Study Plan for organizational context of transport modelling – an empirical study

1. Summary in layman's terms

Experiences from a number of megaprojects within transport infrastructure investments have shown that results from scientific decision support models on which decisions were based, have often been insufficient and sometimes misleading. The aim of this PhD thesis is to investigate how traffic forecasts, transport models and cost benefit analyses applied within the transport sector are used and interpreted in a policy-making context. Besides the thesis aims at investigating how the process of transport modelling, in itself, is influenced by the specific organisational context it is part of. The approach of this PhD thesis involves that it is the political, organisational and cultural aspects of modelling and the use of the models which are in focus rather than the technical aspects. However it will be central to this thesis, how criticism of the model results can be avoided, by disguising the assumptions stored in the models, and the manner this influence on the notion of the model results as objective and highly accurate, even though the assumptions might be highly biased towards particular interests or worldviews.

The problem of this PhD thesis will be investigated through in-depth case studies of 2-4 Danish infrastructure projects. In order to compare findings with a country marked by a different transport political context, a non-Danish case will be investigated as well.

A discourse analysis of the selected cases will be conducted, of both technical reports as well as planning and decision documents. Besides the project will investigate the rationalities held by relevant actors, through qualitative interviews. Such relevant actors might be politicians, planners, consultants, and academic modellers, within the agencies of e.g. the road directorate, counties, municipality, consultant firms, and technical universities.

The PhD thesis will hopefully provide new knowledge about how models, used within the assessment of infrastructure projects, can sometimes distort the political and public debate, as well as provide new knowledge about how the assumptions stored in the models are being shaped by the organisational context it is part of. This knowledge is relevant for the academic and political debate on the use of scientific decision support models within the planning and decision making process. The knowledge produced in this PhD thesis might highlight the importance of increasing the transparency of the models and the manner they are used, in order to avoid highly biased models and enrich democratic aspects of the decision making process.

2. The scientific content of the PhD project

2a. The background for the project problem

The background of this PhD thesis is that experiences from a number of megaprojects within transport infrastructure investments have shown that results from scientific decision support models on which decisions were based, have often been insufficient and sometimes misleading.

As shown by Flyvbjerg *et al.* (2005), among 183 investigated road projects, one half had a deviation between forecasted and actual traffic of more than ±20%, and one fourth more than ±40%.

Despite the above two studies show highly inaccurate road forecasts, Flyvbjerg *et al.* (2005) found that forecasting errors for rail projects were even larger.

Even though techniques for transport modelling have gone through a major technical development during the last few decades, accuracy has not improved over time (Flyvbjerg *et al.* 2003). Nevertheless, despite the widespread inaccuracy of traffic forecast they have often been treated as evidence to justify new road schemes (Terry, 2004).

The main criticism of the models traditionally used within the transport sector can be summarized in the following:

1) Their inherent bias due to the exclusion of important causal factors (notably induced travel and urban structures' impact on travel).
2) The inevitable uncertainty and inaccuracy due to the impossibility to make precise predictions about events in a non-closed system.
3) The black box nature of transport models implies reification and creates a veil behind which it is easy to manipulate without being discovered. This constrains the capacity for the conduct of democratic politics.

2b. state-of-the-art knowledge for the PhD project

In the following I will argue that the aspect of power (Flyvbjerg, 1991; Hauggard, 2003), in one way or another, may be important in order to understand the paradox of why scientific decision support models play an important role in the decision-making process, when it is well documented that model results often are highly inaccurate. The issue of power will be discussed in relation to governmental, political, psychological and organisational/institutional aspects of modelling and the use of model results.

Models as governmental technology

Models can function as a governmental technology or tools with which to govern. The term government is here referred to as the "conduct of conduct" meaning to shape or manage the conduct of one's self or others, in accordance with Foucault's use of the term. This definition of government entails not only relations of power and authority but also issues of self and identity. In other words government consists of power, truth and identity (Dean 2001; Henman 2002).

In order to render the traffic governable, it is necessary that one definition or one specific approach is highlighted, while others are tuned down or excluded. If the traffic problems to be solved by policy-makers are defined in ambiguous manners it becomes difficult to define the appropriate means of action (Dean 2001; Hajer, 2004). Scientific decision support models used within planning of infrastructure can play an important role in this power struggle, about reification of particular rationalities and problem definitions as scientific, objective and exact, at the expense of competing rationalities and definitions.

The reason the models tend to be effective in this power struggle about reification of particular definitions and rationalities is because they often are regarded as *truth-production technologies.* The public image of computer models as being highly accurate and "rational" in operation reinforces the idea that the scientific decision support models 'must be right'. In constructing and constituting truth, such models thereby act as "independent" experts (Henman 2002). This may involve that decisions based on transport model calculations, appear as reified and representing objective and scientific truth, instead of being based on mere ideology or political horse-trading. An important aspect of complex models and modelers which reinforce their functions as truth production technologies and independent experts, and entails that the results appear reified, despite their occasionally low scientific quality is black-boxing (Hajer 2004, 272) of the models embodied values and assumptions. Black-boxing of model's assumptions and their perceived truth production capability can be effective mechanisms in relation to establish a dominant frame or storyline of a policy-issue (Hajer 2004; Throgmorton 1996).

Another issue related to reification of model results, is the creation of a monopoly on the knowledge production about a policy issue. By creating such a monopoly it also becomes possible for the modellers to construct themselves and their models as independent experts (Henman 2002). An issue which may reinforce the monopoly on knowledge production of decision support models, in the decision making process, is that the calculated scenarios may crowd out preparation of other alternatives. This is partly because of the high costs of constructing and maintaining the models which involve that fewer resources are available for alternative approaches of assessment. And partly because of the complexity of the calculated model scenarios often entail that it is almost impossible for opponents to formulate alternatives which appear equal (Tennøy, 2004). In accordance with this Mackett (1998) states that one of the reasons that demand forecasts are still being used despite their inaccuracy is that they appear to provide a scientific objectivity to the decision making process. At the same time this enables professionals to keep people without the required technical knowledge out of the process. This represents a democratic problem because, as Henman (2002) argues, when a domain becomes largely defined by the results of complex computer modelling, the scope for public debate is somewhat narrowed.

A third manner in which traffic model results appear reified as objective, scientific and exact is through presentation of the calculations in absolute figures in the documents introduced to decision-makers and the public. A study conducted in Norway based on 12 cases showed that several of the investigated technical reports omitted to mention uncertainty at all. Furthermore in just under a third of the reviewed documents the likely errors were mentioned only inadequately. The study also showed that it was not only uncertainty which was often omitted from the policy documents. Also the model assumptions, input data and factors used in the predictions were inadequately explained in 56% reviewed documents. The presumptions were, however much more frequently clarified in the technical reports compared to the planning and decisions documents (Tennøy 2003). This does not only involve that decision-makers are not informed about the uncertainties and possible errors associated with the predictions on which their decisions are supposed to be informed, but it also involves that their opportunity to discover such possible errors and uncertainties on their own is hampered due to lack transparency.

Power and political aspects

The use of transport calculations can act as efficient political technologies to conduct politics with. Because of the black-boxing nature of scientific decision support models, they can be constructed to embody specific values and assumptions, and the partisan nature of those assumptions can then be "neutralized" through the complexity and the perceived truth production capability of such models (Hajer 2004; Henman 2002). However, despite model calculations appear as scientific and objective they are easily manipulated in one way or another. According to Flyvbjerg *et al*. (2003; 2005), more or less deliberate distortion of the analysis in order to make the project appear more beneficial seems to take place relatively frequently. Flyvbjerg refers to such deliberated manipulation as strategic misrepresentation. Wachs (1989) is also describing how 'scientific' decision support models can be manipulated to reify pre-preferred solutions as the objective scientific truth, through manipulation.

So far the discussion about power and transport models has been focusing on how model calculations can function as governmental and political technologies. Such aspects of power are working at a more or less conscious level. We now come to relatively cognitive, tacit and unconscious aspects which influence the shaping, use and interpretation of the models.

Psychological aspects of modelling

Psychological perspectives explain large inaccuracy in demand forecasting, in terms of optimism bias. According to Lovallo & Kahneman (2003), optimism bias is a cognitive predisposition found among most people to judge future events in a more positive light than what can be regarded as realistic, by unconsciously omitting risk.

According to Flyvbjerg (2008) "*explanations in terms of optimism bias have their relative merit in situations where political and organizational pressures are absent or low, whereas such explanations hold less power in situations where political pressures are high. Conversely, explanations in terms of strategic misrepresentation have their relative merit where political and organizational pressures are high. Thus, rather than compete, the two types of explanation complement each other*".

Flyvbjerg (2008) here recognizes organizational pressure as influential on strategic misrepresentation and optimism bias, however in the following it will be argued that not only pressure but more broadly organisational context of transport modelling is an important aspect which influence the shaping and use of decision support models and may lead of serious biases. This aspect has just not received much attention in the literature on the issue.

Institutional/organisational context of modelling

The organisational and institutional context of transport modelling combined with disciplinary identity and interpretation horizon are other important aspects of how embodied assumptions of the models are shaped and how the results are interpreted.

According to Olsen (1992) the prevalence of established rules, standard operating procedures and routines govern the actions of the agents within particular sectors of society. Through experience, opinions are established about appropriate, correct and incorrect conduct within that particular segment.

This involves that the framing of a policy issue is influenced by which segment of the political administration is dealing with the issue. Because of the different practices, cultures, values and notions of the importance of different political objectives prevailing within the different ministries, collaboration can be difficult. This is especially problematic for policy issues which demand cross sector planning (e.g. integrated land use and transportation planning). In some cases this causes rivalry between the different segments of the administration about who should take the head of the table, in order to secure their own field of responsibility. Such forms of territorial behaviour are likely to involve that the policy issue is framed within a too narrow interpretation horizon. In a study by Hedegaard-Sørensen (2001) it is e.g. shown that such territorial battles have taken place between the Ministry of Traffic and the Ministry of Environment. These two ministries have traditionally been dominated by the 'predict and provide' and the 'predict and prevent' paradigms respectively.

The aspect of disciplinary identity and interpretation horizons are important because model results are affected by those who build and run the models. This also applies to situations where the objective is to obtain as precise and independent analysis as possible. It's almost inevitable that individuals influence analysis result through choices between approaches, input data, calibration, different logics about cause and effect, etc. (Tennøy 2004; Wachs 1982). Also the cultural and national background of consultants and planners may influence the assumptions embodied in the models. Flyvbjerg *et al*. (2003) illustrates this by an example from the planning of a high-speed rail link between Melbourne and Sydney. Japanese, French and American

consultants arrived at widely differing passenger forecasts, reflecting differences between their home countries as regards the shares of public transport in intercity travel.

It is however, not only the shaping of the models' embodied assumptions which are influenced by disciplinary identity, but also the interpretation of the model result is subjective. As Tennøy (2004) argues, if the results of transport model analyses show that the expected amount of traffic in the road system would exceed the capacity limit, an environmentally minded urban planner would frame the problem as one of reducing car traffic by means of spatial planning. On the other hand a road engineer or transport planner would most likely interpret the results within another frame, and suggest other means of actions, such as road capacity extension (Tennøy 2004, 35).

In sum this involves that if the development and application of traffic models is left to the professional specialists within sectors of society traditionally related to the 'predict and provide' way of reasoning, there is a risk that relevant causal mechanisms other than those traditionally dealt with by the sector (e.g. the issue of induced traffic and land use's impact on travel) will be ignored.

Sum up discussion

Scientific decision support models can undertake many different functions. For example as Henman (2002) argues, scientists use computer modelling both as an intellectual and a scientific technology, but it may in turn be invested with truth claims, thereby becoming a truth-production technology. Similarly, when computer models are used as political technologies, they also simultaneously act as truth- production and forecasting technologies. Indeed, it can be argued that it is this multiplicity of functions scientific decision support models can undertake, which involves that repressive aspects of power and complex modelling in many cases go hand in hand.

Nevertheless, despite complex models in many cases acts as an effective political technology, I will argue that it is wrong to claim that scientific decision support models are an inherently political technology. Such a claim would entail a conspiracy theory and an extreme low ethical codex among a whole academic field. I have no doubt about that many model developers try to improve the technical aspects of models in order to make the predictions more precise and improve the knowledge base of political decision. However, when the models are used within the political sphere, the models may easily be captured by partisan interest and used to reify political decision. Likewise, instead of claiming that all transport modellers are 'bad people' it is more likely that the positivist conception of science prevailing within the field creates a notion that the world can be captured in a precise manner by the models. Also the strong historical tie between the field of transport modelling, particular segments of society and the 'predict and provide paradigm' is likely to involve that transport planners who identify with this paradigm may find it legitimate to exclude particular casual mechanisms from the models because they are regarded of minor importance within this paradigm. This exclusion of particular casual mechanism may be legitimized by institutional practices of particular segments of the society dominated by the same paradigm. In such cases, issues of disciplinary identity and organisational context are more important than political power struggles in a classical sense.

In sum technical biases may explain some of the inaccuracies associated with scientific decision support model computation. However, political, physiological and aspects as well as disciplinary identity may explain why the models don't incorporate important casual mechanisms and why uncertainty associated with the calculations is suppressed.

2.c Research question:

The aim of this PhD thesis is to investigate how power influences the use and interpretation of model calculations by scientific decision support models within the planning infrastructure, as well as how transport modelling, in itself, is influenced and shaped by power and the specific organisational context it is part of. In other words the focus will be on how the models may act as mechanisms, which help create and sustain domination of particular frames, identities, rationalities, values and interests while excluding others, as well as how domination of particular frames, identities, rationalities, values and interests may influence the design and shaping of the models and their embodied assumptions and partisan views.

(Sub-)questions:

1. **The use of different types of models in national and regional decision-making processes:**
   How are model results being used in EIAs and cost-benefit analyses? Are the uncertainties and risks associated with traffic forecasting being presented in the policy documents, or are the model results presented as exact predictions and treated as evidence? Are scientific decision support model calculations used to exclude other kinds of relevant knowledge from the planning and decision making process?

2. **Interpretation of transport model results:**
   How are the results of traffic modelling being interpreted by planners, politicians and modellers themselves during the period up to decision-making on proposed transport infrastructure projects? Does the aspect of disciplinary and/or political identity influence on how results from transport model calculations are interpreted? Are particular interpretation horizons dominating over others? Does the institutional/organisational context influence which interpretation horizon is dominating?

3. **Transport modelling:**
   How is the process of the transport analysis organized? Which rationalities are dominating in the process and which rationalities are put in the back? Is the prevailing national discourse within transport planning influencing the design of the national models? Are models produced within academia being reshaped in order to fit the new organisational context when overtaken by a public or private agency? Why are 'bad' models still being used in assessment of infrastructure projects despite better models has been around for some time? How do the constructors and users of traffic models respond to the criticism posed by other researchers and professionals against the inherent assumptions of the models?

4. **The scope of the need analyses in which traffic model forecasting is used:**
   To which extent do need analyses of major Scandinavian (mainly Danish and Norwegian) transport infrastructure investment projects reflect politically adopted objectives within the transport sector and within other relevant policy fields? To what extent does the use of scientific decision support models within the transport sector distort democratic aspects?

2d. Methods:

The problems of this thesis will be approached based on a conceptual framework of power (Haugaard 2003) including both structural and actor based aspects (although the structural perspective will be the main perspective). In addition neo-institutional theories will be included in the theoretical framework (Olsen 1992).

Substantial theories will also be included (such as theories on induced and generated traffic and land use's impact on travel). Such theories are important in order to evaluate if the models include important casual mechanisms.
The project will investigate the role of traffic models in some selected strategic-level planning and policy formation processes. Such an investigation is interesting in relation to a comparative perspective, because the governmental policy on the issue of induced travel has been different in Norway and England from the one in Denmark since the late 1990ies. Because of that a non-Danish case will be relevant to be included in addition to Danish cases. The selection and exact number of cases (3-5 cases) has not yet been fixed, but relevant candidates might be:

- The work on and political follow-up on the report of the Danish Infrastructure Commission
- The planning of the Third Limfjord Crossing
- The planning of the Silkeborg motorway
- The planning of the Femern Belt Crossing
- The planning of a case in Norway, England or the Netherlands

A document study and discourse analysis of relevant cases will be conducted of both technical reports as well as planning and decision documents.
Besides the project will investigate the rationalities held by relevant actors, through qualitative interviews. Such relevant actors might be politicians, planners, consultants, and academic modellers within the agencies of e.g. the road directorate, counties, municipalities, consultant firms, and technical universities.
The investigation of such rationalities will be conducted in relation to questions about what kind transport problems transport model calculations can be used to provide useful information about. How reliable are such model calculations regarded, and what can they be used for? Why are such model calculations being used in the planning process?
Because model results are being influenced by those who run and construct the models, the institutional/organisational context related to this process will also be included in the investigations.
The investigations will not only focus on the assessment of alternatives for capacity extension in relation to the selected cases, also the assessment of the 0-alternatives will be included. In some cases the most serious biases in the assessment of infrastructure projects may not be evaluation of the different alternatives of capacity extension them self, but rather a misleading negative description of the future situation if the capacity is not extended.

2e. Potential significance and application of the project's expected outcome:

The PhD thesis will hopefully provide new knowledge about power and transport related models which are relevant for the academic and political debate on the use of scientific decision support models. The knowledge produced in this PhD thesis might highlight the importance of increasing the transparency of the models and the manner they are used, in order to increase democratic aspects of the decision making process. Despite the fact that knowledge which will be produced in this thesis concerns models used within the planning of infrastructure, it may also be of significance within other fields of society where models are applied in assessment of diverse issues.

2f. Time schedule:

The project will be started by making a literature review. This will be completed around the first of February 2010. At the same time the theoretical and conceptual framework will be written in a joint paper together with Tim Richardson. This should be completed around May 2010. Parallel to this a pilot study of the 'Third

Limfjord Crossing' will be conducted in collaboration with Petter Næss. Here the theoretical and conceptual framework will be tested. This Paper will be completed around February 2010.
Around April 2010 the collection of empirical data will begin. Here a number of qualitative interviews will be conducted. Depending on the number of interviews and selected cases, this process will be finished around September 2011, and might end out in a paper discussing the investigated cases.
The analysis of the case studies will be conducted parallel with the collection of empirical data, and is expected to be completed around February 2012 and also might end out in a paper.
Between February and September 2012 the previous work will be written together to a monograph.

Most of the teaching and supervision tasks will be done in the middle of the PhD process, spread over the period from the first of February 2010 to September 2011. Especially it will be relevant to teach or supervise at the 5. Semester 'plan og miljø', where the theme of the semester is mobility. Also teaching or supervision of groups at the 8 semester and perhaps 9 semester UPM will be of relevance.

2g. Content of the thesis

The PhD thesis is expected to take the form of a monograph instead of a collection of papers.
However several chapters will also be rewritten as articles for publication in scientific journals, or the other way around (papers for journals will be rewritten as chapters for the monograph).

In addition two joint articles will be prepared. One article concerning my theoretical framework in collaboration with Tim Richardson, and another article which function as a pilot study in order to test my theoretical framework in collaboration with Petter Næss.

2h. tentative titles on papers

- Joint article with Petter Næss (main supervisor). Title: Modeller, miljø og manipulation: Vidensfiltrering og magt i beslutningsprocessen omkring den 3. Limfjordsforbindelse. Journal for publikation: Økonomi & Politik temanummer om trafikinfrastruktur.

3. Agreement on the relationship between supervisor and student:

Jeppe shall send the material he has produced to both Petter and Tim, in due time, before the meetings, so it is possible to give feedback in advance. It has been agreed on that Jeppe must produce a written minutes after each meeting, lasting about 1 to ½ page. It has been agreed that the frequency of the supervision meetings should be approximately one time per two weeks. This agreement is of course flexible. However if longer periods take place where supervision not is possible, the aim is to compensate for this in other periods.

4. Plan for PhD courses:

In the final version there will need to be a table clearly showing ECTS where these are known, and showing total ECTS. Then a text explaining that the remaining ECTS will come from either the courses listed for which ECTS are not yet know, or in some other way.

Project-related courses:

- Seminar and PhD workshop 'Transport Knowledge and Planning Practice': Amsterdam 14-16 October 2009. 1-2 ETCS
- Planning theory and EIA's: (AAU)

- Transport models
- Colloquium related to the overall research project.

Joint courses:

- Critical Discourse theory: Oslo, around March 2010
- Method and Social Science Theory**,** (AAU)**,** 3 ETCS
- Academic writing (the UPM research group's writing seminars)
- Theory of science. (AAU), 2,5 ETCS
- Organisational/neo-institutional theory
- Power theory

5. Plan for dissemination of knowledge and findings from the project:

Conference presentations:
Traffic days at Aalborg University
AESOP (Amsterdam)

Relevant journals for publication:
Transport reviews
Transport policy
Impact Assessment and Project Appraisal
Journal of Environmental Policy & Planning
Social Science Computer Review

6. Agreements on immaterial rights to patents:

I claim no immaterial rights to patents. All knowledge produced in this PhD thesis is available for the public.

7. Plan for external cooperation:

The following suggestions are relevant for external corporation, either as smaller visits or longer stays:
DTU (Otto Anker Nielsen) Oxford (Bent Flyvbjerg and his department), Cambridge (Susan Owens), Delft University, Linkøping, Oslo (Arvid Strand), Edinburg University (Angela Hull), Curtin University (Carey Curtis).

8. Financing budget for the PhD project:

The funding for the PhD is financed by the Danish Council for Strategic Research as well as AAU who are self financing part of budget. The PhD period is set for 36 months and the total salary is 1.297881 DKK. From this salary 865254 DKK is financed by the Danish Council for Strategic Research and 432627 DKK is self-financed by AAU.

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