

## **Models, Environment and Manipulation: Power and Knowledge Filtering in the Decision-making process about the Third Limfjord Crossing<sup>1</sup>**

Jeppe Astrup Andersen<sup>2</sup> / Petter Næss<sup>3</sup>

**[Affiliations on the footnotes]**

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### Abstract

Using the Environmental Impact Assessment of the proposed Third Limfjord Crossing in Aalborg, Denmark as an example, this paper discusses how transport models can be designed, consciously or unconsciously, to be imbued with a political program of discrimination, causing forecasting error in transport infrastructure planning. Assuming that traffic growth would be the same regardless of whether or not a new motorway was constructed, the planners in the Limfjord case concluded that intolerable congestion would arise in the absence of increased road capacity. The paper discusses how the zero-alternative was fabricated through unrealistic assumptions of the Limfjord case traffic model about relevant causal mechanisms, and gives an outline of the planning and decision-making process in which the model was used. The paper concludes that a process of knowledge filtering has taken place, where state-of-the-art knowledge about induced and generated travel ended up being dismissed in the political and legal decision-making system.

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### **Traffic models – a political technology?**

The development of increasingly powerful computer technology at cheaper prices has enabled both the creation of computer models of growing complexity and their more widespread use within academia, public planning and policy-making as well as within the business community. The increased complexity of quantitative decision support models has made formulation of more complex and targeted policies possible. The tendency towards increased complexity has, however, at the same time obscured the transparency of such models, and this may be a problem in terms of democracy when the models are used in public planning and policy-making. First, the scope for public debate is narrowed when a domain is largely dominated by

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<sup>1</sup> Another article based on the same case study, focusing more on how erroneous forecasts of the zero alternative may be an important source of bias in road infrastructure planning, is forthcoming in the journal *Transport Reviews* (See Næss, 2011).

<sup>2</sup> Aalborg University, Department of Development and Planning, Fibigerstræde 13, 9220 Aalborg, Denmark, jeppe@plan.aau.dk

<sup>3</sup> Aalborg University, Department of Development and Planning, Fibigerstræde 13, 9220 Aalborg, Denmark, petter@plan.aau.dk

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complex mathematical calculations. Second, despite the accurate, objective and scientific appearance of such models and the widespread notion that technologies in themselves are neutral, this is not always the case. Langdon Winner (1980) discusses how technological artifacts are not necessary neutral but can be political in two senses. First, technology can be designed, consciously or unconsciously, to open certain social options while closing others. Moreover, Winner argues that some technologies are in their entirety political.

Using the Environmental Impact Assessment (EIA) of the proposed Third Limfjord Crossing in Aalborg as an example, this paper discusses how transport models can be designed, consciously or unconsciously, to be imbued with a political program of discrimination causing forecasting error in transport infrastructure planning. First, the concepts of power and knowledge filtering as applied in this paper will be defined. Second, different types of functions complex decision support tools can undertake and how some of these functions can contribute to biased forecasts will briefly be reiterated. Then, the proposed Third Limfjord Crossing, the planning process so far and some of the main conclusions of the EIA report will be described. Thereupon, the assumptions of the Limfjord case traffic model about relevant causal mechanisms will be discussed in the light of state-of-the-art knowledge about induced and generated traffic, demonstrating how the model's assumptions led to an unrealistically negative representation of the zero-alternative. In the final part, possible explanations of the unreliable traffic forecasts and assessments of traffic-related environmental impacts in the Limfjord case will be discussed. The paper concludes that a process of knowledge filtering has taken place, where state-of-the-art knowledge about induced and generated travel ended up being dismissed in the political and legal decision-making system.

### **Power and Filtering of Knowledge**

In the academic literature dealing with power and the premises for its exercise, two broad factions can be identified. One group conceives power as coercion and relates the concept to personal interests. The other, more broadly defined group holds that power, in one way or another, is the outcome of social order, and also includes productive aspects of power. This paper takes its point of departure in a pluralistic conception of power, developed by Mark Haugaard (2003) and includes aspects from both types of power creation, although the main emphasis is on power as reproduction of social order. This involves that power is attributed to coercion, exclusion, manipulation, productive creation, structural resources, reification, identity as well as discursive mechanism.

In this article, filtering of knowledge is defined as suppression of knowledge which would otherwise have been relevant in the given context. Knowledge filtering is thus inevitably attached to the exercise of power. The application of Haugaard's (2003) theoretical framework implies that knowledge filtering must also be defined in a pluralistic manner. Hence, filtering of knowledge can be related to powerful actors', more or less active, rejection or detention of relevant knowledge, based on conflicts of interests. Filtering of knowledge is, however, not only associated with interests, but also emanates from social structures constraining the

production of knowledge that might threaten or weaken the prevalent social order. Furthermore, the concept is attached to inconsistency between knowledge and discursive beliefs related to identity or interpretation horizons. It is through discourses that power takes part in defining what counts as truth knowledge. In such processes, psychological mechanisms can also play a role. It can be difficult for social actors to sustain great inconsistencies between, on the one hand, their conceptions and practices and, on the other hand, new knowledge relevant to these conceptions and practices. According to Festinger (1956), the solution to this inconsistency or 'dissonance' is either to change one's conception and/or practice, or to reject the new information. Knowledge which is either contra-intuitive and/or conceived as threatening against prevailing lifestyles or habits will therefore often have a problem with being accepted.

### **Manifest and Latent functions**

Models used within transport planning can take on many different functions and can be applied several ways in planning and decision-making processes. One way to make sense of the different roles transportation models can undertake is to distinguish between the manifest and latent functions. The manifest function is the outwardly expressed rationale for use of the models whereas the latent functions are those which are not explicitly acknowledged or openly discussed (Merton, 1957). It can be argued that the models' manifest functions are often attached to an instrumental utilization of the model results whereas the latent functions more are related to a conceptual or symbolic use. Conceptual use implies a diffuse and indirect application of model results, e.g. when a model contributes to create a shared understanding of a policy issue. Symbolic use refers to situations where model results are used to legitimize predetermined decisions (Amara *et al.* 2004).

Utilization of quantitative scientific decision support tools applied within transport planning is traditionally associated with the synoptic planning model. The manifest function that transport modeling tools are to undertake within this planning paradigm is to function as forecasting technologies in order to provide objective and scientific knowledge about alternative policy actions, upon which rational political decisions can be based. However, this view on the role of scientific decision support models can be criticized for operating with far too naive and mistaken views on how rational decision making processes are, or can become (Sager, 2003). The positivist belief in objectivity, value neutrality, and the possibility of making precise projections based on universal causal factors embodied in the tools can also be contested (see e.g. Næss, 2004b). 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 highly inaccurate and sometimes misleading (Flyvbjerg *et al.* 2003). As shown by Flyvbjerg *et al.* (2006), among 183 investigated road projects in 14 different countries, one half had a deviation between forecasted and actual traffic of more than  $\pm 20\%$ , and one fourth more than  $\pm 40\%$ .

In order to illuminate why decision support models are so widely utilized within transport planning despite their widespread inaccuracy, the focus will in the following be directed towards some latent functions transport modeling tools can undertake.

In politics, problems defined in ambiguous manners are often difficult to handle, because ambiguity implies uncertainty whereas policy is believed ideally to rest on solid knowledge. Hence, in order to render a policy area (e.g. transport infrastructure development) governable, it is often necessary that one definition or one specific approach is highlighted, while others are tuned down or excluded (Hajer, 1995; Rose, 1991). Scientific decision support models used within infrastructure planning can play an important role in this power struggle through reification of particular rationalities (i.e. making these rationalities seem natural and unquestionable). The reason why the models tend to be effective in this power struggle about reification is that they are often regarded as truth-production technologies and thereby have the capability of portraying the models and the modellers as “independent” experts (Henman, 2002). Three different aspects reinforce the models’ functions as truth production technologies.

1. The technical complexity and low degree of transparency which characterize many traffic models involve that it can be extremely difficult for lay people to grasp the basis on which model calculations are conducted. Also for professionals outside the modeling process it can be difficult to level a critique, because data and assumptions are often not clarified (Osland & Strand, 2010; Tennøy *et al.* 2006). Even model-users do not always have the opportunity to make a proper qualitative assessment of how the traffic is actually modeled because many standard traffic modeling software programs are insufficiently documented (Nielsen 1995). Seen in this perspective, traffic models could be considered as ‘black boxes’ with a content that it is not considered necessary to take into consideration. According to Hajer (1995:272), black-boxing is a fundamental discursive mechanism, which operates through the production of a veil behind which particular interests, norms and discourses can be cloaked in a natural or scientific appearance.
2. Utilization of model calculations in the decision making process also tends to create a monopoly on the knowledge production about an investigated policy issue by crowding out preparation of other alternatives. This is partly because of the high construction and maintenance costs, which involve that fewer resources are available for alternative approaches of assessment, and partly because the complexity of the calculated model scenarios often entails that it is almost impossible for opponents to formulate alternatives which appear equally well underpinned (Tennøy, 2004).
3. In the documents introduced to the decision-makers and the public, uncertainty is often masked by presenting the calculations in exact numbers (Tennøy *et al.*, 2006)

Transport model calculations can also be applied as efficient political technologies. Despite the scientific and objective appearance of model calculations, they can easily be manipulated in one way or another (Wachs, 1989). According to Flyvbjerg *et al.* (2003), more or less deliberate strategic misrepresentation seems to take place relatively frequently in order to make projects appear more beneficial.

However, transport models can not only be used politically. Arguably, they can also in themselves embody political properties.<sup>4</sup> Following Langdon Winner's line of reasoning, it can be argued that the manner traditional four-step transport models are designed facilitates car orientated solutions to transport problems at the expense of public transportation, non-motorized modes of transportation and compact urban land use (as discussed below). In that sense four-step transport models are not neutral but contain by virtue of their design particular politics. This does however not involve that the application of transport model calculations in the planning process is necessarily a deliberate act of partisan politics. As Gieryn (2002, 43) notes:

***Once sealed shut, machines are capable of steering social action in ways not always meaningfully apprehended by actors or necessarily congruent with their interests or values.***

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Despite the tendency of transport calculations conducted by classical four-step models to frame solutions to transport problems in a manner that favors car traffic, the same model designs are also applied in some situations where there is a political objective to reduce car travel (see e.g. Tennøy, 2004). Hence, there is not always correspondence between the political program defined by the material design of particular models and the program defined by the political aspirations among decision-makers.

### **The proposed Third Limfjord Crossing**

Aalborg is the regional capital of North Jutland and the third largest municipality in Denmark. In the Aalborg area there are presently two road connections and a rail bridge crossing the Limfjord which divides the city. The possibility of constructing a third road connection across the Limfjord has been discussed between local, regional and national authorities for more than three decades. A traffic analysis and subsequent public debate on alternative paths for such a connection were carried out 1993-1996. Some participants in this debate criticized the analyses for failing to illuminate the ways in which the need for road development depends on the urban structure and the future urban development, and for disregarding alternative traffic measures, such as improving the transit system. Therefore, new traffic model simulations were carried out in 1998 and with some minor modifications the work of an Infrastructure Committee, based on these calculations, was established jointly in 2000 by the Municipality of Aalborg, the County of North Jutland and the Ministry of Traffic. In order to avoid future congestion problems on the road network the Committee recommended a 3<sup>rd</sup> Limfjord road crossing to be built. An Environmental Impact Assessment of three different schemes for this

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<sup>4</sup> See Næss (2006) for a discussion about political properties embodied in cost-benefit analyses of transportation investments

crossing was presented in the spring of 2003. After a public hearing, the County of North Jutland adopted an amendment to the County Plan in the autumn of 2003, including land reservation for a 20 km motorway link with access roads, at a cost estimate of approx. 450 million Euros. Three alternative lines of the Third Limfjord Crossing were envisaged: the Egholm Line, the Lindholm Line and the Parallel Tunnel (See figure 1). Among these, a western alternative crossing the island of Egholm was chosen.

Figure 1: *The three alternative solutions for a Third Limfjord Crossing included in the EIAs in 2003 and 2006.* Source: Danish Road Directorate (2010)



However, several formal complaints were submitted to Nature Protection Board of Appeal against the EIA report. Two of these complaints criticized the EIA for an insufficient assessment of the impacts on habitats and species protected by EU legislation, whereas a third complaint criticized the County for having rejected to include in the EIA an alternative aiming to avoid traffic growth through restrictions on auto usage and substantially improved public transport. The latter complaint was not accepted by the Board of Appeal. The content of the complaint and the premises for rejecting it will be discussed more in-depth in a later section of the paper. The two former complaints were, however, accepted by the Board of Appeal. In 2006, the Board

of Appeal thus abolished the Region Plan amendment and the associated EIA report on the Third Limfjord Crossing.

The decision by the Board of Appeal implied that the land reservation for the Egholm motorway was no longer valid. The County of North Jutland therefore decided to initiate a new planning process in cooperation with the Coastal Directorate, the Road Directorate and the Municipality of Aalborg. In the new EIA report (County of North Jutland et al., 2006), more in-depth analyses were made regarding the influence of the proposed road on protected habitats. However, the Danish Forest and Nature Agency considered the EIA report to be insufficient and put forth an objection against the County's proposal for an amendment of the County Plan. This implied that the County did not have the time to adopt the County Plan amendment before January 1, 2007, when the Danish counties were abolished and replaced by a lower number of administrative Regions.

The future of the project is still unclear. In the National Parliament the political parties behind the political agreement 'Better Roads etc.' from December 2<sup>nd</sup> 2009 have agreed to supplement the previous EIAs with additional investigations and assessments of the road system's environmental impacts during both the construction and subsequent operation phase. The new EIA investigations were initiated in the spring 2010 and are scheduled to be completed in 2011. The objective is to take a political decision about the project's future course of event in the fall 2011 (Danish Road Directorate 2010).

### **Some main conclusions of the EIA report**

The 2003 EIA report included assessments of motorway alternatives as well as highway alternatives for the two western crossings, whereas the report from 2006 only included assessment of motorway alternatives. The latter report also included an extended chapter on terrestrial and marine environment, compared to the 2003 report. Apart from that, the 2003 and 2006 EIA reports are fairly similar. In the following, we shall concentrate on the environmental consequences that depend on the volume, speed and composition of the future traffic on the new road links and on other affected parts of the transport infrastructure: energy consumption, air pollution, traffic noise and traffic accidents.

In the environmental assessments, the three motorway construction alternatives were compared to the situation in the year 2015 if no new road is constructed (the 'baseline' alternative). According to the calculations, traffic growth would cause the average speed on the two existing crossings of the Limfjord in the peak period to drop to 15 km/h and 20 km/h in 2015 if the road capacity across the fjord was not increased. With the proposed motorway, congestion would instead be diminished.

The motorway alternatives were forecasted to reduce energy use, air pollution, general exposition to noise and the number of traffic accidents involving personal injury, compared to the baseline alternative.

Greenhouse gas emissions were only mentioned in the section of the EIA where the results of a cost-benefit analysis were presented. The three motorway alternatives were estimated to give the following annual savings due to lower greenhouse gas emissions, compared to the baseline alternative: the Egholm Line DKK 1,075,000; the Lindholm Line DKK 1,439,000; and the Parallel tunnel DKK 611,000.

A slightly higher number of vehicle kilometers by car was forecasted in the motorway alternatives than in the baseline alternative, as the proposed roads would channel a larger proportion of the traffic along routes deviating somewhat more from the straight line between the majority of origins and destinations, compared to traffic on the existing road network (cf. Figure 1). Apart from this, traffic was predicted to grow at the same rate in the motorway alternatives as in the baseline (2 % annually).

### **Scrutinizing the assumptions of the traffic model**

The traffic forecasts of the EIA had 2015 as the time horizon and were carried out by means of the so-called Aalborg Traffic Model. The forecasted traffic volumes in 2015 were based ‘partly on information about planned residential and commercial development within this horizon, combined with a general assumption about the growth in the traffic crossing the fjord, estimated from the past development’ (Road Directorate, County of North Jutland and Municipality of Aalborg, 2006, p. 14). There is no information in the EIA report about the model’s assumptions about factors influencing future traffic development. Whether or not the model takes the effect of induced traffic into account is thus not explicitly stated. The lack of such information is in itself a demonstration of the black-boxing character of the model. However, the almost identical predicted traffic growth in the motorway alternatives as in the baseline alternative clearly indicates that induced travel has not been incorporated into the traffic model. This has also been confirmed in an interview in 2010 with a planner from the former County who has worked on the project (Interview with planner, 2010).

The non-inclusion of induced travel in the model squares well with the so called “predict and provide” paradigm, but is at odds with the most recent manual from the Ministry of Transport (2003) on how to conduct socio-economic analyses within the transport sector. This manual contains specific guidelines for how to estimate short term (but not long-term) effects of induced traffic (Ministry of Traffic, 2003). The disregarding of induced travel is furthermore sharply at odds with state-of-the-art knowledge about impacts of road improvements on traffic volumes. According to theories of transport economics and transport geography as well as a number of empirical studies in several countries (see, e.g., SACTRA, 1994; Noland & Lem, 2002; Litman, 2009), road construction facilitating higher travel speeds will result in generated and induced traffic by influencing:

- route choice
- the proportion who prefer to travel in the peak period

- the amount of travel
- the modal split
- land use (in a longer term)
- the quality of the public transport services (in a longer term).

Changes in the amount of travel (longer and/or more frequent motorized trips) and in the modal split (a higher share of car travel) occur relatively soon after road capacity has been increased. In addition, there are long-term effects reinforcing the immediate changes. Long-term induced traffic is partly a result of the fact that roads facilitating higher travel speeds by car contribute to more dispersed location of residences, jobs and services. In addition to the resulting longer trips, such built environments are difficult to serve by public transport. Moreover, the higher shares of car travel resulting from the short-term changes in modal split usually reduce the income of the public transport companies, with reduced services and/or increased fares as typical responses (Mogridge, 1997; Noland & Lem, 2002).

The verbal discussion in the EIA report mentions that the new road will accommodate long-term traffic growth. This traffic growth is, however, depicted as unavoidable:

***“Even if a Third Limfjord Crossing is not realized, future traffic growth cannot be avoided. If traffic continues its rate of growth without road capacity increases, traffic flows will steadily worsen, with steadily increasing emissions per vehicle kilometer as a result.”*** (Danish Road Directorate, County of North Jutland and Municipality of Aalborg, 2006, p. 28; own translation)

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However, when the traffic modelers assume that traffic growth will continue along a historically observed trajectory, regardless of whether or not the capacity and standard of the road infrastructure is increased, they ignore the fact that the hitherto observed traffic growth is partially a result of road investments having facilitated this growth.

The increase in road capacity represented by the new motorway and associated access roads is assumed to improve overall travel speeds, reduce emissions per vehicle kilometer and improve traffic safety. However, because the assessment ignores induced and generated traffic, these benefits are likely to be considerably exaggerated, because induced travel implies that the new road capacity will gradually start to fill up again, which will eventually cause traffic speeds to drop. In addition, due to induced travel, energy use per vehicle kilometer will be less improved as well, as the number of vehicle kilometers will be higher than indicated by the model results. Most likely, therefore, total energy use and greenhouse gas emissions will be considerably increased instead of being reduced, as indicated by the EIA.

Induced travel also implies that more people will be exposed to the risks of traffic accidents, noise and air pollution. And since trips do not start and end on the slip roads of the motorway, but from origins to

destinations all over the city and the region, the increasing traffic caused by the new motorway will expose a larger than predicted number of people to noise, air pollution and risk of accidents along local roads.

Moreover, the impact assessment of energy use and carbon dioxide emissions does not seem to take into account the fact that an increase in travelling speeds beyond some 80 - 90 km/h entails a considerable increase in energy use per vehicle kilometer, and that energy use per vehicle kilometer is similar when driving 20 km/h as at 120 km/h (IEA, 2005). The gains from avoiding speed levels within the energy-inefficient range below 40 km/h are taken into consideration, but the energy-increasing effect of raising speeds above 80 - 90 km/h does not seem to be incorporated in the model despite the speed limit of the new motorway will probably be 130 km/h (possibly 110 km/h along some stretches).

Another deficiency of both the two above-mentioned EIAs is that neither of them includes an assessment of uncertainties in the analysis, nor a discussion of the validity of the assumptions on which it is based and how these assumptions influence the model results. Such information is required according to the above mentioned manual from the Ministry of Transport as well as the guidelines from the Ministry of the Environment on the Planning Act (Ministry of Transport, 2003; Ministry of the Environment, 1996). As can be seen above, the underlying assumptions of the traffic model is not clarified at all. Such neglect is especially problematic in this case, because all the above-mentioned shortcomings of the model calculations tend to depict the proposed road in a more positive light than what would have been the case if the missing causal mechanisms had been included in the calculations. We shall return to the implications and possible explanations of this in a later section of the paper.

### **The complaint against the rejection to include an alternative aiming to avoid traffic growth**

The above mentioned complaint submitted to the Nature Protection Board of Appeal, which criticized the County for having rejected to include in the EIA an alternative aiming to avoid traffic growth through restrictions on auto usage and substantially improved public transport, was accompanied by an academic assessment of the validity of the County's arguments for refusing to include the proposals. The academic assessment was written by a professor in urban planning and transport researcher, on request (Næss, 2003). The paper criticized the underlying premise of the County's claim, namely that traffic growth would be equally high if this alternative was implemented as it would be with motorway construction and no particular prioritization of buses and bikes. The paper also pointed to the fact that the EIA did not include any discussion – or mentioning whatsoever – of weaknesses in the information and assessments of environmental impacts, despite the requirement for this stated in the Ministerial Guidelines, cf. above. A second paper was later on submitted arguing more in-depth against the claims put forth below by the County in their defense of their estimates (Næss, 2004a).

As part of the handling of the complaint, the Nature Protection Board of Appeal asked for comments from the County of North Jutland. The County withheld its standpoint, referring, among other things, to traffic

model calculations conducted in 1998 predicting that a replacement of one car lane in each direction on the existing Limfjord Bridge with bus lanes would only reduce the number of cars crossing the Limfjord by 0.5% (in total, not annually!), and would result in an increase in the total vehicle kilometers of car traffic by 0.75% (County of North Jutland, 2004).

In the original report from 1998, it is however stated, that these results are rather uncertain. A weakness in the assessment was that the Aalborg Model did not contain a model to calculate mode choice as well as it did not directly include sensitivities toward changes in frequency. Because of that additional investigations were conducted base on travel survey data, but especially the investigations concerning the shift in transportation mode from car to bus did not, according to the planners, give fully satisfactorily results. It was therefore necessary to make adaptations of the traffic model as well as manual corrections of the model results. (Municipality of Aalborg 1998, 13) Moreover because the Aalborg model does not account for induced traffic, the opposite mechanism is also ignored. The fact that reducing road capacity for general traffic and reallocating it for busses, pedestrians, cyclists, etc. can reduce traffic (Cairns *et al*, 2002) was thus not accounted for. As a consequence, the number of cars crossing the Limfjord as well as the number of vehicle kilometers of car traffic are most likely overestimated in the no-build alternative. There are hence good reasons for questioning the validity of the model results as an argument for rejecting to include the proposal.

In a second reply the county attached a technical paper from the consultant firm COWI, where it was maintained that the “method used in the assessment of induced traffic is the method applied generally for new infrastructure schemes in Denmark” (COWI, 2004, p. 2)

COWI’s argument concerning that traffic model used in the Limfjord case is by no means unique in a Danish context is to some extent true. In the best cases (notably the Ørestad Traffic Model, OTM), the models consider only immediate increases in traffic. In the worst cases, including the Danish National traffic model, most Regional models and the model used for the forecasts in the recent report of the Danish Infrastructure Commission induced traffic is not incorporated at all<sup>5</sup> (Danish Infrastructure Commission, 2008, p. 127; Nielsen & Fosgerau, 2005; see also Næss 2011 for a more thorough discussion). Nevertheless, the fact that induced traffic traditionally has not been incorporated into most Danish traffic models does not make this less of a bias. On the contrary, this neglecting has caused the Danish traffic modeling expert Otto Anker Nielsen to state that “time-saving benefits tend to be clearly– and systematically – overestimated in the analyses on which decisions about larger Danish road projects are based” (Nielsen & Fosgerau, 2005).

In 2006, the Nature Protection Board of Appeal decided to reject the complaint about the traffic forecasts and assessment of traffic-related environmental problems. Concerning the traffic elucidations, the Board of

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<sup>5</sup> A new state-of-the-art national traffic model is currently under development in Denmark which, when completed, is supposed to take both short and long term effects of induced traffic into account.

Appeal stated that “[t]here is no base for rejecting the material as obviously incorrect.”(Nature Protection Board of Appeal, 2006, p. 12)

### **Unreliable traffic forecasts: technical, institutional and political explanations**

In the following technical aspects, political-economical reasons and institutional-organizational conditions (cf. Flyvbjerg, 2007) will be discussed as plausible explanations for the apparent forecasting errors attributed to the zero-alternative.

The Aalborg Model was developed back in the 1970’s, in collaboration between Aalborg Municipality, the County of North Jutland and the Road Directorate, with the purpose of analyzing where to locate a third Limfjord Crossing. The model was designed to account only for car traffic, and the trip patterns were based on a fixed trip matrix, which was standard practice for four-step models of that time (Bates 2007). A planner from the former County of North Jutland told in an interview that the fundamental structure of the model involves that it is impossible to adjust the elasticities in the model in a manner reflecting the effect of induced traffic. In order to account for induced traffic in the model, the elasticity will have to be corrected manually for each alternative (Interview with planner, 2010). There are hence clearly technical explanations of the implausible assessments of traffic-related environmental impacts.

However, despite the model deficiencies the technical error of disregarding induced travel may perhaps not be purely technical. Transport researchers have for decades criticized the neglecting of induced travel in traditional traffic models (see, among others, Newman and Kenworthy, 1989; Kenworthy, 1990; Tennøy, 2004). It is technically possible to develop models that include induced and generated traffic (Litman, 2009; Johnston & Ceerla, 1996). When traffic modelers in spite of this continue to construct models in which induced travel is disregarded, and transportation planners and policy-makers continue to use the results of such model calculations as arguments for road construction, part of the reason could be that the model results tend to fit well with the “predict and provide” doctrine. This mind-set is still dominating within many transport planning organizations. Needless to say, it also serves the interests of project promoters. The selective way of dealing with the relationship between driving speed and energy use (and emissions) per vehicle kilometer is another case in point.

The model users who perform the analysis may also be integrated in a professional culture where certain perspectives and values are dominant and cross-sector analyses are not common. Established rules, standard operating procedures and routines constitute/are part of the spheres in which the professionals navigate (Olsen, 1992). Thus some solutions are held as valid while others may be considered ‘no-go’ – unrealistic and/or undesirable. As noted by Priemus (2007), the public decision-making on large infrastructure projects still runs too much along sectoral lines. So even if there seems to be international consensus on the fact that private transportation contributes heavily to polluting the environment and many cities have adopted political

goals of limiting urban motoring, transport planners may still consider the provision of the best possible conditions for car travel as a professional ideal. Moreover, in an empirical study on the motivations of policymakers to select and use policy assessment tools within various policy domains, Nielson *et al.* (2008, 350) found that the core beliefs prevailing within bureaucracies appeared to have a strong influence on the selection of tools, and these beliefs often correlated with organizational or functional affiliations. The social order within the different sectors can hence act as a constraint for the inclusion of new knowledge diverging from these cultural beliefs. As a consequence problems are often approached from extremely narrow terms of reference. This might explain why traffic models which do not include induced traffic, despite the longstanding criticism, have been so widely utilized by transport planning agencies.

From interviews it appears that that the planners and consultants recognize that the effect of induced travel exists, and this has been discussed by the planners in relation to the case. As mentioned above, the Aalborg traffic model cannot account for induced traffic, but requires manual corrections. However, such corrections have not been considered sufficiently important to be carried out. As a consultant who has worked on the project states:

***“Induced traffic has been discussed in relation to the case. ,, It is, however, difficult to estimate how great the effect of induced traffic would be ... Based on that, we think that it just as good to say, we have this amount of traffic and we have these forecasts, then the traffic will be distributed in this manner in 2015 ... And because of the annually growth rate for the fjord crossing traffic is about 2-3% and let’s say that the effect on induced traffic would generate 5000-10000 extra cars the first years, then the annually growth rate would pretty fast level out this effect.”*** (Interview with consultant 2007)

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Despite the difficulty in making an exact estimation of the amount of induced traffic, which varies with context, dependent on amongst others the degree of latent demand and how much the generalized travel costs are reduced, the forecasting error from ignoring it can still be significant - especially in the long term (Noland & Lem, 2002; Litman, 2009). If induced traffic is ignored, total vehicle kilometer traveled, emission and congestion levels will be relatively underestimated in the road alternatives and the results will hence be biased towards road construction (Johnston & Ceerla 1996; Rodier 2004). Moreover the margin of error between the no-built and built alternatives becomes even larger when one considers that the growth in traffic most likely will slow down in the no-built alternative when the road network is utilized close to its maximum capacity.

Political-economic aspects may also be part of the explanation for the apparently biased forecast. In some cases, forecasters have been exposed to strong pressure from elected officials (Flyvbjerg, 2007). Among politicians in North Jutland, there has been – and is still – a strong belief in motorway construction (Langeland, 2008, p. 194). There is no doubt that the political debate has been framed around the need for

motorway construction as the only proper solution to cope with the forecasted congestion problems. As a former municipal politician who was part of the political steering committee stated in an interview:

***“There is nobody who has taken a position on the fact that none of the alternatives has a particularly high rate of return... Instead, the argument is that a gridlock will arise ... and the only way to solve this problem is to construct a western crossing... you find the numbers that best fit into one’s consciousness... The low rate of return indicates that there are other places in the country where road investments are more needed, but when I raise this issue, I am accused of being hostile towards North Jutland, because I don’t attempt to attract investments”*** (Interview with municipal politician, 2010)

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Both at the municipal and regional level investments in infrastructure are regarded as an important condition for generating economic growth. In this growth strategy the Third Limfjord Crossing is regarded as the most important infrastructure investment (Region of North Jutland, 2007). In the decision-making process, motorways have surely been favored in preference to cheaper alternatives. When the then County Council in September 2003 was in the process of passing a resolution about one of the alternative crossings, it was first decided to do so without the highway alternatives, despite these alternatives yielding, according to the cost-benefit analysis, a higher first year rate of return than the motorway alternatives.<sup>6</sup> This was based on the argument that it would be hard to involve the state economically in a smaller road scheme than a motorway (Wormslev, 2003). We have, however, not had access to any information showing whether or not politicians have put any explicit pressure on the forecasting process in the Limfjord Connection case. Probably, any political influence on the forecasts has been more sophisticated and indirect: if the transport planners know that the politicians strongly favor the construction of the new motorway, they may be less concerned about shortcomings in the traffic model if remedying these shortcomings would only weaken the arguments in favour of the politically much wanted new road scheme.

Summarizing, there are obviously technical explanations of the implausible traffic forecasts and assessments of traffic-related environmental impacts of a Third Limfjord Crossing, as the traffic models simply ignore induced travel. But the reasons for sticking to such an inadequate model are probably political-institutional. It is, however, difficult to distinguish which of the two sources of bias – political pressure or institutional inertia – has exerted the strongest influence. Nevertheless it seems like the professionals as well as the majority of politicians have all operated within a ‘predict and provide’ paradigm where infrastructure development making it easier to drive by car has been seen as entirely positive. The reason why neither consultants nor the majority of the politicians have apparently regarded the forecasts as biased might be that the results resonate with their cognitive beliefs concerning the large regional benefits of carrying through the motorway project. In a situation marked by cognitive resonance there is less incentive to control the quality

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<sup>6</sup> This argument does not indicate that the authors regard cost-benefit analyses as a proper decision support tool for infrastructure projects. Cost-benefit analysis contain several in-built biases and contain democratic inadequacies. See Næss (2006) for an elaborate critique.

of model, compared to situations where there is a dissonance between model results and such cognitive beliefs. Hence the misleading forecast is not necessarily a result of deliberated manipulations, but rather the outcome of the dominating social order within the political as well as professional part of the transport sector.

### **A case of knowledge filtering**

Nowadays, it is not common to find academic studies supporting that enhancement of road capacity will contribute to reduced energy use and lower greenhouse gas emissions as it is assumed in those traffic models which leave the traffic-generating impact of increased road capacity in congested transport corridors out of account. Nonetheless such studies still exist. For example, in a recent report, based on micro-simulations carried out by the Norwegian R&D company SINTEF, (Knudsen & Bang, 2007), the authors concluded that:

- Better roads in terms of alignment, sufficient width and capacity which give the traffic the possibility to flow steadily lead to less emission from car traffic and are regarded as a positive contribution to a sustainable environment, and
- Restraining the capacity in the road network is an environmentally unsound measure to promote lower emission from road traffic.

In accordance with assumptions of the model applied in the Limfjord case, the line of reasoning in the report is that increased road capacity in congested transport corridors will reduce the density of vehicles, thus enabling each vehicle to drive more smoothly and at more energy-efficient speeds, with reduced overall energy use and emissions as a result. The effect of induced traffic is, however, not accounted for in the report. Knowledge which is widely accepted within academia is hence disregarded in the report (for an in-depth criticism of the SINTEF study see Strand *et al.* 2009).

Nonetheless the SINTEF study has been used as reference in a recent discussion paper from the Danish Road Association<sup>7</sup> (2009), advocating the construction of 800 kilometers new motorway within the next 30 - 40 years, to argue that road construction can contribute to reduced traffic related CO<sub>2</sub> emissions.

This shows how knowledge considered highly credible among researchers within a field may still be ignored or met with skepticism among policy-makers and stakeholders (Flyvbjerg, 2002). Among policymakers and politicians, there seems to be a quite widespread belief in the possibility of significantly reducing congestion through road construction. If it is possible to claim that there exists a scientific controversy, the scientifically based resistance towards projects promoted by political-economic dominating actors will be weakened.

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<sup>7</sup> Danish Road Association is a lobby group consisting of both firms associated with road construction and firms associated with transportation of goods on the roads. Among the members are the three largest Danish consultant firms. All of these conduct both traffic forecasts and are somehow involved in road construction.

Traffic model calculations showing that the growth in traffic will be equal whether or not road capacity is expanded can contribute to raise such doubt.

In spite of the evidence now available about induced and generated traffic, the academic criticism against the use of inadequate traffic models in the Limfjord case was not able to win through in the practical planning and decision-making process. On the contrary, the highest authority in the Danish society on planning issues (the Nature Protection Board of Appeal) judged that the academic knowledge did not provide a sufficient base for rejecting the results of the traffic model calculations and the associated estimates of energy use and emissions as obviously incorrect.

### **Concluding remarks**

The purpose of an EIA is to assess impacts on the environment. When new, high-capacity roads are constructed in urban areas, the consequences in terms of local pollution, noise, traffic accidents, energy consumption and greenhouse gas emissions are some of the most important environmental impacts. Because of its neglecting of the relationship between increased road capacity and increased car traffic, the Third Limfjord Crossing EIA arrived at the misleading conclusion that the proposed new motorway connection will result in a reduction of all the above-mentioned environmental parameters.

The different roles undertaken by the traffic model in the Limfjord case underpins an argument put forth by Henman (2002: 163) concerning that “the way computer modeling is used in one setting may be ambiguous, and it is this very ambiguity that provides fertile grounds for computer modeling as a political technology”. The manifest function the model was supposed to undertake in the planning process was to act as a forecasting technology, but in spite of the long-standing criticism leveled by transportation researchers, induced travel and the impact of the quality of the public transport services were not included in the model calculations. Anyhow, the model turned out to be invested with truth claim. Assessing the material content of this truth claim was considered to be beyond the legal control of the Nature Protection Board of Appeal. The model calculations thereby became a truth-production technology. This made it possible for the model to carry on its black-boxed political program of discrimination, which aligns with what appears to be an unconscious or at least unspoken coalition between political interests and organizational cultures. In the Limfjord case the model thus served as an “independent expert” reifying the astounding and highly controversial claim – traffic calming means does not reduce environmental impacts – motorway construction do. If this is to be believed, it would almost be environmentally irresponsible not to build the new motorway.

We are not implying that the individual model-builders and the planners are the ‘scoundrels’ to be blamed for the misleading traffic forecasts of the Limfjord case. Their work must be seen in the wider contexts of a professional culture and political climate in which planners and modelers have to navigate. The culture amongst the professionals as well as the political climate can be seen as the context in which planners and

modelers are navigating. If one wants to talk about ‘lying’ (Flyvbjerg, Holm and Buhl, 2002), what we are facing would in this case be ‘institutional lies’ (Martin, 2004). The professionals however have an ethical responsibility to give as correct and instructive presentations as possible. Uncertainties and shortcomings of the model calculations should be communicated clearly, not be put away in footnotes of background reports.

Even if all theoretically plausible and relevant factors of influence were included, the accuracy that transport model computations pretend to provide can hardly be achieved. Notably, their predictions of the ‘general’ and ‘background’ traffic growth are deemed to be highly inaccurate, since the general growth in (urban) mobility depends on several uncertain factors such as economic growth, fuel prices, environmental regulations, etc. Instead of trying to offer an impossible accuracy, the ambitions of transport modelers should be lowered. Assessing the travel behavioral *impact* of a proposed infrastructure or land use measure is a less neck-breaking endeavor than trying to predict the future traffic *situation*. Arguably, such estimates would in many cases not require the use of sophisticated mathematical models at all. What they *would* require is solid theoretical and empirical knowledge about the ways in which changes in transport infrastructure and land use influence transportation behavior.

Even such impact-oriented estimates can hardly be given with the accuracy required for meaningful inputs to cost-benefit analyses. They might, however, be used in a more explorative way, applied to different background scenarios based on, for example, high, moderate or zero general growth in mobility. Anyway, transport modeling should only be used in environmental impact analyses after quality control of the built-in assumptions of the model conducted by independent experts covering a wider range of disciplines than that of the model makers.

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