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Flexible decision support for sustainable development: the SUSTAIN framework model
Sustainable transport planning necessitates a rethinking of traditional decision making. This is conventionally supported by cost-benefit analysis (CBA) that systematically quantifies and compares the various benefits and costs generated by a transportation project or policy. Generally, CBA has been found less useful for the handling and assessment of multiple, often conflicting objectives or criteria like environmental or social issues intrinsically difficult to quantify. Therefore, it is necessary to broaden the decision making process beyond merely economic factors. The Danish research project on Sustainable National Transport Planning (SUSTAIN 2012-2016) seeks, among other things, to develop a flexible decision support model (tool) to include and assess sustainability planning criteria in a socio-economic framework, which makes up the SUSTAIN Framework Model (SFM). The SFM comprises two parts, namely a process part consisting of stakeholder involvement and an analytical tools part consisting of an Excel-based software model. The latter employs the use of CBA, multi-criteria decision analysis and risk analysis techniques enabling the assessment of non-quantifiable impacts within a decision support context. The concept of a planning workshop is introduced as relevant for dealing with the various strategic elements not included in the CBA. Moreover, SUSTAIN is rooted in cross-disciplinary sustainability research that recognises that a transition towards sustainability must involve normative, analytical and strategic considerations to be successful. The paper concludes that the SFM can contribute to the analytical dimension. Thus, the framework model allows for the appraisal of planning criteria (indicator sets) in a socio-economic appraisal setting for national sustainable
transport planning which enhances both the concept and principles of sustainable development while at the same time it provides a flexible decision support tool for policy-makers.

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**Promoting sustainability through national transport planning**
This following special issue of the European Journal of Transport Infrastructure Research (EJTIR) containing 4 scientific papers is the result of the work conducted under the research project 'National Transport Planning – Sustainability, Institutions and Tools' (SUSTAIN) (2012-2017) financed by the Danish Innovation Fund. SUSTAIN was coordinated by first the Department of Transport of the Technical University of Denmark (DTU Transport) and later as the result of a reorganisation of the transport research at DTU by the Department of Management Engineering (DTU Management Engineering). The project was carried out in cooperation with several Danish and international partners.

In SUSTAIN the following definition of national sustainable transport planning (NSTP) was adopted: deliberate, knowledge-based, and strategic endeavours to integrate sustainability principles, criteria and goals in the development, management, regulation and assessment of nationally significant transport systems and services. This paper presents the research outcome by reviewing some of the major findings and seeing these collectively as a basis for promoting sustainability through the formulated research topic of NSTP. This basis includes defining criteria and indicators for use in NSTP combining evidence-based and performance oriented planning approaches. Furthermore, it contains a flexible evaluation framework that includes a decision support model that when informed by criteria and indicators can structure and assist an NSTP practice. This practice can support a planning process aiming at realising a sustainable transport development. Finally, the basis comprises a review of the complex political and administrative fabric in which NSTP is embedded, and thereby it can condition the ability to promote sustainability in practice.
Green Decision Making: How Systemic Planning can support Strategic Decision Making for Sustainable Transport Development

The book is based on my participation in the SUSTAIN research project 2012-2017 about National Sustainable Transport Planning funded by the Danish Research Council (Innovationsfonden). Many of the issues treated here have a backdrop in my book Complex Strategic Choices – Applying Systemic Planning for Strategic Management. The book was published in 2012 by Springer-Verlag, London, as a research monograph in the publisher’s series about Decision Engineering. The intention behind this new book – with its focus upon ‘greening’ of strategic decisions – is to provide a general and less technical description of the possibilities that a systemic approach to complex planning problems seems to offer.

As will appear, the presentation of systemic planning (SP) below is primarily based on applying SP to transport infrastructure investments. However, SP in its process and methodological outline should not be seen as restricted to this application area. In fact a company relocation decision case has been used to introduce the potential of SP as regards providing decision support for strategic decision making. A main concern in this presentation of SP, which deviates from the Springer book referred to above, is to highlight that ‘greening’ of decision making is not an ‘add-on’ activity. More likely it is a possibility that arises by basing complex strategic choices on decision support knowledge established by conducting and combining specific types of examination related to the actual complex decision problem, typically of strategic nature.

Green Decision Making: Sustainable Transport and Systemic Planning (SP)

The generic framework for planning and decision support set out in this paper is the outcome of the research work carried out in recent years in the international research project SUSTAIN concerning national sustainable transport planning. In the paper focus is on sustainable transport and infrastructure assessment and on the methodology and process of systemic planning (SP).

SP theory development has interchanged with practical application and testing of the SP approach in a large number of cases. The word systemic in SP indicates that complex planning problems and provision of decision support in today’s strategic planning needs a focus on what may be addressed as systemic insights in balance with more conventional, systematically-based findings where causal linkages can be modelled and made use of. In practice this means that SP is based on a study-specific combination of hard (quantitative) and soft (qualitative) operations research (OR) methods; especially the latter have a function as regards knowledge generation that relates to obtaining systemic insights. Furthermore, SP applies a process that drives group-based learning forward. The group should be formed with the different stakeholder interests as regards the outcome represented by different group members. The process is guided by a facilitator and is assisted by an analyst, with the analyst providing ongoing, interactive modelling. This collective (man/machine) learning aims to lead to a final decision (or decision recommendation) about the best alternative or course of action for the actual strategic planning problem. The flexibility of SP makes it adaptable to different problem types.

The paper is disposed as follows: After the Introduction about green decision making, Section 2 presents five SP-perspectives, where each perspective is grounded in a particular research approach that serves a particular function in the SP framework. The following Section 3 describes the SP modelling toolbox consisting of 2 x 7 soft and hard OR methods. Based on the previous sections, Section 4 describes the ‘SP-wheel’, which is the process-driver behind an iterative group-based learning cycle, intended to provide decision support for the actual decision making. The SP-wheel consists of 8 steps which produce knowledge that is intended to accumulate as final decision support. In the following Section 5 findings from a number of conducted case studies are applied to illuminate various aspects of the individual steps in the SP-wheel. A final Section 6 presents findings and perspective.

A more comprehensive treatment of the SP framework presented in the paper and the ideas behind the framework is available as a free E-book download from the author’s ResearchGate page:
https://www.researchgate.net/profile/Steen_Leleur GREEN DECISION MAKING – How Systemic Planning can support
Transport project evaluation: feasibility risk assessment and scenario forecasting

This paper presents a new approach to transport project assessment in terms of feasibility risk assessment and reference class forecasting. Conventionally, transport project assessment is based upon a Cost-Benefit Analysis (CBA) where evaluation criteria such as Benefit Cost Ratios (BCR) are obtained. Recent research has however proved that substantial inaccuracies are present when obtaining the monetary input to the CBA, particularly as concerns the construction costs and demand forecasts. This paper proposes a new approach in order to address these inaccuracies in a so-called Reference Scenario Forecasting (RSF) frame. The RSF is anchored in the cost-benefit analysis; thus, it provides decision-makers with a quantitative mean of assessing the transport infrastructure project. First, the RSF method introduces uncertainties within the CBA by applying Optimism Bias uplifts on the preliminary construction cost estimates. Hereafter, a quantitative risk analysis is provided making use of Monte Carlo simulation. This approach facilitates random input parameters based upon reference class forecasting, hence, a parameter data fit has been performed in order to obtain validated probability distribution functions. The latter have been placed and ultimately simulated on the inaccuracies of determining demand forecasts, i.e. leading to travel time savings and ticket revenues of the project. Finally, RSF makes use of scenario forecasting where trend scenarios such as economic growth and level of cross-border integration are investigated. The latter is highly relevant as RSF is demonstrated by a case example concerning the fixed link between Elsinore in Denmark and Helsingborg in Sweden.

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Combining Reference Class Forecasting with Overconfidence Theory for Better Risk Assessment of Transport Infrastructure Investments

Assessing the risks of infrastructure investments has become a topic of growing importance. This is due to a sad record of implemented projects with cost overruns and demand shortfalls leading, in retrospect, to the finding that there is a need for better risk assessment of transport infrastructure investments. In the last decade progress has been made by dealing with this situation known as planners' optimism bias. Especially attention can be drawn to the use of reference class forecasting that has led to adjustment factors that, when used on the estimates of costs and demand, lead to cost-benefit analysis results that are modified by taking historical risk experience into account. This article seeks to add to this progress in risk assessment methodology in two ways: first it suggests to apply reference class forecasting (RCF) in a flexible way where the effort is focused on formulating the best possible reference pool of projects and second to apply overconfidence theory (OT) to interpret expert judgments (EJ) about costs and demand as relating to a specific project up for examination. By combining flexible use of RCF with EJ based on OT interpretation it is argued that the current adjustment factor methodology of RCF can be further developed. The latter is among other things made possible by the comprehensive project databases that have been developed in recent years. For this article the project database developed in the UNITE research project 2009-2013 has been employed. The presented simulation-based risk examination named SIMRISK is concluded to provide a new 'in-depth' possibility for dealing with uncertainties inherent to transport decision making based on socioeconomic analysis. In addition a further research perspective is outlined.

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Creative group decision making for sustainable transport development

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Socio-economic analysis in the transport sector
This compendium is intended to be a tool for students in conducting socio-economic appraisals in the transport sector following the recommendations made by the Danish Manual for Socio-economic Appraisal (DMT, 2003). The appraisal process is in this compendium outlined as a step-by-step process which is adaptable to all types of infrastructure related problems, and which can be used for decision support on both the administrative as well as the political level. In the administrative decision process the socio-economic analysis provides a foundation for a systematic examination of which project types or initiatives that are socio-economically most suitable for handling a specific infrastructure problem. Hence, the socio-economic appraisal can help undertaking a sound selection of the possible solutions that should be examined in further details. The socio-economic analysis is as well an important element in the political decision process. The analysis provides information about how the society’s resources – from an economic viewpoint – are used in the best possible way, and how costs and benefits are distributed between e.g. the state, the users and the environment. The society does not have unlimited economic resources. Thus it is necessary to prioritise between the many projects and initiatives which are being discussed in the public sector. In order to conduct such a comprehensive prioritisation (across different sectors or within the same sector) it is a precondition that a systematic evaluation of the projects/proposals/initiatives’ advantages and disadvantages is carried out. For many years cost-benefit analysis (CBA) has been used as the main tool for the purpose of economic comparison not only in Denmark but also in many other countries around the world. Investment projects that have been prepared thoroughly and evaluated to have a high socio-economic return seem to be able to obtain political acceptance more easily than projects that have not been evaluated through this type of assessment. On the other hand socio-economic assessments can also be used to turn down projects that do not show a satisfactory return. In the political prioritisation process other considerations of a political, environmental or economic character may influence the decision making. Some of these are not traditionally a part of the socioeconomic assessment, but are instead used as a supplement in the final decision phase. The socioeconomic assessment strives towards valuing all advantages and disadvantages of a project. On the background of this the project’s value for the society is calculated. This value can afterwards be compared to the values for other projects. The socio-economic appraisal is one of the most basic and tangible contributions to the planning and decision process within the transport sector when an initiative’s advantages and disadvantages are to be evaluated. The appraisal can be used both for political decision making as well as internally in organisations with planning related tasks.

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Accounting for the inaccuracies in demand forecasts and construction cost estimations in transport project evaluation

For decades researchers have claimed that particularly demand forecasts and construction cost estimations are assigned with/affected by a large degree of uncertainty. Massively, articles, research documents and reports agree that there exists a tendency towards underestimating the costs and overestimating the demand for transport infrastructure projects. It is therefore claimed that ex-ante evaluations of transport-related projects are often based on inaccurate material, which ultimately can lead to severe socio-economic misperformance. This paper seeks to bridge the gap between the inaccuracies in demand and cost estimations and hence the evaluation of transport infrastructure projects. Currently, research within this area is scarce and scattered with no common agreement on how to embed and operationalise the
A huge amount of empirical data that exist within the frame of Optimism Bias. Therefore, a full version of the UNITE-DSS model, which contains an integrated approach to socio-economic analysis, risk-based simulation and database information, will be presented. The procedure is based upon quantitative risk analysis and Monte Carlo simulation and conventional cost-benefit analysis converting deterministic benefit-cost ratios (BCRs) into stochastic interval results. A new data collection (2009–2013) forms the empirical basis for any risk simulation embedded within the so-called UP database (UNITE project database), revealing the inaccuracy of both construction costs and demand forecasts. Accordingly, the UNITE-DSS approach is therefore tested and further explored on a number of fixed case examples to investigate the performance and robustness of the traditional CBA results. Ultimately, a conclusion and perspectives of the further work will be set out.

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Accessibility as indicator in sustainable transport planning
Currently efforts are made in many countries to develop transport planning in a more sustainable direction. In the international research project SUSTAIN national sustainable transport planning is developed in a research programme over four years from 2012 to 2016. One of the important indicators applied in a new SUSTAIN Appraisal Framework (SAF) concerns accessibility, and the paper describes and evaluates an accessibility index and methodology POINTER as concerns its relevance for SAF. POINTER is demonstrated on a Danish national transport infrastructure project. Finally conclusion and perspectives are given.

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Bridging the Gap in Transport Project Evaluation: Accounting for the Inaccuracies in Demand Forecasts and Construction Costs Estimations
For decades researchers have claimed that demand forecasts and construction costs estimations are assigned with large degrees of uncertainty, commonly referred to as Optimism Bias. A severe consequence is that ex-ante socio-economic
evaluation of infrastructure projects becomes inaccurate and can lead to unsatisfactory investment decisions. Thus there is a need for better risk assessment and decision support, which is addressed by the recently developed UNITE-DSS model. It is argued that this simulation-based model can offer decision makers new and better ways to deal with risk assessment.

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**Managing Sustainable Transport Development: The Rail Baltica Case**

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**Multi-criteria decision analysis for use in transport decision making**

1 Introduction
The most common methodology applied so far to the evaluation of transport systems has been conventional cost-benefit analysis (CBA) (Janic, 2003), which supported by traffic- and impact model calculations provides the decision-makers with a monetary assessment of the project's feasibility. A socioeconomic analysis is in this respect a further development of the traditional CBA capturing the economic value of social benefits by translating social objectives into financial measures of benefits (Wright et al., 2009). Internationally seen there has been a growing awareness over the recent years that besides the social costs and benefits associated with transport other impacts that are more difficult to monetise should also have influence on the decision making process. This is in many developed countries realised in the transport planning, which takes into account a wide range of impacts of also a strategic character (van Exel et al., 2002). Accordingly, appraisal methodologies are undergoing substantial changes in order to deal with the developments (Vickerman, 2000) that are varying from country to country and leading to different approaches (Banister and Berechman, 2000). It is, however, commonly agreed that the final decision making concerning transport infrastructure projects in many cases will depend on other aspects besides the monetary ones assessed in a socio-economic analysis. Nevertheless, an assessment framework such as the Danish one (DMT, 2003) does not provide any specific guidelines on how to include the strategic impacts; it merely suggests describing the impacts verbally and keeping them in mind during the decision process.

A coherent, well-structured, flexible, straightforward evaluation method, taking into account all the requirements of a transport infrastructure project is for this reason required. An appropriate ex-ante evaluation method for such projects can be based on multi-criteria decision analysis (MCDA) (Tsamboulas, 2007. Vreeker et al. 2002), which in most cases can be combined with a CBA (Leleur, 2000). Scanning the literature (Belton and Stewart, 2002; Goodwin and Wright, 2009; Keeney and Raiffa, 1993; von Winterfeldt and Edwards, 1986) it is found that the use of MCDA in the decision process usually provides some or all of the following features:

1. Improvement of the satisfaction with the decision process
2. Improvement of the quality of the decision itself
3. Increased productivity of the decision-makers

MCDA can in this respect be seen as a tool for appraisal of different alternatives, when several points of view and priorities are taken into account to produce a common output. Hence, it is very useful during the formulation of a decision support system (DSS) designed to deal with complex issues. The literature on DSS is extensive, providing a sound basis for the methodologies employed and the mathematics involved. Moreover, there are numerous systems covering several
disciplines, policy contexts and users’ needs for specific application environments (Janic, 2003; Salling et al., 2007; Tsamboulas and Mikroudis, 2006). The use of DSS for solving MCDA problems has among others been treated by Barfod (2012), Chen et al. (2008) and Larichev et al. (2002), where it is shown that a DSS can effectively support a decision making process making use of appropriate MCDA methodologies.

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National bæredygtig transportplanlægning - hvad er det?
Bæredygtig transport forudsætter bæredygtig transportplanlægning, hvilket er fokus for forskningsprojektet SUSTAIN. I artiklen ses 'national bæredygtig transportplanlægning' som et fænomen, der kræver, at bæredygtighed reflekteres i mål og værdier, i analysen og i styringsmekanismer. Sverige og Norge har mange generationer af avancerede, nationale transportplaner bag sig. I artiklen bruger vi disse planer til at illustrere, hvad vi karakteriserer som national, bæredygtig transportudvikling.

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Strategisk transportplanlægning - gør vi bæredygtige fremskridt?

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The Meaning of System: Towards a Complexity Orientation in Systems Thinking
This article reviews the generic meaning of 'system' and complements more conventional system notions with a system perception based on recent complexity theory. With system as the core concept of systems theory, its actual meaning is not just of theoretical interest but is highly relevant also for systems practice. It is argued that complexity theory and thinking with reference to Luhmann a.o. ought to be recognised and paid attention to by the systems community. Overall, it is found that a complexity orientation may contribute to extend and enrich the explanatory power of current systems theory when used to complex real-world problems. As regards systems practice it is found that selective use and combination of five presented research approaches (functionalist, interpretive, emancipatory, postmodern and complexity) which function as different but complementing 'epistemic lenses' in a process described as constructive circularity, may strengthen the exploration and learning efforts in systems-based intervention.

National sustainable transport planning - concepts and practices
Sustainability has become a significant ambition for transport planners and policy-makers around the world. However, a transition to sustainable transport is a challenging, long term process, which raises important questions concerning how national, planning processes could support the integration of sustainability. This is the topic of the research project SUSTAIN. Internationally, research on national transport planning is limited, and not well established as a coherent field of research.
This paper presents preliminary results within SUSTAIN. The aim of the paper is to discuss how to conceive and define the concept of 'national sustainable transport planning'. This is done via selected literature within this and associated areas. A definition is provided and it is suggested that three interlinked dimensions are of importance for transitions, thus a normative, an analytic and a governance dimension.
The definition of national sustainable transport planning is confronted with current national transport planning practices in Sweden and Norway, which are somewhat advanced and have long traditions of recurrent, comprehensive, cross modal planning processes and integrated documents. Nevertheless, it is found that the Swedish and Norwegian planning efforts do not qualify to the label of 'national sustainable transport planning'.
Finally three research topics for future research in national sustainable transport planning are proposed, which all link to the above mentioned dimensions and their interlinkages.
Bæredygtig transportplanlægning

Hvordan afgør man præcist, hvor en fast forbindelse mellem Sverige og Danmark skal placeres, hvilke byer der skal forbindes af en ny motorvej, eller hvor en trængselsring skal ligge? Når politikerne skal beslutte sig for investeringer i transportsektoren, er der ofte tale om milliarder af kroner, og beslutningerne har samfundsmæssige konsekvenser i årevis fremover. Cost-benefit-analyser (CBA) udgør sjældent et tilstrækkeligt grundlag for at træffe beslutninger, især når der også skal inddrages sociale og miljømæssige hensyn. Der skal indarbejdes et utal af forskellige variable, ofte modsatrettede og indbyrdes modstridende, og der er behov for et beslutningsværktøj, der kan inndrage langt mere end blot økonomiske faktorer. Et sådant værktøj er EcoMobility-modellen, som giver beslutningstagere mulighed for at vælge projekter, der sikrer minimale miljøpåvirkninger fra transporten samtidig med øget mobilitet og styrket økonomisk vækst.

National Sustainable Transport Planning – What is it and what should it be?

Sustainable transport has become a current and important ambition for transport planners and policy-makers around the world. In Denmark, this is confirmed in a political agreement on a 'Green Transport Policy', where significant new policies have been announced. A transition to sustainable transport raises important questions concerning the organization of national, planning processes integrating sustainability. In Denmark the effectiveness of the previous ‘ad hoc’ approach has been questioned, and some planning innovations have been adopted, like longer time frames, fixed planning cadences and coherent, strategic analyses.

Internationally, transdisciplinary research on national, sustainable transport planning is limited and it is not established as a coherent field of research. The ambition of this paper is to contribute to this new field of research by establishing understandings and definitions of national sustainable transport planning. This will be done by distinguishing between existing national transport planning frameworks; those frameworks that attempt to incorporate sustainability; and a more elaborate and or ideal concept of national sustainable transport planning.

Selected literature on national sustainable transport planning and associated terms form the basis of the paper, and since, neighbouring Norway and Sweden have for a number of years produced major, national transport plans, experiences from these two countries have already been subject to analyses, and will work as examples in the paper.
National sustainable transport planning - what it is and what it should be?
Sustainability has become a significant ambition for transport planners and policy-makers around the world. However, a transition to sustainable transport is a challenging, long term process, which raises important questions concerning how national, planning processes could support the integration of sustainability. This is the topic of the research project SUSTAIN. Internationally, research on national transport planning is limited, and not well established as a coherent field of research.

This paper presents preliminary results within SUSTAIN. The aim of the paper is to discuss how to conceive and define the concept of 'national sustainable transport planning'. This is done via selected literature within this and associated areas. A definition is provided and it is suggested that three interlinked dimensions are of importance for transitions, thus a normative, an analytic and a governance dimension.

The definition of national sustainable transport planning is confronted with current national transport planning practices in Sweden and Norway, which are somewhat advanced and have long traditions of recurrent, comprehensive, cross modal planning processes and integrated documents. Nevertheless, it is found that the Swedish and Norwegian planning efforts do not qualify to the label of 'national sustainable transport planning'.

Finally three research topics for future research in national sustainable transport planning are proposed, which all link to the above mentioned dimensions and their interlinkages.

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Scaling Transformation in the Rembrandt Technique: Examination of the Progression Factors
This paper examines a decision support system (DSS) for the appraisal of complex decision problems using multi-criteria decision analysis (MCDA). The DSS makes use of a structured hierarchical approach featuring the multiplicative AHP also known as the REMBRANDT technique. The paper addresses the influence of the progression factor used when transforming the decision makers' verbal responses from a semantic to a geometric scale in REMBRANDT. Conventionally, the progression factor $2$ is used for calculating scores of alternatives and $\sqrt{2}$ for calculation of criteria weights. Tests are conducted on the magnitude of these progression factors in order to examine the sensitivity towards the final outcome of an analysis. For illustration a case study concerning the appraisal of a large infrastructure project is presented. The results of the sensitivity calculations are compared with the results of a conventional AHP calculation in order to examine what impact the choice of progression factors as well as the choice of technique have on the decision making. Based on this a modified progression factor for the calculation of scores for the alternatives in REMBRANDT is suggested while the progression factor for the criteria weights is suggested to be kept unchanged. Finally, conclusions and perspectives are set out.

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Sustainable national transport planning: Managing multiple objectives and criteria

Sustainable transport planning necessitates a rethinking of traditional assessment based primarily on cost-benefit analysis (CBA) used for a systematic quantification and comparison of the various benefits and costs generated by a transportation project or policy. Generally, CBA has been found less useful for the handling and assessment of multiple, often conflicting objectives or criteria like environmental or social issues intrinsically difficult to quantify. Therefore, it is necessary to broaden the assessment and the decision making process beyond merely economic factors. The research project on Sustainable National Transport Planning (SUSTAIN) seeks, among other things, to develop a flexible decision-support model to assess the sustainability of transport projects and policies, the SUSTAIN framework model.

The SUSTAIN framework model consists of two parts, namely decision conferences and an Excel-based software model. The latter employs the use of CBA, multi-criteria decision analysis and risk analysis techniques enabling the assessment of non-quantifiable impacts within a decision support context. The concept of a decision conference is introduced as relevant for dealing with the strategic elements not included in the CBA. One important part of the assessment is the selection of criteria to be included and this aspect will be examined by an appraisal study of the Rail Baltica corridor. In the study various alternatives are appraised with an explicit consideration of each alternative’s sustainability performance.

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Complex Strategic Choices: Applying Systemic Planning for Strategic Decision Making
Effective decision making requires a clear methodology, particularly in a complex world of globalisation. Institutions and companies in all disciplines and sectors are faced with increasingly multi-faceted areas of uncertainty which cannot always be effectively handled by traditional strategies. Complex Strategic Choices provides clear principles and methods which can guide and support strategic decision making to face the many current challenges.

By considering ways in which planning practices can be renewed and exploring the possibilities for acquiring awareness and tools to add value to strategic decision making, Complex Strategic Choices presents a methodology which is further illustrated by a number of case studies and example applications. Dr. Techn. Steen Leleur has adapted previously established research based on feedback and input from various conferences, journals and students resulting in new material stemming from and focusing on practical application of a systemic approach. The outcome is a coherent and flexible approach named systemic planning.

The inclusion of both the theoretical and practical aspects of systemic planning makes this book a key resource for researchers and students in the field of planning and decision analysis as well as practitioners dealing with strategic analysis and decision making. More broadly, Complex Strategic Choices acts as guide for professionals and students involved in complex planning tasks across several fields such as business and engineering.
Modelling of Transport Projects Uncertainties: Risk Assessment and Scenario Analysis

This paper proposes a new way of handling the uncertainties present in transport decision making based on infrastructure appraisals. The paper suggests to combine the principle of Optimism Bias, which depicts the historical tendency of overestimating transport related benefits and underestimating investment costs, with a quantitative risk analysis based on Monte Carlo simulation and to make use of a set of exploratory scenarios. The analysis is carried out by using the CBA-DK model representing the Danish standard approach to socio-economic cost-benefit analysis. Specifically, the paper proposes to supplement Optimism Bias and the associated Reference Class Forecasting (RCF) technique with a new technique that makes use of a scenario-grid. We tentatively introduce and refer to this as Reference Scenario Forecasting (RSF). The final RSF output from the CBA-DK model consists of a set of scenario-based graphs which functions as risk-related decision support for the appraised transport infrastructure project. The presentation of RSF is demonstrated by using an appraisal case concerning a new airfield in the capital of Greenland, Nuuk.

The EcoMobility Modelling Framework for Sustainable Transport Planning

General information
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Organisations: Transport policy and behaviour, Department of Transport

Research output: Contribution to journal › Journal article – Annual report year: 2011 › Research › peer-review
Composite decision support by combining cost-benefit and multi-criteria decision
This paper concerns composite decision support based on combining cost-benefit analysis (CBA) with multi-criteria decision analysis (MCDA) for the assessment of economic as well as strategic impacts within transport projects. Specifically a composite model for assessment (COSIMA) is presented as a decision support system (DSS). This COSIMA DSS ensures that the assessment is conducted in a systematic, transparent and explicit way. The modelling principles presented are illuminated with a case study concerning a complex decision problem. The outcome demonstrates the approach as a valuable DSS, and it is concluded that appraisals of large transport projects can be effectively supported using a combination of CBA and MCDA. Finally, perspectives of the future modelling work are given.

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Estimating the Robustness of Composite CBA and MCDA Assessments by Variation of Criteria Importance Order
Abstract This paper discusses the concept of using rank variation concerning the stakeholder prioritising of importance criteria for exploring the sensitivity of criteria weights in multi-criteria analysis (MCA). Thereby the robustness of the MCA-based decision support can be tested. The analysis described is based on the fact that when using MCA as a decision-support tool, questions often arise about the weighting (or prioritising) of the included criteria. This part of the MCA is seen as the most subjective part and could give reasons for discussion among the decision makers or stakeholders. Furthermore, the relative weights can make a large difference in the resulting assessment of alternatives (Hobbs and Meier 2000). Therefore it is highly relevant to introduce a procedure for estimating the importance of criteria weights. This paper proposes a methodology for estimating the robustness of weights used in additive utility models.
Examination of Decision Support Systems for Composite CBA and MCDA Assessments of Transport Infrastructure Projects

This paper examines decision support systems (DSS) for composite appraisals of transport infrastructure projects comprising both cost-benefit analysis (CBA) and multi-criteria decision analysis (MCDA). Two DSS, REMBRANDT and COSIMA, are in this context examined and compared using a case study dealing with alternatives for a new high-speed railway line in Sweden. The REMBRANDT system is based on multiplicative value functions and makes use of pair wise comparisons on both attribute and criteria level. The COSIMA system is based on additive value functions and makes use of the REMBRANDT technique using pair wise comparisons on attribute level and swing weights on criteria level. One difference between the two approaches is the focus the COSIMA system puts on combining the CBA and MCDA results influencing, among other things, the way that the final results are expressed. Finally, a recommendation for the use of DSS within transport infrastructure appraisals is set out.
Transport appraisal and Monte Carlo simulation by use of the CBA-DK model

This paper presents the Danish CBA-DK software model for assessment of transport infrastructure projects. The assessment model is based on both a deterministic calculation following the cost-benefit analysis (CBA) methodology in a Danish manual from the Ministry of Transport and on a stochastic calculation, where risk analysis is carried out using Monte Carlo simulation. Special emphasis has been placed on the separation between inherent randomness in the modeling system and lack of knowledge. These two concepts have been defined in terms of variability (ontological uncertainty) and uncertainty (epistemic uncertainty). After a short introduction to deterministic calculation resulting in some evaluation criteria a more comprehensive evaluation of the stochastic calculation is made. Especially, the risk analysis part of CBA-DK, with considerations about which probability distributions should be used, is explained. Furthermore, comprehensive assessments based on the set of distributions are made and implemented by use of a Danish case example. Finally, conclusions and a perspective are presented.
Reference Scenario Forecasting: A New Approach to Transport Project Assessment
This paper presents a new approach to transport project assessment in terms of feasibility risk assessment and reference class forecasting. Normally, transport project assessment is based upon a cost-benefit approach where evaluation criteria such as net present values are obtained. Recent research has however proved that substantial inaccuracies are present when obtaining the monetary input to the cost-benefit analysis, particularly as concerns the construction costs and demand forecasts. This paper proposes a new approach in order to assess these biases in a so-called reference scenario forecasting (RSF) frame. The RSF is anchored in the cost-benefit analysis (CBA), thus, it provides decision-makers with a quantitative mean of assessing the transport infrastructure project. First, the RSF method introduces uncertainties within the CBA by applying Optimism Bias uplifts on the preliminary construction cost estimates. Hereafter, a quantitative risk analysis is provided making use of Monte Carlo simulation. This stochastic approach facilitates random input parameters based upon reference class forecasting, hence, a parameter data fit has been performed in order to obtain validated probability distribution functions. The latter have been placed and ultimately simulated on the inaccuracies of determining demand forecasts, i.e. leading to the travel time savings and ticket revenues of the project. Finally, RSF makes use of scenario forecasting where trend scenarios such as economic growth and level of cross-border integration are investigated. The latter was relevant as RSF is demonstrated by a case example concerning the fixed link between Elsinore (Denmark) and Helsingborg (Sweden) and calculations are performed in the CBA-DK decision support model.

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Samfundsmæssig Vurdering af Alternative Faste Forbindelser mellem Helsingør og Helsingborg

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Strategic Transport Decision-Making: The SIMDEC Approach based on Risk Simulation and Multi-Criteria Analysis

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Customised DSS and decision conferences
This paper presents and exemplifies a combination of techniques for deriving and modelling decision-maker and/or stakeholder preferences using a decision conference process. The applied techniques are used for the development of customised decision support systems (C-DSS) which can be used for appraisals of large transport infrastructure projects. The paper exemplifies how the process at a decision conference can be effectively supported by a DSS customised using appropriate techniques for the specific task in hand. In this respect a conventional cost-benefit analysis (CBA) is combined with a multi-criteria decision analysis (MCDA) featuring the REMBRANDT and the swing weights techniques. The approach is presented based on a case study, which concerns the interaction between stakeholders and decision-makers at a decision conference which was set up for the appraisal of proposals for the alignment of a high-speed railway line in Sweden.
Keyword: Decision Conference, Decision Support Systems, Multi-criteria Decision Analysis, REMBRANDT, Swing Weights

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Estimating the robustness of composite CBA & MCA assessments by variation of criteria importance order
This paper discusses the concept of using rank variation concerning the stake-holder prioritising of importance criteria for exploring the sensitivity of criteria weights in multi-criteria analysis (MCA). Thereby the robustness of the MCA-based decision support can be tested. The analysis described is based on the fact that when using MCA as a decision-support tool, questions often arise about the weighting (or prioritising) of the included criteria. This part of the MCA is seen as the most subjective part and could give reasons for discussion among the decision makers or stakeholders. Furthermore, the relative weights can make a large difference in the resulting assessment of alternatives [1]. Therefore it is highly relevant to introduce a procedure for estimating the importance of criteria weights. This paper proposes a methodology for estimating the robustness of weights used in additive utility models. When assessing larger transport infrastructure projects often several non-monetised impacts could be relevant to include in the appraisal [2]. For many decision makers and stakeholders the task of setting the criteria weights for several criteria can be very difficult. To overcome this, the proposed method uses surrogate weights based on rankings of the criteria, by the use of Rank Order Distribution (ROD) weights [3]. This reduces the problem to assigning a rank order value for each criterion. A method for combining the MCA with the cost-benefit analysis (CBA) is applied as described by Salling et al. in [4]. This methodology, COSIMA, uses a
Examination of decision support systems for composite CBA & MCDA assessments of transport infrastructure projects
This paper examines decision support systems (DSS) for composite appraisals of transport infrastructure projects comprising both cost-benefit analysis (CBA) and multi-criteria analysis (MCA). Two DSS are in this context examined and compared using a case study dealing with alternatives for a new high-speed railway line between the two cities, Norrköping and Bäckeby, in Sweden. Both systems are based on additive value functions and makes use of pair wise comparisons. The first system examined, which is widely used and based on acknowledged methods, comprises the REMBRANDT technique using pair wise comparisons for rating of the alternatives and swing weights for the determination of criteria weights. The results of the CBA are in this system converted into value function scores, assigned with a weight and included as an additional criterion in the MCA appraisal. Hence, the result of the system is a score for each alternative reflecting its performance in the composite appraisal. The second system examined, the so-called COSIMA approach, provides a framework for adding value functions determined in a MCA to impacts monetarily assessed in a CBA. The system makes use of the same methods as the latter for the rating of alternatives and the determination of criteria weights, namely the REMBRANDT technique combined with swing weights. However, this system does not convert the results of the CBA into value function scores. Instead the value functions computed in the MCA are added to the CBA results using a trade-off indicator. Hence, the result is a total rate for each alternative reflecting its attractiveness in the appraisal as a function of the trade-off between the CBA and MCA and their individual results. Thus, a sensitivity measure for the MCA’s influence on the final result of the composite analysis is achieved. The input for the two DSS examined was generated using the previous mentioned case study. A decision conference was set up where various stakeholders and decision makers under the guidance of a facilitator were producing input in form of their preferences. The purpose of the examination and comparison of the two systems is to determine which is the most appropriate for conducting composite appraisals of transport infrastructure projects. The first system provides a conventional widely used and theoretical well founded framework. The COSIMA framework is founded on a somewhat different set of axioms. However, the two systems provide the decision makers with the same kind of result, only expressed differently. The question treated in this context is hence if the COSIMA system provides the decision makers with some information that the conventional system does not provide and vice versa. The paper also treats issues regarding the use of scales within additive value functions. E.g. using a local scale defined by the alternatives that are under consideration set against a global scale defined by reference to a wider set of possibilities. Moreover, if an intrinsically important criterion in the appraisal does not differentiate much between the alternatives – if the minimum and maximum points on the value scale correspond to similar levels of performance – then that criterion should maybe be ranked quite low or even omitted from the appraisal. This issue particularly arises if the degree of differentiation differs significantly across criteria; on one criterion the reference points may represent low discrimination ability between the alternatives under consideration, whereas on another criterion the reference points may lead to high discrimination as concerns influence on the assessment score. It is examined if some lower boundary rule can be defined in this respect indicating when a criterion should be assigned with a low weight.
or even omitted from the appraisal. Finally, conclusions are drawn including a recommendation based on the case study for the most appropriate system for conducting composite appraisals of transport infrastructure projects, and research questions defining future work in the context of composite DSS and their use in decision making processes are set out.

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Helhetsorienterad utvärdering av kollektivtrafikåtgärder

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Modelling of Transport Projects Uncertainties: Risk Assessment and Scenario Analysis
This paper proposes a new way of handling the uncertainties present in transport decision making based on infrastructure appraisals. The paper suggests to combine the principle of Optimism Bias, which depicts the historical tendency of overestimating transport related benefits and underestimating investment costs, with a quantitative risk analysis based on Monte Carlo simulation and to make use of a set of exploratory scenarios. The analysis is carried out by using the CBA-DK model representing the Danish standard approach to socio-economic cost-benefit analysis. Specifically, the paper proposes to supplement Optimism Bias and the associated Reference Class Forecasting (RCF) technique with a new technique that makes use of a scenario-grid. We tentatively introduce and refer to this as Reference Scenario Forecasting (RSF). The final RSF output from the CBA-DK model consists of a set of scenario-based graphs which function as risk-related decision support for the appraised transport infrastructure project.

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The meaning of system: From CAS to CHESS

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At navigere mod fremtiden: Systemisk planlægning som ide og metode

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Hållbart transportsystem för inre och yttre attraktionskraft - STMØ 2: Integration, konkurrenskraft och utbildning i Öresundregionen

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Road Pricing, the Economy and the Environment
Strategic Location Planning: A ‘Hard’ Approach Supported by ‘Semi-Soft’ Methods

Systemic Planning - Second Edition: Principles and Methodology for Planning in a Complex World

Systems Science and Complexity: Some Proposals for Future Development
A Composite Modelling Approach to Decision Support by the Use of the CBA-DK Model: The Hornsherred Case

This paper presents a decision support system for assessment of transport infrastructure projects. The composite modelling approach, COSIMA, combines a cost-benefit analysis by use of the CBA-DK model with multi-criteria analysis applying the AHP and SMARTER techniques. The modelling uncertainties are dealt with by use of a feasibility risk study elaborating over the decision-makers risk aversion towards a given problem. After these modelling principles a case study is examined with incorporation of a scenario analysis based upon various policy aspects. The final model outcome is presented both as a deterministic single point estimate and a stochastic interval result.

Appraisal of Airport Alternatives in Greenland by the Use of Risk Analysis and Monte Carlo Simulation

This paper presents an appraisal study of three different airport proposals in Greenland by the use of an adapted version of the Danish CBA-DK model. The assessment model is based on both a deterministic calculation by the use of conventional cost-benefit analysis and a stochastic calculation, where risk analysis is carried out using Monte Carlo simulation. The feasibility risk adopted in the model is based on assigning probability distributions to the uncertain model parameters. Two probability distributions are presented, the Erlang and normal distribution respectively assigned to the construction cost and the travel time savings. The obtained model results aim to provide an input to informed decision-making based on an account of the level of desired risk as concerns feasibility risks. This level is presented as the probability of obtaining at least a benefit-cost ratio of a specified value. Finally, some conclusions and a perspective are presented.
Comparing a soft and a hard multi-methodology approach: Location of an IT company in the Øresund Region

This paper deals with different ways of supporting a knowledge intensive IT company in a strategic relocation of their Scandinavian headquarter in the Øresund Region. Choosing a new location is a problem situation that can be regarded as a complex strategic planning problem, which calls for a systemic planning approach. Two types of decision support systems are provided. They are both based on a multi-methodology approach, one consisting of soft methods and one of hard methods. This paper addresses a comparison between the soft and the hard approach which were used in the decision support system applied in the STMØ project (2005-2007). The soft approach explores litmus test, CSH, SSM and SWOT analysis, while the hard method approach combines preference analysis, CBA, AHP, SMARTER, MCA and COSIMA. Both approaches are supported by simple soft methods as stakeholder analysis and brainstorming. A major issue examined in the paper is whether or not the soft approach provides important information that the hard approach would not be able to identify. With regard to a complementary use of soft and hard methods findings are finally set out based on the relocation case and the various method results.

COSIMA-ES-PORT: A new Decision Support Model for the handling of road/rail/cargo related impacts

This article describes the results of the research project – WP3 East-west, Interreg IIIB – concerning the development of a new composite decision model, COSIMA-ES-PORT, for the assessment of three pre-feasibility studies situated at the Port of Esbjerg: a road project, a railway project and a multimodal terminal. The three studies indicates that a new road connection to the Port of Esbjerg is a very profitable project due to large travel time savings, whereas a new railway connection is not economically viable. However, a new multimodal terminal is also a very profitable project. The COSIMA-ES-PORT model showed some promising perspectives in the handling of the three pre-feasibility studies. Parameters such as cargo handling and ship related issues could with advantage be implemented in the decision model and forecasted similarly to road infrastructure impacts. Furthermore, the development of COSIMA-ES-PORT showed some promising perspectives with regard to the implementation of other means of transportation for composite decision model assessment.
Decision-Oriented Project Ranking for Asset Management System: Rail Net Denmark
The Danish rail net operator, Rail Net Denmark, has through the past years built up an Asset Management system, containing a certain percentile of all the company's assets. This paper contains an elaborate overview on how to strengthen the system seen from a decision-support perspective. The focus is to apply a modified project ranking methodology: Asset Management System Priority Module (AMS-PM), which is a practical tool for assessing and ranking various project proposals in a straightforward manner. The methodology is set-out by a multi-criteria approach where weights are applied ultimately resulting in priority indices for the state-of-repair data. This paper is disposed as follows; firstly, a description of the Asset Management system is set-up including an overview of the state-of-repair data and the case study. Secondly, is the AMS-PM software model implemented through an exploratory case study and finally conclusions and a perspective are given.

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Improving Public Investment Management for Large-Scale Government Projects: Focusing on the Feasibility Studies: Lessons and Challenges

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Edition: 1
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Modelling decision support and uncertainty for large transport infrastructure projects: The CLG-DSS model of the Øresund Fixed Link
This paper presents a decision support system, named the CLG-DSS model, which makes it possible for decision makers to assess various uncertainties in project appraisal in a systematic and explicit way. This model, a decision support system (DSS) developed within the Danish Centre for Logistics and Freight Transport (CLG), the CLG-DSS model, is based on cost-benefit analysis (CBA) embedded in a wider multi-criteria analysis (MCA) by some principles for composite modelling assessment (COSIMA). The CLG-DSS model is set-up to make use of scenario analysis (SA) and Monte Carlo simulation
(MCS). A particular concern in the model is the handling of varying information across the assessment criteria and the application of SA to inform the MCS parameter setting. After the presentation of the modelling principles some ex-post case calculations for the Øresund Fixed Link are illuminating different aspects of appraisal uncertainty and thereby, at the same time, demonstrate the features of the CLG-DSS model as a useful decision support tool. It is finally concluded that appraisal of large infrastructure projects can be effectively supported by dealing with uncertainty issues in accordance with the principles described.

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Research output: Contribution to journal › Journal article – Annual report year: 2007 › Research › peer-review

Strategic Planning and Decision Analysis: Presentation of the COSIMA Software System
This paper presents a composite decision support system, COSIMA, programmed in MS Excel. COSIMA provides assistance to the decision maker as concerns complex decisions and strategic planning. The COSIMA software is designed as interconnected modules which make it possible to conduct Cost-Benefit Analysis and Multi-Criteria Analysis (MCA) either in combination or separated. The MCA module is based on the AHP and SMARTER techniques. COSIMA also handles risk analysis using Monte Carlo simulation.

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Systemic planning: Dealing with complexity by a wider approach to planning

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Assessment of Transport Infrastructure Projects by the use of Monte Carlo Simulation: The CBA-DK Model

This paper presents the Danish CBA-DK software model for assessment of transport infrastructure projects. The assessment model is based on both a deterministic calculation following the cost-benefit analysis (CBA) methodology in a Danish manual from the Ministry of Transport and on a stochastic calculation, where risk analysis (RA) is carried out using Monte Carlo Simulation (MCS). After a description of the deterministic and stochastic calculations emphasis is paid to the RA part of CBA-DK with considerations about which probability distributions to make use of. Furthermore, a comprehensive assessment of the set of distributions are made. Finally conclusions and a perspective are presented.

Development of sustainable traffic planning: Analysis of Danish planning visions 2005 and 2015

Traffic and city planning has for a long period of time been a matter of solving actual problems with specific plans rather than by making visionary long-termed planning to prevent new problems from occurring. As the amount of traffic is rapidly increasing and congestion problems are appearing there has, however, been a renewed focus on the interaction between transport and sustainability. To exemplify the advancement of Danish planning methodology this paper in this respect reviews a visionary traffic planning report worked out by the Danish Ministry of Transport in 1993 called “Trafik 2005”. On this basis a resent set of planning visions for 2015 is examined and by using a simple counting technique the development in Danish transport planning is monitored. Finally some conclusions are given.
Modeling Decision Support and Uncertainty using @RISK: The COSIMA-ROAD Model

This paper concerns a newly developed software model called COSIMA-ROAD for project evaluation in the Danish road sector. COSIMA-ROAD is developed as a combined effort in co-operation between the Danish Road Directorate and the Technical University of Denmark. The applied case study is developed by the Danish Road Directorate. The main purpose of this paper is primarily to describe how @RISK is used in COSIMA-ROAD. First the two main modules of COSIMA-ROAD are described as respectively a traditional cost-benefit analysis (deterministic point estimate) and a risk analysis using Monte Carlo Simulation (stochastic interval estimate). Next the actual case example is presented with the obtained results. Finally, conclusions and a perspective of the future modeling work are given.

Strategic Transport Management as a Regional Development Competence

Sustainable Development and Strategic Transport Management in the Øresund Region

Traffic planning has developed over the years and has produced both longterm and short term solutions of different kinds. In general, however, in many urban and regional areas, traffic planning has until now not been able to treat and resolve the increasing problems relating to uncurbed traffic growth. Therefore new planning strategies and approaches are needed. In addition, the quality of transport networks and other types of traffic infrastructure are becoming more and more important features for metropolis and regions when competing in attracting investment, development and knowledge. This is especially relevant for a cross-boarder region as the Øresund region treated in this paper. To ensure a sustainable development while at the same time upgrading the quality of urban and reginal transport is thus a major challenge. To deal with this situation the paper outlines a wider approach to sustainable regional transport planning. This is done by setting up a so-called holistic approach to planning and afterwards, based on holistic planning, by presenting the ideas of Strategic Transport Management (STM) as an important new planning and management concept. Finally some conclusions are given together with a perspective.
Systems Science and Complexity: Comparing a Complexity-Based Approach with Other Research Approaches

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S.
Number of pages: 10
Publication date: 2006

Host publication information
Title of host publication: UKSS Proceedings 2006
Publisher: UKSS
Source: orbit
Source-ID: 191280
Research output: Chapter in Book/Report/Conference proceeding – Article in proceedings – Annual report year: 2006 – Research – peer-review

Transportnet, planlægning, miljø og sikkerhed: STMØ - Kortlægning af barrierer i Øresundsregionen - Delrapport 1:4

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport, Traffic Modelling, Logistics & ITS
Number of pages: 131
Publication date: 2006

Publication information
Publisher: Malmö högskola
ISBN (Print): 91-976407-4-3
Original language: Danish
Source: orbit
Source-ID: 193158

COSIMA - A New Decision Support System for the Assessment of Large Transport Infrastructure Projects

This paper presents a new proto-type decision support system named COSIMA-DSS for composite method for assessment – decision support system. This userfriendly system makes it possible for decision makers to assess large infrastructure projects and take special account of various uncertainties in a systematic and explicit way. The model applied is based on cost-benefit analysis (CBA) embedded in a wider multi-criteria analysis (MCA) and makes use of scenario analysis (SA) and Monte Carlo simulation (MCS). A particular concern of the model is the handling of varying information across the assessment criteria and the application of SA to inform the MCS parameter setting. After the presentation of the modelling principles, some ex-post case calculations for the Øresund Fixed Link connecting Denmark and Sweden are presented. These illuminate different aspects of appraisal uncertainty and demonstrate the features of the COSIMA-DSS model as a useful decision support tool. It is finally concluded that appraisal of large infrastructure projects can be effectively supported by dealing with uncertainty issues in accordance with the described principles.

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Salling, K. B., Jensen, A. V., Holvad, T., Leleur, S.
Publication date: 2005

Host publication information
COSIMA-DSS Evaluation System: A new Decision Support System for Large-Scale Transport Infrastructure Projects

This paper presents a new decision support model COSIMA-DSS that examines socio-economic feasibility risks involved in the implementation of transport infrastructure projects. The model makes use of conventionally cost-benefit analysis embedded within a wider multi-criteria analysis. The basic approach set out in the paper looks upon the mix between so-called "hard" and "soft" evaluation criteria. Finally, a Monte-Carlo simulation is used to take account of the varying information relating to the different criteria.

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Salling, K. B., Jensen, A. V., Leleur, S.
Pages: 601-607
Publication date: 2005

COSIMA-VEJ – Software Applied towards Project Evaluation in the Danish Road Sector: COSIMA-VEJ – Software til projektvurdering i den danske vejsektor

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Salling, K. B., Jensen, A. V., Leleur, S.
Publication date: 2005

DTU's Center for Trafik og Transport (CTT): Forskning, udvikling og uddannelse

General information
Publication status: Published
Organisations: Department of Transport
Contributors: Madsen, O. B., Leleur, S., Nielsen, O. A.
Pages: 3
Publication date: 2005
Peer-reviewed: Unknown

Publication information
Journal: Dansk Vejtidsskrift
Multi-criteria analysis and systemic planning: Towards a tetra-logical approach to planning and assessment
This paper presents systemic planning (SP) with emphasis on multi-criteria decision analysis (MCDA). Specifically, SP is presented as a "tetra-logical" methodology approach with MCDA as one out of four major method orientations. The Danish-Swedish Øresund Fixed Link is used as application example. It is concluded that the combination of SP and MCDA better than ordinary cost-benefit analysis can provide the necessary decision support for major, long-range investment decisions.

Systemic Planning: Principles and Methodology for Planning in a Complex World
This book presents principles and methodology for planning in a complex world. It sets out a so-called systemic approach to planning, among other things, by applying "hard" and "soft" methodologies and methods in combination. The book is written for Ph.D and graduate students in engineering, business and other fields, and it is useful for all professionals, across a wide range of employment areas, who share an interest in renewing planning practice. Such an endeavour is seen as both important and timely, recognising that many complex planning tasks necessitate organisations – be they public or private – to engage in planning to prepare proactive decision-making.

Systemic Planning: Dealing with Complexity by a Wider Approach to Planning
On the basis of a new book Systemic Planning this paper addresses systems thinking and complexity in a context of planning. Specifically, renewal of planning thinking on this background is set out as so-called systemic planning (SP). The principal concern of SP is to provide principles and methodology that can be helpful for planning under circumstances characterised by complexity and uncertainty. It is argued that compared to conventional, planning – referred to as systematic planning - there is a need for a wider, more systemic approach to planning that is better suited to current real-world planning problems often characterised by complex issues.
SCOPE – An Integrated Framework for Multi-Attribute Decision Making

This article presents an integrated framework for multi-attribute decision making named SCOPE (System for Combined Planning and Evaluation) that was developed to assess infrastructure policy initiatives—in complex decision environments. The framework comprises scanning as well as assessment issues that are supported by a methodology of both a systemic and a systematic type. Specific use is made of operational research methods such as critical systems heuristics, scenario technique, stakeholder analysis and multi-attribute decision making (MADM). To deal with issues of complexity and ambiguity, planning is redefined as being a systemic endeavour embedded in multi-methodology and reflection-in-practice.
The article addresses the purpose, background and principles of systemic planning, and exemplifies the SCOPE process with reference to the Øresund Fixed Link.

**General information**
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S.
Pages: 259-270
Publication date: 2004
Peer-reviewed: Yes

**Publication information**
Journal: Innovation: The European Journal of Social Science Research
Volume: 17
Issue number: 3
ISSN (Print): 1351-1610
Scopus rating (2004): SJR 0.267 SNIP 0.701
Web of Science (2004): Indexed yes
Original language: English
DOI: 10.1080/1351161042000241171
Source: orbit
Source-ID: 159075

**Systemic Decision Support in a Complex Business Environment**

**General information**
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S., Yucesan, E., Chick, S.
Pages: 71-76
Publication date: 2004

**Host publication information**
Title of host publication: Proceedings of the Future Business Technology Conference
Publisher: EUROSOIS
Editors: Yucesan, E., Chick, S.
Source: orbit
Source-ID: 155470

**A Scenario Generator for the European Freight Transport Sector**

**General information**
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S.
Publication date: 2003
Peer-reviewed: No
Source: orbit
Source-ID: 155452
Research output: Contribution to conference – Paper – Annual report year: 2003 – Research

**Development of the CLG-DSS Evaluation Model: Midterm Report presenting the CTT Contribution to Task 9**

**General information**
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Organisations: Decision Modelling, Department of Transport
Transport and Environment: In Search of Sustainable Solutions

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S., Feitelson, E., Verhoef, E.
Pages: 87-88
Publication date: 2003
Peer-reviewed: Yes

Publication information
Journal: Innovation: The European Journal of Social Science Research
Volume: 16
Issue number: 1
ISSN (Print): 1351-1610
Ratings:
Scopus rating (2003): SJR 0.13 SNIP 0.227
Original language: English

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Invited book review
Source: orbit
Source-ID: 39176

New Appraisal Methods in Transport Planning with an Emphasis on Large Transport Infrastructure Projects

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S.
Publication date: 2002
Peer-reviewed: No
Source: orbit
Source-ID: 155472

Transport Infrastructure Planning: Assessment of Strategic Mobility by Use of the POINTER Impact Model

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Kronbak, J., Leleur, S.
Publication date: 2002

Host publication information
Title of host publication: Proceedings at Traffic day at University of Aalborg
URLs:
Source: orbit
Source-ID: 36304
Research output: Chapter in Book/Report/Conference proceeding

Panel Report on Sustainability, Environment and Natural Resources (SENR), Enlargement Futures Project, Institute for Prospective Technological Studies (IPTS), EU Joint Research Centre (JRC)

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
The Traffic and Its Strategic Impacts: Assessment Methodologies

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S.
Publication date: 2001

Transport Infrastructure Planning: Modelling of Socio-Economic Feasibility Risks

General information
Publication status: Published
Organisations: Decision Modelling, Department of Transport
Contributors: Leleur, S.
Publication date: 2001

Host publication information
Title of host publication: Proceedings of EUROSIM 2001: Shaping Future with Simulation
Publisher: EUROSIM 2001
Editor: Heemink, A.
Source: orbit
Source-ID: 155443

Comparing the economic performance and environmental impact of Trans-European Road Networks: the EUNET project and assessment tool

General information
Publication status: Published
Organisations: Department of Planning, National Technical University of Athens, University of Leeds, Marcial Echenique & Partners Ltd.
Contributors: Tsamboulas, D., Pearman, A., Larkinson, J., Leleur, S.
Publication date: 1999

Host publication information
Title of host publication: Conference Proceedings
Place of publication: Bruxelles
Publisher: DG VII
Source: orbit
Source-ID: 174029
Research output: Chapter in Book/Report/Conference proceeding — Article in proceedings — Annual report year: 1999 — Research — peer-review

TENASSESS
Transport policy review: Denmark, Sweden, Finland. Ex-post and ex-ante case studies, barrier model for implementation of major transport infrastructure projects, corridor planning and evaluation model (COPE)
Citizen Participation Through Communicative Action: Towards a New Framework and Synthesis

**General information**
Publication status: Published
Organisations: Department of Planning, Illinois Institute of Technology
Contributors: Khisty, C. J., Leleur, S.
Pages: 119-137
Publication date: 1997
Peer-reviewed: Yes

**Publication information**
Journal: Journal of Advanced Transportation
Volume: 31
Issue number: 2
ISSN (Print): 0197-6729
Original language: English
Source: orbit
Source-ID: 168448
Research output: Contribution to journal › Journal article – Annual report year: 1997 › Research › peer-review

Societal Planning: Identifying a New Role for the Transport Planner-Part I

**General information**
Publication status: Published
Organisations: Department of Planning, Illinois Institute of Technology
Contributors: Khisty, C. J., Leleur, S.
Pages: 17-25
Publication date: 1997
Peer-reviewed: Yes

**Publication information**
Journal: Innovation
Volume: 10
Issue number: 1
Original language: English
Source: orbit
Source-ID: 168444
Research output: Contribution to journal › Journal article – Annual report year: 1997 › Research › peer-review

Societal Planning: Identifying a New Role for the Transport Planner-Part II: Planning Guidelines

**General information**
Publication status: Published
Organisations: Department of Planning, Illinois Institute of Technology
Contributors: Khisty, C. J., Leleur, S.
Pages: 27-36
Publication date: 1997
Peer-reviewed: Yes

**Publication information**
Journal: Innovation
Volume: 10
Issue number: 1
Original language: English
Source: orbit
Source-ID: 168445
Research output: Contribution to journal › Journal article – Annual report year: 1997 › Research › peer-review

Vejtrafik: Trafikteknik & Trafikplanlægning

**General information**
Publication status: Published
Organisations: Department of Planning, Aalborg University
Transportforsknin i EU

General information
Publication status: Published
Organisations: Department of Planning
Contributors: Leleur, S.
Pages: 30-31
Publication date: 1996
Peer-reviewed: No

Publication information
Journal: Dansk Vejtidskrift
Volume: Nr. 73
Issue number: 8/96
ISSN (Print): 0011-6548
Original language: Danish
Source: orbit
Source-ID: 165386
Research output: Contribution to journal › Journal article – Annual report year: 1996 › Research

Transport Project Evaluation: Integrating Cost-Benefit and Multi-Criteria Examination by the Use of Segregated Investment Return Rates (SIRR)

General information
Publication status: Published
Organisations: Department of Planning
Contributors: Leleur, S.
Pages: 175-186
Publication date: 1996

Host publication information
Title of host publication: Transport Policy
Place of publication: Oxford
Publisher: Pergamon - Elsevier Sc. Ltd.
Source: orbit
Source-ID: 165379
Research output: Chapter in Book/Report/Conference proceeding › Article in proceedings – Annual report year: 1996 › Research › peer-review

Transport Research APAS (actions de preparation, d'accompagnement et du suivi): Road Transport - Evaluation

General information
Publication status: Published
Organisations: Department of Planning, COWI AS
Contributors: Leleur, S., Pedersen, K. S., Bendtsen, U.
Publication date: 1996

Publication information
Original language: English
Source: orbit
Source-ID: 169869
Research output: Book/Report › Report – Annual report year: 1996 › Research › peer-review
Transport Research EURET Concerted Action 1.1: Cost-benefit and multi-criteria analysis for new road construction

General information
Publication status: Published
Organisations: Department of Planning, Danish Road Directorate
Contributors: Leleur, S., Fogh, S.
Number of pages: 390
Publication date: 1996

Publication information
Original language: English
Source: orbit
Source-ID: 169868
Research output: Book/Report › Report – Annual report year: 1996 › Research › peer-review

Projects:

Optimering af beslutningsstøtte for vurdering af større trafikale infrastrukturprojekter
Salling, K. B., PhD Student, Department of Transport
Leleur, S., Main Supervisor
Madsen, O. B. G., Examiner
Brundell-Freij, K., Examiner
Lannér, G., Examiner
Centerfinansieret
01/08/2004 → 19/12/2008
Award relations: Optimering af beslutningsstøtte for vurdering af større trafikale infrastrukturprojekter
Project: PhD

Metoder i infrastrukturplanlægning med særligt henblik på jernbaner
Hansen, S., PhD Student, Department of Transport
Nielsen, O. A., Main Supervisor
Leleur, S., Supervisor
Madsen, O. B. G., Examiner
Larsen, O. I., Examiner
Nielsen, L. D., Examiner
Anden sektorministeriel finansiering - SU
01/10/1997 → 19/08/2004
Award relations: Metoder i infrastrukturplanlægning med særligt henblik på jernbaner
Project: PhD

Infrastrukturplanlægning, med særligt henblik på jernbaner
Gissel, S., PhD Student, Department of Planning
Jørgensen, N. O., Main Supervisor
Leleur, S., Examiner
Anden sektorministeriel finansiering - SU
01/07/1996 → 17/12/1999
Award relations: Infrastrukturplanlægning, med særligt henblik på jernbaner
Project: PhD

Trafikplanlægning med særlig vægt på anvendelse af GIS-T til beslutningsstøtte
Moshøj, C. R., PhD Student, Department of Transport
Leleur, S., Main Supervisor
Nielsen, O. A., Supervisor
Jørgensen, N. O., Examiner
Sektorministerium, Stip-SU
01/05/1995 → 08/09/1998
Award relations: Trafikplanlægning med særlig vægt på anvendelse af GIS-T til beslutningsstøtte
Project: PhD
Trafikplanlægning og GIS-baserede konsekvensberegninger
Kronbak, J., PhD Student, Department of Transport
Leleur, S., Main Supervisor
Nielsen, O. A., Supervisor
Jørgensen, N. O., Examiner
Grissen, G., Examiner
Forskerakademiets Samfinansier
01/10/1994 → 01/10/1998
Award relations: Trafikplanlægning og GIS-baserede konsekvensberegninger
Project: PhD

Tele-Information and Operations Research
Borges, P. M. F. C., PhD Student, Department of Informatics and Mathematical Modeling
Vidal, R. V. V., Main Supervisor
Leleur, S., Examiner
Friplads_SU
01/09/1994 → 28/01/1999
Award relations: Tele-Information and Operations Research
Project: PhD

Sustainable Transport Planning - A Multi-Methodology Approach to Decision Making
Jeppesen, S. L., PhD Student, Department of Transport
Leleur, S., Main Supervisor
Christensen, L., Examiner
Vidal, R. V. V., Examiner
Hiselius, L. W., Examiner
DTU-lønnet stipendie
01/10/2006 → 05/05/2010
Award relations: Sustainable Transport Planning - A Multi-Methodology Approach to Decision Making
Project: PhD

Performance indicators frameworks for national sustainable transport planning
Cornet, Y., PhD Student, Department of Transport
Gudmundsson, H., Main Supervisor
Leleur, S., Supervisor
Nielsen, P. S., Examiner
Marsden, G., Examiner
Macharis, C., Examiner
Technical University of Denmark
15/02/2013 → 29/09/2016
Award relations: Performance indicators frameworks for national sustainable transport planning
Project: PhD

Appraisal of Transport Projects: Combining Cost-Benefit Analysis and Multi-Criteria Analysis
Jensen, A. V., PhD Student, Department of Transport
Leleur, S., Main Supervisor
Nielsen, T. A. S., Examiner
Kronbak, J., Examiner
Lannér, G., Examiner
Technical University of Denmark
01/01/2008 → 28/09/2012
Award relations: Appraisal of Transport Projects: Combining Cost-Benefit Analysis and Multi-Criteria Analysis
Project: PhD

Optimising Transport Decision Making by use of Customised Decision Models and Decision Conferences
Barfod, M. B., PhD Student, Department of Transport
Leleur, S., Main Supervisor
Kveiborg, O., Examiner
Naess, P., Examiner
Pearman, A., Examiner
Technical University of Denmark
01/01/2008 → 28/03/2012
Refinement and application of the method of successive calculations in transport project evaluations
Meisch, D., PhD Student, Department of Mathematics
Nielsen, B. F., Main Supervisor
Leleur, S., Supervisor
Van Dijk, N. M., Supervisor
Conradsen, K., Examiner
Telek, M., Examiner
Van Dijk, N. M., Examiner
1/3 FUU, 1/3 inst 1/3 Andet
01/06/2010 → 02/09/2014
Award relations: Refinement and application of the method of successive calculations in transport project evaluations
Project: PhD

SUSTAIN: National Transport Planning - sustainability, institutions, tools
A widespread consensus exists internationally and in Denmark about the relevance of pursuing goals for sustainable transport development but only limited research about how national transportation planning can become a pillar in this process. The goal of SUSTAIN is to expand this research and consolidate a framework on three core domains for a National Sustainable Transport Planning (NSTP): 1) sustainability, 2) institutions and 3) tools. Research within these three domains will address the following questions: How can the concept of sustainability be operationalised and transformed into strategic performance measures for national transport planning? How can these types of knowledge about organisational forms and planning processes contribute to the achievement of such sustainability measures? And how can these new types of knowledge be built into new model-based planning tools that can help advance the strategic planning in the desired sustainable direction?

An important feature of SUSTAIN is that it will seek to combine the results of social and technical sciences in planning research with extensive policy relevant knowledge in dialogue with practitioners and international experts. Furthermore, the SUSTAIN research will be underpinned by multi-faceted case research based on both Danish and international cases. Close connection with ongoing Danish planning practice will serve to demonstrate the potential of the formulated NSTP framework, which is expected to have a broad strategic and policy-oriented appeal and impact on promoting future sustainable transport.

Leleur, S., Project Participant, Department of Transport, Transport policy and behaviour
Gudmundsson, H., Project Participant, Department of Transport, Transport policy and behaviour
Sørensen, C. H., Project Participant, Department of Transport, Transport policy and behaviour
Salling, K. B., Project Participant, Department of Transport, Transport policy and behaviour
Jensen, A. V., Project Participant, Department of Transport, Transport policy and behaviour
Barfod, M. B., Project Participant, Department of Transport, Transport policy and behaviour
Cornet, Y., Project Participant, Department of Transport, Transport policy and behaviour
01/06/2012 → 31/05/2016
Collaborators: Monash University, Danish Ministry of Transport, Building and Housing, Danish Transport, Construction and Housing Authority, Transport Analysis, Sweden, Nagoya University, COWI AS, Texas A&M University, Danish Road Directorate, Transport-Economic Society, Denmark, University of Oxford, Copenhagen Business School, CONCITO
Documents:
SUSTAIN description 28092012
Project: Research

The EcoMobility project
The Øresund EcoMobility project's purpose is to promote sustainable and climate friendly transport solutions. Throughout the Øresund region, there is profound knowledge and many competencies on the subject "climate friendly transportation”. Øresund EcoMobility Knowledge & Innovation Centre strives to gather these competencies in a unified network of universities, industries and regional authorities. This unique network of regional competencies, will consist of over 40 experts within areas such as: cleantech, environmental science, infrastructure, city and transport planning, logistics and supply chain management. The project was built on three stages:
1. Cross-science Triple-Helix Thematic Knowledge Exchange Networks which gather knowledge on climate friendly transportation of goods and people.
2. Øresund EcoMobility Knowledge & Innovation Centre, which carries out knowledge dissemination, innovation and competence building.
3. Øresund Competence Building and Knowledge Sharing activities, such as publications, websites, workshops, conferences and courses for professionals, university students etc.
The DTU team developed the EcoMobility model as part of its project contribution.
Leleur, S., Project Participant, Department of Transport, Transport policy and behaviour
Jensen, A. V., Project Participant, Department of Transport, Transport policy and behaviour, Decision Modelling
Danish Transport Council project: Transport Economics and Decision Models (TEAM)
The main objective of TEAM is to formulate socio-economic project evaluation methods that are based on welfare economic principles. The methods, furthermore, shall be useful for examination of current transport planning issues and, at the same time, be made available as modules of decision models aiming at decision support applications. It is also intended that the project shall establish collaboration between the participating organisations: Copenhagen University, Institute of Economics, Technical University of Denmark, Department of Planning, and COWIconsult. The project consists of two main parts, namely one part relating to Assessment Theory and another to Decision Models. It is intended that all three partners are involved in both parts. Specifically, IFP will be responsible for two projects, with one project concerning the Development of Strategic Mobility Impact Models and the other, the Formulation of Optimal Investment Strategies for a Corridor Programme of Transport Infrastructure Projects. In addition to the research project, TEAM also organises a monthly seminar where topics of relevance for the research area are presented.

Leleur, S., Project Manager, Department of Planning
Kronbak, J., Project Participant, Department of Planning
Moshøj, C. R., Project Participant, Department of Planning
Ukendt: DKK1,000,000.00
01/02/1998 → 01/02/2001
Collaborators: COWI AS, University of Copenhagen
Award relations: Danish Transport Council project: Transport Economics and Decision Models (TEAM)
Project: Research

Trans Tools
TRANS-TOOLS aims to produce a European transport network model covering both passengers and freight, as well as intermodal transport, which overcomes the shortcomings of current European transport network models. Main shortcomings include the unsatisfactory representation of mix of traffic (short/long distance and freight/passenger), the (partly) missing presence of intermodality and freight logistics in models, differences in implementation of Origin-Destination base year for freight traffic in some models, outdated character of some models, no sufficient linkage of network based transport models with socio-economic effects and external effects.

As on the European realm different models for different options and with different IPR settings are anticipated, it is useful to construct an IPR free instrument on the basis of the best available knowledge (i.e. notably at partners that have been involved in building models that involve European policy questions).

The aim is to develop a European network-based transport model starting from the ideas consolidated in the modelling experience of the consortium partners. This means that some of the features of the current available EU models will be added, considering that while the model cannot be a tool for every purpose, the selection of the model features should be essentially on the basis of the policy needs addressed by the European Commission services. It is already quite clear that the SCENES model approach will provide good suggestions for the treatment of passenger transport and the interaction of local and long distance traffic, that the VACLAV transport network will be a suitable basis for the development of an efficient transport assignment model, that NEAC will provide the information for proper description of freight transport and that the SCENES model will constitute a reference for the treatment of intermodal transport, as well as SLAM for logistics. This will lead in the following clear innovations obtained form TRANS-TOOLS:

• New set up of a demand/supply model;
• Intermodality for passenger/freight (as National and European transport policies seek to promote intermodality through different measures);
• Inclusion of intercontinental flows (mainly for freight), as some models do not cover this segment;
• Full coverage of Central and Eastern Europe (Accession Countries and the countries at the borders of the enlarged European Union);
• Integration of the new Member States at a level similar to those of EU 15;
• Feedback infrastructure development economy (as the question of indirect effects in the economy and on network level is important, especially where investment has a substantial influence - notably for Accession Countries);
• Logistics/freight chain explicitly included;
• Coupling method with local traffic in order to address the effect of congestion on long-distance traffic;
• The consortium provides access to all relevant experience concerning EU and national modelling;
• A software approach is chosen which results in a software modelling tool on network level.

Overgård, C. H., Project Manager, Department of Transport
Würtz, C. J., Project Participant, Department of Transport
Nielsen, O. A., Project Participant, Department of Transport
Leleur, S., Project Participant, Department of Transport
Hansen, S., Project Participant, Department of Transport
The use of digital maps and adjacent databases have the potential to ease the work process when setting up traffic models. However, such methods do not necessarily secure against data errors. The amount of data in traffic models is rapidly increasing (especially due to new technologies such as GIS), which results in extremely time consuming quality controls in practice. Due to the amount and complexity of the work, many errors and deficiencies are overlooked. Such disregards in the data foundation of traffic models results often in doubtful traffic models. In addition it becomes difficult to determine whether problems stems from the data foundation, simplified assumptions or the structure of the traffic models. Thus quality control of data and models must be seen as a whole.

It is the sub-projects goal to develop GIS-based methods and guidelines for quality control of data, as well as to develop validation methods for traffic models. This will provide a significant contribution to the quality of traffic forecasts. Several good experiences with the methodologies have already been achieved in different applied projects (especially the Harbour Tunnel project) and several Danish/Nordic and International papers on the subject are on their way. See the GIS-T programme for organizational details on the project.

Nielsen, O. A., Project Manager, Department of Planning
Leleur, S., Project Participant, Department of Planning
Brems, C. R., Project Participant, Department of Planning
Thorlacius, P., Project Participant, Department of Planning
Greve, B., Project Participant, Department of Planning
Nielsen, E. R., Project Participant, Department of Planning
Israelson, T., Project Participant, Department of Planning
Hansen, C. O., Project Participant, Tetraplan A/S
Bloch, K. S., Project Participant, Tetraplan A/S
Nielsen, J., Project Participant, Tetraplan A/S
Nielsen, M., Project Participant, Tetraplan A/S
Petersen, J. M., Project Participant, Tetraplan A/S

Ukendt: DKK1.00
02/01/1996 → 01/06/1997
Collaborators: Tetraplan A/S
Award relations: GIS-T; Sub-project on methods for quality control of data and model results
Project: Research
Probit models for mode choice
Logit-models are almost solely used for mode choice modelling. Often, the model-type is used also to model trip distribution and sometimes trip production. The relatively simpleness of the logit-models and the availability of standard software packages are some of the reasons for its prevalence. The disadvantages by logit-models on the other hand are their premise of indepen-dence between alternatives, which is problematic when dealing with many alternatives partly dependent of each other (e.g. car, bicycle, bus, light rail and rail). This can be avoided by using probit-models. However, the multinomial probit-model have so far been difficult to handle for real-scale cases, but recent developments in computer technology and mathematical simulation methods have given new possibilities for use of this model.

The project investigates both from a theoretical and practical point of view the possibilities of using Probit models for mode-choices. In addition the subjects of mode-chains and trip-chains are dealt with.

Methods for trip matrix estimation
Most conventional methods for estimating trip matrices from traffic counts assumes either that the counts are error-free deterministic variables or they use a simplified traffic assignment model. Without these quite rough assumptions, the methods often demand prohibitive calculation times. In the project a new matrix-estimation method, 'Multiple Path Matrix Estimation' (MPME) has been developed which do not have these properties. Regarding route choices it corresponds to the models developed in 2a.

For practitioners, MPME is most promising in cases where an old trip-matrix needs to be updated for use in sketch-plan models or as pivot-matrix in larger traffic models. MPME has been tested and used successfully in several full-size cases (from small cities with 25,000 inhabitants to metropolitan areas with 5 million inhabitants). In all cases, the method gave lower deviations between traffic counts and estimated traffic than other tested methods. It converged smoothly within acceptable calculation times. It is now being implemented in the US GIS-T, 'TransCAD', which is produced by the Boston-company, 'Caliper Corporation'.

Route Choice Models and Traffic Assignment
Route choice models are critical as they provides the final output of traffic models and thus give input to impact analyses on link-level, e.g. local environmental and safety considerations. As such, it is mostly the results of route choice models that are directly addressed by the political decision maker.

A major task in the project has been to develop route choice models which consider delays in intersections. In addition the
traditional Stochastic User Equilibrium Model has been extended to consider differences in road users utility functions. These two theoretical developments has proven successfully in several applied projects. Sub-projects have carried out together with Tetraplan and Hague Consulting. Issues concerning passenger's route choices in public transport, multiple-class assignment and methods to enumerate cost from assignment models are now being developed.

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Nielsen, E. R., Project Participant, Department of Planning
Israelsen, T., Project Participant, Department of Planning
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Ukendt: DKK500,000.00
01/09/1994 → 01/09/1999
Collaborators: Tetraplan A/S
Award relations: Route Choice Models and Traffic Assignment
Project: Research

GIS-T; Sub-project on traffic models
In recent years a Danish debate on the use of traffic models have taken place in the professional community. IFP has among others participated intensively in this debate. One of the conclusions has been that many reminiscences of the early development of traffic models still exist - despite the recent development in computer and software technology, as well as theoretical development. A number of fundamental problems are:
1) That the coherence between sub-models seldom equals the road users and passengers decision-making process.
2) That use of variables in different sub-models seldom are consistent with each other.
3) That advantages and disadvantages with the sequential versus other more recent model approaches have not been discussed thoroughly.
4) That people do not act rational as most models assumes.
5) That supply models (e.g. matrix estimation, route choice and traffic assignment) are too simplified in many decision making context.
In phase 2 of the GIS-T programme, the above problems are dealt with in more fundamental discussions, while the following sub-models are dealt with more thoroughly; 1) Route Choice Models, 2) Matrix Estimation Methods and 3) Probit models for mode choices.

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Hansen, C. O., Project Participant, Tetraplan A/S
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Ukendt: DKK1,00
01/09/1996 → 01/06/1997
Collaborators: Tetraplan A/S
Award relations: GIS-T; Sub-project on traffic models
Project: Research

The GIS-T Programme: Use of Geographic Information Systems in Traffic Planning and Decision Support (GIS-T)
The GIS-programme's underlying purpose is to renew the quantitative methodologies used in traffic planning and to open for the treatment of questions, which so far has been overwhelming of data- and software reasons. The main goals of the programme can be summarised as:
1) To clarify possibilities and limitations of the use of quantitative methods, including GIS-based methods, as basis for decision making regarding traffic and infrastructure.
2) Hence to develop new improved decision tools, among other approaches by utilising the possibilities in the GIS-technology.
3) To test the newly developed methods in applied projects.
4) To propagate theoretical and practical knowledge in Danish and International fora and to involve the results in the M.Sc.- and Ph.D.-education at the department.
These goals are to be fulfilled within the following areas of focus:
1) Methods for data-handling and quality control
2) Traffic models
3) Impact analyses (among others economics, accessibility, safety and environmental impacts)
4) Decision Support Systems and
5) Methods for quality control of models and their results.
The GIS-T programme consists of a number of coordinated projects, where GIS (Geographic Information Systems) are used. The projects have different focus within the area of traffic planning but they all have in common that GIS can ease and improve the methodologies and state of practice. The largest projects are described individually other places in this annual report. Otto Anker Nielsen is coordinator of the programme.
Nielsen, O. A., Project Manager, Department of Planning
Leleur, S., Project Participant, Department of Planning
Kronbak, J., Project Participant, Department of Planning
Brems, C. R., Project Participant, Department of Planning
Thorlacius, P., Project Participant, Department of Planning
Greve, B., Project Participant, Department of Planning
Nielsen, E. R., Project Participant, Department of Planning
Israelsen, T., Project Participant, Department of Planning
Moshøj, C. R., Project Participant, Department of Planning
Hansen, C. O., Project Participant, Tetraplan A/S
Bloch, K. S., Project Participant, Tetraplan A/S
Nielsen, J., Project Participant, Tetraplan A/S
Nielsen, M., Project Participant, Tetraplan A/S
Petersen, J. M., Project Participant, Tetraplan A/S
Ukendt: DKK3,300,000.00
01/09/1994 → 01/06/1997
Collaborators: Tetraplan A/S
Award relations: The GIS-T Programme: Use of Geographic Information Systems in Traffic Planning and Decision Support (GIS-T)

EU 5th FP project: TRANS-TALK
The general aim of the TRANS-TALK project is to provide a framework for the integration of various policy and project assessment methodologies in the field of transport.
Leleur, S., Project Manager, Department of Planning
Kronbak, J., Project Participant, Department of Planning
Moshøj, C. R., Project Participant, Department of Planning
01/01/2000 → 31/12/2001
Project: Research

The OK Project
The purpose of the OK project is to examine the transport corridor Oslo-Gothenburg-Malmoe-Copenhagen.
Leleur, S., Project Manager, Department of Planning
Kronbak, J., Project Participant, Department of Planning
01/01/2000 → ...
Project: Research

EU 4th FP project, Strategic Transport: CODE-TEN
The main objective of CODE-TEN is (1) to define a comprehensive strategic assessment methodology, (2) to describe major policy recommendations in transport corridor and TEN developments, including extensions to the CEEC/CIS in a long-term perspective through case studies, (3) to define and develop decision models (presented in a report and an interactive computer programme) which can be used in relation to assess interactions between policy instruments and corridor/network developments and (4) to prepare a short manual/guide for strategic policy assessment on TEN developments and its extensions to the CEEC/CIS, addressing the policy and decision-makers. The project focuses on the complexity of decision-making in transport policy at the European level. The current trends in the transport geography of Europe can be expressed by two words: integration and expansion of transport corridors. The extension not only includes current expansion of the EU but also possible future expansion and activated (transport) contacts with CEEC/CIS and the Mediterranean. The centrale purpose of CODE-TEN is to help with decision-making in the context of this complexity. It does so in two ways: by providing a comprehensive strategic assessment methodology (including user-friendly decision tools) and by presenting major policy-related issues and the associated scenarios and assumptions in a consistent way. Among other things, CODE-TEN is an integrative study making use of the results from a number of the other RTD projects in the Strategic Transport part of the 4th Framework Programme, for example EUNET (socio-economic evaluation methodology) and TEN-ASSESS (policy assessment). IFP is as work package leader responsible for the development of the baseline methodology. For further information: http://www.iccr.co.at/transpor/codeten/index.htm
Application of Geographic Information Systems in Traffic Planning with a special emphasis on Decision Support

The Ph.D. project concerns the use of Geographic Information Systems (GIS) for traffic planning with a special emphasis on decision support modelling. The study comprises two main areas: (1) Analyses of the applicability and possible advantages from the use GIS in the planning process. A GIS-based decision support system that includes traffic economic effects, accidents, local environmental effects, and the effects on the land-use is developed. Other effects may also be included. (2) Clarification of how uncertainties in connection to the evaluation of transport infrastructure investments can be treated. Approaches for the inclusion and quantification of uncertainties in the traffic planning model complex are evaluated. The project is concerned with multi-modal planning processes.

BRIDGES - A GIS-T for accessibility studies at an European level

The projects main focus is to coordinate strategic traffic models, GIS and decision support frameworks (mainly accessibility measures) to be used for strategic studies at EU-level. The name 'BRIDGES' refer to the intention to bridge different methodical approaches. IFP's contribution to the project are concentrated within the following work-packages:

**WP4 - Data links**

**WP5 - GIS links**

**WP6 - Links to Transport Models**

**WP7 - Specialised GIS Interfaces**

**WP8 - Decision Support System**

**WP10 - User Demo-Workshops**

Some of these can be grouped within the following fields (IFP's part is largest in WP5 and WP7):

1) Forecast interfaces implemented in GIS (WP5 & WP7). IFP is responsible for WP7.
2) Traffic models (WP5) and interfaces to traffic models (WP7).
3) Decision support (WP8) and validation of models (WP10) in a GIS-environment.

Traffic Planning and Impact Analysis based on the use of Geographic Information Systems

The Ph.D. project concerns the use of Geographic Information Systems (GIS) for traffic planning with a special emphasis on Impact Analysis and Accessibility. The project concerns to major areas: (1) Analyses on how to conduct GIS-based impact analysis in traffic planning. This part of the project will consist of theoretical and empirical analyses of the improvements on existing impact models that the use of GIS can provide. Noise and emission models will be in focus. (2) A quantification of the concept of accessibility. Functional models have to be identified and formulated in order for accessibility to be integrated as a part of the traffic planning process. The research is currently covering the accessibility for passengers in a transport network. The project will end with a number of analyses of the use of the impact model in a
Multi-Modal Traffic planning Process (MM-TP).
Kronbak, J., Project Manager, Department of Planning
Leleur, S., Project Participant, Department of Planning
Nielsen, O. A., Project Participant, Department of Planning
Ukendt: DKK1,000,000.00
01/10/1994 → 01/07/1998
Award relations: Traffic Planning and Impact Analysis based on the use of Geographic Information Systems
Project: Research

EU 4th FP project, Strategic Transport: TEN-ASSESS
The main objective of TEN-ASSESS is (1) to provide a preliminary policy assessment methodology related to decisions on transport, (2) to provide a comprehensive policy assessment of the European Common Transport Policy (CTP) with a view of advancing forward recommendations that may assist its further development and implementation and (3) to provide input and data for further or parallel research on the subject (the EUNET project among others). The approach taken consists of: integrated research methodology, combined modelling, corridor case(s) and other studies relevant to TEN, expert interviews and simulation of policy discussions via Delphi analysis. IFP, Traffic Studies is, with COWIconsult as subcontractor, particularly involved in data collection and policy evaluation modelling. For further information:
www.iccr.co.at/transpor/tenassess/index.htm

Leleur, S., Project Manager, Department of Planning
Moshøj, C. R., Project Participant, Department of Planning
Ukendt: DKK432,000.00
01/05/1996 → 31/12/1999
Award relations: EU 4th FP project, Strategic Transport: TEN-ASSESS
Project: Research

EU 4th FP project, Strategic Transport: EUNET
The main objective of EUNET is to develop a comprehensive methodology for the assessment of the impacts of transport initiatives (i.e. infrastructure and technology investments, regulative and fiscal policies). The focus is on inter-urban investment. The approach is flexible to be applicable across modes and across large and small investments. The planned outcome is an operational assessment tool oriented towards the particular needs of decision makers. IFP, Traffic Studies is, with COWIconsult as subcontractor especially involved in the development of the multi-modal evaluation methodology. For further information: http://fpiv.meap.co.uk/fpiv/eunet2.htm
Leleur, S., Project Manager, Department of Planning
Moshøj, C. R., Project Participant, Department of Planning
Kronbak, J., Project Participant, Department of Planning
Gissel, S., Project Participant, Department of Planning
Nielsen, O. A., Project Participant, Department of Planning
Ukendt: DKK665,250.00, Ukendt: DKK525,570.00
18/06/1996 → 31/01/2000
Award relations: EU 4th FP project, Strategic Transport: EUNET, EU 4th FP project, Strategic Transport: TEN-ASSESS
Project: Research

Danish Technical Committee on Road Standards: Application of road types
The research project is carried out by the KAFKA Task Force within Project Group 1 (PG1) concerning new standards for inter-urban roads set up by the Danish Technical Committee on Road Standards. The project concerns determination and optimal use of road types (geometry, traffic flow, capacity and level of service).
Leleur, S., Project Manager, Department of Planning
08/11/1994 → 31/01/1999
Collaborators: Danish Road Directorate, Grontmij A/S
Project: Research

CLG: Centre for Logistics and Freight Transport
The Centre for Logistics and Freight Transport (CLG) is a multi-disciplinary research centre on logistics and freight transport. The Centre is headed by CTT. CLG is a cooperation between a number of Danish and international universities and companies. CLG is funded by The Danish Technical Research Council (STVF).
The objective of the Centre is to strengthen the Danish research on logistics and transport. This is achieved through
specific research projects and through networking activities within the center. A number of the research projects are multi-
disciplinary.

The scope of the Centre is to obtain an increased knowledge about the various stakeholders within the logistics and
transport sector and to develop new methods and concepts which are applicable to the stakeholders. This includes
organisatorial and management concepts as well as methods based on mathematical models in order to support the
various stakeholders which briefly can be characterized as follows:

Manufacturers and consumers of goods (transport users).
Transporters (operators, forwarders, etc.).
Transport infrastructure owner (public authorities, ports, airports, etc.).
Public authorities (political means and control).
National economics (derived effects of the transport system and the external influences).

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Madsen, O. B. G., Project Participant, Department of Transport
Leleur, S., Project Participant, Department of Transport
Overgård, C. H., Project Participant, Department of Transport
Rich, J., Project Participant, Department of Transport
Jørgensen, R. M., Project Participant, Department of Transport
Larsen, A., Project Participant, Department of Transport
Pedersen, M. B., Project Participant, Department of Transport
Salling, K. B., Project Participant, Department of Transport
Jensen, A. V., Project Participant, Department of Transport
Serensen, M. V., Project Participant, Department of Transport
Landex, A., Project Participant, Department of Transport
Holvad, T., Project Participant, Department of Transport

STMØ: Strategic Transport Management in the Øresund region

Strategic Transport Management in the Øresund region, STMØ, is a project conducted in co-operation between Malmö
Högskola, Danmarks Tekniske Universitet, Københavns Handelshøjskole, Sjöfartsverket in Sweden, Yrkeshögskolan in
Helsingborg, Øresund Logistics, Landskrona kommun, Øresundsuniversitetet, Malmö Stad, Københavns Kommune and
Region Skåne.

One aim of the project is to develop a new scientific field, rooted in the Øresund region, which will be able to deal with
questions associated to the interaction between traffic related consequences and development of society. At the same
time the project seeks to develop an interregional master education, located at Øresundsuniversitetet, which will provide
students, business, organisations and authorities competences to make optimised and valid solutions for Transport
Management.

A reason for creating a new education is the business desire to save costs and increase competition on production, trade,
logistic and transport and thereby optimise the production- and transport chains. Another main focus is to try to define the
increasing need for transportation, due to global, regional and local development and describe how this can be combined
with a fair development of society. Several areas of importance has been identified and grouped as economic-, legal-,
structural-, functional-, environmental- and technical matters. These matters need to be discussed and integrated in order
to define and overcome possible barriers for an optimised and valid transport development.

Thus STMØ aims at analysing the specific education needs related to the above mentioned matters, and based on the
analysis creating the master education of Strategic Transport Management in such a way that it will be compatible with
other educations already located in the Øresund region.

Leleur, S., Project Participant, Department of Transport, Decision Modelling
Jeppesen, S. L., Project Participant, Department of Transport, Decision Modelling
Jensen, A. V., Project Participant, Department of Transport, Decision Modelling

Project ID: 421-35044
Forskningsrådene - STVF: DKK15,723,006.00
25/06/2001 → 31/12/2006
Award relations: Centre for Logistics and Freight Transport
Project: Research

OK-korridoren, delprojekt 1

Leleur, S., Project Manager, Department of Transport
Project ID: 491-35056
Forsk. Andre offentlige og private - Nordiske: DKK116,628.00
13/09/2001 → 31/12/2006
Award relations: OK-korridoren, delprojekt 1
Project: Research