Forecasting inaccuracies: a result of unexpected events, optimism bias, technical problems, or strategic misrepresentation?

Abstract: Based on the results from a questionnaire survey and qualitative interviews among different actors involved in traffic forecasting, the paper will discuss what evidence can be found in support of competing explanations of forecasting errors. There are indications that technical problems and manipulation, but to a lesser extent optimism bias, may be part of the explanation of observed systematic biases in forecasting. In addition, unexpected events can render the forecasts baffled, and many respondents and interviewees consider it to be simply not possible to make precise predictions about the future. The results give rise to some critical reflections about the reliability of project evaluations based on traffic forecasts susceptible to several systematic as well as random sources of error.

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1 Introduction

Experience from a number of large-scale investment projects has shown that the traffic forecasts on which decisions to implement the projects were based, have often been insufficient and sometimes misleading (see, e.g.,Wachs, 1990; Flyvbjerg et al., 2003 and 2005; Flyvbjerg, 2007, Bain, 2009, NOU 1999:28, Nicolaisen, 2012). In particular, Flyvbjerg's analysis of a large sample of international large-scale transport infrastructure projects has gained wide attention. According to Flyvbjerg and his

colleagues, misleading quantification of the demand for the chosen solution usually implies that the need for the proposed project is exaggerated. Overly optimistic demand analyses have in particular been documented for railroad projects, especially urban rail.

Inaccurate traffic forecasts have also been found in a study of 179 transport infrastructure projects in the Scandinavian countries (mostly Denmark) and the United Kingdom, of which 148 non-tolled road projects and 31 rail projects (Nicolaisen, 2012). In line with the results from the studies by Flyvbjerg and his colleagues as well as a number of other studies (NAO, 1988; Pickrell, 1990; Fouracre et al., 1990; Parthasarathi and Levinson, 2010; Welde and Odeck, 2011;), Nicolaisen found a tendency of underestimated traffic for road projects (11 % on average) and overestimated passenger forecasts for rail projects (20 % on average). There are also examples of underestimation of the demand in situations where growth is not considered desirable. This has occurred in connection with proposed road investments in urban areas where non-growth of car traffic is a goal (Næss, Flyvbjerg & Buhl, 2006). Misleading analyses of what will happen if a proposed investment project is not implemented, have in some cases left the impression that the proposed solution is necessary in order not to end in a future situation few would wish (Næss, 2011). Nicolaisen (2012) found a tendency of overestimated forecasts for the traffic volumes (and hence also the level of congestion) on the existing road network in the absence of road building (7 % on average), thus supporting previous case studies where 'pessimism bias' against the 'zero alternative' have been found.

While there appears to be considerable consensus within the literature on the findings that traffic forecasts are inaccurate, there is less agreement on the causes of observed forecasting inaccuracies. Mackie and Preston (1998) listed 21 potential sources of error and bias in transport project evaluation, pertaining to objectives, definitions, data, models and evaluation conventions. According to Flyvbjerg (2007), various sources of forecasting errors for transportation infrastructure projects can be boiled down to three main categories: technical, psychological and political–economic explanations. In Flyvbjerg's view, shortcomings in the forecasting techniques, inadequate data, 'honest mistakes' and the inherent uncertainty in predicting the future, etc. all belong to the category of technical explanations. His term 'psychological explanations' refers to a widespread human tendency of wishful thinking, causing project promoters and planners to underestimate problems and exaggerate benefits of proposed projects. Typically, such 'optimism bias' results in underestimated construction costs and environmental impacts and exaggerated benefits in terms of congestion relief or new public transport passengers. Flyvbjerg's last category, the political–economic explanations, refers to situations where project promoters and planners are deliberately and strategically overestimating benefits and underestimating costs in their forecasts in order to increase the likelihood that the projects will be approved and funded (Flyvbjerg, 2007, pp. 583–584).

The explanations given in the research literature of inaccuracy and bias in traffic forecasting have been criticized for drawing inferences mainly from observed deviations between forecasted and actual traffic (e.g. Osland & Strand, 2008; Nicolaisen, 2012; Andersen, 2013; Eliasson & Fosgerau, 2013). The studies made by Flyvbjerg and his colleagues (Flyvbjerg & Cowi, 2004; Flyvbjerg, 2007) do, however, also include interviews with a number of public officials, planners, and consultants who had been involved in the development of transportation infrastructure projects, and the same applies to the older study by Wachs (1990). There is, however, lack of evidence in these studies about the representativeness of the statements given by those interviewed. Moreover, the different kinds of explanations are dealt with in the above-mentioned studies as if they were mutually exclusive, although theoretical considerations and case studies of transport planning processes indicate that they can be highly entangled and should be seen as complementary rather than competing (Næss, 2011; Andersen, 2013). Finally, we think the 'technical explanations' category discussed by Flyvbjerg (2007) is too broad and heterogeneous to make up one single category. In our view, 'inherent problems in predicting the future', which is included in Flyvbjerg's conceptualizing of technical explanations (cf. above) is not a technical shortcoming but an ontological precondition and should be classified as such (Næss & Strand, 2012).

Based on empirical data from the Scandinavian countries, the present paper discusses what evidence can be found in support of different explanations of forecasting errors: ontological explanations (unexpected events), optimism bias, technical problems, and strategic misrepresentation. The structure of the paper is as follows: In the next section (2), the research design, methods and data material of the study will be outlined. Section 3 presents the key findings about the relevance attributed by our respondents and interviewees to different explanations of forecasting inaccuracy, addressing first ontological explanations, then optimism bias, there upon technical explanations, and finally strategic misrepresentation. A brief discussion and some concluding remarks are given in the last section (4).

2 Research design and methods

The study has been carried out as part of a larger research project ("Uncertainties in Transport Project Evaluation" – UNITE), which was conducted jointly by the Danish Technical University, Aalborg University and a number of sub-contractors. The part of the project on which this paper is based included in-depth research interviews, a questionnaire survey and document studies.

16 key stakeholders in the production or use of traffic forecasts as decision support were interviewed: model developers, consultants, traffic planners, transport-sector civil servants involved in policy-making at national or local level, and politicians with transportation policy as a field of responsibility. The interviewees were selected in order to gain information from persons having roles in the forecasting process. All the interviewees were from Danish institutions, except two Swedish researchers involved in

the development of what had been characterized by other interviewees as 'state-of-the-art' transport models, The Danish focus was mainly due to practical considerations, as all interviews were carried out by researchers located at Aalborg University. The interviews took place over the period 2010-2012, lasted from one to three hours and were tape-recorded and subsequently transcribed. In this paper, we have primarily drawn upon the interviews with persons actively involved in transport model construction or the production of traffic forecasts, although we have also to some extent (in the concluding section) made use of material from interviews with politicians.

The questionnaire survey was conducted in 2010 among the same categories of stakeholders. Many of the questions of the questionnaire were formulated as statements with which the respondents were asked to indicate their extent of agreement along a five-point Likert scale. Compared to the interviews, the questionnaires covered a broader Scandinavian context. Invitations to respond to web-based questionnaires were distributed by e-mail to transport related university research units, transport units in consultancy firms, road and rail directorates, transport sections in regions/municipalities, transport/environment related NGOs, and parliamentary transport committees in Denmark, Norway and Sweden. The mail recipient at the contact address was asked to forward the invitation to those employees or elected officials for whom the questionnaire would be relevant. National-language versions of the questionnaire were provided for each country. After one dissemination of reminder mails, 453 completed questionnaires were obtained. Roughly 40% of the respondents were from Denmark, another 40% from Norway and the remaining 20% from Sweden. In this paper, the statistics are based mainly on the sub-sample of 92 Scandinavian experts most closely involved in model-based traffic forecasting: by constructing transport models or by producing traffic forecasts. The reason for concentrating on this sub-sample is that we consider this group of respondents to be particularly qualified for providing an 'insider view' on potential causes of forecasting inaccuracy.

3 Findings

In this section, the key findings of the study will be structured according to the following four main categories of explanations for forecasting inaccuracies: Ontological explanations, optimism bias, technical explanations, and strategic misrepresentation. Under each category, findings from the qualitative interviews as well as from the questionnaire survey will thus be presented.

When interpreting the results from the questionnaire survey, it should be noted that some of the questions were asking specifically for the respondents' opinions on the roles of various circumstances as explanations of forecasting inaccuracies, whereas other questions simply asked for the respondents' opinions about the occurrence of the circumstances mentioned. From theoretical considerations, the latter circumstances could also be expected to contribute to forecasting inaccuracy, but this was not specifically mentioned in these questions. Information on the question category to which

each statement belongs is given in footnotes to the figures. Since the circumstances asked about in the questions not including any reference to forecasting error may exist also in situations where they do not cause such errors, there is a risk of exaggerating the perceived role of these circumstances as reasons for forecasting inaccuracies, compared to the characteristics mentioned in the questions explicitly referring to forecasting inaccuracy. This should be borne in mind when interpreting the results.

Moreover, for the questions asking about potential causes of forecasting inaccuracy, there are relatively high proportions of missing answers (20-22 %). This might reflect that some respondents, although perhaps having an opinion about the occurrence of the phenomena asked about, do not have any concrete experience or awareness about the ways in which they may lead to forecasting errors, and they might therefore feel unable to answer these questions. In this case, the missing answers might be interpreted similar to 'don't know'. But missing answers could arguably also be interpreted as an indication of non-interest in the issue asked about, where the absence of any positive attribution of any role of the circumstance mentioned as a contribution to forecasting error might signify that the respondent does not consider the circumstance as a main source of forecasting error. It is hard to say which one of these ways of interpreting missing answers is the most reasonable one. For the questions where the rates of missing answers were high, we have therefore chosen to display the percentages for each answer alternative calculated from the number of valid answers as well as from the total number of respondents of the sub-sample included in the study.

3.1 Ontological explanations

Six of the questions in the questionnaire concerned different ways in which unexpected future events can jeopardize forecasts. Many of the factors influencing traffic development depend on inherently unpredictable geopolitical trajectories as well as contested political decision-making. Since the difficulty in predicting future traffic volumes is largely due to the relative openness of the socio-spatial systems within which transport projects are implemented (Bhaskar, 2008; Danermark et al., 2001), we consider the impossibility of making precise traffic forecasts as an ontological condition (Næss & Strand, 2012). In line with this, explanations referring to unpredictable and unforeseen future events as a source of forecasting errors will be referred to as ontological explanations. Our category of ontological explanations includes several explanations referred to by Flyvbjerg and his colleagues (Flyvbjerg et al., 2002 and 2005; Flyvbjerg, 2007) as technical explanations. Since the difficulty in predicting these unexpected events is an ontological condition rather than a technical shortcoming of the forecasting tools, we think the term 'ontological explanations' is more appropriate than the term 'technical explanations'.

Figure 1 shows the respondents' degree of agreement or disagreement with different ontological explanations of forecasting errors. Among the total sub-sample, 53 % positively express that they wholly or partially agree that impossibility of making precise predictions about the future is a main source of forecasting inaccuracy, whereas

only 22 % express full or partial disagreement. If only valid answers are considered, the proportion agreeing in the statement is 68 %.

The general impossibility of knowing beforehand how all relevant factors of influence will develop in the future is also reflected in explanation (b), where different development of critical input data from what was assumed in the forecast is pointed at as a main source of forecasting error. 45 % of the total sub-sample positively support this explanation fully or partially, whereas the percentage disagreeing is only 10 %. Among those who have given valid answers, 57 % express full or partial agreement.

The widespread disbelief in the possibility of making exact predictions about the future is reflected in the following statement by one of the interviewees:

> No damned person knows whether things really will turn out [as expected] some ten years ahead. …. Indeed, [for the forecast to be accurate,] the development has to go in the same direction. But there are of course a lot of things that may change, both in the project specifications and in the overall conditions. (Civil servant in the Ministry of Transport, Denmark, in interview July 2011)

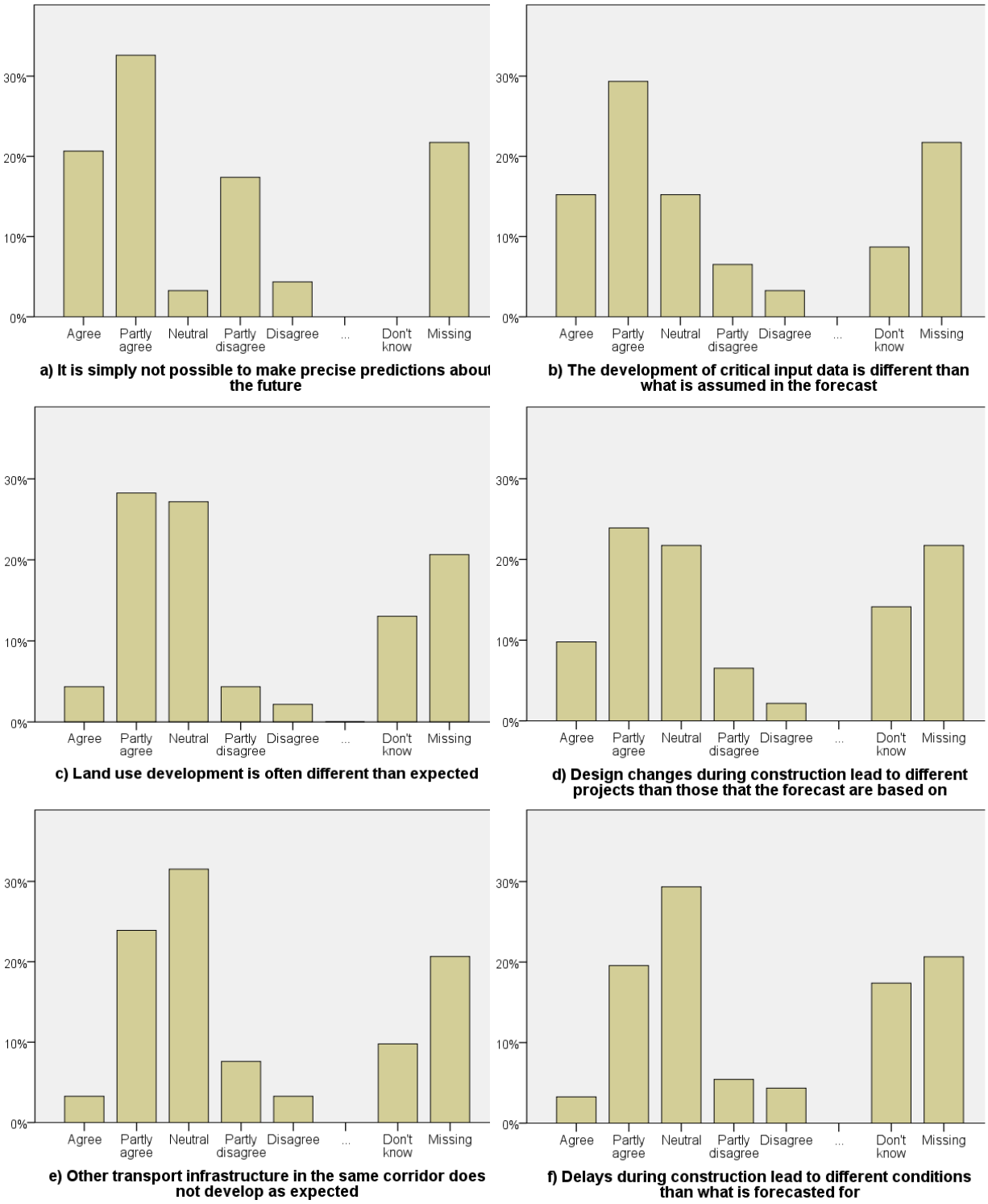

Figure 1: Respondents' opinions about different explanations associated with unexpected events as a main source of forecasting inaccuracy[1]. Percentages of the total sub-sample. N = 92 Scandinavian experts involved in model-based traffic forecasting as constructors of transport models or producers of traffic forecasts.

Whereas the above explanation (a) and (b) refer to general difficulty in predicting future events and situations, the four remaining explanations included in Figure 1 refer to specific types of unexpected events frequently mentioned as sources of forecasting errors. Since these specific circumstances include only a few of the many unexpected kinds of events that may jeopardize forecasting accuracy, it is hardly a surprise that the percentages considering them as main sources of erroneous forecasts are lower than for the explanations referring to general uncertainty about the future. The percentages of the total sub-sample considering design changes during construction, unforeseen land use changes or unforeseen development of other transport infrastructure as main sources of forecasting inaccuracy vary between 34 % and 27 % (43 % and 34 % when considering only valid answers), whereas the percentage attributing inaccurate forecasts to delays during construction is a bit lower (23 % among the total sub-sample and 29 % among valid answers). It should be noted that the proportions disagreeing in the explanation statements are also lower for the more specific explanations than for the statements referring to general difficulty in predicting the future. Even for the explanations obtaining the lowest proportions of 'agree' and 'partly agree', the proportions fully or partly agreeing are more than twice as high as the proportions fully or partly disagreeing. This reflects much higher percentages of 'neutral' and 'don't know' for the more specific explanations: whereas only 3.3 % of the total sub-sample has ticked for these answers regarding general impossibility of precise predictions about the future, the proportions makes up 47 % for the 'delays in construction' explanation. This probably reflects that many respondents do not have any specific experience with these circumstances as sources of forecasting errors, while most of them probably have experienced the general difficulty in predicting the future – in traffic forecasting as well as in life in general.

3.2 Optimism bias

The explanation category referred to as optimism bias, understood as a psychological tendency of wishful thinking, was not explicitly addressed in the questionnaire Nor does our interview material suggests that such a psychological mechanism is a very important cause of error in traffic forecasting. Also when asking the questionnaire respondents about optimism bias more generally (without mentioning explicitly the psychological tendency of wishful thinking), cf. Figure 2, the percentages fully or partly agreeing that this is a main source of forecasting inaccuracy are relatively modest (22 % among the total sub-sample and 26 % among valid answers). Although the proportions of 'neutral' and 'don't know' are quite high, the proportions of respondents fully or partially disagreeing that forecasts turn out to be inaccurate because they are overly optimistic about the success of the project are higher than the proportions fully or partly agreeing in this statement.

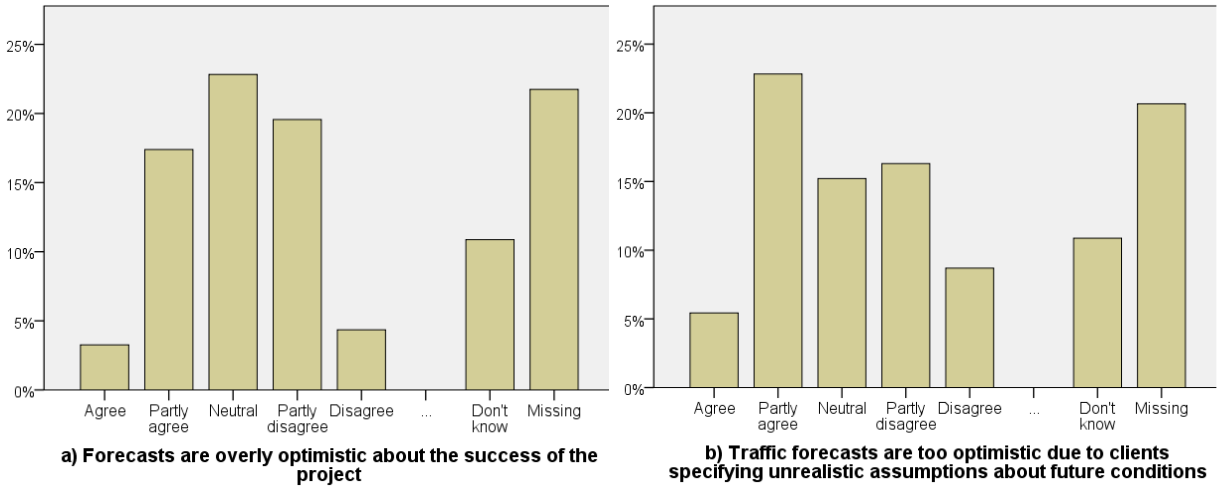

Figure 2: Respondents' opinions about different explanations associated with optimism bias as a main source of forecasting inaccuracy. Percentages of the total sub-sample. N = 92 Scandinavian experts involved in model-based traffic forecasting as constructors of transport models or producers of traffic forecasts.

Slightly higher proportions than in the above-mentioned reference to general over-optimism as an explanation agree in the more specific statement that traffic forecasts get wrong because they are too optimistic due to clients specifying unrealistic assumptions about future conditions. Here, the optimism bias is attributed to the clients and not to the forecasters themselves. This might, on the one hand, reflect uneasiness among the forecasters to admit that they are themselves over-optimistic, making them instead blame the clients. But we consider it more likely that the statement reflects that several forecasters have actually experienced that clients have persuaded them into feeding the forecasting models with input data resulting in more optimistic forecasts than the forecasters themselves consider realistic. The question then remains whether this reflects wishful thinking among the clients or is an example of strategic misrepresentation. We will return to this issue below.

3.3 Technical explanations

While we maintain that the occurrence of unexpected events rendering the assumptions of the forecasting models obsolete and erroneous is a cause of forecasting inaccuracy belonging to the ontological and not the technical category of explanations, technical explanations do exist as well. Some of the shortcomings of existing transport models can probably be reduced or eliminated through future research and development, but until such improved models have been developed there will be some forecasting inaccuracy due to these potentially solvable model problems. Moreover, the models used in practical forecasting are for several reasons not always the best ones. There may also be difficulties in obtaining good input data necessary for model calibration.

The two upper graphs of Figure 3 refer to the imperfectness of existing traffic models and the use of models of less than state-of-the-art quality. A quite high proportion of the respondents (63 %) fully or partially agrees that more advanced models would yield

more accurate results, and the proportion holding that resource constraints result in traffic forecasts often being based on relatively simple models are also rather high (52 %). For the above explanations, the proportions fully or partially agreeing are two and a half to three times higher than the proportions fully or partially disagreeing. Although the two above-mentioned questions were not introduced by any text explicitly coupling model imperfectness with forecasting inaccuracy, we find it plausible to interpret respondent statements about needs for model improvement and frequent use of less-than-optimal models as indirect indications of model shortcomings as sources of forecasting inaccuracies.

The use of a model not belonging to the most advanced ones in transport planning practice was commented on as follows by one of our interviewees:

> You may well use a traffic model that is not as top-tuned as it ought to be. But since the same model is used to analyze all four [road-building alternatives], some of its errors will be eliminated when comparing across. (Model developer/consultant, Denmark, in interview June 2010.)

We also asked the respondents to state how well-abled they considered traffic models were for performing certain tasks frequently mentioned in the literature as model weaknesses: to reflect impacts of land use changes, to reflect impacts of changes in the public transport system, and to forecast the traffic-increasing effect of transport infrastructure improvement (induced traffic). High proportions of disagreement in the suitability of traffic models for performing these tasks would then serve as indications that these specific model shortcomings were partial explanations for forecasting inaccuracies.

The results show that the majority of respondents (68 – 70 %) consider traffic models to be good at reflecting impacts of land use changes and impacts from changes in the public transport system. In contrast, only around 17 and 21 %, respectively, disagree fully or partially in the well-performance statements about these aspects.

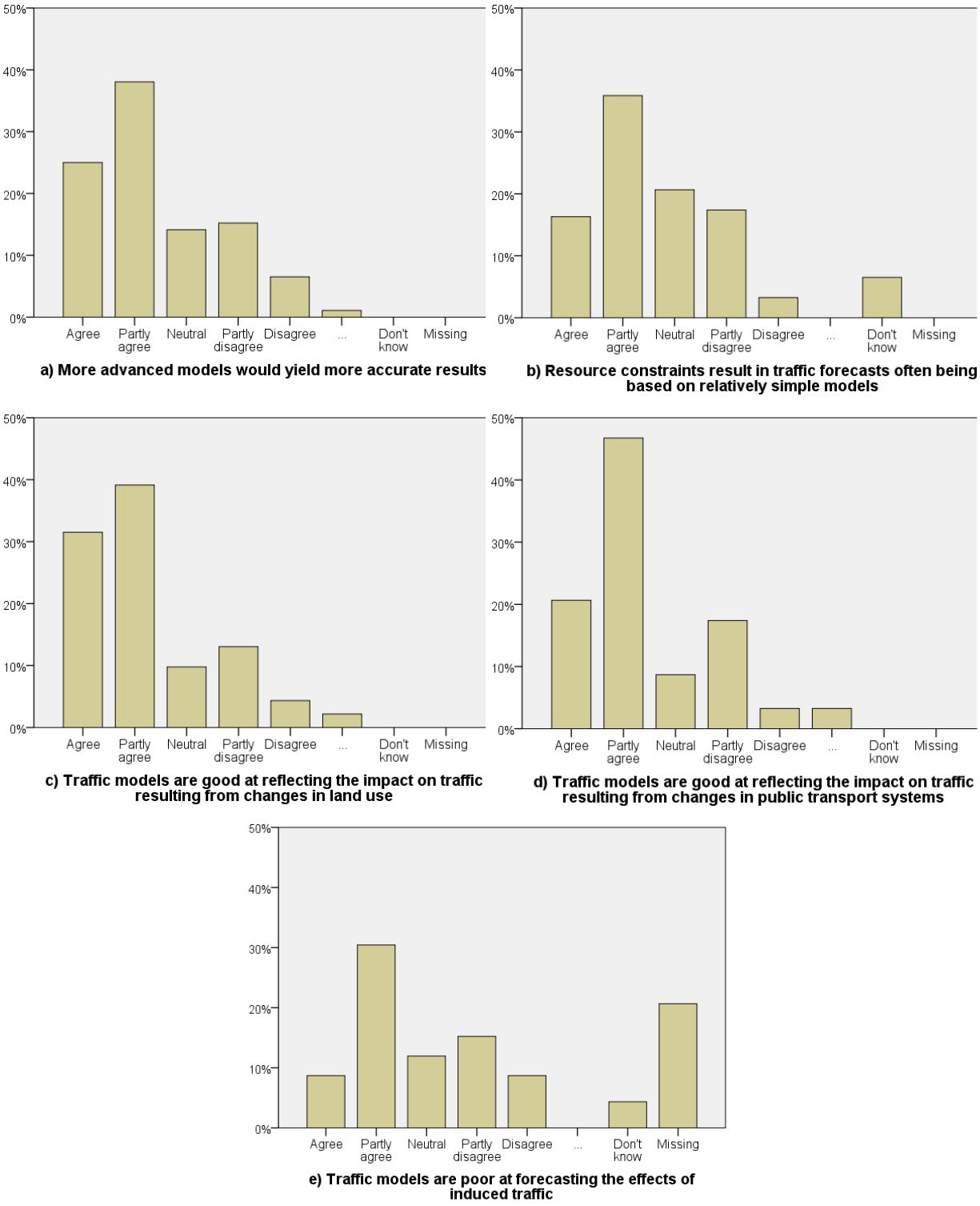

Figure 3: Respondents' opinions about different explanations associated with technical shortcomings as a main source of forecasting inaccuracy[2]. Percentages of the total sub-sample. N = 92 Scandinavian experts involved in model-based traffic forecasting as constructors of transport models or producers of traffic forecasts.

The respondents' faith in the models' predictive ability is, however, substantially lower when it comes to the traffic-increasing effect of transport infrastructure improvement. Among the total sub-sample, 39 % fully or partially agree that forecasts tend to become

inaccurate because traffic models are poor at forecasting the effects of induced traffic, compared to 24 % who fully or partially disagree. If only the valid answers are included, 49 % are fully or partially agreeing while 30 % fully or partially disagree.

An issue here is, of course, whether the respondents are sufficiently knowledgeable about the nature and magnitude of traffic impacts from land use changes, changes in the public transport system and road capacity increases in different contexts to discover model shortcomings related to these aspects. The questionnaire included questions asking respondents to express their agreement or disagreement with statements about the existence of such impacts. For each of the three above-mentioned kinds of impacts, around three out of four respondent fully or partially agreed that such changes have significant influences on travel behavior (and for road capacity expansion that the effect is an overall increase in traffic), whereas only 6 – 16 % were fully or partially disagreeing. These figures still do not necessarily entail that the respondents consider that traffic models tend to underestimate the size of such changes – the perceived error could also be that the effects were exaggerated. Regarding the impact of road capacity increase, some of the modelers and forecasters who participated in the qualitative interviewees and who recognized induced traffic as a real phenomenon, considered it to be of modest magnitude and a much more limited phenomenon geographically and topically than depicted in the academic literature (Næss et al., 2014).

In the quote above, the use of a model with recognized shortcomings was defended by one of our interviewees. This model did not take induced traffic into consideration, but since the resulting error would be nearly the same for all the road-building alternatives, the model was considered to be good enough for its purpose. Ignoring induced traffic will, however, lead to biased results when comparing road construction with the 'no-build'-alternative. Neglect of induced traffic tends to systematically underestimate adverse traffic-related environmental effects, and in congested regions it is also likely to severely exaggerate time-saving benefits from road construction. Omission of induced traffic can thus serve to place proposed road-building projects in a more flattering light than what would be the case if the traffic-increasing effect of road construction were taken into account. The question therefore arises: Is the continuing use of models ignoring or grossly underestimating induced traffic, despite strong criticism leveled by academics as well as stakeholders in local planning processes against this practice[3], a merely technical issue?

3.4 Strategic misrepresentation

One of the questions in the questionnaire survey asked explicitly about deliberate manipulation as a possible source of forecasting error. Not many respondents agree in this being a main source of forecasting inaccuracy. As can be seen in Figure 4, only 14 % of the total sub-sample express full or partial agreement, while 42 % fully or partially disagree. Counting valid answers only, the percentages are 18 % and 54 %, respectively. A widespread normative rejection of deliberate manipulation is also reflected in the qualitative interviews, as illustrated in the quote below:

> We must be able to solve the tasks for both sides in a dispute. We need to be able to say: This is precisely the way we do it. (Consultant, Denmark, in interview July 2010)

It is well-known from the literature on questionnaire survey methods that socially undesirable and unacceptable behavior generally tends to be under-reported (e.g. Bradburn, Sudman & Wansink, 2004). Our sub-sample consists of respondents who are themselves deeply involved in model construction and the production of traffic forecasts. Admitting that forecasting inaccuracies might stem from deliberate manipulation might place their own profession in an unflattering light. Viewed this way, one might perhaps have expected the proportions fully or partially agreeing in the statement to be even lower. The fact that 14 % of the total sample (i.e. 13 respondents) identify deliberate manipulation as a main source of forecasting inaccuracy is in this perspective not very reassuring. Moreover, when asking about specific practices that might be part of, or related to, strategic misrepresentation, higher proportions of respondents give affirmative answers.

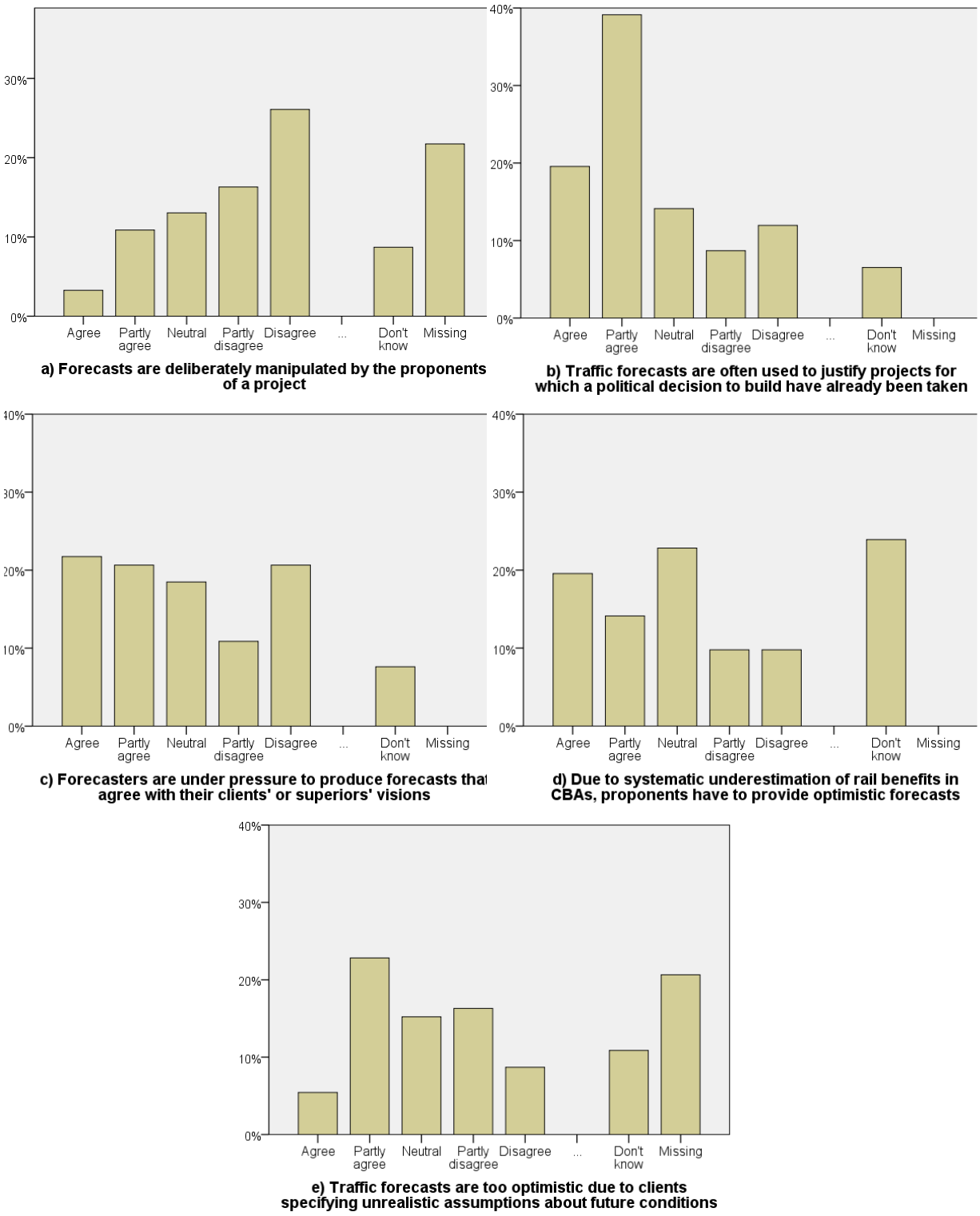

Figure 4: Respondents' opinions about different explanations associated with strategic misrepresentation as a main source of forecasting inaccuracy[4]. Percentages of the total sub-sample. N = 92 Scandinavian experts involved in model-based traffic forecasting as constructors of transport models or producers of traffic forecasts.

We have already (in the section on optimism bias) mentioned that 28 % of the total sub-sample (and 36% among those who have given valid answers) consider forecasters'

acceptance of unrealistic assumptions imposed by their clients about future conditions to be a main source of erroneous forecasts. The following quote suggests that dialectic interplay is sometimes taking place between political preferences about future development and the decision-support material delivered by forecasters:

> *Interviewee:* Is the acceptance of the [very high] passenger forecasts for the xxx rail line a result of naïve optimism or deliberate manipulation, given the available information?
>
> *Parliamentary politician:* I would rather say: It is at least an attempt to avoid running into a difficult situation. And maybe also a belief that there are no limits. … Obviously, if you expect economic growth of 2-3 % annually over the next 40 years, there will be a lot of demand for all kinds of things. Then there is the question of whether this rise in consumption is consistent with the adopted environmental goals. Which it isn't. But the non-achievement of these goals will not be apparent until later. So, although the importance of this explanation is difficult for me to gauge, what may be the case is that decision-makers want to avoid putting themselves in a situation where they have to choose. I think some politicians are very much aware that they should not make too much queries into this [the assumptions underlying the forecasts], because then they would have to make a choice. (Member of the Danish Parliament, in interview January 2011.)

The respondents' answers to the questions about their agreement/disagreements with statements b, c and d in Figure 4 also give reasons for concern. 48 % of the respondents fully or partially agree that traffic forecasts are often used to justify projects for which a political decision to build have already been taken, whereas only two thirds of this percentage (32 %) disagree. This is also pointed at in some of the qualitative interviews, as illustrated by the following quotes:

> Very often … what the politicians do is to choose the forecast leading to the decision they [beforehand] prefer. … If you change the assumptions just a little bit, the resulting changes will simply overrule its [the model's] finesses. (Model developer/Consultant, Denmark, in interview June 2010.)
>
> The point is anyway that it ends up in horse trading. Then you try to construct some rational arguments for what you do. (Member of the Danish Parliament, in interview January 2011.)

Respondents fully or partially agreeing that forecasters are under pressure to produce forecasts that agree with their clients' or superiors' visions (41 %) outnumber those who fully or partially disagree in this statement (32 %). The following quote illustrates some of the dynamics that can make forecasters yield to such pressure:

> I refuse to believe that those carrying out this work [modeling] are not influenced by knowing that the result they arrive at is to be used by agencies that are subsequently supposed to order new studies. (Member of the Danish Parliament, in interview January 2011.)

Perhaps even more worrying are the respondents' opinions about a statement saying that proponents of rail projects have to provide optimistic forecasts to get projects approved, since rail benefits are systematically underestimated in cost-benefit analyses. 34 % agree fully or partially in this statement, while only 20 % express full or partial disagreement. As illustrated by the quote below, forecasters may also be influenced by attitude-based preference for certain modes of transport:

> People working in the rail sector are usually quite interested in railroad and they really like trains – in a way that – sometimes you don´t feel that they are really neutral to their study object. That´s at least my impression. And that impression is based on – mainly from my work at xxxx, where people working in the rail sector they kind of *like* rail. …… We have had some projects in Sweden, where the assumptions were, I would say, a little bit rough – or optimistic – where things weren´t exactly – I don´t think it was done the correct way. .. It´s .. quite well known in Sweden that the Nordre Botnia Banan railroad along the north – the east coast north of Gävle up to .. Sundsvall and Umeå – there the forecast wasn´t really based – wasn´t made on the correct assumptions I think. And … I´m not the only one who question this forecast. (Swedish consultant and researcher, in interview October 2011)

It should be noted that the proportions of 'neutral' and 'don't know' answers is particularly high for the last question in Figure 4 (46 %) and considerable also for the statements about a priori decisions and pressure from clients (around 25 %). Nevertheless, the pattern emanating from the answers in Figure 4 and the above quotes from the qualitative interviews clearly indicates that strategic misrepresentation should not be dismissed as an important source of forecasting error.

4 Concluding remarks

Our material suggests that several categories of explanations exist for traffic forecasting inaccuracy in a Nordic context. Instead of regarding ontological, psychological, technological and political/institutional explanations as competing categories, we consider it more fruitful – and better in line with our data – to see these different explanatory categories as complementing each other. In particular, our respondents and interviewees are of the opinion that ontological, technological and political/institutional circumstances are important sources of forecasting errors, whereas the support of psychological explanations is less clear in the material.

Ontological conditions – the inevitability of unexpected events in open systems – are recognized by the respondents and interviewees as important causes of forecasting errors. Such unexpected events result in large, non-systematic differences between forecasted and actual traffic. The large standard deviations of the inaccuracy levels found in studies comparing actual and forecasted traffic volumes are mainly attributable to this category of explanations.

The human psychological tendency of judging outcomes of planned actions too optimistically is identified as a source of error by a relatively moderate number of respondents and by few interviewees. In contrast, poor technical model quality is widely held by our respondents and interviewees as a source of inaccuracy. The inaccuracies in question are in the form of unsystematic deviations as well as systematic bias – the latter occurring, for example, when using transport models that do not take induced traffic into consideration. There is, however, reason for critically asking whether continued use of technically biased models should be understood as an 'innocent' and purely technical matter. As argued by Næss (2011), the reasons for sticking to transport models that exaggerate time savings and underestimate negative environmental impacts

of road building may well be of a political/institutional nature (see also Andersen, 2013). If someone actually wanted to manipulate forecasts in order to place a project or a policy in a flattering light, choosing model assumptions that make the project outcomes look favorable is arguably the way such manipulation could be done with the least risk of being discovered.

Most respondents and interviewees disagree, however, in the explicit and general statement that forecasting errors may be due to deliberate manipulation. But many respondents (and some interviewees) consider various specific kinds of misrepresentation (justification of already chosen projects, satisfying clients' opinions, or 'compensating' for bias in rail CBAs) as quite widespread. Since these kinds of practices are likely to lead to skewed forecasts, they can reasonably be identified as sources of forecasting bias. So while we do not claim that strategic misrepresentation is the only or dominating source of forecasting error, we do find evidence indicating that political/economic causes of biased forecasts cannot be ruled out. The limited size of our sample of respondents should still be borne in mind.

Incentives for strategic misrepresentation clearly exist. Among our sub-sample of 145 Scandinavian politicians at national and local level, large majorities (82 and 73 %, respectively) consider traffic forecasts to be important in negotiations for state funding and for justifying the need for capacity expansion. A municipal politician put it this way:

> "They [the forecasts] don't matter so much at the early stage. But they become important if you are to proceed with an idea. .... Then they are decisive for the acceptance of the arguments." (Former city council member and chairman of the municipal transport committee, Denmark, in interview November 2010.)

The high levels of forecasting inaccuracy and bias found in previous studies, combined with the different sources of errors pointed at by our respondents and interviews, gives rise to serious concerns about existing forecasting practice and in particular the socioeconomic assessments into which the forecasts are fed. The lesson for practice to be learnt from the ontological explanations of forecasting errors is that it is futile to try to make exact forecasts of the future traffic volume on a proposed piece of infrastructure. Instead, we propose to separate the so-called strategic, tactical and operational levels of traffic forecasting into three distinct methodological approaches reflecting the different degrees of openness/closure of the systems at hand: Scenario analyses at the strategic level (were different trajectories for the general, 'background' growth or decrease in traffic can be explored); theory-informed, mainly qualitative analyses supplemented with simple calculations at the tactical level (where the changes in traffic volumes caused by a proposed project are assessed); while more traditional micro-simulations should be applied only at a detailed operational level (Næss & Strand, 2012, 2014). Moreover, when assessing the impacts of a proposed project, it is crucial that induced traffic is included in the calculations.

The possibilities of different kinds of strategic misrepresentation call for a radically more transparent forecasting process than what is typically the case today. The lack of transparency characterizing most model-based forecasting work contributes to a reification of quantitative model output, despite the usually high degree of uncertainty and possible bias. In particular, the process will have a 'black box' nature if the assumptions of the traffic model are dealt with as the 'business secret' of a consultancy firm. Replacing traditional modeling at the 'tactical' level with the theory-informed analyses and simpler calculations proposed here will in itself contribute to more transparency. In addition, the built-in assumptions of the analysis (whether model-based or based on simpler methods) should be quality controlled by independent external experts covering subject fields wider than that of the forecasters themselves.

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Notes

[1] For each of the questions in Figures 1 and 2, the answer alternatives were introduced by a text asking the respondents to indicate for each statement how much they agreed in this statement being a main explanation for potential inaccuracy in traffic forecasts.

[2] For questions a, b, c and d, the answer alternatives were introduced by a text asking the respondents to indicate how much they agreed in each statement. For question e, the answer alternatives were introduced by a text asking the respondents to indicate for each statement how much they agreed in this statement being a main explanation for potential inaccuracy in traffic forecasts.

[3] See, e.g., Newman and Kenworthy, 1989; Tennøy, 2003; Næss, 2011.

[4] For questions b, c and d, the answer alternatives were introduced by a text asking the respondents to indicate how much they agreed in each statement. For question a and e, the answer alternatives were introduced by a text asking the respondents to indicate for each statement how much they agreed in this statement being a main explanation for potential inaccuracy in traffic forecasts.