is still perceived as the most important substantive problem.

More specifically, we think it is surprising that, despite the long tradition with transport modeling, 'problems with estimation of travel time savings' is the most mentioned problem category in the interviews. Key participants in the CBA practice perceive that errors in the estimation of travel time savings might severely influence the outcome of a CBA and the ranking of project alternatives. However, the issue is absent in the Ministry of Infrastructure and the Environment's CBA research agenda (Ministry of Infrastructure and the Environment, 2011). Our empirical analysis suggests that the low position of 'problems with travel time savings' on this research agenda is not correct. We assume that the long tradition of transport modeling and the perception that Dutch transport models are state-of-the-art may give developers of CBA guidelines, and / or academics that study CBA, the idea that the further development of the capability for transport models to estimate travel time savings is not very important for increasing the quality of CBAs.

Because Dutch transport models are perceived as state-of-the-art by key participants and studies of Flyvbjerg (2005) and Flyvbjerg et al., (2005) show that inaccuracy in travel demand forecasts is a worldwide problem, we have no reason to assume that the conclusion 'estimation of travel time savings is an important problem category' is unique for the Netherlands. Hence, we recommend analyzing whether this issue has an unjustifiable low position on research agendas in all countries using CBA.

Specific versus non-specific CBA problems

An interesting third main conclusion of this study is that a large part of the substantive problems mentioned by the key participants in the Dutch CBA practice are not specifically CBA related. If people experience problems with the estimation of the non-monetized project effects (the problem cluster most mentioned) or other non-specific CBA problems (see figure 1) they would face the same problem when using other ex-ante impact studies (e.g. multi-criteria analysis, cost-effectiveness analysis, environmental impact analysis). Because of this, a policy recommendation is that it would be wise to identify whether or not a specific or a non-specific CBA problem is emphasized when the use of CBA in a particular decision making process regarding spatial-infrastructure projects is criticized. When a non-specific CBA problem is stressed as an argument to criticize the use of CBA in the decision making process, one should emphasize that other ex-ante impact evaluation studies have to face the non-specific CBA problems as well. This might improve the acceptability of CBA as an ex-ante evaluation method and the usage of CBA in the decision making process regarding spatial-infrastructure projects. Moreover, we think that this observation should be taken into account in debates concerning research agendas for improving CBA usage. In these debates, much attention often goes to specific CBA issues such as 'problems with monetizing project effects' and 'problems with discounting' but it seems that there is also much to gain from 'simply' improving methods (and models) to assess the effects of new spatial-infrastructure projects in their own non-monetized units (see previous point on the incorrect low position of problems with the estimation of travel time savings on CBA research agendas).

Consultants and scientists/researchers, especially, perceive 'problem analysis' as an important problem

A fourth conclusion that comes out of this empirical research is that, in a broad sense, there is consensus among the different groups in the Dutch CBA practice concerning their perception of the seriousness of problem clusters and the way they rank the problem clusters. The 'problem analysis' problem cluster is an interesting exception. Although key participants in the Dutch CBA practice on average perceive that the absence of high quality independent problem analyses in CBAs is a very important substantive problem, none of the 19 policy makers that filled out the questionnaire perceives that the quality of the 'problem analysis' problem cluster is problematic. Based on the literature (Miser and Quade., 1988; Priemus., 2010; Williams., 1972) we assume that it is conceivable that this difference in perception among policy makers and consultants/scientists/researchers holds true for other countries using CBA. Hence, we recommend that consultants and scientists/researchers study how the presence of high quality problem analyses could be enhanced in CBAs and / or decision making processes with regard to spatial-infrastructure projects, with or without the support of policy makers.

To what extent are results of this study imperative for setting a research agenda?

Contrary to our expectations, key participants in the Dutch CBA practice perceive substantive problems with the estimation of costs, the estimation of the value of a statistical life and discounting as less important substantive problems. We are surprised here because there is a wealth of literature on (solutions for) substantive problems with cost estimations (e.g. Flyvbjerg et al., 2003; Cantarelli et al., 2010), discounting (e.g. Stern Review, 2006; Nordhaus, 2007) and the value of a statistical life (e.g. Grant-Muller et al., 2001; Hauer., 1994; Verhoef., 1994). However, one should be careful to conclude that these problems are 'insignificant substantive problems' in the Dutch CBA practice. Using the perception of key participants in the Dutch CBA practice is an important way of analyzing the significance of substantive problems but it is not the only way. For instance, it is plausible to defend the case that the impact the problem has on the CBA outcome is decisive for the determination of the significance of the problem. For instance, van Wee (2007) concludes that substantive problems with cost estimations and demand forecasts might be considered as major CBA problems because of the impact of faulty cost estimations and demand forecasts on the CBA outcome in recent CBA practices.

Building a superior CBA model

This paper details the perceptions of different participants in the Dutch CBA practice concerning substantive problems with CBA. Turner (1979) and Mackie (2010) emphasize that CBA practices differ in place, time and culture. As a consequence one should be cautious when applying the results of this study to other CBA practices. However, we are convinced that the results of this study are very relevant for other uses of CBA because this study could be a building block of 'the superior international CBA model', suggested by Hayashi and Morisugi (2000). Hayashi and Morisugi (2000, p 87) state that *'by conducting a careful study on the components of the different models, it would be possible to come up with a superior model by integrating all the good components of the existing models. This is a simple case of learning from each country's experience'*. A suggestion for generating more building blocks is to replicate this research in other CBA practices and compare the results with this study.

Politicians underrepresented in this contribution

An interesting observation regarding the methodology of this study is that although politicians are participants in the decision making process regarding spatial-infrastructure projects, and they have to make a decision – informed by a CBA – about the development of a spatial-infrastructure project, only four (ex) politicians were mentioned by respondents as people that needed to be interviewed in order to make sure that the entire population of key participants in the Dutch CBA practice was interviewed. On the one hand one could interpret this observation as a limitation of this study. On the other hand there is some evidence in the literature that politicians are in fact relatively unimportant participants in the CBA practice. For instance, Eliasson and Lundberg (2011) concluded that planners' rankings of investments are influenced by CBA outcomes while politicians rankings are not. Moreover, Sager and Ravlum (2005) found that 'political decision makers gather information and do not use it; ask for more information and ignore it; make decisions first and look for relevant information afterwards; and collect and process a great deal of information that has little or no direct relevance to decisions'.

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