Analysing improvements to on-street public transport systems: a mesoscopic model approach

Light rail transit and bus rapid transit have shown to be efficient and cost-effective in improving public transport systems in cities around the world. As these systems comprise various elements, which can be tailored to any given setting, e.g. pre-board fare-collection, holding strategies and other advanced public transport systems (APTS), the attractiveness of such systems depends heavily on their implementation. In the early planning stage it is advantageous to deploy simple and transparent models to evaluate possible ways of implementation. For this purpose, the present study develops a mesoscopic model which makes it possible to evaluate public transport operations in details, including dwell times, intelligent traffic signal timings and holding strategies while modelling impacts from other traffic using statistical distributional data thereby ensuring simplicity in use and fast computational times. This makes it appropriate for analysing the impacts of improvements to public transport operations, individually or in combination, in early planning stages. The paper presents a joint measure of reliability for such evaluations based on passengers’ perceived travel time by considering headway time regularity and running time variability, i.e. taking into account waiting time and in-vehicle time. The approach was applied on a case study by assessing the effects of implementing segregated infrastructure and APTS elements, individually and in combination. The results showed that the reliability of on-street public transport operations mainly depends on APTS elements, and especially holding strategies, whereas pure infrastructure improvements induced travel time reductions. The results further suggested that synergy effects can be obtained by planning on-street public transport coherently in terms of reduced travel times and increased reliability.

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Delay estimation on a railway-line with smart use of micro-simulation
This paper formulates a delay propagation model that estimates total railway line delay as a polynomial function of a single primary delay. The estimate is derived from a finite series of delays over a horizon that spans two dimensions: the length of the railway line and the number of trains in the service plan. The paper shows that the total delay estimate is a cubic relation for small primary delays.
A probabilistic approach is presented to combine the total delay functions of primary delays given to different trains. The final estimate is the total delay on railway lines, after a random incident has occurred. The model can be integrated in railway timetable analysis to reduce the number of necessary simulations, and can be used when the computation speed is an issue, such as on-line rescheduling algorithms. The model is demonstrated with an analysis of a Danish suburban railway.

Dynamic queuing transmission model for dynamic network loading
This paper presents a new macroscopic multi-class dynamic network loading model called Dynamic Queuing Transmission Model (DQTM). The model utilizes ‘good’ properties of the Dynamic Queuing Model (DQM) and the Link Transmission Model (LTM) by offering a DQM consistent with the kinematic wave theory and allowing for the representation of multiple vehicle classes, queue spillbacks and shock waves. The model assumes that a link is split into a moving part plus a queuing part, and that traffic dynamics are given by a triangular fundamental diagram. A case-study is investigated and the DQTM is compared with single-class LTM, single-class DQM and multi-class DQM. Under the model assumptions, single-class models indicate that the LTM and the DQTM give similar results and that the shock wave property is properly included in the DQTM, while the multi-class models show substantially different travel times for two vehicle classes. Moreover, the results show that the travel time will be underestimated without considering the shock wave property.

Dynamic network loading, Dynamic queuing transmission model, Link transmission model, Kinematic wave theory, Queue spillbacks

Effects of new bus and rail rapid transit systems – an international review

Cities worldwide are implementing modern transit systems to improve mobility in the increasingly congested metropolitan areas. Despite much research on the effects of such systems, a comparison of effects across transit modes and countries has not been studied comprehensively. This paper fills this gap in the literature by reviewing and comparing the effects obtained by 86 transit systems around the world, including Bus Rapid Transit (BRT), Light Rail Transit (LRT), metro and heavy rail transit systems. The analysis is twofold by analysing (i) the direct operational effects related to travel time, ridership and modal shifts, and (ii) the indirect strategic effects in terms of effects on property values and urban development. The review confirms the existing literature suggesting that BRT can attract many passengers if travel time reductions are significantly high. This leads to attractive areas surrounding the transit line with increasing property values. Such effects are traditionally associated with attractive rail-based public transport systems. However, a statistical comparison of 41 systems did not show significant deviations between effects on property values resulting from BRT, LRT...
and metro systems, respectively. Hence, this paper indicates that large strategic effects can be obtained by implementing BRT systems at a much lower cost.
Home-end and activity-end preferences for access to and egress from train stations in the Copenhagen region

Increasing public transport use with the aim of improving the sustainability of cities should focus not only on enhancing level and quality of the service offered, but also on understanding determinants of the choice of access and egress modes to and from the railway network. This study analyzes the difference in preferences at the home-end and activity-end for travelers who have chosen train as their main travel mode while investigating the effect of policy variables such as car parking availability, bicycle parking availability and type, and bicycle on train possibility. Specifically, this study analyzes the choices between five transport modes (i.e., “walk,” “bicycle,” “car driver,” “car passenger,” “bus”) for 2921 home-end and 3658 activity-end trips. Joint mixed logit models are specified and estimated to account for heteroscedasticity and correlation across alternative modes as well as taste heterogeneity across travelers. Model estimates and pseudo-elasticities uncover the importance of travel time and underline how the improvement of walkability, bikeability, and bus service would contribute significantly to the increase in the probability of choosing sustainable modes to and from train stations. Moreover, model results emphasize the role of bicycle parking in terms of the sheer number of spaces to be increased as well as covered places to be offered at the activity end, de facto giving the possibility to leave a bicycle at that end during the night. Lastly, model results show that it is a matter of not only time and trip characteristics, but also traveler characteristics, occupation, and purpose.

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Authors: Halldórsdóttir, K. (Intern), Nielsen, O. A. (Intern), Prato, C. G. (Intern)
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ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.558 SNIP 0.445 CiteScore 0.98
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BFI (2008): BFI-level 1
Road signage comprehension and overload: The role of driving style and need for closure
This study looks at the provision of information via traffic signs and its relation with driving styles, need for closure and socio-economic characteristics of road users. A web-based questionnaire allowed collecting information about traffic signs and road surface markings in 12 traffic locations that were presented in two variations: (i) in the first 6 cases, a first configuration contained information that led to ambiguity about the manoeuvres that were legal and a second configuration added traffic signs to eliminate the ambiguity; (ii) in the second 6 cases, a first configuration presented the road environment without signs and a second configuration added traffic signs to verify information redundancy. Respondents indicated for each location which manoeuvres they deemed legal and how many conflicts they estimated without traffic signs, and safety perception and comfort level improved with the traffic signs. Moreover, respondents reported their socio-economic characteristics and filled two questionnaires about need for closure and driving styles. Completed questionnaires from 753 participants from Hungary with expertise in transport and traffic were analysed via statistical and factor analysis, and results reveal that: (i) road users are heterogeneous in their perception and processing of information, as the number of manoeuvres correctly identified as legal relates to their socio-economic characteristics; (ii) the perception of improvements after the provision of information relates also to the road users’ socio-economic characteristics and their driving style and need for closure; (iii) different amounts of information are sufficient for different road users not to feel uncertain regarding manoeuvres being legal at a certain traffic location.

Strategic assessment of capacity consumption in railway networks: Framework and model
In this paper, we develop a new framework for strategic planning purposes to calculate railway infrastructure occupation and capacity consumption in networks, independent of a timetable. Furthermore, a model implementing the framework is presented. In this model different train sequences are generated and assessed to obtain timetable independence. A stochastic simulation of delays is used to obtain the capacity consumption. The model is tested on a case network where four different infrastructure scenarios are considered. Both infrastructure occupation and capacity consumption results are obtained efficiently with little input. The case illustrates the model’s ability to quantify the capacity gain from infrastructure scenario to infrastructure scenario which can be used to increase the number of trains or improve the robustness of the system.

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The restricted stochastic user equilibrium with threshold model: Large-scale application and parameter testing

This paper presents the application and calibration of the recently proposed Restricted Stochastic User Equilibrium with Threshold model (RSUET) to a large-scale case-study. The RSUET model avoids the limitations of the well-known Stochastic User Equilibrium model (SUE) and the Deterministic User Equilibrium model (DUE), by combining the strengths of the Boundedly Rational User Equilibrium model and the Restricted Stochastic User Equilibrium model (RSUE). Thereby, the RSUET model reaches an equilibrated solution in which the flow is distributed according to Random Utility Theory among a consistently equilibrated set of paths which all are within a threshold relative to the cost on the cheapest path and which do not leave any attractive paths unused. Several variants of a generic RSUET solution algorithm are tested and calibrated on a large-scale case network with 18,708 arcs and about 20 million OD-pairs, and comparisons are performed with respect to a previously proposed RSUE model as well as an existing link-based mixed Multinomial Probit (MNP) SUE model. The results show that the RSUET has very attractive computation times for large-scale applications and demonstrate that the threshold addition to the RSUE model improves the behavioural realism, especially for high congestion cases. Also, fast and well-behaved convergence to equilibrated solutions among non-universal choice sets is observed across different congestion levels, choice model scale parameters, and algorithm step sizes. Clearly, the results highlight that the RSUET outperforms the MNP SUE in terms of convergence, calculation time and behavioural realism. The choice set composition is validated by using 16,618 observed route choices collected by GPS devices in the same network and observing their reproduction within the equilibrated choice sets generated by the RSUET model. Relevantly, the RSUET model is very successful in reproducing observed link.

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The role of information systems in non-routine transit use of university students: Evidence from Brazil and Denmark

In this study we seek to understand the relation between travel information, transit use intentions and night travel. We hypothesize that transit use is related to the perceived usefulness and the ease-of-use of the system, which are related to information quality and real-time information availability. The hypothesized relations are anchored theoretically in the Technology Acceptance Model and validated empirically in two case-studies: (i) Copenhagen (Denmark), characterized by a highly integrated transit system with an advanced web-based information system; (ii) Recife and Natal (Brazil), characterized by a lower perceived level-of-service and non-integrated information sources. Data from a tailor-made survey of 1123 university students were collected. Structural equation models were employed for explaining the use of transit as a function of the observed respondent characteristics and the latent constructs. The results show that: (i) information search quality and source explain transit use; (ii) information quality underlies level-of-service and familiarity; (iii) the use of real-time information links to information quality and familiarity; (iv) general transit use and non-routine use during night and to unfamiliar places are correlated; and (v) the behavioral framework is confirmed with the two case-studies. (C) 2016 Elsevier Ltd. All rights reserved.
Causal Analysis of Railway Running Delays

Operating delays and network propagation are inherent characteristics of railway operations. These are traditionally reduced by provision of time supplements or "slack" in railway timetables and operating plans. Supplement allocation policies must trade-off reliability in the service commitments against service transit times and railway asset productivity. Methods to investigate the quality of supplement time allocation are necessary to reduce the behavioral response and the waste of resources. This is a preliminary study that investigates train delay data from the year 2014 supplied by Rail Net Denmark (the Danish infrastructure manager). The statistical analysis of the data identifies the minimum running times and the scheduled running time supplements and investigates the evolution of train delays along given train paths. An improved allocation of time supplements would result in smaller overall aggregate timetable supplement, reduced transport travel times, and higher productive utilization of train rolling stock. The study results will lead eventually to both better allocation of time supplements in timetable structures, and identification of areas that should be a high priority for correction.
(ii) de nyeste forskningserfaringer i dansk sammenhæng, samt (iii) egne undersøgelser af data indsamlet i forbindelse med transportvaneundersøgelsen kombineret med detaljerede netværksundersøgelser. Formålet med projektet er således baseret på internationale erfaringer samt nyeste forskning i national sammenhæng, at kortlægge forskellige karakteristika der påvirker brugen af stationer/stop samt giver forslag til alternative måder at, baseret på disse karakteristika, fastlægge relevante stationer/stop.

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Latent lifestyle and mode choice decisions when travelling short distances

In the quest for sustainable travel, short distances appear the most amenable to curbing the use of the automobile. Existing studies about short trips evaluate the potential of shifting from the automobile to sustainable travel options while considering the population as homogeneous in its preferences and its tendency to accept these alternative travel options as realistic. However, this assumption appears quite unrealistic and the current study offers a different perspective: the mode choices when travelling short distances are likely related to lifestyle decisions. Short trip chains of a representative sample of the Danish population in the Copenhagen Region were analysed, and more specifically a latent class choice model was estimated to uncover latent lifestyle groups and choice specific travel behaviour. Results show that four lifestyle groups are identified in the population: car oriented, bicycle oriented, public transport oriented and public transport averse. Each lifestyle group has specific perceptions of travel time (with extremely different rates of substitution between alternative travel modes), transfer penalties in public transport trip chains, weather influence (especially on active travel modes), and trip purpose effect on mode selection. Consequently, when thinking about measures to increase the appeal of sustainable travel options, decision-makers should look at specific individuals within the population and more sensitive individuals to comfort and level-of-service improvements across the lifestyle groups.

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When looking at railway planning, a discrepancy exists between planners who focus on the train operations and publish fixed railway schedules, and passengers who look not only at the schedules but also at the entirety of their trip, from access to waiting to on-board travel and egress. Looking into this discrepancy is essential, as assessing railway performances by merely measuring train punctuality would provide an unfair picture of the level of service experienced by passengers. Firstly, passengers’ delays are often significantly larger than the train delays responsible for the passengers to be late. Secondly, trains’ punctuality is often strictly related to too tight schedules that in turn might translate into knock-on delays for longer dwelling times at stations, trip delays for increased risk of missing transfer connections, and uncertain assessment of the level of service experienced, especially with fluctuating passenger demand. A key aspect is the robustness of railway timetables. Empirical evidence indicates that passengers give more importance to travel time certainty than travel time reductions, as passengers associate an inherent disutility with travel time uncertainty. This disutility may be broadly interpreted as an anxiety cost for the need for having contingency plans in case of disruptions, and may be looked at as the motivator for the need for delay-robust railway timetables. Interestingly, passenger-oriented optimisation studies considering robustness in railway planning typically limit their emphasis on passengers to the consideration of transfer maintenance. Clearly, passengers’ travel behaviour is far more complex and multi-faceted and
thus several other aspects should be considered, as becoming more and more evident from passenger surveys. The current literature review starts by looking at the parameters that railway optimisation/planning studies are focused on and the key performance indicators that impact railway planning. The attention then turns to the parameters influencing passengers’ perceptions and travel experiences. Finally, the review proposes guidelines on how to reduce the gap between the operators’ railway planning and performance measurement on the one hand and the passengers’ perception of the railway performance on the other hand. Thereby, the conclusions create a foundation for a more passenger-oriented railway timetabling ensuring that passengers are provided with the best service possible with the resources available.

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Scopus rating (2006): SJR 0.604 SNIP 1.22
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Scopus rating (2003): SJR 0.614 SNIP 0.541
Scopus rating (2002): SJR 0.315 SNIP 1.068
Timetable-based simulation method for choice set generation in large-scale public transport networks

The composition and size of the choice sets are a key for the correct estimation of and prediction by route choice models. While existing literature has posed a great deal of attention towards the generation of path choice sets for private transport problems, the same does not apply to public transport problems. This study proposes a timetable-based simulation method for generating path choice sets in a multimodal public transport network. Moreover, this study illustrates the feasibility of its implementation by applying the method to reproduce 5131 real-life trips in the Greater Copenhagen Area and to assess the choice set quality in a complex multimodal transport network. Results illustrate the applicability of the algorithm and the relevance of the utility specification chosen for the reproduction of real-life path choices. Moreover, results show that the level of stochasticity used in choice set generation should be high in order to provide stable parameter estimates when the choice sets are used for estimation regardless of the initial parameters for choice set generation. Last, results illustrate that adding heterogeneity across travellers should be required because coverage increases significantly, a relevant result considering that models are becoming more disaggregate in nature in real-life applications.

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ISI indexed (2011): ISI indexed no
**Assessment of Stochastic Capacity Consumption in Railway Networks**

The railway industry continuously strive to reduce cost and utilise resources optimally. Thus, there is a demand for tools that are able to fast and efficiently provide decision-makers with solutions that can help them achieve their goals. In strategic planning of capacity, this translates into being able to evaluate capacity considering robustness of the operation efficiently. To achieve this efficiency a timetable should not be needed as input, as producing timetables is very time consuming. In this paper we therefore propose a model to calculate the capacity consumption distribution in networks where a timetable is not needed as input. We account for robustness using a stochastic simulation of delays to obtain the stochastic capacity consumption in a network. The model is used on a case network where four different infrastructure scenarios are considered and both deterministic and stochastic capacity consumption results are obtained efficiently. The case study show that the results of capacity analysis depends on the size of the network considered. Furthermore, we find that the capacity gain in the case scenarios are greater when delays are considered compared to a deterministic setting.

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State: Published  
Organisations: Department of Transport, Traffic modelling and planning, Rambøll Danmark A/S  
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**A Predictive Maintenance Model for Railway Tracks**

For the modern railways, maintenance is critical for ensuring safety, train punctuality and overall capacity utilization. The cost of railway maintenance in Europe is high, on average between 30,000 – 100,000 Euro per km per year [1]. Aiming to reduce such maintenance expenditure, this paper presents a mathematical model based on Mixed Integer Programming (MIP) which is designed to optimize the predictive railway tamping activities for ballasted track for the time horizon up to four years. The objective function is setup to minimize the actual costs for the tamping machine (measured by time). Five technical and economic aspects are taken into account to schedule tamping: (1) track degradation of the standard deviation of the longitudinal level over time; (2) track geometrical alignment; (3) track quality thresholds based on the train speed limits; (4) the dependency of the track quality recovery on the track quality after tamping operation and (5) Tamping machine operation factors. A Danish railway track between Odense and Fredericia with 57.2 km of length is applied for a time period of two to four years in the proposed maintenance model. The total cost can be reduced with up to 50% comparing to the optimization of the number of tamping [2][3], which shows that the model has great potential to support railway tamping planning in practice.

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**Assessment of Stochastic Capacity Consumption in Railway Networks**

The railway industry continuously strive to reduce cost and utilise resources optimally. Thus, there is a demand for tools that are able to fast and efficiently provide decision-makers with solutions that can help them achieve their goals. In strategic planning of capacity, this translates into being able to evaluate capacity considering robustness of the operation efficiently. To achieve this efficiency a timetable should not be needed as input, as producing timetables is very time consuming. In this paper we therefore propose a model to calculate the capacity consumption distribution in networks where a timetable is not needed as input. We account for robustness using a stochastic simulation of delays to obtain the stochastic capacity consumption in a network. The model is used on a case network where four different infrastructure scenarios are considered and both deterministic and stochastic capacity consumption results are obtained efficiently. The case study show that the results of capacity analysis depends on the size of the network considered. Furthermore, we find that the capacity gain in the case scenarios are greater when delays are considered compared to a deterministic setting.

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**A Predictive Maintenance Model for Railway Tracks**

For the modern railways, maintenance is critical for ensuring safety, train punctuality and overall capacity utilization. The cost of railway maintenance in Europe is high, on average between 30,000 – 100,000 Euro per km per year [1]. Aiming to reduce such maintenance expenditure, this paper presents a mathematical model based on Mixed Integer Programming (MIP) which is designed to optimize the predictive railway tamping activities for ballasted track for the time horizon up to four years. The objective function is setup to minimize the actual costs for the tamping machine (measured by time). Five technical and economic aspects are taken into account to schedule tamping: (1) track degradation of the standard deviation of the longitudinal level over time; (2) track geometrical alignment; (3) track quality thresholds based on the train speed limits; (4) the dependency of the track quality recovery on the track quality after tamping operation and (5) Tamping machine operation factors. A Danish railway track between Odense and Fredericia with 57.2 km of length is applied for a time period of two to four years in the proposed maintenance model. The total cost can be reduced with up to 50% comparing to the optimization of the number of tamping [2][3], which shows that the model has great potential to support railway tamping planning in practice.

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**Assessment of Stochastic Capacity Consumption in Railway Networks**

The railway industry continuously strive to reduce cost and utilise resources optimally. Thus, there is a demand for tools that are able to fast and efficiently provide decision-makers with solutions that can help them achieve their goals. In strategic planning of capacity, this translates into being able to evaluate capacity considering robustness of the operation efficiently. To achieve this efficiency a timetable should not be needed as input, as producing timetables is very time consuming. In this paper we therefore propose a model to calculate the capacity consumption distribution in networks where a timetable is not needed as input. We account for robustness using a stochastic simulation of delays to obtain the stochastic capacity consumption in a network. The model is used on a case network where four different infrastructure scenarios are considered and both deterministic and stochastic capacity consumption results are obtained efficiently. The case study show that the results of capacity analysis depends on the size of the network considered. Furthermore, we find that the capacity gain in the case scenarios are greater when delays are considered compared to a deterministic setting.

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**A Predictive Maintenance Model for Railway Tracks**

For the modern railways, maintenance is critical for ensuring safety, train punctuality and overall capacity utilization. The cost of railway maintenance in Europe is high, on average between 30,000 – 100,000 Euro per km per year [1]. Aiming to reduce such maintenance expenditure, this paper presents a mathematical model based on Mixed Integer Programming (MIP) which is designed to optimize the predictive railway tamping activities for ballasted track for the time horizon up to four years. The objective function is setup to minimize the actual costs for the tamping machine (measured by time). Five technical and economic aspects are taken into account to schedule tamping: (1) track degradation of the standard deviation of the longitudinal level over time; (2) track geometrical alignment; (3) track quality thresholds based on the train speed limits; (4) the dependency of the track quality recovery on the track quality after tamping operation and (5) Tamping machine operation factors. A Danish railway track between Odense and Fredericia with 57.2 km of length is applied for a time period of two to four years in the proposed maintenance model. The total cost can be reduced with up to 50% comparing to the optimization of the number of tamping [2][3], which shows that the model has great potential to support railway tamping planning in practice.

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Behavioural models for cycling - Case studies of the Copenhagen Region.

Bicycle transport has traditionally been underrepresented in traffic models, because historically the main focus has been on modelling more resource-intensive investments in motor traffic roads and public transport. In order to decrease road congestion and to reduce the related health and societal problems, there is a growing interest in promoting more sustainable transport systems, with a particular emphasis on the bicycle as a sustainable transport alternative.

Accordingly, the objective of this PhD study is to expand the knowledge about travellers’ choices of the bicycle as a mean of transport above other alternatives, as well as to create knowledge on the interaction between infrastructure and cyclists’ route choices. In this study, the focus is on the traditional approaches to mode choice modelling, where the focus is on all transport modes, as well as the modelling of cyclists’ route choices. The study focuses on identifying which conditions can:

(i) promote bicycle use, with an emphasis on everyday cycling;
(ii) influence the shift from motorised private transport to a more sustainable transport alternative; and
(iii) find methods that make cycling more attractive, e.g., improving accessibility.

The private car is the most dominant mode of transportation in cities throughout the world, even for short trips where it could easily be replaced by more sustainable transport options, such as bicycles. Like the car, a bicycle provides flexibility when travelling. It also cost much less and, in some cases, is even a faster and more efficient choice of transport, especially in highly congested areas. While the car might be a more popular alternative, especially in suburban or rural areas where activities are dispersed over large distances, short trips appear more receptive to a decrease in the use of the car. In this PhD study, the mode choice behaviour when travelling short distances was analysed, in the Copenhagen Region, in order to identify factors that affect the travellers’ choices. Mixed logit models were estimated, in order to capture taste variations and differentiate travel time parameters across modes, on a dataset including trip information and socioeconomic variables for 7,958 individuals and 10,982 trip chains with five available alternative modes (i.e., walking, cycling, car driver, car passenger, and public transport). The results showed that travellers’ have heterogeneous preferences regarding the travel time of nonmotorised modes, and more homogeneous preferences regarding the travel time of motorised modes. The results also showed that mode choice behaviour in short distance travelling is related to travellers’ personal characteristics (i.e., gender, occupation, income, and having a public transport monthly pass) and their household characteristics (i.e., number of cars and family composition). Finally, the results showed that the mode choice is also related to the trip characteristics (i.e., hilliness, temperature, trip purpose, urban characteristics, and parking availability).

In order to encourage the shift from private cars to more sustainable transport alternatives, decision-makers need to address specific population groups for specific trip purposes and focus on factors that are able to make cycling more attractive. The results suggested that further investigation of heterogeneity might uncover whether different population groups exhibit different preference structures. In previous literature on short trips, the focus has mainly been on mode choice models to uncover the determinants of choice between car and sustainable transport alternatives. Generally, the focus has been more on the characteristics of the alternatives and less on the socio-economic characteristics of the travellers, while considering the population to have homogeneous preferences and the same probability of shifting mode, regardless of their characteristics. However, this assumption appears rather unrealistic. In this thesis, in the first study on travel behaviour when travelling short distances, it was concluded that the choice between transport alternatives is not only related to the level-of-service characteristics of the alternatives, but also to a large extent the socio-economic characteristics of the travellers. Based on that study, a more suitable methodological approach was adopted, namely a latent class choice model, to identify lifestyle groups and to understand how lifestyle affects mode choice decisions when travelling short distances. The model allows linking observable characteristics of the individual with the probability of them having chosen a certain lifestyle and then the probability of individuals, with that specific lifestyle, choosing a specific transport mode for short distances. Short trip chains in the Copenhagen Region were investigated, on a data sample with 10,982 observations with five available alternative modes (i.e., walking, cycling, car driver, car passenger, and public transport). The results highlight the importance of investigating the heterogeneity of the population, when analysing the potential for switching from the car to sustainable travel modes. The results showed that the population is split into four lifestyle groups: auto-oriented, bicycle-oriented, public transport-oriented, and public transport-averse. This population split is according to several characteristics (i.e., gender, age, family composition, number of cars, income, occupation, and residence location). Each lifestyle group has a heterogeneous perception of travel time, where the rates of substitution between alternative transport modes were extremely different. In addition, each lifestyle group weighs the dispreferences for public transport transfers differently, has a different perception of weather conditions on active travel modes, and selects a transport mode depending on the trip purpose. When thinking about measures to increase the attractiveness of sustainable transport options in short distance travelling, decision-makers should: (i) propose traditional or creative solutions to encourage car-oriented individuals out of their cars; (ii) direct public transport-averse individuals with policies that make the car unattractive; and (iii) hinder the attractiveness of cars in the future for bicycle- and walk-oriented individuals. When thinking about bicycle infrastructure improvements, the reduction of cycling travel time has little effect on
car-oriented individuals, unless the time savings are very high, and bicycle-oriented individuals will only modify their routes as they already consider bicycles the fastest choice. Efforts to increase the use of public transport, with the aim of improving the sustainability of cities, usually focus on the service of the public transport system itself, while the accessibility to and from the public transport network receives less attention. This PhD study contributes to the existing literature by investigating the choice of access and egress modes to and from train stations in the Copenhagen Region. This study adopted a mixed logit model that distinguished between the preference structure at the home-end and activity-end for travellers who have chosen trains as their main transport mode. The model accounted for the heterogeneity in the travellers’ preferences and alternative mode perceptions, while investigating the effect of policy variables such as car parking availability, park & ride opportunities, bicycle parking availability and type, and the possibility of carrying bicycles on trains. The choices between five alternative transport modes was analysed (i.e., walking, cycling, being a car driver, being a car passenger, and riding a bus) for 2,921 observations of trips at the home-end of journeys, and 3,683 trips at the activity-end of journeys. The results showed that the choice of access and egress mode is affected by travel time and trip characteristics (i.e., travelling with someone or in the city centre), as well as underlining the relevance of bicycle parking and the possibility of carrying bicycles on trains to the choice of cycling to the train station. Most importantly, the results showed that travellers’ have heterogeneous preferences with regard to travel time and perception of the alternatives, as well as their preference structure relates more to their socio-economic characteristics (i.e., gender, season ticket, occupation and trip purpose, along with the number of cars and other motorists in the household) than the trip characteristics. The study successfully identified factors that can contribute to the sustainability of the travel choices after selecting a train as the main transport mode, e.g., by improving bicycle parking availability at train stations, but focusing on specific population groups might also contribute further, especially when considering travellers’ occupation and trip purpose. Bicycle route choice models provide measures to search for factors that make cycling more attractive. In this study, the findings from the model estimates depend on the observation of actual route choices and the generation of realistic alternatives. While collecting data on actual route choices has greatly profited from enhancements in GPS device technology, the post-processing of such large data is still difficult. In this study, a fully automatic postprocessing procedure was proposed and applied to extract relevant information for further analysis. It makes it possible to process raw individual-based GPS data, with no additional information required from the respondent, by combining fuzzy logic- and GIS-based methods. By applying this method it is possible to automatically identify trips, trip-stages, and the most probable transport mode used on each trip-stage. The method was validated on a dataset consisting of raw individual-based GPS logs, collected from 183 respondents living in the Greater Copenhagen area, with a total of 427 trip legs, thereof 113 bicycle trips legs. The method was validated through the application of a control-questionnaire. The study showed that using the proposed method: (i) correctly linked 82% of the reported trip legs to corresponding trip legs, (ii) avoided classifying non-trips such as scatter around activities as trip legs, (iii) correctly identified the transport mode for more than 90% of the trip legs, and was robust through the specification of the model parameters and thresholds. The results document that using the proposed method enabled the possibility of using individual-based GPS units to collect travel surveys in large-scale multi-modal networks. The literature on the generation of alternative route sets has mainly focused on the implementation of path generation methods for cars or public transport, which are normally generated on a simplified network. Only few studies have focused on bicycle route choice sets, which require a highly detailed network. In this study, the efficiency of choice set generation methods was analysed by their ability to generate relevant and heterogeneous bicycle routes in a high-resolution network by using different evaluation methods, such as replicating the observed routes while also generating realistic alternatives that take into account taste heterogeneity across cyclists. Three choice set generation methods for bicycle route choice were examined: A doubly stochastic generation function, a breadth first search on link elimination, and a branch & bound algorithm. The dataset used to evaluate the methods consisted of 778 bicycle trips traced by GPS and carried out by 139 persons. In addition, the extension of cost functions was proposed with bicycle-oriented factors not limited to distance and time, but also other factors considered relevant to cyclists, i.e., scenic routes, dedicated cycle lanes, and road types. The results showed that both the doubly stochastic generation function and the breadth first search on link elimination generated realistic routes, while the first produced more heterogeneous routes and the latter outperformed in computation cost. The two methods revealed similar performances in terms of coverage, i.e., almost 64% and 68%, respectively. The branch & bound method had lower coverage compared to the other two methods, as it reproduced approximately 40% of the observed routes. As to be expected, shorter routes resulted in a very good coverage for all methods, where there are typically (much) less possible alternative routes, while longer routes exhibited larger differences across algorithms, with the doubly stochastic generation function performing best. The results also indicated the heterogeneous and complex preference structure for cyclists when considering routes, thus emphasising the importance of realistic and heterogeneous alternative route sets for model estimation. Based on the above data, cyclists’ route choices were analysed by estimating a path-size logit model, accounting for similarities between the alternative routes. A large sample of GPS observations was estimated, comprised of 3,363 bicycle trips total. The logarithm of the pathsize variable was significant and positive, thus correctly accounts for route overlap. The results showed that cyclists are sensitive to the effects of distance, cycling the wrong way, turn frequency, hilliness, different bicycle facility types, bicycle bridges, surface type, intersection type (i.e., cyclists prefer roundabouts over other crossing types), the number of motorised traffic lanes, and crossing water/sea on motorised traffic bridges. Whereas motorised traffic type, speed limit, annual average daily traffic (AADT), time dependent traffic volumes, and accident patterns had no statistically significant effect on cyclists’ route choices. Most importantly, the results showed that cyclists appear to place relatively high value on different land-use conditions along the routes, that is, dispreference for high residential area and/or town centre and industrial areas, a willingness to take detours to cycle in recreational areas or parks when they are on both sides of the path, but avoidance of these detours when such areas are on one side of the path. Previous model estimates showed that the parameters describing paths along a scenic area and in forests did not have a significant effect on cyclists’ route choices. The results also showed that personal characteristics influence the route choice (i.e., gender and type of cyclist), that there were differences in route choice preferences depending on the time of day and whether it
was weekday or weekend, and also different weather conditions (i.e., temperature, rain, and sunshine). The route choice model can be used to forecast future travel behaviour. However, the interaction between the bicycle route choice model and the mode choice models needs to be investigated. By focusing on the interaction between infrastructure and route choice of cyclists, it is possible to contribute to the understanding of which factors influence cyclists’ route choices. The work conducted in the PhD study contributes to the current literature on bicycle transport by investigating the choice of the bicycle as a transport alternative and cyclists’ route choices. Problems related to the modelling of cyclists’ route choices were successfully solved, i.e., by collecting actual route choices using individual-based GPS units, postprocessing the raw GPS data in order to get usable information on observed bicycle routes, and effectively generating realistic alternatives in a high resolution network. It was possible to analyse travel behaviour on extensive revealed preference data and the study showed that it is possible to estimate quite advanced models on an elaborate set of variables and utility functions. The findings showed that it is important to take into consideration the heterogeneity of individuals and that decision-makers should focus on specific individuals or groups within the population when thinking about measures to increase the appeal of sustainable travel options. The findings also showed the importance of well-built bicycle facilities and the importance of choosing the location of such facilities carefully.

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How uncertainty in input and parameters influences transport model output: four-stage model case-study
If not properly quantified, the uncertainty inherent to transport models makes analyses based on their output highly unreliable. This study investigated uncertainty in four-stage transport models by analysing a Danish case-study: the Næstved model. The model describes the demand of transport in the municipality of Næstved, located in the southern part of Zealand. The municipality has about 80,000 inhabitants and covers an area of around 681 km². The study was implemented by using Monte Carlo simulation and scenario analysis and it focused on how model input and parameter uncertainty affect the base-year model outputs uncertainty. More precisely, this study contributes to the existing literature on the topic by investigating the effects on model outputs uncertainty deriving from the use of (i) different probability distributions in the sampling process, (ii) different assignment algorithms, and (iii) different levels of network congestion. The choice of the probability distributions shows a low impact on the model output uncertainty, quantified in terms of coefficient of variation. Instead, with respect to the choice of different assignment algorithms, the link flow uncertainty, expressed in terms of coefficient of variation, resulting from stochastic user equilibrium and user equilibrium is, respectively, of 0.425 and 0.468. Finally, network congestion does not show a high effect on model output uncertainty at the network level. However, the final uncertainty of links with higher volume/capacity ratio showed a lower dispersion around the base uncertainty value. Results are also obtained from the implementation of the analysis on a real case involving the finalization of a ring road around Næstved. Three different scenarios were tested. The resulting uncertainty in the travel time savings from the comparison of the three scenarios expressed in terms of coefficient of variation, turned out to be between 0.133 and 0.145, thus confirming the importance of uncertainty analysis in transport policy assessment.

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How uncertainty in socio-economic variables affects large-scale transport model forecasts

A strategic task assigned to large-scale transport models is to forecast the demand for transport over long periods of time to assess transport projects. However, by modelling complex systems transport models have an inherent uncertainty which increases over time. As a consequence, the longer the period forecasted the less reliable is the forecasted model output. Describing uncertainty propagation patterns over time is therefore important in order to provide complete information to the decision makers. Among the existing literature only few studies analyze uncertainty propagation patterns over time, especially with respect to large-scale transport models. The study described in this paper contributes to fill the gap by investigating the effects of uncertainty in socio-economic variables growth rate projections on large-scale transport model forecasts, using the Danish National Transport Model as a case study. Population, gross domestic product, employment, and fuel prices were analyzed to quantify their uncertainty for 5 year intervals over a period of 15 years. The output of this procedure was then used to implement model sensitivity tests. The results from the model sensitivity tests showed how the model output uncertainty grows over time, reflecting the increase in the uncertainty of the model variables. Furthermore, the resulting uncertainty temporal pattern was neither linear nor similar for the different model outputs investigated. This highlights the importance of investigating uncertainty for different model outputs, and also that a dynamic approach is required whenever the model has to provide mid-long time period forecasts.
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Large-scale transport models, Forecasts, Monte Carlo simulation, Sensitivity tests, Stochastic variables, Uncertainty

Improved methods to deduct trip legs and mode from travel surveys using wearable GPS devices: A case study from the Greater Copenhagen area

GPS data collection has become an important means of investigating travel behaviour. This is because such data ideally provide far more detailed information on route choice and travel patterns over a longer time period than possible from traditional travel survey methods. Wearing a GPS unit is furthermore less requiring for the respondents than filling out (large) questionnaires. It places however high requirements to the post-processing of the data. This study developed and tested a combined fuzzy logic and GIS-based algorithm to process raw GPS data. The algorithm is applied to GPS data collected in the highly complex large-scale multi-modal transport network of the Greater Copenhagen area. It detects trips, trip legs and distinguishes between five modes of transport. The algorithm was validated by comparing with a control questionnaire collected among the same persons and a sensitivity analysis was performed. This showed that the algorithm (i) identified corresponding trip legs for 82% of the reported trip legs, (ii) avoided classifying non-trips such as scatter around activities as trip legs, (iii) identified the correct mode of transport for more than 90% of trip legs, and (iv) were robust towards the specification of the model parameters and thresholds. The method thus makes it possible to use GPS for travel surveys in large-scale multi-modal networks.
Public transport optimisation emphasising passengers’ travel behaviour.

Passengers in public transport complaining about their travel experiences are not uncommon. This might seem counterintuitive since several operators worldwide are presenting better key performance indicators year by year. The present PhD study focuses on developing optimisation algorithms to enhance the operations of public transport while explicitly emphasising passengers’ travel behaviour and preferences. Similar to economic theory, interactions between supply and demand are omnipresent in the context of public transport operations. In public transport, the demand is represented by the passengers and their desire to complete particular journeys, while the supply is the transit network and its characteristics. Changing the supply (e.g. by changing line plan configuration, stopping patterns or the timetable itself), thus makes the demand adapt accordingly. Acknowledging the interaction between supply and demand is important when transit operations are planned but also when performance is evaluated. Assessing public transport performance merely by measuring vehicle punctuality would provide an unfair picture of the level of service experienced by these passengers. The unfair picture can be explained by the fact that passenger delays are often significantly larger than the vehicle delays responsible for the passengers to be late e.g. because passengers on a slightly delayed train may experience a large delay if they miss their desired connection. To overcome the discrepancy between the published performance measures and what passengers actually experience, a large academic contribution of the current PhD study is the explicit consideration of passengers’ travel behaviour in optimisation studies and in the performance assessment. Besides the explicit passenger focus in transit planning, also the applicability to real large-scale network has been a main focus of the current thesis. Consequently, heuristic (i.e. not exact) methods are developed. The PhD study contributes to the state-of-the-art by proposing. A literature review outlining the discrepancy between planners, who focus on the vehicle operations and publish fixed vehicle schedules and, on the other hand, passengers, who look not only at the schedules but also at the entirety of their journey from the access to the waiting, the on-board travel, the transfers and the egress.

(ii) A metaheuristic algorithm to enhance the line plan configuration of a high frequent transit network explicitly taking into account passengers’ travel behaviour. A heuristic algorithm to optimise stopping patterns in a railway network where passengers’ adapted stop-to-stop path choice is considered explicitly. A metaheuristic algorithm minimising passengers’ transfer waiting time by changing vehicle departure times from the initial stop, again passengers’ route choice behaviour is considered. A methodological framework is proposed to assess the resilience of a transit network from the passengers’ perspective. Empirical evidence indicates that passengers give more importance to travel time certainty than travel time reductions as they associate an inherent disutility with travel time uncertainty. This disutility may broadly be interpreted as an anxiety cost for the need for having contingency plans in case of disruptions, and may be looked at as the motivator for delay-robust railway timetables. Interestingly, passenger oriented optimisation studies considering robustness in railway planning typically limit their emphasis on passengers to the consideration of transfer maintenance. Clearly, passengers’ travel behaviour is more complex and multifaceted, thus several other aspects should be considered as becoming more and more evident from passenger surveys identifying passengers’ preferences when using transit systems. This literature review and in particular the finding that passengers’ path choice is rarely considered in the operations planning was the main motivation for the papers. In figure 1 the steps in the planning of transit operations are outlined along with the planning horizon. The arrows indicate that the outcome of a former step serves as input to a subsequent step. The current PhD study is focused around Network Route Design and Timetable Development. Although Network Route Design typically belongs to the strategic planning level, we approach the line planning and skip-stop planning on the tactical planning level, thereby making it possible to approximate passengers’ travel choice with higher certainty. This is done by formulating bi-level optimisation problems, where the upper level solves the particular optimisation problem given passengers’ route choice while the lower level derives passengers’ route choice based on the updated network characteristics defined by the upper level. Due to its inherent complexity, these bi-level minimisation problems are extremely difficult to solve mathematically, since the analytical optimisation problem itself often is either non-convex non-linear or a mixed-integer linear problem, with passenger flows defined by the route choice model, where the route choice model is a nonlinear non-continuous mapping of the timetable. Therefore, the bi-level optimisation problems are solved heuristically. To speed up the convergence of the bi-level algorithms, the lower level problem is incorporated in the upper level problem formulation. Integrating the upper level and lower level makes the algorithm converge faster compared to the case where the two problems are solved sequentially without taking into account interdependencies.

Figure 1 - Planning public transport The PhD study develops a metaheuristic algorithm to adapt the line plan configuration in order better to match passengers’ travel demand in terms of transfers as well as their waiting time experienced at boarding and transfers stations, respectively. The approach is based on swapping one part of a railway line with one part of another railway line at a station where the two lines meet. To search the solution space intelligently, a tabu search framework is applied to optimise the line plan configuration, while a passenger transit assignment model finds passengers’ adapted route choices. The bi-level algorithm is validated on the suburban railway network in the Greater Copenhagen area in Denmark. Applying the improving bi-level passenger oriented line planning algorithm to this network yields a reduction of 3.83 % in railway passengers’ number of transfers and 3.88 % in their waiting time. Another part of the Network Route Design is determining stopping patterns on transit lines. Travel time reductions in railways are typically costly and achieved through investments in rolling stock or infrastructure. Skipping stops, on the other hand, is a cost-effective way to reduce in-vehicle travel time for on-board passengers and at the same time reduce the heterogeneity of the railway operations, which reduces the risk of knock-on delays. A passenger assignment yields passenger flows, which serve as input to the skipstop optimisation. The updated stopping patterns and the reduced in-vehicle times then serve as input in the subsequent route choice calculation. The bi-level approach is applied to the suburban railway network in the
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Robustness indicators and capacity models for railway networks
In a world continuous striving for higher mobility and the use of more sustainable modes of transport, there is a constant pressure on utilising railway capacity better and, at the same time, obtaining a high robustness against delays. During the planning of railway operations and infrastructure this can be assisted by improving decision support systems to enable planners to use their time more efficiently. In the context of strategic (long-term) planning, efficient decision-support tools translate into being able to evaluate infrastructure and timetable scenarios fast with little data input. This has motivated the research conducted and described in this thesis, where the objective has been to develop and improve existing methods to achieve timetable and infrastructure plans with robust capacity utilisation aimed at the strategic and early tactical planning phases.

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Stochastic user equilibrium with equilibrated choice sets: Part II - Solving the restricted SUE for the logit family

We propose a new class of path-based solution algorithms to solve the Restricted Stochastic User Equilibrium (RSUE), as introduced in Watling et al. (2015). The class allows a flexible specification of how the choice sets are systematically grown by considering congestion effects and how the flows are allocated among routes. The specification allows adapting traditional path-based stochastic user equilibrium flow allocation methods (originally designed for pre-specified choice sets) to the generic solution algorithm. We also propose a cost transformation function and show that by using this we can, for certain Logit-type choice models, modify existing path-based Deterministic User Equilibrium solution methods to compute RSUE solutions. The transformation function also leads to a two-part relative gap measure for consistently monitoring convergence to a RSUE solution. Numerical tests are reported on two real-life cases, in which we explore convergence patterns and choice set composition and size, for alternative specifications of the RSUE model and solution algorithm.

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The aim of this paper is to remove the known limitations of Deterministic and Stochastic User Equilibrium (DUE and SUE), namely that only routes with the minimum cost are used in DUE, and that all permitted routes are used in SUE regardless of their costs. We achieve this by combining the advantages of the two principles, namely the definition of unused routes in DUE and of mis-perception in SUE, such that the resulting choice sets of used routes are equilibrated. Two model families are formulated to address this issue: the first is a general version of SUE permitting bounded and discrete error distributions; the second is a Restricted SUE model with an additional constraint that must be satisfied for unused paths. The overall advantage of these model families consists in their ability to combine the unused routes with the use of random utility models for used routes, without the need to pre-specify the choice set. We present model specifications within these families, show illustrative examples, evaluate their relative merits, and identify key directions for further research.
System convergence in transport models: algorithms efficiency and output uncertainty

Transport models most often involve separate models for traffic assignment and demand. As a result, two different equilibrium mechanisms are involved, (i) the internal traffic assignment equilibrium, and (ii) the external equilibrium between the assignment model and the demand model. The objective of this paper is to analyse convergence performance for the external loop and to illustrate how an improper linkage between the converging parts can lead to substantial uncertainty in the final output. Although this loop is crucial for the performance of large-scale transport models, it has not been analysed much in the literature. The paper first investigates several variants of the Method of Successive Averages (MSA) by simulation experiments on a toy-network. It is found that the simulation experiments produce support for a weighted MSA approach. The weighted MSA approach is then analysed on large-scale in the Danish National...
Transport Model (DNTM). It is revealed that system convergence requires that either demand or supply is without random noise but not both. In that case, if MSA is applied to the model output with random noise, it will converge effectively as the random effects are gradually dampened in the MSA process. In connection to DNTM it is shown that MSA works well when applied to travel-time averaging, whereas trip averaging is generally infected by random noise resulting from the assignment model. The latter implies that the minimum uncertainty in the final model output is dictated by the random noise in the assignment model.

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**Traffic assignment models in large-scale applications**
Transport models are becoming more and more disaggregate to facilitate a realistic representation of individuals and their travel patterns. In line with this development, the PhD study focuses on facilitating the deployment of traffic assignment models in fully disaggregate activity-based model frameworks. In the correct integration, such frameworks allow realistic representation of individual-specific household interactions, time-space constraints and preference structures. Individual trips can also be evaluated on a detailed address-to-address level and aggregation biases are avoided. The study focuses on large-scale applications and contributes with methods to actualise the true potential of disaggregate models. To
achieve this target, contributions are given to several components of traffic assignment modelling, by (i) enabling the utilisation of the increasingly available data sources on individual behaviour in the model specification, (ii) proposing a method to use disaggregate Revealed Preference (RP) data to estimate utility functions and provide evidence on the value of congestion and the value of reliability, (iii) providing a method to account for individual mis-perceptions in the choice set generation for complex multi-modal networks, and (iv) addressing the difficulty of choice set generation by making available a theoretical framework, and corresponding operational solution methods, which consistently distinguishes between used and unused paths. The availability of data is essential in the development and validation of realistic models for large-scale applications. Nowadays, modern technology facilitates easy access to RP data and allows large-scale surveys. The resulting datasets are, however, usually very large and hence data processing is necessary to extract the pieces of information relevant to the analysis at hand. Manual processing of the datasets is typically not possible, and it is therefore necessary to have methods available which in some automated ways clean and prepare the data for the desired use. The present study proposes a fully automatic post-processing procedure that combines fuzzy logic- and GIS-based methods to process raw individual-based GPS data with no additional information required from the respondent. The method categorises trips and trip legs and associates the trip legs with the most probable mode of transport used. The method was validated through the application to a dataset consisting of raw individual-based GPS logs collected among 183 respondents living in the Greater Copenhagen area. Through the use of a control-questionnaire, the study found that the proposed method (i) vii identified corresponding trip legs for 82% of the reported trip legs, (ii) avoided classifying nontrips such as scatter around activities as trip legs, and (iii) identified the correct mode of transport for more than 90% of the trip legs. These results are very promising, especially when compared to results generated by existing algorithms. The results highlight the potential of the method proposed and the possibility to use individual-based GPS units for travel surveys in real-life large-scale multi-modal networks. Congestion is known to highly influence the way we act in the transportation network (and organise our lives), because of longer travel times, but the reliability of the travel time also has a large impact on our travel choices. Consequently, in order to improve the realism of transport models, correct understanding and representation of two values that are related to the value of time (VoT) are essential: (i) the value of congestion (VoC), as the VoT varies with traffic conditions and hence congestion multipliers reflect the complexity of driving conditions when more vehicles are present on the road, and (ii) the value of reliability (VoR), as the VoT relates to the predictability of travel time and the repeatability of the travel experience. Congestion and reliability highly influence each other, but so far only studies based on Stated Preference (SP) data considered concurrently congestion and reliability variables. The PhD study contributes to the state-of-the-art by presenting a new approach to estimate the VoR and VoC based on RP data. The approach applies a mean-variance model that considers congestion and reliability concurrently. The model was applied to GPS data and it successfully estimated mixed Path Size Logit models, using a sample of 5,759 observations in the peak period and a sample of 7,964 observations in the off-peak period. Results illustrated that the value of the different time components (free-flow, congestion, and reliability) and the congestion multiplier were significantly higher in the peak period. This seems reasonable because of possible higher penalties for being late and, as a consequence, possible higher time pressure. Results also showed that the marginal rate of substitution between travel time reliability and the total travel time, considering the average congestion level, did not vary across time periods and traffic conditions. The study highlights the potential of exploiting the growing availability of observations of actual behaviour to obtain estimates of the (monetary) value of different travel time components, thereby increasing the behavioural realism of largescale models. vii The generation of choice sets is a vital component in route choice models. This is, however, not a straightforward task in real-life applications, as: (i) there are almost infinitely many alternatives, but large choice sets are computationally demanding or even unfeasible; (ii) congestion effects need to be considered; (iii) the choice sets should contain all relevant alternatives, including the observed route if one such is available, while leaving out unreasonable and redundant routes; and (iv) the attributes of the alternatives should vary enough to facilitate consistent parameter estimates if the choice sets are to be used for choice model estimation. The PhD study contributes to the state-of-the-art by proposing and validating a simulation-based choice set generation method for general networks. The validation used 5,131 observed route choices collected on the highly complex large-scale Greater Copenhagen area public transport network. By evaluating alternative ways to specify the stochasticity and the level of this, it was found that the level of stochasticity should be high to induce high coverage and statistically efficient parameter estimates when the choice sets are used for estimation. The level of stochasticity should, however, be introduced with parsimony, as significant increases translate into generating redundant and counter-intuitive paths with no considerable improvement in coverage. Adding heterogeneity across travellers improved the results considerably, and induced coverage levels up to a very high 98.8% at an 80% overlap threshold. This shows the potential of the method proposed as well as the importance of accounting for as much individual heterogeneity as possible as models become more disaggregate. A revisit to the original conditions underlying the Stochastic User Equilibrium (SUE) has led to the realisation that the difficulty of specifying the choice set is related to the assumption on the distribution of the mis-perceptions. It is the commonly adopted assumption that the distributed elements follow unbounded distributions which induces the need to enumerate all paths in the SUE, no matter how unattractive they might be. The Deterministic User Equilibrium (DUE), on the other hand, has a built-in criterion distinguishing definitely unused from potentially used routes, but the cut-off in terms of cost differences is strict. Based on this, two new model frameworks and corresponding equilibrium formulations are introduced. Both models combine the strengths of the SUE and DUE by permitting the consistent combination viii of (i) equilibrated non-universal choice sets and (ii) flow distribution according to random utility maximisation theory. One model allows distinction between used and unused routes based on the distribution of the random error terms, while the other model allows this distinction by posing restrictions on the costs of used/unused routes. Generic path-based solution algorithms and convergence measures are introduced for the model which seemed the most straightforward to apply given its connection to existing RUM-based models (the one adding restrictions). Different variants of the algorithms were validated for the MultiNominal Logit and Path Size Logit choice models on the Sioux Falls as well as the large-scale Zealand network. A novel consistent convergence measure verified extremely fast and well-behaved convergence to an
equilibrated solution on non-universal choice sets (across different congestion levels, scale parameters and step-sizes). The composition of the choice sets were validated by comparison to real-life route choices of 16,618 individual trips on the Zealand network. The applications were also very successful in reproducing observed link counts. The solution algorithms are thus computationally attractive, and the solutions and the underlying framework are behaviourally realistic. This causes the new framework and solution algorithms to be highly attractive to apply as models become more disaggregate. Summarising, the PhD study has given contributions to several of the components that concern the estimation and solution of traffic assignment models in large-scale applications. Through this, the PhD study has successfully facilitated the consistent integration at the disaggregate level across traffic model parts. This means that the true potential of the activity-based models can be actualised.

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**Uncertainties in Transport Project Evaluation: Editorial**
This following special issue of the European Journal of Transport Infrastructure Research (EJTIR) containing five scientific papers is the result of an open call for papers at the 1st International Conference on Uncertainties in Transport Project Evaluation that took place at the Technical University of Denmark, September 2013. The conference was held under the auspices of the project ‘Uncertainties in transport project evaluation’ (UNITE) which is a research project (2009-2014) financed by the Danish Strategic Research Agency. UNITE was coordinated by the Department of Transport of the Technical University of Denmark (DTU Transport) and carried out in cooperation with several Danish and international partners.

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The Effects of Uncertainty in Speed-Flow Curve Parameters on a Large-Scale Model

Uncertainty is inherent in transport models and prevents the use of a deterministic approach when traffic is modeled. Quantifying uncertainty thus becomes an indispensable step to produce a more informative and reliable output of transport models. In traffic assignment models, volume-delay functions express travel time as a function of traffic flows and the theoretical capacity of the modeled facility. The U.S. Bureau of Public Roads (BPR) formula is one of the most extensively applied volume delay functions in practice. This study investigated uncertainty in the BPR parameters. Initially, BPR parameters were estimated by analyzing observed traffic data related to the Danish highway network. Then, BPR parameter distributions were generated by using the resampling bootstrap technique. Finally, the generated parameter vectors were used to implement sensitivity tests on the four-stage Danish national transport model. The results clearly highlight the importance to modeling purposes of taking into account BPR formula parameter uncertainty, expressed as a distribution of values rather than assumed point values. Indeed, the model output demonstrates a noticeable sensitivity to parameter uncertainty. This aspect is evident particularly for stretches of the network with a high number of competing routes. Model sensitivity was also tested for BPR parameter uncertainty combined with link capacity uncertainty. The resultant increase in model sensitivity demonstrates even further the importance of implementing uncertainty analysis as part of a robust transport modeling process.

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User perspectives in public transport timetable optimisation

The present paper deals with timetable optimisation from the perspective of minimising the waiting time experienced by passengers when transferring either to or from a bus. Due to its inherent complexity, this bi-level minimisation problem is extremely difficult to solve mathematically, since timetable optimisation is a non-linear non-convex mixed integer problem, with passenger flows defined by the route choice model, whereas the route choice model is a non-linear non-continuous mapping of the timetable. Therefore, a heuristic solution approach is developed in this paper, based on the idea of varying and optimising the offset of the bus lines. Varying the offset for a bus line impacts the waiting time passengers experience at any transfer stop on the bus line. In the bi-level timetable optimisation problem, the lower level is a transit assignment calculation yielding passengers' route choice. This is used as weight when minimising waiting time by applying a Tabu Search algorithm to adapt the offset values for bus lines. The updated timetable then serves as input in the following transit assignment calculation.

The process continues until convergence.

The heuristic solution approach was applied on the large-scale public transport network in Denmark. The timetable optimisation approach yielded a yearly reduction in weighted waiting time equivalent to approximately 45 million Danish
kroner (9 million USD).

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Danish long distance travel: A study of Danish travel behaviour and the role of infrequent travel activities

Historically there has been a lack of knowledge with respect to long distance travel. Due to the considerable contribution of long distance travel to total travelled kilometres and the related energy consumption from the transport sector and derived impacts on greenhouse emissions, this is problematic. The average travel distance has steadily increased during the latest decades together with the increasing motorisation of daily travel and international aviation. Previously most focus has been on domestic daily travel activities, but globalisation has, together with changes in price structures and increasing income, emphasised a travel type segment with significant impact on the total level of travelling. International travel has increased its market shares considerably, and the strong relation with income changes suggests a travel type segment of significant importance regarding future travel behaviour and emissions from transportation in particular. i) The work of this thesis is not limited to a distinct definition of long distance travel, but explores long distance travel in a broader context. The analysis applies data from three different travel surveys: The Danish National Travel Survey (TU), the TU overnight survey, and the Danish Tourism Statistics from the Business and Holiday Survey (HBS). This has enabled focus on infrequent travel activities segmented relative to travel purpose, distance threshold, or travelling with overnight stays. At an overall level the thesis has three main objectives: i) to describe and combine empirical knowledge on Danish travel behaviour in relation to long distance travel, ii) to provide information on the troubles and uncertainties related to different travel survey methodologies, and iii) to reveal some of the drivers of long distance travel related to e.g. socio-economic variables. The analysis of Danish travel activities described in the three different travel surveys has outlined detailed information on Danish travel behaviour at an aggregated level during the past two decades. It has above all revealed the significant role of leisure travel. Private travel represents more than 60% of all travelled kilometres by individuals, and almost 25% alone stem from international holiday tourism even though international holiday travels represent only 0.1% of all travel activities. The study of holiday tourism has outlined some apparent trends that are of high relevance when considering future emissions from transportation. Besides the fact that the share of Danish holiday travellers has increased, the characteristics of the holiday activities have changed as well. The number of domestic holiday activities has stayed more or less constant and the growth is mainly observed in international travel and travel by plane in particular. The development in destinations is two-fold, with a substantial growth in destinations outside Europe as well as a significant growth in European weekend holiday activities. These travel activities are furthermore found to be more sensitive to income changes. The analyses of the three travel surveys also contribute to a validation of different survey methodologies and their ability to describe travels, with overnight stays, in a comprehensive way. The comparison of the travel surveys outlines the classical trade-off between sample sizes and survey uncertainties related to tailored retrospective travel surveys. From a three month retrospective survey it is found that travels with overnight stays are underestimated by 11%, but also that a retrospective survey period is necessary to achieve representative samples. The memory loss of respondents is certainly present in a retrospective survey focussing on multiday travel even though travel activities with overnight stays, intuitively iii should be easier to recall than e.g. travelling above a specific distance threshold. The analysis stresses the importance of further targeting the travel activities of interest to reduce the impacts of memory loss or on the contrary to reduce the survey period. In addition to the descriptive statistics and the comparison of different travel surveys presented in part I of this thesis, the thesis includes four studies of travel behaviour presented in paper form in part II. The first paper outlines and exemplifies the presence and magnitude of different survey biases in the Danish National Travel Survey (TU). The study finds that response biases are heterogeneous distributed across the population and that the bias leads to significant overestimation of car ownership and a consequently underestimation of the respective income elasticity. The study evaluates the impact of measurement error and reveals considerable problems in the data collection of income which in this case reduces the income elasticity. The second paper includes all three Danish travel surveys in a study of leisure travel, with an analysis of the income elasticity of this travel segment. Due to the different survey methodologies, the samples of leisure activities describe the whole span from daily leisure travel activities embedded into people’s daily routines to the infrequent holiday activities. The applied model describes the travel distance of leisure travel including the probability of having leisure activities or not. The study finds increasing income elasticities of travelling or not and increasing income elasticities of travel distances as the leisure purposes become less frequently completed activities. This includes larger elasticities for long distance journeys and journeys with an overnight stay. The paper furthermore reveals and analyses differences in travel patterns for different regions in Denmark, and contribute hereby to an understanding of how future changes in location of the population will influence leisure travelling and the length of long distance travel behaviour. The income elasticity of long distance travel is also examined in the third paper. This study is based on the Danish expenditure survey and analyses consumption of plane tickets and travel packages in relation to the consumption on other non-durable goods. This study finds these infrequent travel activities to be somewhat more sensitive to income changes than found from the three travel surveys. The two different studies of income elasticities outline a wide span of income elasticities for leisure travel that varies between 0.1-1.4 when iv measured in terms of travel demand and from 0.2-0.6 when measured in terms of travel distances. The final paper differs from the others as it explores and evaluates the impacts of the Oresund Bridge ten years after its opening. The new bridge resulted in significant changes in travel behaviour that was not as dominated by long distance leisure travel activities as expected, but rather resulted in a considerable integration of daily travel behaviour between the two countries. The financial benefits were compared with the construction and maintenance costs of the bridge in an ex-post cost benefit assessment which suggests that the bridge is a sound socio-economic investment.
Efficiency of choice set generation methods for bicycle routes
The current study analyses the efficiency of choice set generation methods for bicycle routes and proposes the extension of cost functions to bicycle-oriented factors not limited to distance and time. Three choice set generation methods for route choice were examined in their ability to generate relevant and heterogeneous routes: doubly stochastic generation function, breadth first search on link elimination, and branch & bound algorithm. Efficiency of the methods was evaluated for a high-resolution network by comparing the performances with four multi-attribute cost functions accounting for scenic routes, dedicated cycle lanes, and road type. Data consisted of 778 bicycle trips traced by GPS and carried out by 139 persons living in the Greater Copenhagen Area, in Denmark. Results suggest that both the breadth first search on link elimination and the doubly stochastic generation function generated realistic routes, while the former outperformed in computation cost and the latter produced more heterogeneous routes.
Estimating railway infrastructure project cost from transferring nominal price to real price by considering the working time possessions

The purpose of the paper is to estimate railway project construction cost based on the nominal market price. Currently, estimation of project costs within railway infrastructure procurement is particularly challenging due to; 1) construction costs highly depend on possession timeframes and duration and 2) railway construction work costs are not transparent in the market.

This paper suggests separating the costs into 3 sub-categories: materials, labour and machinery. Evidently, the materials are further broke-down into subcomponents which then remains fixed whereas the cost of labour and machinery are varying depending on the working time possessions presented through the closure of the railway line. The effective working hours, type of construction work and construction speed are used as constraints to ensure the track closure plan remains feasible.

To demonstrate the approach a Danish railway construction project, the new line to the fixed link across Fehmarn Belt, is introduced where it is shown that the non-material cost is about 19% of the total expenditure. By assuming three sets of track blocking scenarios with the same amount of construction works it is proven that given an optimal track closure plan – the overall cost can be decreased by 2.7%. It can be concluded that our approach with an optimal working possession plan can identify the low cost track closures.

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Estimating Value of Congestion and of Reliability from Observation of Route Choice Behavior of Car Drivers

In recent years, a consensus has been reached about the relevance of calculating the value of congestion and the value of reliability for better understanding and therefore better prediction of travel behavior. The current study proposed a revealed preference approach that used a large amount of GPS data from probe vehicles to provide insight into actual behavior in choosing a route. Mixed path size correction logit models were estimated from samples of 5,759 observations in the peak period and 7,964 observations in the off-peak period, while a mean-variance model was specified to consider both congestion and reliability terms. Results illustrated that the value of time and the value of congestion were significantly higher in the peak period because of possible higher penalties for drivers being late and consequently possible higher time pressure. Moreover, results showed that the marginal rate of substitution between travel time reliability and total travel time did not vary across periods and traffic conditions, with the obvious caveat that the absolute values were significantly higher for the peak period. Last, results showed the immense potential of exploiting the growing availability of large amounts of data from cheap and enhanced technology to obtain estimates of the monetary value of different travel time components from the observation of actual behavior, with arguably potential significant impact on the realism of large-scale models.
Evaluation of robustness indicators using railway operation simulation

The classical way of evaluating the robustness of railway timetables is the use of microscopic simulation. This is precise and offers a high level of detail, but it also requires a high amount of work. The alternative is to use robustness indicators that directly or indirectly indicate the robustness of a railway system. However, the semantics of these are mainly unknown and indicators are therefore best for comparison of alternatives. The paper therefore reviews and evaluates different robustness indicators against a microscopic simulation. This evaluation show that the indicators compare well to the microscopic simulation and are, to some extent, able to predict the outcome of the simulation. © 2014 WIT Press.

Multimodal route choice models of public transport passengers in the Greater Copenhagen Area

Understanding route choice behavior is crucial to explain travelers’ preferences and to predict traffic flows under different scenarios. A growing body of literature has concentrated on public transport users without, however, concentrating on multimodal public transport networks because of their inherent complexity and challenges. In particular, choice set generation and modeling route choice behavior while accounting for similarity across alternatives and heterogeneity across travelers are non-trivial challenges. This paper tackles these challenges by focusing on the revealed preferences of 5,641 public transport users in the Greater Copenhagen Area. A two-stage approach consisting of choice set generation and route choice model estimation allowed uncovering the preferences of the users of this multimodal large-scale public transport network. The results illustrate the rates of substitution not only of the in-vehicle times for different public transport modes, but also of the other time components (e.g., access, walking, waiting, transfer) composing the door-to-door experience of using a multimodal public transport network, differentiating by trip length and purpose, and accounting for heterogeneity across travelers.
Robustness in Railway Operations (RobustRailS)
This study considers the problem of enhancing railway timetable robustness without adding slack time, hence increasing the travel time. The approach integrates a transit assignment model to assess how passengers adapt their behaviour whenever operations are changed. First, the approach considers the existing stopping patterns of the railway lines. Then, based on the passenger demand we try to optimize the overall utility by changing the stopping pattern in a way that capacity utilization is reduced without affecting the frequency of the train lines nor increasing the passengers' travel time.

Trafikanalyser af et net af letbaner og BRT i Hovedstaden: Rapport 8
Denne rapport gennemgår et projekt for Region Hovedstaden, hvor letbanenet fra forårets opgave for Region Hovedstaden (Nielsen, Ingvarsson & Andersen, 2013) blev detaljeret, viderebearbejdet og forbedret, hvorefter der er gennemført beregninger af forskellige varianter med OTM Trafikmodellen. Arbejdet er foregået som en to-delt proces, hvor først fire basisnet er defineret, konkretiseret og trafikmodelleret. Baseret på resultaterne af trafikmodellberegningerne er det bedste basisnet viderebearbejdet og forbedret til tre hovednet, der igen er trafikmodelleret og vurderet. Resultaterne præsenteres og sammenlignes med tidligere net og beregninger, der er blevet gennemført i Trængselskommissionens regi.

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Trafikanalyser af et net af letbaner og BRT i Hovedstaden: Rapport 8
Denne rapport gennemgår et projekt for Region Hovedstaden, hvor letbanenet fra forårets opgave for Region Hovedstaden (Nielsen, Ingvarsson & Andersen, 2013) blev detaljeret, viderebearbejdet og forbedret, hvorefter der er gennemført beregninger af forskellige varianter med OTM Trafikmodellen. Arbejdet er foregået som en to-delt proces, hvor først fire basisnet er defineret, konkretiseret og trafikmodelleret. Baseret på resultaterne af trafikmodellberegningerne er det bedste basisnet viderebearbejdet og forbedret til tre hovednet, der igen er trafikmodelleret og vurderet. Resultaterne præsenteres og sammenlignes med tidligere net og beregninger, der er blevet gennemført i Trængselskommissionens regi.
Uncertainty calculation in transport models and forecasts.
Transport projects and policy evaluations are often based on transport model output, i.e. traffic flows and derived effects. However, literature has shown that there is often a considerable difference between forecasted and observed traffic flows. This difference causes misallocation of (public) resources, hence resulting in socio-economic losses. Along with technical and decision-process related issues, such inaccuracy also originates from transport models’ inherent uncertainty, which in turn originates from the complexity of the systems generating both transport supply (e.g. services, infrastructure, and regulation) and demand. Uncertainty pertains to everything the modeller does not know to a full extent about the system object of the modelling process due to a limited knowledge or stochasticity of some model components. Thus, ultimately uncertainty reflects the inability of the modeller to represent the complex system in a deterministic way. By modelling complex systems, transport models are subject to uncertainty. The main consequence of such uncertainty is that point estimates of modelled traffic flows, and their derived measures, only represent one of the possible outputs generated by the model. Analyses based on point estimates invariably produce uncertain results and decisions taken relying on them may easily lead to unexpected consequences. Thus, it is essential to assess uncertainty inherent to transport models. This requires producing uncertainty measures by investigating which are the main sources of uncertainty within the model, how uncertainty propagates throughout the model and, finally, how it affects the model output. The purpose of the studies described in this thesis was to investigate uncertainty inherent to transport models. Despite its importance, the relation between the uncertainty of the transport model components and that of transport models’ output, and the processes that govern such relation, are not often explored by the existing literature. The collection of the four papers that compose the present thesis fills some of the gaps of this study area. The analyses were implemented by using an approach based on stochastic techniques (Monte Carlo simulation and Bootstrap re-sampling) or scenario analysis combined with model sensitivity tests. Two transport models are used as case studies: the Naestved model and the Danish National Transport Model. 3 The first paper investigated the effects of uncertainty in the volume-delay function parameters used in the Danish National Transport Model1. The results showed that some links in the modelled network have high sensitivity to the variability in the function parameters. In particular, the affected links mainly refer to short, mid-distance road types potentially hosting commuting traffic. Any assessment of projects potentially affecting traffic flow on those links should then take into consideration this sensitivity and integrate uncertainty analysis in the decision process. The second paper analysed the uncertainty in a four-stage transport model related to different variable distributions (to be used in a Monte Carlo simulation procedure), assignment procedures and levels of congestion, at both the link and the network level. The analysis used as case study the Naestved model, referring to the Danish town of Naestved2. The results highlighted that both the choice of the variable distributions and the use of different assignment algorithms have a noticeable impact on model output. Besides, it showed that the higher the link congestion, the lower the level of final uncertainty. The third paper presented in this thesis deals with uncertainty in transport demand forecasts. In particular, the uncertainty in the socio-economic variables (population, GDP, employment and petrol prices) growth rate projections is investigated and a method is suggested to assess its propagation throughout time. The analysis used as case study the Danish National Transport Model3. The resulting model output uncertainty was neither linear nor similar for the different model outputs investigated. Transport related projects may focus on different model outputs which have a different temporal uncertainty propagation patterns. Thus, making acknowledgeable the uncertainty propagation pattern over time specific for key model outputs becomes strategically important. 1 Manzo, S., Nielsen, O. A. & Prato, C. G. (2014). The Effects of uncertainty in speed-flow curve parameters on a large-scale model. Transportation Research Record, 1, 30-37. 2 Manzo, S., Nielsen, O. A. & Prato, C. G. (2015). How uncertainty in input and parameters influences transport model output: a four-stage model case-study. Transport Policy, 38, 64-72. 3 Manzo, S., Nielsen, O. A. & Prato, C. G. (2015). How uncertainty in socio-economic variables affects large-scale transport model forecasts. Forthcoming: European Journal of Transport and Infrastructure Research, 15-3, 64-72. 4 The last paper examined uncertainty in the spatial composition of residence and workplace locations in the Danish National Transport Model. Despite the evidence that spatial structure influences travel behaviour, there is no consensus on the strength of such influence. To provide insights to this topic, the study investigated a number of possible future scenarios affecting the spatial structure. Among the others, the observed trend of increasing population in the major Danish cities and the variation of employment location scenarios were analysed. The results show that the combined effect of higher urban density and social mobility produces an increase in number of trips; of these, density seems to be the dominant factor. However, at the same time, the proximity of the destinations increases, so decreasing the average trip length and consequently the total mileage travelled. Overall, results from the studies collected in this thesis visibly show the importance of integrating in a systematic way uncertainty analysis in transport modelling frameworks. This should be a standard approach to produce the information necessary to increase the quality of the
decision process and to develop robust or adaptive plans. In fact, project evaluation processes that do not take into account model uncertainty produce not fully informative and potentially misleading results so increasing the risk inherent to the decision to be taken. Uncertainty analysis, by allowing identifying the main sources of uncertainty within the model and by providing knowledge on the level of confidence of the model output, ultimately enhances the robustness of the travel demand models and of the analyses based on their output.

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**Behavioural Models for Route Choice of Passengers in Multimodal Public Transport Networks**
The subject of this thesis is behavioural models for route choice of passengers in multimodal public transport networks. While research in sustainable transport has dedicated much attention toward the determinants of choice between car and sustainable travel options, it has devoted less attention toward the route choices of public transport users. Clearly, identifying relevant factors that affect route choice decisions could guide stakeholders (e.g., local governmental agencies and public transport agencies) toward effective improvement of public transport services in metropolitan areas in order to increase their attractiveness with respect to the car. Accordingly, this PhD thesis faces the multi-faceted challenge of modelling route choices of travelers moving in a metropolitan multimodal network. The analysis focuses on revealed preferences data collected for the multimodal network of the Greater Copenhagen Area and solves the multiple facets of the challenge concerning (i) data collection, (ii) data analysis, (iii) choice set generation, and (iv) model estimation.

From the data perspective, this thesis overcomes limitations in the collection of actual route choices of public transport users. The literature shows a lot of effort in modelling route choices of car users, which has benefited from increasingly accurate GPS devices to track vehicles and increasingly precise map-matching algorithms to translate the GPS points into routes on GIS networks. However, the literature shows scarce effort in the estimation of route choice models of public transport users based upon observed choices. Public transport route choice models have not benefited from the same technological enhancements as car models because of the necessity (i) to collect additional information concerning lines and transfers, and (ii) to overcome technical limitations related to GPS signals not always being retrievable in tunnels that are used by metro and urban rail systems. In this PhD project, a questionnaire to collect details about the actual route choice behaviour in public transport networks was developed and tested in a full scale test. Afterwards the questions were added to the Danish Travel Behaviour Survey that collects daily travel diaries with a questionnaire covering activities and travel of a representative sample of the population. When the travel is by public transport modes, an additional section of the survey with the new questions collects detailed information about access modes, stations, lines, departure and arrival times, trip purposes, transfers, and egress modes. In order to analyse travellers’ preferences in the multimodal network, about 6,000 observations from the Greater Copenhagen Area were collected and processed in this study. The characteristics of the collected data are analysed and the actual choices of the public transport passengers are revealed in the thesis. The data were map-matched to the GIS network of the area and quality controlled in a multi-step procedure.

From the choice set generation perspective, this thesis generates attractive routes for the origin-destination pair of each traveller. The problem is not trivial when considering the combinatorial nature of the problem. The dense network of the Greater Copenhagen Area includes metro, trains (regional, suburban, urban and local), and buses (high-frequency, express and regular), and access and egress modes comprise both private (bicycle and car) and public transport modes. Accordingly, the universal realm of possible combinations (i.e., access modes, public transport modes, lines, transfers, egress modes) is large. This thesis proposes a doubly stochastic approach for generating alternative routes that are relevant to travellers, since the method allows accounting for both perceived costs of the network elements and heterogeneity in the preferences of travellers. The coverage of the observed choices with the generated choice sets provides a measure of the behavioural plausibility of the applied path generation technique. Notably, the definition of the coverage for public transport networks is different from the one for automobile users because of the increased dimensionality of the problem, as similarity in multimodal networks may be calculated at both the line level and the link level. The thesis describes testing of the choice set generation algorithm with regard to the number of routes generated as well as its ability to generate the observed routes. From the model estimation perspective, this thesis describes the estimation of route choice models able to account for similarities across alternatives. A simple approach is the formulation of a Path Size Logit in which the different definitions of similarity (i.e., at the line level and at the link level) are alternatively tested. A more elaborated approach is the formulation of a Mixed Path Size Logit. For both approaches, the utility function is specified in order to consider the multidimensional nature of the problem in terms of access/egress characteristics, waiting time, in-vehicle travel time, and transfer characteristics. Moreover, travellers’
characteristics and trip purposes enrich the model and provide insight into the preference structures of different travellers
with different motivations for travelling, and finally the study indicates that the actual length of the trip has an impact on the
preferences of the travellers. The estimation confirms the expected importance of waiting and transfer times, shows
different preferences for bus and train, emphasize the importance of the trip length, shows the effect of specific modes of
access and egress, and indicates the relevance of individual characteristics within and across trip purposes. The results
suggest the importance of coordination between different public transport modes, the relevance of transfer locations that
allow seamless passage from one vehicle to another, and the significance of access and egress modes in terms of parking
availability for both automobiles and bicycles. In this specific study, parameters not only allow assessing travellers’
preferences that shed light on the necessary improvements in public transport networks for an even higher attractiveness
of sustainable travel options, but also allow providing input to the public transport assignment model of the Danish
National Transport Model.

The contributions of the thesis are thus to demonstrate a new survey-based data collection technique that can reveal
passengers route choices in large and complex multi-modal networks, how such data can be map-matched and choice
sets be generated for model estimation, and the results of the estimation of a multimodal route choice model based upon
this data. Finally, the thesis describes revealed preferences and behavioural interpretations of the study.

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A disaggregate pseudo-dynamic assignment for the activity-based model of the Greater Copenhagen Area
The COMPAS (Copenhagen Model for Person Activity Scheduling) model being developed for the Greater Copenhagen
Area recognizes the limitations of traditional approaches to transport planning, and embraces the active stream of
research focusing on the activity-based paradigm for predicting travel demand and supply. On the demand side, the
COMPAS model proposes a micro-simulation approach to the representation of activity and travel patterns of
Copenhageners as individuals and household members. On the supply side, the COMPAS model proposes a
disaggregate pseudo-dynamic approach to the assignment of Copenhageners to the multimodal network of the Greater
Copenhagen Area. This paper focuses on the development of the framework for the supply side of the COMPAS model.
The framework is developed by considering that using an activity-based paradigm with a static traffic assignment negates
much of the advantages of predicting travel patterns at the disaggregate level in continuous time. Accordingly, the
proposed traffic assignment is individual-based, pseudo-dynamic, and multi-modal. Firstly, the assignment loads onto the
network activity and travel patterns of the individuals between parcels. Secondly, the framework uses a pseudo-dynamic
approach able to capture the dynamic nature of the travel pattern of the individuals and hence the building of congestion.
Last, the framework loads onto the network car users, public transport users and the important share of cyclists
commuting in the Greater Copenhagen Area.

The framework proposes interesting insights from a behavioral and a time perspective. From a behavioral perspective, the
framework allows representing individual preference structures depending on individual attributes (e.g., value-of-time,
income, age) and incorporating non-linear terms in the utility functions. The calculation of level-of-service for non-chosen
alternatives (e.g., non-chosen routes, non-chosen modes, non-chosen destinations) may be solved with ghost probes
running (but not loading) the network. From a time perspective, the proposed framework has a complexity similar to the
static assignment. While adding the time dimension to a matrix-based assignment increases the calculation complexity
significantly, proposing an individual-based approach requires only some more updating of speed-flow and flow-density
functions is required. The advantages are the complexity similar to static assignment, the absence of loss of information
on the trips from the demand model, the increase in explanation and prediction abilities, and the avoidance of aggregation
bias of the level-of-service variables in the feedback to the demand models.

The disaggregate pseudo-dynamic traffic assignment allows: (i) capturing time-dependent interactions of travel demand
and network supply of the network; (ii) representing the network at a disaggregate level; (iii) representing congestion build-
up and dissipation; (iv) evaluating the effect of traffic management measures and traffic policies. When considering the
main policies discussed in the Greater Copenhagen Area (e.g., measures of traffic control management, adoption of
intelligent transport systems, adoption of road pricing policies), a state-of-the-art instrument such as an activity-based
model with an individual-based pseudo-dynamic traffic assignment will prove highly valuable to decision makers.
I mange europæiske storbyer er el-drevne, støjsvage og hurtige letbaner på vej frem. De moderne "sporvogne" er både erstatning for busser, men også et supplement til metro, S-tog og regionaltog.

I hovedstadsregionen er letbanen langs med Ring 3 fra Lundtofte til Ishøj tæt på at blive til virkelighed med et passagergrundlag, der bliver større end kystbanen. Det viser den netop fremlagte udredning fra Ringby – Letbanesamarbejdet.

Cost benchmarking of railway projects in Europe – can it help to reduce costs?
This paper highlights the methodology of construction cost benchmarking of railway projects in the EU and its preliminary results. Benchmarking helps project managers learn from others, improve particular project areas, and reduce project costs. For railway projects, benchmarking is essential for the comparison of unit costs for major cost drivers (e.g. tunnels, bridges, etc.).
This methodology was applied to the case study described in this paper, the first high-speed railway project in Denmark, "The New Line Copenhagen-Ringsted". The aim was to avoid cost overruns and even reduce final budget outcomes by looking for the best practices in the construction and implementation of other high-speed lines in Europe and learning from their experience.
The paper presents benchmarking from nine railway projects that are comparable with the Copenhagen-Ringsted project. The results of this comparison provide a certain overview of the range of costs in various budget disciplines. The Copenhagen-Ringsted project is shown to be right in the middle of the range in terms of total costs per kilometre, and its values in the discipline comparisons do not significantly differ from the values of the less expensive projects. Deeper analysis of project unit costs is still continuing, but the preliminary results show that the cost values for projects located in the same geographical zone are similar. For example, this can be explained by their use of the same construction companies. However, unit prices in southern Europe are lower than in northern Europe.

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Estimating passenger numbers in trains using existing weighing capabilities
Knowing passenger numbers is important for the planning and operation of the urban rail systems. Manual and electronic counting systems (typically infrared or video) are expensive and therefore entail small sample sizes. They usually count boarding and alighting passengers, which means that errors in estimates of total numbers of passengers propagate along train runs. Counting errors in manual and electronic counting systems are typically flow-dependent, making uncertainty a function of volume. This paper presents a new counting technique that exploits the weighing systems installed in most modern trains to control braking. This technique makes passenger counting cheaper and ensures a complete sample. The paper compares numbers estimated by this technique with manual counts and counts from an infrared system in trains in urban Copenhagen. It shows that the weighing system provides more accurate passenger counts than the infrared equipment. The method has been validated on a large data set and is now in full operation in the urban Copenhagen rail system.

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Framework for Railway Phase-based Planning

In the railway field, planning the maintenance and renewal strategy from Life Cycle Cost (LCC) perspective gets more and more attentions recent years. The new approach looks at all the costs through the infrastructure life span and use the annuity (continuing payment with a fixed total annual spending) to evaluate the project alternatives. The comparison result can identify the most cost-efficient solution in a long run and therefore reduce the overall costs.

This article defines a phase-based framework to guide the railway maintenance and renewal project planning at strategic level. The framework evaluates the project options from a larger LCC scope: The costs from train operation companies and passengers, together with the maintenance and renewal costs from Infrastructure Managers are included in the calculation.

The framework simplifies the planning processes and the LCC calculation into 7 phases. By going through the phases, the project’s key evaluation indicators such as track quality and life time, the LCC annuity, Cash flow and Cumulated NPV curve over years, can be visualized into charts, so that the maintenance and renewal alternative proposals can be easily illustrated and compared.

A case study is introduced in the article to demonstrate how the framework works to compare timber sleepers and concrete sleepers from strategic planning level. Two Life Cycle Cost oriented policies are discussed to illustrate: high quality track is necessity to improve the cost efficiency of railway maintenance and renewals.
Investigating uncertainty in BPR formula parameters: a case study

Transport models play a prominent role in many decision-making processes. However, transport models are subject to uncertainty, which refers to the impossibility to model with a deterministic approach. If not properly quantified, the uncertainty inherent in transport models makes analyses based on their output highly unreliable. The main consequence of this inherent uncertainty is that modelled traffic flows cannot be expressed as a point estimate, because this would only represent one of the possible outputs generated by the model. Instead, modelled traffic flows are better expressed as a central estimate and an overall range of uncertainty margins articulated in terms of (output) values and likelihood of occurrence.

Uncertainty analysis relates to how uncertainty in each model component propagates to the model output and how to express the model output as a distribution, so reflecting the overall uncertainty within the model. The research described in this paper investigated uncertainty in the BPR formula parameters. Within traffic assignment models, the relationship between travel time and traffic flows is commonly described by the BPR formula. The BPR formula works as a link performance function; given free flow travel time, observed flow and link capacity, it uses parameters to fit the equation to various types of roadways and circumstances. Usually, the values for the parameters are pre-defined, based on assumptions and practice. The present paper describes a work implemented to define the BPR formula parameters distributions from observed data. Two dataset related to the Danish road network, namely Mastra and Hastrid, were analysed so as to estimate the parameters distributions for three different types of roadways: highways, urban roads and local roads. Non-linear regression analyses were implemented to simultaneously calculate the values of the BPR formula parameters for each of the road sections included in the two samples, for a total of 28 sections. The resulting parameters distributions were then used to implement an uncertainty analysis on modelled traffic from the Danish national model based on Monte Carlo sampling technique combined with sensitivity tests. For comparative purposes, in some sections the parameters uncertainty was also quantified through Bootstrap random sampling simulation technique.

The results clearly highlight the importance for modelling purposes of taking into account BPR formula parameters uncertainty, expressed as distribution of values, rather than assumed point values. Indeed, the model output demonstrated a high sensitivity to different parameters values and type of distribution. This proved true for all the three types of roadways analysed, highways, urban roads and local roads. However, different levels of parameters uncertainty, i.e. different levels of spread around the mean values, were observed for the different roadway classes. The results also highlighted the differences in terms of parameters mean values and distribution shape resulting from the use of Monte Carlo sampling as compared to Bootstrap.

Bootstrap sampling procedures, whenever possible, should be preferred to Monte Carlo sampling due to the lower level of assumptions required by the modeler throughout the sampling process.

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Recognizing the limitations of solution algorithms to the behaviourally sound SUE and the efficiency of solution algorithms to the DUE, we introduce a transformation of the cost function. This transformation function opens up a larger array of possible solution algorithms to the SUE, as it allows us to apply any path-based DUE solution algorithm and then obtain a flow solution which satisfies the RSUE or SUE on a pre-specified choice set. The underlying choice model is however restricted to being logit-type. Due to the consistency with the IIA property of logit-type models, we propose heuristic solution algorithms where the direction finding is based on a pair-wise path-swapping algorithm. The transformation function also leads to the proposal of a new Relative GAP-measure (convergence measure) valid for any SUE or RSUE solution algorithm based on the logit-type choice models. Numerical tests on a synthetic network as well as the Sioux Falls network indicate that the proposed solution algorithms induce interesting and promising convergence patterns.

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**Mobilitet og trængsel - Trafikkens centrale dilemma**

Mobilitet og trængsel er helt grundlæggende begreber, når vi taler transport:


Derfor er en af de helt store udfordringer i transportplanlægning og transportpolitik at sikre fortsat høj mobilitet ved at begrænse trængslen. I dette kapitel forklares begreberne, og det vises, hvordan mobilitet og trængsel kan måles. Der vises desuden eksempler på, hvordan bilkøer udvikles over tid, og hvordan serviceniveauet i den kollektive trafik påvirker vores valg af transportmidler.

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**Quantitative Methods for Assessment of Railway Timetables**

The aim of this PhD thesis is to improve the attractiveness of future railway timetables. To achieve this goal, the qualitative term “timetable attractiveness” needs to be made quantifiable. To establish what timetable attractiveness is, the thesis gives an introduction to railway timetables in the form of a timetable definition and an overview of commonly used timetable types and existing timetable classes. All major timetables stakeholders in a given railway sector must agree on the timetable aspects covered by the term “timetable attractiveness”. This research succeeded in creating such an agreement in the Danish railway sector, through a process that included individual stakeholder interviews followed by a joint timetabling criteriaworkshop. The agreement is a list of six prioritized timetable evaluation and optimization criteria. To make the
evaluation criteria quantifiable, a set of key performance indicators (KPIs) was developed for each criterion. A total of 13 KPIs are presented. Their practical applicability has been successfully tested on examples of real-life Danish timetables. The thesis recommends a revised timetabling process at railwayinfrastructure manager Rail Net Denmark (in Danish: Banedanmark) that will take the recommended KPIs into consideration. This new time-tabling process will create the necessary foundation for improving future rail railway timetable attractiveness in Denmark. The aim and the structure of this PhD thesis are described in Chapter 1. The thesis shows how railway traffic and the railway timetable have been interlinked almost from the opening of the first public railway line in 1825. A timetable increases both the traffic safety and the attractiveness of railways. Timetables plan traffic, avoid train collisions, and announce train services to potential customers. Chapter 2 gives an introduction to railway timetables. The thesis identifies a need for an improved European definition of a railway timetable. A two-part definition is introduced, with one part covering a liberalized railway sector and the other covering a state-owned or completely privately owned railway monopoly. The former is an agreement between an infrastructure manager and one or more train operating companies. The latter is an internal company agreement. This is followed by the presentation of some basic facts that apply to all railway timetables. A railway timetable has a time period of validity. In the European Union this has been harmonized to one year and the timetable changes take place on the Sunday following the second Saturday in December. The thesis distinguishes between timetables created as part of long or short-term planning. A short-term timetable tries to make the best of the available resources, such as railway infrastructure and rolling stock fleets, to accommodate as many railway customer preferences as possible. When preparing a long-term timetable, the starting point is to create an ideal timetable that fulfils the customer preferences on the assumption that the necessary infrastructure and rolling stock can be made available. Moreover, the thesis identifies eight basic line structures for train services found in a railway timetable. These basic train service line structures are: 1. Point-to-point line (high speed trains); 2. Circle line (suburban trains or metro); 3. Centralized nodes (e.g. Paris or London); 4. Corridor/tree structure (e.g. the Danish railway network); 5. Star shape (e.g. the metro in Rome); 6. Universal star shape (e.g. the metro in Athens); 7. River network with a core route (suburban trains in Copenhagen and Munich); 8. Meshed railway network (German InterCity-Express trains). Chapter 3 gives an overview of the six most commonly used timetable types in the railway sector. These timetable types are: 1. The public timetable (available to everybody, on paper and/or digitally); 2. The working timetable (primarily used by train staff); 3. The graphical timetable or train graph (used by timetable planners and traffic dispatchers); 4. The track occupation diagram (used by timetable planners and traffic dispatchers); 5. Rolling stock roster plan (used by employees of the train operating companies); 6. Train staff roster plan (used by employees of the train operating companies). The thesis identifies seven existing basic railway timetable classes. At the beginning of Chapter 4, an extended timetable categorization model is presented. The categorization of timetables into classes is based on the level of structure in a given timetable. A set of basic structural characteristics determine the level of structure. These structural characteristics are: 1. Timetable periodicity; the timetable is systematic (repeating traffic patterns); 2. Timetable symmetry (same stopping pattern and travel times for both driving directions of a train service); 3. High frequency train services (train services run at least every 10 minutes). The seven basic railway timetable classes identified by this thesis are: 1. The periodic/systematic timetable; 2. The symmetric periodic/systematic timetable; 3. The integrated fixed interval timetable (IFIT); 4. The high frequency timetable; 5. The non-periodic/non-systematic timetable; 6. The non-periodic/non-systematic timetable. Based on earlier British and Swiss approaches to measuring the level of structure in a railway timetable, the thesis proposes improvements to these existing methods and introduces two new timetable structure indexes based on the newly developed concept of timetable patterns. The two indexes are: 1. Systematic timetable index – using the most used timetable pattern time interval; 2. Systematic timetable index – using the longest continuous timetable pattern time interval. Finally, the seven timetable classes are described and compared in detail with each other. This gives an overview of strengths and weaknesses based on selection, but generally accepted, timetable evaluation criteria. Identifying the basic railway timetable classes in a timetable that covers an entire network is difficult and labour-intensive work. Chapter 5 presents a series of examples of timetable analyses to illustrate the VI Summary Complexity of the task. It starts with the example of one railway line section served by one train service, running according to one timetable class; goes on to the more complicated example of one railway line section served by several train services with different timetable classes, and ends with the most complicated example of an entire railway network served by several timetable classes. The thesis recommends weighting the timetable classes identified with timetable statistical factors such as: the number of train runs, passenger numbers, freight tons, train-kilometres, and passenger or freight ton-kilometres. Chapter 6 starts with a brief historical overview of the liberalization process in the European railway sector and the liberalization of the Danish railway sector in particular. This is followed by a presentation of the overall Danish railway timetabling process. The process is one of collaboration between the infrastructure manager Rail Net Denmark (in Danish: Banedanmark), the train operating companies, and the Danish Transport Authority (in Danish: Trafikstyrelsen), which is the buyer of public railway service traffic. Next comes a detailed description of the timetabling processes at the following railway timetable stakeholders: 1. The Danish Transport Authority – buyer of public railway service traffic; 2. The Danish Transport Authority – buyer of public railway service traffic; 3. The Danish Transport Authority – buyer of public railway service traffic; 4. The Danish Transport Authority – buyer of public railway service traffic; 5. The Danish Transport Authority – buyer of public railway service traffic; 6. The Danish Transport Authority – buyer of public railway service traffic; 7. The Danish Transport Authority – buyer of public railway service traffic. Both DSB and Rail Net Denmark have informal learning loops in their existing timetable processes, in the form of experience based input from employees at the beginning (Rail Net Denmark) and/or evaluation of the proposed timetable before the final approval (DSB and Rail Net Denmark). The research for this thesis initiated a process to reach a consensus on timetable attractiveness in the form of timetable evaluation and optimization criteria in the Danish railway sector for the first time ever. Chapter 7 describes the process in detail. First, the most important railway timetable stakeholders were identified. They are: 1. DSB – the biggest Danish passenger train operating company; 2. Arriva Danmark – the biggest Danish passenger train operating company; 3. Banedanmark – the biggest Danish passenger train operating company; 4. Rail Net Europe – the biggest Danish passenger train operating company; 5. Trafikstyrelsen – the biggest Danish passenger train operating company; 6. The Danish Transport Authority – buyer of public railway service traffic; 7. The Danish Transport Authority – buyer of public railway service traffic.
they could be automated and integrated into future versions of timetabling software packages. Themselves in practical applications on examples of real-life Danish timetables. All calculations were done manually, but the same platform out of the total number 13. Proportion of timetable travel time prolongation (Travel time) - Timetabled extra travel time compared to what is available today. A set of 13 key performance indicators for the Danish railway system is presented in Chapter 9. Seven of these are newly developed. Each key performance indicator is connected to one of the six timetable evaluation criteria. The key performance indicators are: 1. Systematic timetable index (Systematic timetable) - Based on the total time of the most used timetable pattern. 2. UIC 406 methodology (Capacity consumption on railway line sections) - Summary of Compressed timetables based on the blocking time theory. 3. Degree of deviation from timetable planning rules (Robustness of the timetable) - Focus on agreed upon running times and timetable supplements. 4. Conflict Risk Index (Robustness of the timetable) - The number of potential train path conflicts at a station and their estimated risk level. 5. Timetable train path fix points (Robustness of the timetable) - Geographical and temporal distribution of potential train path conflicts. 6. Proportion of train paths with shared rolling stock (Robustness of the timetable) - Number of train paths with shared rolling stock compared to the total number. 7. Proportion of train paths with shared train staff (Robustness of the timetable) - Number of train paths with shared train staff compared to the total number. 8. Proportion of buffer time in turnaround time and hand-over time for rolling stock (Robustness of the timetable) - Level of time supplements at terminus stations for rolling stock until next departure. 9. Proportion of buffer time in turnaround time and hand-over time for train staff (Robustness of the timetable) - Level of time supplements at terminus station for train staff until next departure. 10. Independent organization carrying out customer satisfaction surveys (Societal acceptance of the timetable) - Inspired by the British organization "Passenger Focus". 11. Proportion of timetable transfer time prolongation (Attractive transfer options) - Timetabled extra transfer time compared to physical minimum possible transfer time. 12. Proportion of optimal transfer conditions (Attractive transfer options) - Number of transfers planned to take place on the same platform out of the total number. 13. Proportion of timetable travel time prolongation (Travel time) - Timetabled extra travel time compared to travel time for theoretical non-stop train. These key performance indicators have proven themselves in practical applications on examples of real-life Danish timetables. All calculations were done manually, but they could be automated and integrated into future versions of timetabling software packages.

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Skal hovedstaden lande i trængsel?
Trængselsproblemerne i hovedstadsområdet vil blive markant forværret de næste år. Selv Trængselskommissionens omfattende pakke af forslag er langt fra tilstrækkelig til at løse problemerne. Der skal mere visionære beslutninger til.

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The potential cost from passengers and how it impacts railway maintenance and renewal decisions
To plan Maintenance and Renewals (M&R) for the heavy railway lines, scheduling work possession time and deciding the closure of railway line are quite challenging for Infrastructure Manager (IM) at tactical planning level. As usual, the direct costs such as the materials costs, man power price and machinery costs are the important factors for IM to evaluate all the alternative schedules. At the same time, the potential cost from passengers is also crucial to minimize the impacts to the society.

A phase-based planning toolkit is developed to help IM to plan and compare project proposals from a wider cost scope, integrating the passenger loss and direct costs into the comparison at planning stage. Passenger loss is estimated basing on the potential delay time values.

The case study shows the potential cost from passengers is one of the key factors impacting the rank of M&R options. It even dominates the overall cost comparison for the busiest railway stations. In such case, the track closure time has to be decided according to the passenger loss instead of the direct costs. Sometime the best proposal for society might be the most expensive solution for IM. Therefore the potential passenger loss is not something that can be ignored at planning stage.

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Efficiency of Choice Set Generation Methods for Bicycle Routes
With a growing interest in sustainable transport systems, the interest has increased on encouraging more cycling. To encourage cycling, it is important to identify which network attributes influence cyclists route choice and evaluate the trade-offs among these attributes. To analyse travel behaviour, observed choices and alternatives composing the choice set of each cyclist are necessary. However, generating the alternative choice sets can prove challenging. This paper analyses the efficiency of various choice set generation methods for bicycle routes in order to contribute to our understanding of choice generation for highly detailed networks.

There is a substantial amount of literature that studies cyclists’ route choices. Most studies have been based on stated preference (SP) data (see, e.g., [1,2]). Although SP data have a lot of benefits there are some disadvantages, e.g. the challenge to, without bias, predefine what cyclists consider when choosing a route. There have been few revealed preference (RP) studies reported in the literature (see, e.g., [1,2]). One disadvantage with RP data is that generating
alternative routes can prove difficult. The benefit of collecting travelling information with GPS loggers, compared to self-reported RP data, is more accurate geographic locations and routes. Also, the GPS traces give more reliable information on times and prevent trip underreporting, and it is possible to collect information on many trips by the same person without reporting fatigue. GPS data require nevertheless extensive post-processing and in some cases mode imputation. They also require a very detailed digital network to map the routes accurately, which can lead to high computation times during choice set generation, as well as issues with behavioural realism that might produce inconsistent estimates. There have been some studies on bicycle route choice set generation reported in the literature, whereof few studies focussed on route choice models for bicyclist estimated from GPS observations. Menghini et al. [3] successfully applied a Breadth First Search on Link Elimination (BFS-LE) approach. Broach et al. [4] tested three different choice set generation methods, i.e. K-shortest paths, simulated shortest paths, and route labelling. None of these methods proved to be satisfactory and a modified route labelling method was proposed instead.

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Companies in many different business areas face unexpected budget overruns when carrying out large-scale projects. Usually this happens because of underestimation of actual costs during budgeting. That is why it is important to have specific knowledge of the market situation, not only in one specific country, but also outside the country’s borders. It helps, for example, to find relevant information about construction materials to lower prices and reducing a project’s planned costs by several per cent. The same is true of technology and the companies involved in the construction of the project. “The New Line Copenhagen-Ringsted” project being developed by Rail Net Denmark will be the first high-speed railway line in Denmark with a total budget of EUR 1.10 billion. The focus is on avoiding a budget overrun and on therefore looking for ways of reducing project costs. We have conducted a benchmark study of other similar high-speed railway lines in Europe. France, Italy, and Spain have long and productive experience in constructing and operating high-speed railway lines. Investigating their best practices brings valuable knowledge to the project. This paper presents the data we gathered and our results, which will be useful for other infrastructure managers. Infrastructure managers will be able to make their own benchmarks to come.

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GNSS-based Road Charging Systems - Assessment of Vehicle Location Determination

An increasing demand for satellite-based road charging systems is developing in Europe. Satellite-based road charging involves charging road users for their road usage by allowing the vehicles to locate themselves within a certain charge area using Global Navigation Satellite Systems (GNSS). The research presented in this thesis deals with the performance and technological challenges of vehicle location determination within GNSS-based road charging systems.

GNSS-based road charging systems may take on a number of different forms. Depending on the charging objective, these road charging systems can be designed in various forms and varied by both policy and technology but they all share the overall function of charging vehicle users for their road usage. The first part of the thesis presents a comprehensive overview and classification of the various forms of road charging systems and enabling technologies; supplemented with a review of different worldwide examples. Next the system fundamentals are defined and presented in a conceptual framework which forms the basis for the research presented in this thesis. In order to understand the structure and behaviour of GNSS-based road charging systems, it is important to highlight the overall system architecture and define the essential system functions and describe the relationship among them. The framework is used as a means to structure the discussion about the technological challenges of GNSS-based road charging systems.

The thesis discusses the overall performance requirements for the road charging process within GNSS-based road charging systems. GNSS allows for time-distance-place charging, where charges are calculated for each individual vehicle based on the distance driven, the time of the trip and the vehicle’s geographic position. Timedistance-place charging is therefore considered a more fair and efficient way of charging as these systems levy charges proportionally to the distance travelled, and thereby reflects a usage-based approach more accurately than other charging policies. However, road charging on the basis of the distance travelled is technically challenging and is seen as one of the most complex schemes. Determining the distance driven is the key part of the charging process and the main dependability concerns therefore revolve around the road charging process and the performance of the vehicle location determination function. The thesis provides a thorough review of the different GNSS-based trials and experiments conducted within recent years to assess the performance and possibilities of GNSS-based charging systems. In 2007–2009, a GNSS-based road charging experiment was conducted in Copenhagen as part of this research in cooperation with Siemens to assess the performance and technical challenges of GNSS-based road charging systems based on state of the art road charging technology. This thesis presents the experiment conducted and provides an assessment of the vehicle location determination function within GNSS-based road charging systems. Previous trials and performance assessments of GNSS-based road charging systems have generally focused on the possibilities of the charging systems rather than on the impossibilities. Often it has not been clearly described which errors and shortages existed in the collected data, but instead they have just been excluded as invalid data prior to the assessments which then concluded that more focus should be placed on the errors occurred. Hence, it has been deliberate in this PhD research not to exclude faulty and incorrect data in the assessment. The results presented in this thesis are based on all the collected data from the experiment, in its original form, as it would be used as input for the automated charge calculation process in a road charging system. Furthermore, new methodologies are developed for assessing the performance of the vehicle location determination function in terms of data reliability and navigation function performance. The results from the assessments conducted in this thesis demonstrate that although significant performance improvements have happened during the last five years, there are significant challenges to overcome in relation to implementation and operation of GNSS-based road charging systems. The technical experiment conducted in this PhD study proved to suffer from different technical challenges which had different impacts on the overall system dependability. Due to these challenges, data includes both inaccurate and incomplete data information, and it is hence concluded that with these high levels of data invalidity and deficiency, data could not be used in its current form as basis for a road charging process. These results underline the importance of a data processing functionality prior to the road charge calculation and usage determination in the road charging process.

The assessment of the vehicle location determination function show significant difference in the required navigation performance. While the accuracy requirement in Copenhagen was partly met, the continuity and hence availability required for vehicle location determination suffered from severe gaps in the positioning data. These gaps were due to both satellite unavailability, caused by poor urban signal reception and long receiver acquisition times, and furthermore due to the various technical problems and configuration faults which occurred during the experiment. As both the satellite visibility and the positioning accuracy had improved significantly, the results indicate that the main challenges related to vehicle location determination are not as often stated due to positioning inaccuracies but rather due to a high level of positioning interruptions mainly caused by GPS. From the performance assessment it is furthermore concluded that the main concerns regarding the unavailability of the vehicle location determination should be how to eliminate the large downtime and configuration gaps and reduce the occurrence of the many GPS gaps. As data outages and failures may affect the determination of the distance driven in continuous charging schemes, the thesis provides means to assess and understand the positioning gap occurrence, contribution and effects in relation to GNSS-based road charging systems. Hence, an assessment of the driven distance determination tolerance towards these
different positioning related outages is provided. The assessment is conducted on the basis of a simulation methodology developed in this thesis. It analyzes the influence of positioning gaps on the determination of the driven distance in both distance-based and distance-related GNSS-based road charging schemes. The gap tolerance of the distance determination in both types of charging schemes is important for the road charging system’s ability to meet the performance requirements and charge the road users correctly for their road usage. The simulation analyses of the gap influence on the driven distance determination show that the distance determination function is relatively robust against small gaps of less than 10 seconds in the positioning. However, with several medium and large gaps in the trips, both distance determination methods have trouble in reproducing the driven distances with distance deviations more than 1 % from the truth. The importance of these results is that for the majority of trips the distance driven can be determined with less than 1 % distance deviation as the occurrence of small gaps is most frequent in trips. GNSS-based road charging systems are considered liability-critical systems, where denial of service and undetected fault and failures generate significant legal or economic negative consequences. Any fault or failures that lead to incorrect charging may cause economic loss or provoke wrong legal decisions as the economic liability is associated to the legal aspects due to the repercussion of potential claims. Hence, the thesis introduces the use of system dependability of GNSS-based road charging systems. The concepts of system dependability, adapted from computer engineering, provide an effective means of managing various concerns for road charging systems within a single conceptual framework. Dependability is an important requirement for a GNSS-based road charging system as the system must provide fair charging and gain user trust by ensuring system reliability and liability. This thesis discusses the impact of the assessment results in relation to system dependability and provides a qualitative dependability risk matrix for the vehicle location determination function.

To ensure high dependability of the road charging process, fault tolerant design should hence be considered in relation to many different components and functionalities within the process. Based on fault tolerant methodologies, this thesis provides guidelines of how to maintain correct service in the presence of different faults caused by technical problems related to vehicle location determination. The main objective of fault tolerant design within the road charging process is to ensure fair charging of the road users. This means that redundant systems, procedures and components should be implemented to ensure that when fault and failures occur within the road charging process, the road charge foundation will still be dependable and provide fair results towards both the road users and the road charging system. This thesis therefore concludes that though the vehicle location determination performance is fair, the focus of the system performance concerns should be placed on how future GNSS-based road charging system can be designed to work reliably with the occurrence of both data invalidity and data deficiency. It is therefore important to widen the focus from technical challenges and component inaccuracies alone to a focus on the system dependability as a whole. There is however still some technological challenges to overcome, which to a greater extent are remediated by better collaboration across the many different subject areas. As with many other ITS systems, a successful design, implementation and operation of a system is only achieved when the many different stakeholders understand each other’s requirements to the system. The system architecture as a conceptual design together with the system engineering methodology can help to involve all the different parties in the system development and hence minimize the misunderstandings which at the end can become very costly for the system.

Based on the several findings of this PhD research, some general guidelines are finally formulated for future GNSS-based road charging systems. The proposed guidelines described in the thesis address both GNSS-based road charging trials in general and a future GNSS-based road charging system in Denmark.

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Socioeconomic differences in public acceptability and car use adaptation towards urban road pricing
Urban road pricing is regarded as an effective instrument to reduce traffic congestion and environmental-related problems in metropolitan areas. Whereas the overall impact of urban road pricing on car use adaptation and public acceptability is known, there are only inconsistent results concerning the socioeconomic differences in the response towards road pricing.
However, this knowledge is necessary for the development of urban road pricing packages. This paper uses a segmentation approach to identify groups of car users with a similar background in relevant socioeconomic variables and compares their responses towards road pricing. Three groups are identified: young families, suburban families, and singles and couples. These groups indeed differ in their car use adaptation towards urban road pricing as well as in their preferred revenues use. While all three groups significantly reduced their private car use, the young families reduced their car use most, followed by the group of singles and couples. Complementary measures are discussed that are believed to facilitate car use adaptation of each group in response towards urban road pricing.

**General information**

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Generation and quality assessment of route choice sets in public transport networks by means of RP data analysis

Literature in route choice modelling shows that a lot of attention has been devoted to route choices of car drivers, but much less attention has been dedicated to route choices of public transport users. As modelling route choice behaviour consists of generating relevant routes and estimating discrete choice models, this paper focuses on the issue of choice set generation in public transport networks. Specifically, this paper describes the generation of choice sets for users of the Greater Copenhagen public transport system by applying a doubly stochastic path generation algorithm and evaluating the ability to reproduce choices collected in the Danish Travel Survey.

System Convergence in Transport Modelling

A fundamental premise of most applied transport models is the existence and uniqueness of an equilibrium solution that balances demand $\lambda(t)$ and supply $t(x)$. The demand consists of the people that travel in the transport system and on the defined network, whereas the supply consists of the resulting level-of-service attributes (e.g., travel time and cost) offered to travellers. An important source of complexity is the congestion, which causes increasing demand to affect travel time in a non-linear way.

Transport models most often involve separate models for traffic assignment and demand modelling. As a result, two different equilibrium mechanisms are involved, (i) the internal traffic assignment equilibrium, and (ii) the external equilibrium loop between the assignment model and the demand model. Traditionally, there has been much research focus on the internal assignment equilibrium, which involves iterating...
between a route-choice (demand) model and a time-flow (supply) model. It is generally recognised that a simple iteration scheme where the level-of-service level is fed directly to the route-choice and vice versa may exhibit an unstable pattern and lead to cyclic unstable solutions. It can be shown that the contractor region, e.g. the region for which \((x,t)\) is stable, depends on the demand and the supply curve. Generally, as the slope \((i.e., \frac{dx(t)}{dt} and \frac{dt(x)}{dx})\) between the curves increases, the contractor region shrinks. To obtain stable convergence various techniques including the method-of-successive-averages (MSA) have been proposed. Convergence of the MSA under fairly weak regularity conditions was shown in Robbins and Monro (1951).

The iteration between demand and assignment ? the external equilibrium ? are in many models either decoupled or follow a very simple iteration pattern. However, as demand models are often based on logit or probit models, and thus conform to the way demand is represented in stochastic assignment models, there is reason to believe that convergence problems should also be expected in the external equilibrium loop. The intuitive explanation is that, if an iterative solution algorithm may not converge in traffic assignment with fixed demand (base OD-matrix), adding the complexity of variable demand makes the problem even more difficult to solve. At a more practical level there is also the issue of computation time needed to obtain a certain level of precision. As the external equilibrium loop involves running a complete assignment model combined with a complete demand model (which may involve simulation of taste heterogeneity), iterations are much more costly than for the inner loop. This does not justify a simple iteration scheme for the sake of simplicity. As only 3 to 8 iterations may be possible in practice, it is important that these are spent wisely.

In the paper, we first investigate in details the convergence of the inner assignment loop and demonstrate the conditions for stability. On a synthetic network we explore convergence performance of various techniques including MSA, weighted MSA and adaptive averaging. Hereafter, we focus on the convergence of the external loop. To facilitate the analysis, the synthetic model framework is extended to include a demand model for the choice of mode, which is iterated with a stochastic assignment algorithm. A detailed stability analysis based on simulation experiments is presented and conditions for stability are explored. Finally, we investigate techniques for improved speed of convergence. In addition to the techniques tested for the inner-loop, which were all based on the MSA averaging principle, we explore the possibility of using gradient-based algorithms. This includes a simple linear curve fit approach, a spline approximation, and a Newton-based algorithm. In each of these cases, the idea is to utilise knowledge of the curvature of the demand curve to obtain faster convergence. Problems and limitations are discussed.

**General information**

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Methods to estimate railway capacity and passenger delays

CHAPTER 1 explains the importance of having knowledge about railway capacity and how, over time, it has become possible to operate more trains by improving the infrastructure and rolling stock. Additionally, the aim and structure of the thesis are outlined. CHAPTER 2 describes the difficulties of defining railway capacity, which depends on the infrastructure, the rolling stock and the actual timetable. In 2004, the International Union of Railways (UIC) published a leaflet giving a method to measure the capacity consumption of line sections based on the actual infrastructure and timetable (and thereby also the rolling stock used)—the UIC 406 capacity method. The UIC 406 capacity method can be used in an analytical way determining the capacity consumption as the sum of the occupation time, buffer time, and time supplements. This sum is then divided by the time window observed. In addition to the analytical way of determining the capacity consumption, capacity consumption can be measured by compressing the timetable graphs as much as possible for the line section and then using the compression ratio as a measurement of the capacity consumption. CHAPTER 3 shows how the UIC 406 method can be expounded in different ways. It is, therefore, important to divide the railway line into line sections of the “right” length. The thesis illustrates that it may be reasonable not to divide the railway lines into line sections at all locations as suggested in the UIC 406 capacity method. Not dividing the railway lines into line sections at overtakeings may result in additional challenges when working out the capacity consumption. To handle overtakeings in line sections, the thesis recommends maintaining the order of the trains (both before and after the overtaking) and also allowing for changing the dwell time to the minimum dwelling time for exchange of passengers and/or the needed time for start moving (a freight train) after a complete halt. At crossing stations, line end stations, larger stations with shunting, and junctions, the thesis recommends that attention be paid to conflicting train paths. The crossing station’s lack of ability to handle parallel movement can reduce the capacity of the line section as the dwell time is extended. The line end stations can be limiting for the capacity because not all avoiding lines may be scheduled and/or the layover time is longer than needed. The thesis recommends dealing with this by reducing the layover time to a minimum and by using all possible avoiding tracks. Larger stations with shunting can be difficult to examine due to lack of knowledge of the exact shunting operation. Therefore, the thesis recommends that larger stations should be evaluated according to the published timetable and only the known shunting operations but with a higher quality factor or other time supplements to include the remaining shunting implicitly. At junctions and crossing stations, conflicting train routes can result in reduced capacity for some train paths. Accordingly, the thesis recommends extending the analysis area for crossing stations and junctions to include the entire crossing station and/or junction. For line sections with more than two tracks, the thesis illustrates that attention must be paid to the order of the trains at both the beginning and the end of the line section as otherwise there is a risk of additional overtakeings occurring. Furthermore, more tracks can result in uneven capacity consumption. Accordingly, the thesis recommends allowing trains to change from one track to another if there is a large difference in the capacity consumption of the tracks. If tracks are located apart from each other it might be difficult to determine how many tracks a railway line comprises. Therefore, the thesis proposes that the railway line is considered as one line section if there is mainly one-way operation on the tracks and if both corridors are served in both directions and different stations are serviced it should be considered as two lines. The thesis puts forward a method to use the UIC 406 capacity leaflet to evaluate the future capacity consumption without knowing the exact infrastructure and/or timetable. This is done by using successive calculation, where the capacity consumption is calculated for the best-case situation (where the lowest capacity consumption is achieved by bundling the trains) and the worst-case situation (where the highest capacity consumption is achieved) together with the capacity consumption of a proposed future timetable. These capacity consumptions are then weighted together to describe the expected capacity consumption. IV DTU Transport, Technical University of Denmark

The thesis shows that not all idle capacity can be used to operate more trains—this can be due to capacity constrains outside the analysis area, network effects or the fact that more trains will reduce the punctuality of the railway line. Although the UIC 406 capacity method is a straightforward and (with the right tools) fast method to evaluate railway capacity, the method has paradoxes. The thesis demonstrates that if the UIC 406 capacity method is used stringently, an extra overtaking due to lack of capacity can result in much more capacity as the railway line is divided into shorter line sections. The thesis also shows that an extra train line resulting in shorter line sections can result in more capacity as the railway line should be divided at all line end stations. For single track railway lines, the thesis shows that there is a paradox of an extra train line resulting in more capacity as a consequence of more stations where the trains pass each other. This uncertainty can be reduced by adding “dummy” trains in the timetable and dividing the railway line into line sections where crossings occur and then compressing the timetable (without the “dummy” trains). To obtain a detailed overview of railway capacity, it is not sufficient to describe merely the capacity consumption. With this in mind, the thesis recommends also describing how the capacity is utilized. The UIC 406 capacity method describes how the capacity is utilized based on four topics (Number of trains, Average speed, Heterogeneity, and Stability)—the so-called “balance of
capacity. The four topics are normally correlated, but analytical measurements dealing with each topic individually are developed in CHAPTER 4. The thesis illustrates that the four measurements (developed in chapter 4) describing the balance of capacity can be used at different levels of detail. The different levels of detail make it possible to describe how the capacity is expected to be utilized in all stages of planning. In the first stages of planning—with only limited knowledge about infrastructure and timetable—the measurements describing how the capacity will be utilized are uncertain but as more detailed information becomes available, a more precise description of the capacity utilization can be given. When conducting capacity analyses, it is important to be able to communicate the results in an understandable way. CHAPTER 5 suggests this to be done by visualizing the results in different intervals on maps, e.g., free capacity, balance, shortage, and problem. The thesis demonstrates that when visualizing and describing the results, the results depend on the quality factor used and the accepted level of punctuality. Consequently, it is important that the same intervals and quality factors are used for the different analyses in order to be able to compare the results. The thesis shows that while it is possible to illustrate individually the capacity consumption, number of trains, average speed, heterogeneity, complexity, and stability it is difficult to illustrate the factors simultaneously and in a straightforward manner. Therefore, the thesis suggests using a GIS-based system to show maps of the capacity with the possibility of clicking on a line section to get other details of the capacity consumption. If changes are made in the way of stating railway capacity, the line sections or the methodology behind the calculations, it is difficult/impossible to compare the results. For this reason, the thesis recommends documenting the changes and make overlapping statements to be able to compare the results over time. CHAPTER 6 shows how capacity is affected in the event of contingency operation such as reduced number of tracks and/or speed restrictions on a railway line. Further, the chapter shows how the best location of crossovers can be found to ensure a reasonable service in times of contingency operation. However, to ensure sufficient capacity in the case of (un)scheduled single track operation, the chapter describes how capacity can be gained by bundling the trains. Contingency operation can result in delays, but delays can also occur due to smaller incidents such as errors on trains and/or signal failures. CHAPTER 7 divides the delays on railways into initial delays and consecutive delays. The thesis demonstrates that the amount of consecutive delays can be estimated DTU Transport, Technical University of Denmark V analytically based on the initial delay, the headway time, and the minimum headway time. The thesis also shows that the amount of consecutive delays depends on the consumption of the railway line. Consecutive delays can be estimated analytically only for idealized situations, as, for example, delays can propagate from railway line to railway line. The thesis shows that two initial delays occurring just after each other can result in fewer consecutive delays than if the initial delays occurred at longer time intervals, and that this situation may be difficult to detect analytically. To have a more accurate estimation of delays, the thesis proposes using simulation models. The simulation models can calculate the delays for an entire network and take the time interval between the initial delays into account too. Although simulation models are the most accurate method to estimate delays, the thesis states that models could be improved if more realistic dispatch strategies were developed. When a train is delayed the passengers, too, are delayed. CHAPTER 8 presents different methods and models that can be used to calculate these passenger delays. The thesis categorizes the passenger delay models into generations and evaluates their advantages and disadvantages. "0th generation" models that do not incorporate route choices of the passengers are highly inaccurate, whilst 1st generation models that assume full knowledge of the delayed timetable systematically underestimates the passenger delays. 2nd generation methods that simulate several timetables partly overcome this problem. The 3rd generation models incorporate en route changes of decisions, whereby the passengers are first assumed to act on delays when they occur in time and space. The thesis also describes how the en route changes increase the accuracy of the passenger delay model. The thesis shows that it is possible to implement and run a 3rd generation passenger delay model for a network the size of the Copenhagen suburban railway network. Depending on the amount of delays, the run time of the model is 5–10 minutes for one day. Since the routes are recalculated when delays occur, the calculation time increases with the irregularity of the operation. The thesis shows that the resulting passenger delays differ largely from the train delays in the Copenhagen suburban railway network. The difference between the train punctuality and passenger delays is due to the different number of passengers in the trains during the day, transfers between lines, and the fact that passengers (to some extent) will change routes due to delays. Furthermore, there is a higher risk of delays in rush hours due to more trains and more passengers on the trains. Chapter 8 develops a method to combine 3rd generation passenger delay models with simulation software for railway operation on the microscopic level. This makes it possible to generate a number of timetables that can be used as input when calculating the expected passenger delays in a future situation. The thesis shows that an evaluation of passenger delays obtained with simulation software (in this case RailSys) and the passenger delay model is comparable with the daily operation of the Copenhagen suburban railway network. Using a microscopic simulation model, the thesis demonstrates that it is possible to compare travel times and delays (for both trains and passengers) for different future scenarios and for changes in the infrastructure as well as in timetables. CHAPTER 9 illustrates that railway operation can have scheduled delays denoted as scheduled waiting time. This is when a fast train in the timetable must reduce speed because it cannot overtake a slower train. The additional running time affects both the trains and the passengers on the trains. However, the thesis demonstrates that the passengers are also affected by scheduled waiting time in the case of transfers. The thesis explains how scheduled waiting time for trains can be calculated by simulation models, such as the Danish SCAN model and the North American TPC model. Based on the scheduled waiting time for trains and passenger delay models (1st generation and upwards) it is possible to calculate the scheduled waiting time for passengers. The thesis also explains how it is possible to estimate the scheduled waiting time in the case of delays. In this case, the thesis recommends that the 3rd generation passenger delay model is used (when the data are available) since it is the most precise type of passenger delay model and does not require more work effort than previous generations of passenger delay models. VI DTU Transport, Technical University of Denmark Calculating scheduled waiting times for candidate timetables makes it possible to test different timetable strategies and choose the best strategy for the final timetable. This can improve the timetables for both the operator(s) and the passengers. In the longer term, the approach can be used at the centralized control offices in the event of contingency operation. Here, an evaluation of the network effects can be used to select the
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Sample selection and taste correlation in discrete choice transport modelling
The subject of this thesis is discrete choice analysis in transport modelling. Many situations within transportation research may be modelled as a choice from a discrete set of alternatives. The framework of random utility maximisation is well-established to model such choices but there are still many issues that deserve attention. This thesis investigates how sample selection can affect estimation of discrete choice models and how taste correlation should be incorporated into applied mixed logit estimation. Sampling in transport modelling is often based on an observed trip. This may cause a sample to be choice-based or governed by a self-selection mechanism. In both cases, there is a possibility that sampling affects the estimation of a population model. It was established in the seventies how choice-based sampling affects the estimation of multinomial logit models. The thesis examines the question for a broader class of models. It is shown that the original result may be somewhat generalised. Another question investigated is whether mode choice operates as a self-selection mechanism in the estimation of the value of travel time. The results show that self-selection can at least partly explain counterintuitive results in value of travel time estimation. However, the results also point at the difficulty of finding suitable instruments for the selection mechanism. Taste heterogeneity is another important aspect of discrete choice modelling. Mixed logit models are designed to capture observed as well as unobserved heterogeneity in tastes. But just as there are many reasons to expect unobserved heterogeneity, there is no reason to expect these tastes for different things to be independent. This is rarely accounted for in transportation research. Here three separate investigations of taste correlation in willingness-to-pay estimation are presented. The first contribution addresses how to incorporate taste correlation in the estimation of the value of travel time for public transport. Given a limited dataset the approach taken is to use theory on the value of travel time as guidance in the specification of the correlation. The second contribution examines how different distributional assumptions are affected by the inclusion of taste correlation. The third contribution investigates the correlation patterns between willingness-to-pay measures for different public transport modes and how to capture them in the simplest possible way. A general feature of the three investigations is that we find scale heterogeneity. Since this induces correlation it is an important aspect of taste correlation to specify the scale correctly. We see that scale heterogeneity may be partly explained by background variables. Looking at the three contributions on taste correlation there seems to be the general conclusion that significant taste correlation is often present and that it sometimes has an effect on willingness-to-pay evaluation. A conclusion for applied work is that it should allow for correlation if this has not been sufficiently captured by the remaining specification of the model.
Estimation of speed-flow and flow-density relations on the motorway network in the greater Copenhagen region

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Improving and optimising road pricing in Copenhagen

The question whether to introduce toll rings or road pricing in Copenhagen has been discussed intensively during the last 10 years. The main results of previous analyses are that none of the systems would make a positive contribution at present, when considered from a socio-economic view. Even though quite a number of proposed charging systems have been examined only a few pricing strategies have been investigated. This paper deals with the optimisation of different designs for a road pricing system in the Greater Copenhagen area with respect to temporal and spatial differentiation of the pricing levels. A detailed transport model was used to describe the demand effects. The model was based on data from a real test of road pricing on 500 car drivers. The paper compares the price systems with regard to traffic effects and generalised costs for users and society. It is shown how important it is to evaluate different temporal and spatial charge settings for a given road pricing system. In particular, the kilometre-based system could be considerably improved. By optimising the system it became profitable with regard to generalised user costs. However, even though the best toll ring
could be considerably improved, it did not reach break-even with regard to generalised user costs.
Large-scale international road traffic assignment - challenges and solutions

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Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
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Large-scale schedule-based transit assignment - Further optimisation of the solution algorithm

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Passengers route choices in delayed rail networks

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Sensitivity analysis of traffic model zone aggregation

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The AKTA road pricing experiment in Copenhagen

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Authors: Nielsen, O. A. (Intern), Vildrik, M. (Ekstern)
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The European TRANS-TOOLS transport model

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Traffic Model for Copenhagen - Updating of trip matrices

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Authors: Nielsen, O. A. (Intern), Overgård, C. H. (Intern), Vuk, G. (Intern)
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A socio-economic assessment of proposed road user charging schemes in Copenhagen

Road pricing, congestion charging, toll-systems and other road charging instruments are intensively discussed in many countries. Although many partial analyses of the consequences have been published, few overall socio-economic analyses have been carried out. The article presents such a socio-economic analysis of four different proposed road pricing schemes for the Copenhagen area. The purpose was to assess all benefits and costs involved, including impacts on traffic and environment, maintenance and financing costs as well as tax distortion effects. It was concluded that the socio-economic surplus of the projects depends crucially on the congestion level. With the current traffic level, road pricing will not yet be socially expedient in Copenhagen. However, if the opening year is postponed to 2015, the two most favourable schemes will turn positive. The analyses also showed that the magnitude of demand response by introducing road pricing is likely to have significant impact on the project surplus. This is an important observation because most short term driven traffic models will then underestimate the projected surplus. Finally, it was found that the degree to which benefits outweigh costs depends considerably on the use of revenue. Although it may contribute to decreasing road congestion, recycling all of the revenue back to the transport sector turned out to be inefficient and costly.
Estimation of a route choice model with congestion and congestion charging explicitly described

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Authors: Rich, J. (Intern), Mabit, S. L. (Intern), Nielsen, O. A. (Intern)
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Estimation of speed-flow and flow-density relations on the motorway network of the greater Copenhagen area

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Fremtidens S-bane: - idéoplæg om ny S-togslinie gennem København

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Improved map-matching algorithms for GPS-data - - Methodology and test on data from The AKTA roadpricing experiment in Copenhagen.

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Modelling route choice sets in transportation networks: Principles and empirical validity

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Network Effects in Railways

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Road pricing and its consequences for individual travel patterns

While mobility pricing is discussed as a suitable tool for tackling urban traffic problems, its impact on the travel pattern of individuals is largely unexplored. Individual responses to pricing emerge as a number of different changes. As an example, it involves the reduction in actual trip-making, more efficient route-choice decisions, trip chaining, and change of destination choice. The analysis of reliable data seems necessary to gain a deeper insight into the personal motivations of behavioural adjustments to the new monetary constraints. The AKTA Copenhagen study - which was part of the European Union-funded project Pricing Road Use for Greater Responsibility, Efficiency and Sustainability in Cities (PROGRESS) - was a real-life experiment of road pricing in the greater Copenhagen region, which allows one to trace these changes under realistic conditions. During 2001 and 2002, 400 cars were equipped with GPS data-loggers over a period of up to 26 weeks, of which 352 cars had enough observations for further information. In 2003 a third round was carried out with 100 cars, resulting in 91 valid observations. The on-board systems monitored vehicle movement data for each second and were used to simulate road pricing by displaying cost information for every trip driven. The experiment showed significant demand effects with a decrease in daily kilometres travelled between 0 and 40 per cent depending on the location and the pricing scheme; however, the deeper impacts on personal mobility have so far been largely unexplored. One of the appealing features of AKTA is the possibility of examining the different pricing systems applied in their impact on personal mobility. This article explores the question of how road pricing impacts destination choice by a detailed analysis of the rich GPS trip dataset. The panel structure with multiple observations for single cars/drivers allows us to investigate the diversity of individual activity repertoires and related travel patterns in both the control and the pricing periods. In particular, the analysis aims at describing how road pricing affects the choice of destinations and the size and structure of activity spaces (employing measures developed for longitudinal travel data by Schönfelder and Axhausen).

General information
Sensitivity analysis of socio-economic values of time for public transport projects
The socio-economic time benefits of two light rail projects in Copenhagen are investigated using three different sets of values of time. The first set is the one the Ministry of Transport recommends for use in socio-economic analysis in Denmark; this is used as basis for comparison with the two other sets of values of time. The second set is the expected new recommended values of time that has the same time values for non-business travel. The third set is estimated from traffic modelling parameters and operates with different in-vehicle time values; the reason for this is thoroughly described supported by examples. Traffic modelling of the two light rail projects has been performed and the results are used to generate the time benefits. The time benefits for the two light rail projects using the expected new values of time will increase around 20% compared to the result when using the values recommended by the Ministry of Transport. Differentiated in-vehicle values prove to generate an even higher increase in time benefits, but vary depending on the projects.
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Triangulation of data sources for analysing responses to road pricing in Copenhagen.

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Title of host publication: Urban Transport XII : Urban Transport and the Environment in the 21st Century

An Analysis of Stand-alone GPS Quality and Simulated GNSS Quality for Road Pricing

Use of GPS for road pricing has often been suggested as the way of creating more efficient charging strategies than existing systems based on cordon lines or time use. In Denmark, Copenhagen participated with the AKTA project in the PRoGRESS programme, sponsored by the EU. The major part of the AKTA project was to equip 500 cars with GPS receivers. The paper presents the methods and results from a study of GPS quality in relation to road pricing in a dense urban area. The collected data from 500 cars over a two-year period in the Copenhagen region was analyzed in order to determine whether the stand alone GPS quality and reliability is adequate for implementation of an operational road pricing system in Copenhagen. The results from the analysis show that the satellite availability in Copenhagen is not sufficient to form the basis for a reliable operational road pricing system. The narrow street canyons in downtown Copenhagen prevent a sufficient amount of satellite signals to reach street level, which causes too many gaps in the position logs to implement a fair and reliable taxation scheme. The need for augmentation is evident, and with the advent of Galileo within a few years, it is relevant to investigate how integrated GPS/Galileo receivers will change the situation.

With a Galileo simulator, an analysis of the GNSS (Global Navigation Satellite Systems) availability in the streets of Copenhagen was carried out. The results show, that there will still be streets in downtown Copenhagen were the receiver–satellite geometry represented by the HDOP is not sufficient for reliable positioning during the full 24 hours of a day, even when combined GPS-Galileo receivers are introduced.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Zabic, M. (Intern), Nielsen, O. A. (Intern)
Pages: 859-868
Publication date: 2006

Host publication information
Title of host publication: Urban Transport XII : Urban Transport and the Environment in the 21st century
Place of publication: Southampton, UK
Publisher: WIT Press
Editors: Brebbia, C., Dolezel, V.
Main Research Area: Technical/natural sciences
Conference: Urban Transport 2006, Prague, CZ, 01/01/2006

Dårligere passager- end toregularitet

General information
**Deliverable 3: Report on model specification and calibration results**

**General information**
State: Published
Organisations: Traffic Modelling, Department of Transport
Number of pages: 84
Publication date: 2006

**Publication information**
Place of publication: DGTRen, European Commision
Publisher: TNO, Holland
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188496
Publication: Research › Report – Annual report year: 2006

**Fremtidsscenarier for transport i Danmark: Fremtidsscenarier vedr. transport i Danmark**

**General information**
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Landex, A. (Intern), Rørbech, J. (Intern)
Number of pages: 84
Publication date: 2006

**Publication information**
Publisher: Ugebladet Ingeniøren
Original language: Danish
Main Research Area: Technical/natural sciences
Electronic versions: ing_trafikrapport_sep2006.pdf
Source: orbit
Source-ID: 192950
Publication: Communication › Report – Annual report year: 2006

**Future scenarios for transport in Denmark**

**General information**
State: Published
Organisations: Department of Transport
Authors: Nielsen, O. A. (Intern), Rørbech, J. (Intern), Landex, A. (Intern)
Pages: 82-82
Publication date: 2006
Globalization and public transport - Myth or reality

General information
State: Published
Organisations: Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2006

It is a bad idea to use all the revenue from roadpricing to the public transport

General information
State: Published
Organisations: Department of Transport
Authors: Nielsen, O. A. (Intern), Rich, J. (Intern), Nielsen, U. (Ekstern)
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: The Engineer
ISSN (Print): 0013-7758
Ratings:
Scopus rating (2016): SJR 0.1 SNIP 0 CiteScore 0
Scopus rating (2015): SJR 0.1 SNIP 0 CiteScore 0
Scopus rating (2014): SJR 0.1 CiteScore 0
Scopus rating (2013): SJR 0.1 SNIP 0 CiteScore 0
ISI indexed (2013): ISI indexed no
Scopus rating (2012): SJR 0.1 SNIP 0 CiteScore 0
ISI indexed (2012): ISI indexed no
Scopus rating (2011): SJR 0.1 SNIP 0 CiteScore 0
ISI indexed (2011): ISI indexed no
Scopus rating (2010): SJR 0.1
Scopus rating (2009): SJR 0.102
Scopus rating (2008): SJR 0.1
Scopus rating (2007): SJR 0.1
Scopus rating (2006): SJR 0.1
Scopus rating (2005): SJR 0.101
Scopus rating (2004): SJR 0.1
Scopus rating (2003): SJR 0.1
Scopus rating (2002): SJR 0.1
Light rail project in Copenhagen: the Ring 2½ corridor
The need for high class public transport service of the increasing travel across the radial urban structure of the greater Copenhagen region was examined through planning of a light rail. The exact corridor (defined as the Ring 2½ corridor) and alignment of the light rail were documented and the locations of stops were examined through analyses of catchment areas. The timetable of the light rail was determined through travel time and correspondences with other high class public transport lines/corridors. The justification of the light rail was examined through factors like traffic impacts, operation economy, socioeconomics and strategic impacts. The light rail shows a good result on most factors. But it displays socioeconomic non-viability. However, this was expected when using the standard procedures. But the Ring 2½ light rail shows a better socioeconomic result than many other examined light rail projects

Long term traffic solution in Copenhagen - Does the harbour tunnel have a role

Measuring congestion in Copenhagen with GPS
Modelling expected train passenger delays on large scale railway networks

Forecasts of regularity for railway systems have traditionally – if at all – been computed for trains, not for passengers. Relatively recently it has become possible to model and evaluate the actual passenger delays by a passenger regularity model for the operation already carried out. First the paper describes the passenger regularity model used to calculate passenger delays of the Copenhagen suburban rail network the previous day. Secondly, the paper describes how it is possible to estimate future passenger delays by combining the passenger regularity model with railway simulation software. The paper demonstrates the possibility of predicting future passenger delays by calculating the expected passenger regularity of the entire Copenhagen suburban network. The results obtained with the passenger regularity model used together with the simulation software are very similar to the daily calculated passenger regularity of the Copenhagen suburban network. Since the method to predict the future passenger regularity includes simulation software and reflects the actual passenger regularity, it is possible to use a combination of a passenger regularity model and simulation software to evaluate and compare future scenarios. In this way it is possible to estimate the network effects of the passengers and to identify critical stations or sections in the railway network for further investigation or optimization.

Optimisation of timetable-based, stochastic transit assignment models based on MSA

Public transport assignment models have increased in complexity in order to describe passengers’ route choices as detailed and correctly as possible. Important trends in the development are (1) timetable-based assignment, (2) inclusion of feeder modes, (3) use of stochastic components to describe differences in passengers’ preferences within and between purposes and classes (random coefficients), as well as to describe non-explained variation within a utility theory framework, and (4) consideration of capacity problems at coach level, system level and terminal level. In the Copenhagen-Ringsted Model (CRM), such a large-scale transit assignment model was developed and estimated. The Stochastic User Equilibrium problem was solved by the Method of Successive Averages (MSA). However, the model suffered from very large calculation times. The paper focuses on how to optimise transit assignment models based on MSA combined with a generalised utility function. Comparable tests are carried out on a large-scale network. The conclusion is that there is potential of optimising MSA-based methods. Examples of different approaches for this is presented, tested and discussed in the paper.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Landex, A. (Intern), Nielsen, O. A. (Intern)
Publication date: 2006

Host publication information
Title of host publication: Proceedings of WCRR
Main Research Area: Technical/natural sciences
Conference: 7th World Congress on Railway Research, Montreal, Canada, 04/06/2006 - 04/06/2006
Electronic versions:

Optimisation of timetable-based, stochastic transit assignment models based on MSA

Public transport assignment models have increased in complexity in order to describe passengers’ route choices as detailed and correctly as possible. Important trends in the development are (1) timetable-based assignment, (2) inclusion of feeder modes, (3) use of stochastic components to describe differences in passengers’ preferences within and between purposes and classes (random coefficients), as well as to describe non-explained variation within a utility theory framework, and (4) consideration of capacity problems at coach level, system level and terminal level. In the Copenhagen-Ringsted Model (CRM), such a large-scale transit assignment model was developed and estimated. The Stochastic User Equilibrium problem was solved by the Method of Successive Averages (MSA). However, the model suffered from very large calculation times. The paper focuses on how to optimise transit assignment models based on MSA combined with a generalised utility function. Comparable tests are carried out on a large-scale network. The conclusion is that there is potential of optimising MSA-based methods. Examples of different approaches for this is presented, tested and discussed in the paper.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Pages: 263-285
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Volume: 144
Issue number: 1
ISSN (Print): 0254-5330
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
Road Charging in Copenhagen: Traffic effects

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Rich, J. (Intern), Nielsen, O. A. (Intern)
Publication date: 2006

Publication information
Publisher: Institut for Miljøvurdering
ISBN (Print): 87-7992-043-8
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 195042
Roadpricing in Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Rich, J. (Intern), Nielsen, U. (Ekstern)
Publication date: 2006

Host publication information
Title of host publication: System design, use of revenue and the future of roadpricing
Main Research Area: Technical/natural sciences
Conference: The annual Danish Transport Research Conference, AUC, 01/01/2006
Source: orbit
Source-ID: 194826
Publication: Research › Article in proceedings – Annual report year: 2006

Roadpricing in Copenhagen

General information
State: Published
Authors: Nielsen, O. A. (Intern), Rich, J. (Ekstern), Nielsen, U. (Ekstern)
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: The Engineer
ISSN (Print): 0013-7758
Ratings:
Scopus rating (2016): SJR 0.1 SNIP 0 CiteScore 0
Scopus rating (2015): SJR 0.1 SNIP 0 CiteScore 0
Scopus rating (2014): SJR 0.1 CiteScore 0
Scopus rating (2013): SJR 0.1 SNIP 0 CiteScore 0
ISI indexed (2013): ISI indexed no
Scopus rating (2012): SJR 0.1 SNIP 0 CiteScore 0
ISI indexed (2012): ISI indexed no
Scopus rating (2011): SJR 0.1 SNIP 0 CiteScore 0
ISI indexed (2011): ISI indexed no
Scopus rating (2010): SJR 0.1
Scopus rating (2009): SJR 0.102
Scopus rating (2008): SJR 0.1
Scopus rating (2007): SJR 0.1
Scopus rating (2006): SJR 0.1
Scopus rating (2005): SJR 0.101
Scopus rating (2004): SJR 0.1
Scopus rating (2003): SJR 0.1
Scopus rating (2002): SJR 0.1
Scopus rating (2001): SJR 0.1
Scopus rating (2000): SJR 0.1
Scopus rating (1999): SJR 0.1
Original language: Danish
Source: orbit
Source-ID: 195631
Publication: Communication › Journal article – Annual report year: 2006

Roadpricing - is it the way forward?

General information
Simulating disturbances and modelling expected train passenger delays
Forecasts of regularity for railway systems have traditionally – if at all – been computed for trains, not for passengers. It has only relatively recently become possible to model and evaluate the actual passenger delays. This paper describes how it is possible to use a passenger regularity model to estimate the actual passenger delays. The combination of the passenger regularity model with railway simulation software is described, demonstrating the possibility of predicting future passenger delays. The described passenger regularity model is run daily to calculate the passenger delays of the Copenhagen suburban rail network the previous day. The results obtained with the passenger regularity model used together with the simulation software are very similar to the daily calculated passenger regularity of the Copenhagen suburban network. As the combined method includes simulation software and reflects the actual passenger regularity, it is possible to use a combination of a passenger regularity model and simulation software to evaluate and compare future scenarios.

Simulering af passagerforsinkelser på jernbaner

Socio-economic assessment of road pricing systems – results from two projects in Copenhagen.
The AKTA roadpricing experiment in Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Sørensen, M. V. (Intern)
Publication date: 2006

Host publication information
Title of host publication: Roadpricing, the economy and the environment
Publisher: Springer
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 194829
Publication: Research - peer-review › Book chapter – Annual report year: 2006

The effect of correlated value of travel time savings in public transport

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Mabit, S. L. (Intern), Nielsen, O. A. (Intern)
Publication date: 2006

Host publication information
Title of host publication: Proceedings ETC 2006
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 192619
Publication: Research - peer-review › Article in proceedings – Annual report year: 2006

The European Transport Model - GIS-foundation

General information
State: Published
Organisations: Department of Transport
Authors: Nielsen, O. A. (Intern), Burgess, A. (Ekstern)
Publication date: 2006

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 194854
Publication: Education › Compendium/lecture notes – Annual report year: 2006

The European Transtools Model.

General information
State: Published
Organisations: Department of Transport, Traffic modelling and planning
Authors: Nielsen, O. A. (Intern)
Publication date: 2006
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Paper – Annual report year: 2006
The future traffic development in Denmark

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Rørbech, J. (Intern), Landex, A. (Intern)
Publication date: 2006

Host publication information
Title of host publication: The future traffic development in Denmark
Main Research Area: Technical/natural sciences
Conference: The annual Danish Transport Research Conference, AUC, 01/01/2006
Source: orbit
Source-ID: 194827
Publication: Research › Article in proceedings – Annual report year: 2006

The Greenland Air Transport Model System.

General information
State: Published
Organisations: Department of Transport, Traffic modelling and planning
Authors: Nielsen, O. A. (Intern), Israelsen, T. (Intern)
Publication date: 2006
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Paper – Annual report year: 2006

The National Rail’s doubtful market shares

General information
State: Published
Authors: Nielsen, O. A. (Intern)
Publication date: 2006
Main Research Area: Technical/natural sciences

Publication information
Journal: The Engineer
Original language: Danish
Source: orbit
Source-ID: 195636
Publication: Communication › Journal article – Annual report year: 2006

The Ørestad Traffic Passenger Demand Model, version 5.0

General information
State: Published
Organisations: Traffic Modelling, Department of Transport, Danish Transport Research Institute
Authors: Overgård, C. H. (Intern), Vuk, G. (Ekstern), Nielsen, O. A. (Intern)
Publication date: 2006

Host publication information
Title of host publication: Trafikdage på Aalborg Universitet
Main Research Area: Technical/natural sciences
Conference: Trafikdage på AUC, Aalborg Universitet, 01/01/2006
Electronic versions:
Trafikdage-2006-527.pdf
Source: orbit
Source-ID: 194038
Publication: Research › Article in proceedings – Annual report year: 2006
The strange commuting tax reduction

The Travellers in Copenhagen do know that it is healthy to use bicycles

Traffic growth, capacity and bottleneck problems in the traffic infrastructure
Traffic model for Copenhagen-updating of the trip matrices

**General information**
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Vuk, G. (Ekstern), Overgård, C. H. (Intern)
Publication date: 2006

**Host publication information**
Title of host publication: Proceedings of the European Transport Conference (ETC)
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 194835
Publication: Research › Article in proceedings – Annual report year: 2006

Traffic Model for Greenland

**General information**
State: Published
Organisations: Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2006

**Publication information**
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 194908
Publication: Education › Compendium/lecture notes – Annual report year: 2006

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

**General information**
State: Published
Organisations: Decision Modelling, Department of Transport, Traffic Modelling, Logistics & ITS
Authors: Jeppesen, S. L. (Intern), Leleur, S. (Intern), Jensen, A. V. (Intern), Varhelyi, A. (Ekstern), Rørbech, J. (Intern), Madsen, O. B. (Intern), Nielsen, O. A. (Intern)
Number of pages: 131
Publication date: 2006

**Publication information**
Publisher: Malmö högskola
ISBN (Print): 91-976407-4-3
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 193158
Publication: Research › Report – Annual report year: 2006

TRANSTOOLS

**General information**
State: Published
Organisations: Department of Transport, Traffic modelling and planning
Authors: Nielsen, O. A. (Intern), Burgess, A. (Ekstern)
Publication date: 2006
Uncertainty in traffic models.

We base the models on the road users' actual behaviour

Optimization models and solution methods for intermodal transportation
Availability of GNSS for Road Pricing in Copenhagen

General information
State: Published
Organisations: Department of Informatics and Mathematical Modeling, Traffic Modelling, Department of Transport
Authors: Jensen, A. B. O. (Intern), Zabic, M. (Intern), Overø, H. M. (Ekstern), Ravn, B. (Ekstern), Nielsen, O. A. (Intern)
Pages: 2951-2961
Publication date: 2005

Host publication information
Title of host publication: Proceedings of the 18th International Technical Meeting of the Satellite Division of the Institute of Navigation-ION GNSS 2005
Publisher: The Institute of Navigation
Main Research Area: Technical/natural sciences
Conference: ION GNSS 2005, Long Beach, California. USA, 01/01/2005
Links:
http://www2.imm.dtu.dk/pubdb/p.php?4218
Source: orbit
Source-ID: 185775
Publication: Research › Article in proceedings – Annual report year: 2005

Deliverable 1: Report on Policy Requirements and Selected Relevant Models/Methods

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Number of pages: 136
Publication date: 2005

Publication information
Place of publication: DGTrén, European Commision
Publisher: TNO, Holland
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188497
Publication: Research - peer-review › Report – Annual report year: 2005

Does the theoretical development in assignment procedures matter in practice?

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Knudsen, M. A. (Intern)
Publication date: 2005
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188491
Publication: Research › Conference abstract for conference – Annual report year: 2005
DTU's Center for Trafik og Transport (CTT): Forskning, udvikling og uddannelse

General information
State: Published
Organisations: Department of Transport
Authors: Madsen, O. B. (Intern), Leleur, S. (Intern), Nielsen, O. A. (Intern)
Pages: 3
Publication date: 2005
Main Research Area: Technical/natural sciences

Publication information
Journal: Dansk Vejtidsskrift
Volume: 82
Issue number: 8
ISSN (Print): 0011-6548
Ratings:
BFI (2008): BFI-level 1
Original language: Danish
Source: orbit
Source-ID: 186283
Publication: Communication › Journal article – Annual report year: 2005

Experiment with road charging in Copenhagen: The AKTA - project, Copenhagen.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Sulkjær, P. (Ekstern), Bonnevie, N. (Ekstern), Nielsen, O. A. (Intern), Peder, J. (Ekstern), Meiner, M. L. (Ekstern)
Number of pages: 59
Publication date: 2005

Publication information
Place of publication: The Municipality of Copenhagen
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188498
Publication: Research - peer-review › Report – Annual report year: 2005

Forbedring af GIS data til trafikmodeller

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Hansen, S. (Intern), Landex, A. (Intern), Nielsen, O. A. (Intern)
Publication date: 2005

Host publication information
Title of host publication: Trafikdage, 2005
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 186000
Publication: Communication › Article in proceedings – Annual report year: 2005

Integrated transport modelling in ArcGIS.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2005
Large-scale schedule-based transit assignment: Further optimisation of the solution algorithm

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Publication date: 2005
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188493
Publication: Research › Conference abstract for conference – Annual report year: 2005

Letbaneprojekter i København

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Landex, A. (Intern), Nielsen, O. A. (Intern)
Publication date: 2005

Publication information
Original language: Danish
Main Research Area: Technical/natural sciences
Electronic versions:
Vurdering af letbaneprojekter i Hovedstadsområdet.pdf
Source: orbit
Source-ID: 182581
Publication: Research › Sound/Visual production (digital) – Annual report year: 2005

Modelling Train Passenger Delays

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Publication date: 2005
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188495
Publication: Research › Conference abstract for conference – Annual report year: 2005

Modelling train passenger delays based on realised timetables

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2005
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188494
Opgørelse af passagerregularitet i S-tog

General information
State: Published
Organisations: Traffic Modelling, Department of Transport, DSB S-tog, Rapidis Aps
Authors: Seest, E. (Ekstern), Nielsen, O. A. (Intern), Frederiksen, R. D. (Ekstern)
Publication date: 2005

Host publication information
Title of host publication: Trafikdage 2005
Main Research Area: Technical/natural sciences
Conference: Trafikdage, Aalborg, 01/01/2005
Source: orbit
Source-ID: 182332
Publication: Communication › Article in proceedings – Annual report year: 2005

Opgørelse af trængsels tidsomkostninger baseret på trafikmodelberegninger

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2005

Host publication information
Title of host publication: Trafikdage 2005
Main Research Area: Technical/natural sciences
Conference: Trafikdage, Aalborg, 01/01/2005
Source: orbit
Source-ID: 182335
Publication: Communication › Article in proceedings – Annual report year: 2005

Overvurderes tidsbenefit af vejprojekter?

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Fosgerau, M. (Intern)
Publication date: 2005

Host publication information
Title of host publication: Trafikdage 2005
Main Research Area: Technical/natural sciences
Conference: Trafikdage, Aalborg, 01/01/2005
Source: orbit
Source-ID: 182334
Publication: Research › Article in proceedings – Annual report year: 2005

Road pricing and individuals responses within travel patterns behaviouiral change - lessons from the Copenhagen AKTA study

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Schönfelder, S. (Ekstern), Rich, J. (Intern), Nielsen, O. A. (Intern), Würtz, C. J. (Intern), Kay W., A. (Ekstern)
Publication date: 2005
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 188490
Publication: Research › Conference abstract for conference – Annual report year: 2005
Sensitivity of variable definitions in sp-analyses - An empirical study of car-users' evaluation of length, cost and time components.

General information
State: Published
Organisations: Department of Transport, Traffic modelling and planning
Authors: Nielsen, O. A. (Intern), Sørensen, M. V. (Intern)
Publication date: 2005
Main Research Area: Technical/natural sciences
Publication: Research - peer-review › Paper – Annual report year: 2005

Technological innovation in the transport sector: A platform for necessary political decisions

General information
State: Published
Organisations: Department of Transport, Traffic Modelling, Coastal, Maritime and Structural Engineering, Department of Mechanical Engineering
Authors: Rørbech, J. (Intern), Christensen, S. (Ekstern), Bach, N. (Ekstern), Christensen, J. (Ekstern), Lemberg, K. (Ekstern), Nielsen, O. A. (Intern), Olesen, P. (Ekstern), Pedersen, P. T. (Intern), Sillemann, K. (Ekstern)
Number of pages: 77
Publication date: 2005

Traffic models: The misery is not as noticeable as claimed

General information
State: Published
Authors: Nielsen, O. A. (Intern)
Pages: 6
Publication date: 2005
Main Research Area: Technical/natural sciences

Publication information
Journal: Ingenioeren
Volume: 20
ISSN (Print): 0105-6220
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: English
Source: orbit
Source-ID: 183952
Publication: Communication › Journal article – Annual report year: 2001

Vejforbindelse mellem Lyngbyvej og Gittervej: Et eksempel på Braess paradox

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Landex, A. (Intern)
Publication date: 2005

Host publication information
Vurdering af letbaneprojekter i Hovedstadsområdet

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Landex, A. (Intern), Nielsen, O. A. (Intern)
Publication date: 2005

Why traffic models often overestimates the future traffic.

General information
State: Published
Authors: Nielsen, O. A. (Intern)
Pages: 26
Publication date: 2005
Main Research Area: Technical/natural sciences

Store transportinfrastrukturprojekter og deres strategiske virkninger med særlig fokus på effekter for virksomheder

General information
State: Published
Organisations: Decision Modelling, Department of Transport, Traffic Modelling
Authors: Hansen, S. (Intern), Leleur, S. (Intern), Nielsen, O. A. (Intern)
Publication date: Aug 2004
Assessment of Traffic Noise Impacts

A steady growth in traffic intensities in most urban areas throughout the world has forced planners and politicians to seriously consider the resulting environmental impact, such as traffic noise, accidents and air pollution. The assessment of such negative factors is needed in order to reveal the true social benefit of infrastructure plans. The paper presents a noise assessment model for the Copenhagen region, which brings together GIS technology and non-linear hedonic regression models to reveal the implicit costs of traffic noise measured as the marginal percentage loss in property values with respect to the decibel traffic noise. The model distinguishes between houses and apartments and shows that the ability to include refined accessibility variables have significant impact on estimated prices.
A stochastic multi-modal freight transport assignment model with random coefficients

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2004

Host publication information
Title of host publication: World Conference on Transport Research Society (WCTRS)
Volume: D02 paper 1431
Main Research Area: Technical/natural sciences
Conference: 10th World Conference on Transport Research, Istanbul, Turkey, 04/07/2004 - 04/07/2004
Source: orbit
Source-ID: 178136
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

A stochastic schedule-based freight transport assignment model with random coefficients

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2004

Host publication information
Title of host publication: TRISTIAN V - Trennial Symposion on Transportation Analysis
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178139
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

Behavioural responses to pricing schemes: Description of the Danish AKTA experiment.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Pages: 233-251
Publication information
Journal: Journal of Intelligent Transportation Systems
Volume: 8
Issue number: 4
ISSN (Print): 1547-2450
Ratings:
BFI (2017): BFI-level 1
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.884 SNIP 1.264 CiteScore 1.69
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.611 SNIP 1.787 CiteScore 2.28
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.645 SNIP 1.545 CiteScore 1.32
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.071 SNIP 1.525 CiteScore 1.67
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.746 SNIP 1.212 CiteScore 1.2
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.99 SNIP 1.511 CiteScore 1.44
ISI indexed (2011): ISI indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.805 SNIP 2.438
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.704 SNIP 1.541
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.742 SNIP 1.243
Scopus rating (2007): SJR 0.559 SNIP 0.988
Scopus rating (2006): SJR 1.383 SNIP 2.228
Scopus rating (2005): SJR 0.336 SNIP 1.126
Scopus rating (2004): SJR 0.364 SNIP 0.4
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 0.101 SNIP 0
Scopus rating (2002): SJR 0.125 SNIP 0.171
Scopus rating (2001): SJR 0.327 SNIP 0.85
Scopus rating (2000): SJR 0.145 SNIP 0.241
Scopus rating (1999): SJR 0.155 SNIP 0.821
Original language: English
Source: orbit
Source-ID: 178102
Publication: Research - peer-review › Journal article – Annual report year: 2004

Education in Logistics at DTU

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Michelsen, A. (Ekstern), Nielsen, O. A. (Intern)
Pages: 48-50
Publication date: 2004

Host publication information
Title of host publication: Danish Logistics Information
Forskning inden for logistik og transport på DTU.

General information
State: Published
Organisations: Department of Transport, Department of Management Engineering
Authors: Nielsen, O. A. (Intern), Michelsen, A. U. (Intern)
Pages: 48-50
Publication date: 2004
Main Research Area: Technical/natural sciences

GIS på CTT

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Landex, A. (Intern), Nielsen, O. A. (Intern)
Publication date: 2004

Impact of a priori Distributions on Mixed Logit Model Estimation. Tests on Synthetic Data

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern)
Publication date: 2004

Host publication information
Title of host publication: Proceedings of World Conference on Transport Research Society (WCTRS)
Volume: D01
Main Research Area: Technical/natural sciences
Conference: 10th World Conference on Transport Research, Istanbul, Turkey, 04/07/2004 - 04/07/2004
Source: orbit
Source-ID: 39045
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004
Incorporating logistic elements into freight transport modelling – missing links and shortcuts

General information
State: Published
Organisations: Department of Transport, Traffic Modelling
Authors: Nielsen, O. A. (Intern)
Publication date: 2004

Host publication information
Title of host publication: International symposium: Transportation and Logistics
Main Research Area: Technical/natural sciences
Conference: International symposium: Transportation and Logistics, Molde University College, 01/01/2004
Source: orbit
Source-ID: 183382
Publication: Research › Article in proceedings – Annual report year: 2004

Map-matching algorithms for GPS-data - methodology and test on data from the AKTA road pricing experiment in Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2004

Host publication information
Title of host publication: 19th European Conference for ESRI users. : Session L203 on Traffic, Transport and Logistics
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178116
Publication: Research - peer-review › Article in proceedings – Annual report year: 2004

Map-matching algorithms for GPS-data – Methodology and test on data from the AKTA road pricing experiment in Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport, Logistics & ITS
Authors: Nielsen, O. A. (Intern), Jørgensen, R. M. (Intern)
Publication date: 2004

Host publication information
Title of host publication: TRISTIAN V - Trennial Symposion on Transportation Analysis
Main Research Area: Technical/natural sciences
Project Congestion – Summary: Municipality of Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Number of pages: 18
Publication date: 2004

Publication information
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178174
Publication: Research › Report – Annual report year: 2004

Research in Logistics and Transport at DTU

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Michelsen, A. (Ekstern)
Pages: 51-53
Publication date: 2004

Host publication information
Title of host publication: Danish Logistics Information
Volume: No. 5
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178169
Publication: Research › Book chapter – Annual report year: 2004

Roadpricing – a feasible path

General information
State: Published
Authors: Nielsen, O. A. (Intern)
Pages: 4
Publication date: 2004
Main Research Area: Technical/natural sciences

Publication information
Journal: JPKøbenhavn. Fokus
Original language: Danish
Source: orbit
Source-ID: 183948
Publication: Communication › Journal article – Annual report year: 2004

Road pricing behavioural models - Car users' trade off between trip time, length and cost. Roadpricing, the economy and the environment

General information
State: Published
Authors: Vuk, G. (Intern), Nielsen, O. A. (Intern)
Publication date: 2004

Host publication information
Rule-based, object-oriented modelling of freight transport systems in GIS

Sensibility of Variable definitions in SP-analysis.: An empirical study of car-users, evaluation og length, cost and time

Strengthening knowledge within logistics and freight transport

Traffic Models
Uddannelser inden for logistik på DTU

General information
State: Published
Organisations: Department of Management Engineering, Department of Transport
Authors: Michelsen, A. U. (Intern), Nielsen, O. A. (Intern)
Pages: 52-54
Publication date: 2004
Main Research Area: Technical/natural sciences

Use of GPS- and SP-data to estimate changes of driver behaviour due to road pricing

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Rich, J. H. (Intern)
Publication date: 2004

Discrete Choice Models - Estimation of Passenger Traffic

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern)
Number of pages: 201
Publication date: Sep 2003

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
A functional dynamic traffic assignment model

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Trafikdage
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Conference: Trafikdage, AUC, 01/01/2003
Source: orbit
Source-ID: 183432
Publication: Research › Article in proceedings – Annual report year: 2003

A large scale stochastic multi-class schedule-based transit model with random coefficients.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Number of pages: 296
Pages: 51-77
Publication date: 2003

Host publication information
Title of host publication: Schedule-Based Dynamic Transit Modelling – Theory and Applications.
Publisher: Kluwer Academic Publishers
Editors: Nuzzolo, A., Wilson, N.
ISBN (Print): 1402076878
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178103
Publication: Research - peer-review › Book chapter – Annual report year: 2004

Analysis of congestion and speeds based on GPS-data

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Traffic days at AUC
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178155
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

A national freight transport model - Methodological study

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
A national freight transport model - recommendations

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Fosgerau, M. (Ekstern), Hansen, C. O. (Ekstern), Holmblad, M. (Ekstern), Rich, J. (Intern)
Publication date: 2003

Publication information
Place of publication: The Danish Transport Research Institute
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 183436
Publication: Research › Report – Annual report year: 2003

A proposed design of a Danish national freight model

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Fosgerau, M. (Ekstern), Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Conference on National and International freight transport models : With application to the Scandinavian - European Transport Corridor
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178142
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Behavioural effects of road pricing – First lessons from Copenhagen.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Kristensen, J. P. (Ekstern)
Publication date: 2003

Host publication information
Title of host publication: 19th World Congress and Exhibition on Intelligent Transport Systems and Services
Volume: Session: PS 129
Main Research Area: Technical/natural sciences
Conference: 19th World Congress and Exhibition on Intelligent Transport Systems and Services, Madrid, November, 2003., 01/01/2003
Source: orbit
Source-ID: 178108
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003
Behavioural responses to pricing schemes

General information
State: Published
Organisations: Department of Transport, Traffic Modelling
Authors: Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Workshop on Behavioural responses to ITS
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178143
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Estimation of random coefficient models on GPS-data

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: European Transport Conference (PTRC): Seminar on Methodological Innovations
Volume: CDROM with proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178110
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Estimation of route choice models based on GPS-data

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Traffic days at AUC
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178153
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Hedonic Evaluation of Traffic Noise - an emperical study

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Rich, J. H. (Intern), Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Trip research conference: The Economics and Environmental Consequences of Regulating Traffic
Main Research Area: Technical/natural sciences
Conference: Trip research conference: The Economics and Environmental Consequences of Regulating Traffic, February 2-3, 2003, Hillerød, Denmark, 01/01/2003
Source: orbit
Source-ID: 178145
Modelling assignment of freight transport

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Conference on National and International freight transport models : With application to the Scandinavian - European Transport Corridor
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178141
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

MSL for Mixed Logit Model Estimation: On shape of Distributions

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Proceedings of European Transport Conference
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39043
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

MSL for mixed logit model estimation – on shape of distribution

General information
State: Published
Organisations: Department of Transport, Traffic Modelling
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Seminar on Methodological Innovations
Publisher: PTRC
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 183380
Publication: Research › Article in proceedings – Annual report year: 2003

National freight model: pre-study

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Publication date: 2003

Publication information
Original language: Danish
National value-of-timestudy: pre-study

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Publication date: 2003

Publication information
Original language: Danish

Series: COWI report
Number: 57632
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39096
Publication: Research - peer-review › Report – Annual report year: 2003

Prestudy for socio-economic value of times

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Number of pages: 130
Publication date: 2003

Publication information
Publisher: Danish Ministry of Transport
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39098
Publication: Research - peer-review › Report – Annual report year: 2003

Sensitivity of variable definitions in SP-analysis. An empirical study of car-users, evaluation of length cost and time components

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Jovicic, G. (Ekstern)
Publication date: 2003

Host publication information
Title of host publication: Trip research conference: The Economics and Environmental Consequences of Regulating Traffic
Main Research Area: Technical/natural sciences
Conference: Trip research conference: The Economics and Environmental Consequences of Regulating Traffic, February 2-3, 2003, Hillered, Denmark, 01/01/2003
Source: orbit
Source-ID: 178144
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003
The AKTA road pricing experiment in Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Jovicic, G. (Ekstern)
Publication date: 2003

Host publication information
Title of host publication: 10th International Conference on Travel Behaviour Research.
Volume: Proceedings, session 3.2 Valuation/Pricing.
Main Research Area: Technical/natural sciences
Conference: 10th International Conference on Travel Behaviour Research, Lucerne, Switzerland, 10/08/2003 - 10/08/2003
Source: orbit
Source-ID: 178111
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

The Helsingør-Helsingborg Tunnel Project: Atkins Report

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Rich, J. H. (Intern), Holm, J. (Ekstern), Nielsen, O. A. (Intern)
Publication date: 2003

Publication information
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39095
Publication: Research - peer-review › Report – Annual report year: 2003

TRIP and the price of silence

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Bjørner, T. B. (Ekstern), Rich, J. H. (Intern), Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Environmental Research : The Strategic Research Programme
Volume: No. 57
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178172
Publication: Research › Book chapter – Annual report year: 2003

Using GPS for road pricing: Experiences from Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Kristensen, J. (Ekstern), Würtz, C. J. (Intern)
Publication date: 2003
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39117
Publication: Research › Paper – Annual report year: 2003
Value of travel time in the AKTA project

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Jovicic, G. (Ekstern), Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Traffic days at AUC
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178154
Publication: Research - peer-review › Article in proceedings – Annual report year: 2003

Values of travel time in the AKTA project

General information
State: Published
Organisations: Danish Transport Research Institute, Technical University of Denmark
Authors: Vuk, G. (Intern), Nielsen, O. A. (Intern)
Publication date: 2003

Host publication information
Title of host publication: Trafikdage på Aalborg Universitet
Publisher: Trafikforskningsgruppen på Aalborg Universitet
Main Research Area: Technical/natural sciences
Conference: Trafikdage på Aalborg Universitet, Aalborg Universitet, 01/01/2003
Links:
Source: orbit
Source-ID: 236053
Publication: Research › Article in proceedings – Annual report year: 2003

A multi-class timetable-based transit assignment model with error components in the utility functions

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2002

Host publication information
Title of host publication: First International Workshop on the Schedule-based Approach in Dynamic Transit Modelling
Main Research Area: Technical/natural sciences
Conference: First International Workshop on the Schedule-based Approach in Dynamic Transit Modelling, 27/5. Ischia, Italy, 01/01/2002
Source: orbit
Source-ID: 178149
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

A multi-class timetable-based transit assignment model with error components in the utility functions

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2002

Host publication information
Title of host publication: Nordic Research Network on Modelling Transport, Land-Use and the Environment: Sixth Workshop
Main Research Area: Technical/natural sciences
A SP-survey of car users Value of Times, congestion and road pricing

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Jovicic, G. (Ekstern)
Pages: 193-208
Publication date: 2002

Host publication information
Title of host publication: Traffic days at AUC
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178161
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

A Stochastic Route Choice Model for Car Travellers in the Copenhagen Region

The paper presents a large-scale stochastic road traffic assignment model for the Copenhagen Region. The model considers several classes of passenger cars (different trip purposes), vans and trucks, each with its own utility function on which route choices are based. The utility functions include distributed coefficients (Error Components) estimated on SP-data in a mixed logit model. This was compared with a traditional nested logit model. A number of alternative formulations of EC were tested, and the resulting distributions of value of times are discussed. In application, the different classes and types of vehicles influence all the speed-flow relationships on links within an equilibrium framework. Sub-models for intersections and roundabouts describe queues and geometric delays.

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern), Daly, A. (Ekstern)
Pages: 327-346
Publication date: 2002
Main Research Area: Technical/natural sciences

Publication information
Journal: Networks and Spatial Economics
Volume: 2
Issue number: 4
ISSN (Print): 1566-113X
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 1.561 SNIP 1.798 CiteScore 2.66
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.371 SNIP 1.307 CiteScore 2.06
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.064 SNIP 1.641 CiteScore 1.67
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.215 SNIP 1.569 CiteScore 1.61
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.569 SNIP 1.622 CiteScore 1.42
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Cost-Benefit Evaluation of Infrastructure: Doing it the hedonic way

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Rich, J. H. (Intern), Nielsen, O. A. (Intern)
Publication date: 2002

Host publication information
Title of host publication: European Transport Conference (PTRC) : Seminar on Methodological Innovations
Volume: CDROM with proceedings, PTRC.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39090
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Cost-Benefit Evaluation of Infrastructure: Doing it the hedonic way

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Rich, J. H. (Intern), Nielsen, O. A. (Intern)
Publication date: 2002

Host publication information
Title of host publication: Nordic Research Network on Modelling Transport, Land-Use and the Environment : Sixth Workshop
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178157
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

DTU har fagforløb i jernbaner

General information
En SP-analyse af bilisters tidsværdier, trængsel og roadpricing

General information
State: Published
Organisations: Danish Transport Research Institute
Authors: Vuk, G. (Intern), Nielsen, O. A. (Intern)
Pages: 193-208
Publication date: 2002

Host publication information
Title of host publication: Trafikdage på Aalborg Universitet
Volume: 283
Publisher: Trafikforskningsgruppen på Aalborg Universitet
Editors: Lahrmann, H., Nielsen, J.

Series: ISP Skriftserie
Main Research Area: Technical/natural sciences
Conference: Trafikdage på Aalborg Universitet, Aalborg Universitet, 01/01/2002
Source: orbit
Source-ID: 236052
Publication: Research › Article in proceedings – Annual report year: 2002

GIS-based object oriented modelling of public transport terminals

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Hansen, J. (Ekstern), Nielsen, O. A. (Intern)
Pages: 119-130
Publication date: 2002

Host publication information
Title of host publication: Traffic days at AUC
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178163
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Minimizing Passenger Transfer Times in Public Transport Timetables

General information
State: Published
Organisations: Logistics & ITS, Department of Transport, Traffic Modelling
Authors: Jansen, L. N. (Ekstern), Pedersen, M. B. (Intern), Nielsen, O. A. (Intern)
Optimising bus timetables to minimise passengers transfer times

General information
State: Published
Organisations: Logistics & ITS, Department of Transport, Traffic Modelling
Authors: Pedersen, M. B. (Intern), Jansen, L. (Ekstern), Nielsen, O. A. (Intern)
Pages: 105-118
Publication date: 2002

Portzone model for the Øresund Region: forecasting the traffic potential for a new train tunnel between Ellsinore and Helsingborg

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Rich, J. H. (Intern), Nielsen, O. A. (Intern), Holm, J. (Ekstern)
Pages: 119-219
Publication date: 2002

The AKTA Road Pricing Experiment in Copenhagen

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Herslund, M. (Intern)
Publication date: 2002
The Øresund Traffic Forecast Model

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern), Schauby, J. (Ekstern)
Pages: 157-174
Publication date: 2002

Host publication information
Title of host publication: Proceedings of Traffic days at AUC
Main Research Area: Technical/natural sciences
Conference: Traffic days at AUC : (the Annual Danish Traffic Research Conference), 01/01/2002
Source: orbit
Source-ID: 39048
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

The Øresund transport model

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern), Schauby, J. (Ekstern)
Pages: 157-174
Publication date: 2002

Host publication information
Title of host publication: Traffic days at AUC
Volume: Proceedings, Vol. 2
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178159
Publication: Research - peer-review › Article in proceedings – Annual report year: 2002

Timetable-based transit assignment model with error components in the utility functions

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Pages: 1-12
Publication date: 2002
Unreasonable short-sighted that the Government will shut down the Danish Transport Council

A Large-scale model system for the Copenhagen-Ringsted railway project

A microeconomic model for car ownership, resident and work location
Assessing Distributions of Error Components in a Complex Traffic Model

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern)
Publication date: 2001

Host publication information
Title of host publication: 9th World Conference on Transport Research
Volume: Pre-prints
Main Research Area: Technical/natural sciences
Conference: 9th World Conference on Transport Research : session D1-O1, Seoul, Korea, Republic of, 22/07/2001 - 22/07/2001
Source: orbit
Source-ID: 39040
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Centre for Research in Logistics and Freight Transport

General information
State: Published
Authors: Nielsen, O. A. (Intern)
Pages: 25-26
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Transportrådets nyhedsbrev
Volume: 2
Original language: Danish
Source: orbit
Source-ID: 183945
Publication: Research › Journal article – Annual report year: 2001

Centre for Research in Logistics and Freight Transport

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Pages: 87-96
Publication date: 2001

Host publication information
Title of host publication: Traffic days at AUC
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178167
Publication: Communication › Article in proceedings – Annual report year: 2001

Demand for research and training in Denmark

General information
State: Published
For få forskerstjerner på trafikområdet

General information
State: Published
Authors: Nielsen, O. A. (Intern)
Pages: 18
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Ingenioeren
ISSN (Print): 0105-6220
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Source: orbit
Source-ID: 183953
Publication: Communication › Journal article – Annual report year: 2001

Generalised Transportation-data Format (GTF): Data, Model and Machine Interaction

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Mandel, B. (Ekstern), Ruffert, E. (Ekstern)
Publication date: 2001

Host publication information
Title of host publication: European Transport Conference (PTRC) : Seminar on Applied Transport Method, Session on Transport Metadata.
Volume: CDROM with proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178113
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Intelligent management of multi modal network data

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Grevy, B. (Intern), Frederiksen, R. D. (Intern), Skriver, J. (Ekstern), Israelsen, T. (Ekstern), Brun, B. (Ekstern)
Publication date: 2001

Host publication information
Title of host publication: Twenty-first Annual ESRI (Environmental Systems Research Institute) International User Conference
Large Scale Model Systems

**General information**
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Daly, A. (Ekstern), Nielsen, O. A. (Intern)
Number of pages: 940
Pages: 315-325
Publication date: 2001

**Host publication information**
Title of host publication: Travel behaviour Research: The Leading Edge.
Volume: Chapter 18
Publisher: Pergamon
Editor: Hensher, D.
ISBN (Print): 0080439241
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178107
Publication: Research - peer-review › Book chapter – Annual report year: 2001

Optimisation of timetable-based, stochastic models for travellers' route choices in public transport

**General information**
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Pages: 143-157
Publication date: 2001

**Host publication information**
Title of host publication: Traffic days at AUC (the Annual Danish Traffic Research Conference) : Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39023
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Optimising timetable-based stochastic transit assignment models

**General information**
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Pages: 195-200
Publication date: 2001

**Host publication information**
Title of host publication: Trennial Symposion on Transportation Analysis - TRISTIAN IV
Volume: Preprints, Vol. 1
Main Research Area: Technical/natural sciences
Conference: Trennial Symposion on Transportation Analysis - TRISTIAN IV, Sãu Miguel, Azores, 01/01/2001
Source: orbit
Source-ID: 178151
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001
Rule-based, object-oriented modelling of public transport systems: A description of the Transportation Object Platform

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Publication date: 2001

Host publication information
Title of host publication: 9th World Conference on Transportation Research (WCTR)
Volume: Pre-prints, session D1-01
Publisher: Elsevier
Main Research Area: Technical/natural sciences
Conference: 9th World Conference on Transportation Research (WCTR), 23/7 Seoul, Korea, 01/01/2001
Source: orbit
Source-ID: 178150
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Rule-based Object-Oriented Modelling of Public Transport Systems

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Intern)
Publication date: 2001

Host publication information
Title of host publication: Nordic Research Network on Modelling Transport, Land-Use and the Environment : Fifth Workshop
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178165
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Sacred cows and cattle trades.: The traffic agreement: Calculations and evaluations of the environmental and socio-economic impacts are missing.

General information
State: Published
Authors: Nielsen, O. A. (Intern)
Publication date: 2001
Main Research Area: Technical/natural sciences

Publication information
Journal: Berlingske Tidende
ISSN (Print): 0106-4223
TOP: Experiences, efficiencies and further projects

General information
State: Published
Organisations: Department of Transport, Traffic Modelling
Authors: Grevy, B. (Intern), Frederiksen, R. D. (Intern), Israelsen, T. (Ekstern), Skriver, T. (Ekstern), Brun, B. (Ekstern), Poulsen, M. (Ekstern), Nielsen, O. A. (Intern)
Pages: 133-142
Publication date: 2001

Host publication information
Title of host publication: Traffic days at AUC (the Annual Danish Traffic Research Conference) : Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39024
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Validation and test of a complex stochastic traffic model

General information
State: Published
Organisations: Traffic Modelling, Department of Transport, Atkins Denmark A/S
Authors: Sørensen, M. V. (Intern), Nielsen, O. A. (Intern), Filges, D. (Ekstern)
Publication date: 2001

Host publication information
Title of host publication: European Transport Conference (PTRC) : Seminar on Methodological Innovations, Session on Networks and Assignment.
Volume: CDROM with proceedings, PTRC.
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 39039
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001

Value of Time in Traffic Models

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Pages: 13-30
Publication date: 2001

Host publication information
Title of host publication: Traffic days at AUC
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 178168
Publication: Research - peer-review › Article in proceedings – Annual report year: 2001
A large-scale model system for the Copenhagen-Ringsted railway project

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Hansen, C. O. (Ekstern), Daly, A. (Ekstern)
Publication date: 2000

Host publication information
Title of host publication: 9th International Conference on Travel Behaviour Research
Place of publication: Gold Cost, Queensland, Australia
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 177453
Publication: Research - peer-review › Article in proceedings – Annual report year: 2000

A stochastic multi-class road assignment model with distributed time and cost coefficients

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Ekstern), Daly, A. (Ekstern)
Publication date: 2000

Host publication information
Title of host publication: 9th International Conference on Travel Behaviour Research
Place of publication: Gold Cost, Queensland, Australia
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 177454
Publication: Research - peer-review › Article in proceedings – Annual report year: 2000

A Stochastic Traffic Assignment Model Considering Differences in Passengers Utility Functions

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Pages: 337-402
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: Transportation Research. Part B: Methodological
Volume: 34B
Issue number: 5
ISSN (Print): 0191-2615
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 2
Scopus rating (2016): SJR 2.742 SNIP 2.433 CiteScore 4.57
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 3.027 SNIP 2.85 CiteScore 5.15
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 3.007 SNIP 3.022 CiteScore 4.21
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 3.203 SNIP 3.487 CiteScore 4.64
ISI indexed (2013): ISI indexed yes
Development of route choice models – from heuristic to theoretical basis: Grant paper for Professor Bendtsens
Remembrance Grant for Transport Researchers

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern)
Publication date: 2000

Host publication information
Title of host publication: Trafikdage
Volume: Supplementary Volumes of Proceedings
Main Research Area: Technical/natural sciences
Conference: Trafikdage, AUC, 01/01/2000
Source: orbit
Source-ID: 183391
Publication: Research › Article in proceedings – Annual report year: 2000

Fæmtern-traffic undervurderet

General information
State: Published
Organisations: Department of Transport
Authors: Nielsen, O. A. (Intern), Flyvbjerg, B. (Ekstern), Rørbech, J. (Intern)
Models as basis for decision-making – Post Femer Belt

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Rørbech, J. (Intern)
Pages: 149-165
Publication date: 2000

Host publication information
Title of host publication: Trafikdage
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Conference: Trafikdage, AUC, 01/01/2000
Source: orbit
Source-ID: 183387
Publication: Research › Article in proceedings – Annual report year: 2000

Object oriented description of public transport network

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Thorlacius, P. (Intern)
Publication date: 2000

Host publication information
Title of host publication: Trafikdage
Volume: Supplementary volumes of Proceedings
Main Research Area: Technical/natural sciences
Conference: Trafikdage, 01/01/2004
Source: orbit
Source-ID: 183384
Publication: Research › Article in proceedings – Annual report year: 2000

Paper on the evaluation of traffic analyses and forecasts, Femer Bælt: The Expert Group concerning traffic forecasts. Conference on the decision basis for the Femer Bælt connection

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Rørbech, J. (Ekstern), Flyvbjerg, B. (Ekstern)
Publication date: 2000

Host publication information
Rule-based Object-Oriented Modelling of Public Transport Systems in Arcinfo 8

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Brun, B. (Ekstern), Nielsen, E. R. (Ekstern)
Publication date: 2000

Host publication information
Title of host publication: Twentieth Annual ESRI International User Conference
Place of publication: San Diego
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 177455
Publication: Research - peer-review › Article in proceedings – Annual report year: 2000

The Copenhagen – Ringsted Traffic Model

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Filges, D. (Ekstern), Sørensen, M. V. (Intern), Brix, J. (Ekstern)
Publication date: 2000

Host publication information
Title of host publication: Trafikdage
Volume: 1
Main Research Area: Technical/natural sciences
Conference: Trafikdage, AUC, 01/01/2000
Source: orbit
Source-ID: 183392
Publication: Research › Article in proceedings – Annual report year: 2000

The Femer Bridge on its way

General information
State: Published
Authors: Nielsen, O. A. (Intern), Rørbech, J. (Ekstern)
Publication date: 2000
Main Research Area: Technical/natural sciences

Publication information
Journal: Berlingske Tidende
ISSN (Print): 0106-4223
Ratings:
ISI indexed (2013): ISI indexed no
ISI indexed (2012): ISI indexed no
ISI indexed (2011): ISI indexed no
Original language: Danish
Publication: Communication › Journal article – Annual report year: 2000

Validation and test of a stochastic traffic model

General information
State: Published
Organisations: Department of Transport, Traffic Modelling
A large-scale stochastic Timetable-based transit assignment model for route and sub-mode choices

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Jovicic, G. (Ekstern)
Publication date: 1999

Host publication information
Title of host publication: Proceedings of Seminar F, Transportation Planning Methods
Volume: Vol. P 434
Publisher: Cambridge
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 183376
Publication: Research › Article in proceedings – Annual report year: 1999

A model for passengers route choices considering capacity restrictions and regularity problems

General information
State: Published
Organisations: Department of Planning, Tetraplan A/S
Authors: Nielsen, O. A. (Intern), Jovicic, G. (Ekstern), Pedersen, J. M. (Ekstern)
Pages: 461-476
Publication date: 1999

Host publication information
Title of host publication: Trafikdage på Aalborg Universitet, vol 2
Place of publication: Aalborg
Publisher: Transportrådet og Trafikforskningsgruppen
Main Research Area: Technical/natural sciences
Conference: Trafikdage 1999, Aalborg, 01/01/1999
Source: orbit
Source-ID: 175742
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

A model for terminal improvements impact on public transport: The EU project MIMIC

General information
State: Published
Organisations: Department of Planning, Banestyrelsen rådgivning
Authors: Nielsen, O. A. (Intern), Sørensen, M. V. (Ekstern)
Pages: 143-152
Publication date: 1999

Host publication information
Title of host publication: Trafikdage på Aalborg Universitet, vol S
Place of publication: Aalborg
Publisher: Transportrådet og Trafikforskningsgruppen
Main Research Area: Technical/natural sciences
Conference: Trafikdage 1999, Aalborg, 01/01/1999
A stochastic multi class road assignment model with distributed coefficients for time and costs

General information
State: Published
Organisations: Department of Planning, Tetraplan A/S
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Ekstern)
Pages: 483-494
Publication date: 1999

Host publication information
Title of host publication: Trafikdage på Aalborg Universitet, vol 2
Place of publication: Aalborg
Publisher: Transportrådet og Trafikforskningsgruppen
Main Research Area: Technical/natural sciences
Conference: Trafikdage 1999, Aalborg, 01/01/1999
Source: orbit
Source-ID: 175743
Publication: Research - peer-review › Article in proceedings – Annual report year: 1999

GIS in Public Transport Planning

General information
State: Published
Organisations: Department of Planning, ScanRail Consult
Authors: Nielsen, O. A. (Intern), Thorlacius, P. (Ekstern)
Pages: 173-192
Publication date: 1999

Host publication information
Title of host publication: GIS in Denmark - 2
Place of publication: Copenhagen
Publisher: Teknisk Forlag
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 175739
Publication: Research › Article in proceedings – Annual report year: 1999

GIS in Traffic Research

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Pages: 235-247
Publication date: 1999

Host publication information
Title of host publication: GIS in Denmark 2
Place of publication: Copenhagen
Publisher: Teknisk Forlag
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 175740
Publication: Research › Article in proceedings – Annual report year: 1999

Organisation of traffic models and data

General information
State: Published
A new model for passengers route choices in public transport

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1998

Host publication information
Title of host publication: Conference report, part 1,
Place of publication: Aalborg
Publisher: Transportraadet
Main Research Area: Technical/natural sciences
Conference: Traffic days at AUC (the Annual Danish Traffic Research Conference), Aalborg, DK, 01/01/1998
Source: orbit
Source-ID: 171623
Publication: Research › Article in proceedings – Annual report year: 1998

A route choice model for several classes of road users

General information
State: Published
Organisations: Department of Planning, Tetraplan Ltd.
Authors: Nielsen, O. A. (Intern), Frederiksen, R. D. (Ekstern)
Pages: 159-174
Publication date: 1998

Host publication information
Title of host publication: Traffic days at AUC (the Annual Danish Traffic Research Conference). Supplementary report,
Main Research Area: Technical/natural sciences
Conference: Traffic days at AUC (the Annual Danish Traffic Research Conference), Aalborg, 01/01/1998
Source: orbit
Source-ID: 171624
Publication: Research › Article in proceedings – Annual report year: 1998

BRIDGES TO GIS – Methodology

General information
State: Published
Organisations: Traffic Modelling, Department of Transport
Authors: Nielsen, O. A. (Intern), Israelsen, T. (Intern), Nielsen, E. R. (Intern)
Publication date: 1998

Publication information
Publisher: Deliverable D5 & D6. BRIDGES Contract No PL96-1138. Project funded by EU, DG7, 4th Framework Programme
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 183433
Publication: Research › Report – Annual report year: 1998

Deliverable D1 – Baseline Methodology

General information
State: Published
Handling of traffic modelling networks in GIS; conflicts, solutions and applications (in Danish)

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Israelsen, T. (Intern), Nielsen, E. R. (Intern)
Pages: 143-158
Publication date: 1998

Host publication information
Title of host publication: Traffic days at AUC (the Annual Danish Traffic Research Conference). Supplementary report,
Main Research Area: Technical/natural sciences
Conference: Traffic days at AUC (the Annual Danish Traffic Research Conference), Aalborg, 01/01/1998
Source: orbit
Source-ID: 171964
Publication: Research › Article in proceedings – Annual report year: 1998

Handling Traffic Modelling Networks in GIS, Conflicts-, Solutions- and Applications

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Israelsen, T. (Intern), Nielsen, E. R. (Intern)
Publication date: 1998

Host publication information
Title of host publication: Handling Traffic Modelling Networks in GIS, Conflicts-, Solutions- and Applications
Main Research Area: Technical/natural sciences
Conference: 8th World Conference on Transportation Research, Antwerp, Belgium, 12/06/1998 - 12/06/1998
Source: orbit
Source-ID: 171963
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

Stochastic User Equilibrium Traffic Assignment with Turn-delays in Intersections.

General information
State: Published
Organisations: Department of Planning, Tetraplan Ltd.
Authors: Nielsen, O. A. (Intern), Simonsen, N. (Intern), Frederiksen, R. D. (Ekstern)
Publication date: 1998

Host publication information
Title of host publication: International Transactions in Operational Research.
Publisher: Pergamon Press
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 171620
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998

Traffic analysis of the Copenhagen Harbour Tunnel Project, Preconditions and results.

General information
Two new methods for estimating Trip Matrices from Traffic Counts

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Israelsen, T. (Intern), Nielsen, E. R. (Intern)
Publication date: 1998

Publication information
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 171625
Publication: Research - peer-review › Report – Annual report year: 1998

Using Expert System Rules to establish data on Intersections and Turns in Road Networks

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1998

Publication information
Place of publication: Oxford, UK
Publisher: Elsevier Science
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 171621
Publication: Research - peer-review › Book – Annual report year: 1998

A Stochastic Traffic Assignment Model Considering Differences in Passengers Utility Functions

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1997

Host publication information
Title of host publication: International Transactions in Operational Research
Publisher: Pergamon
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 171619
Publication: Research - peer-review › Article in proceedings – Annual report year: 1998
Estimation af turmatricer ud fra snittællinger - to metoder

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Pages: 377-390
Publication date: 1997

Host publication information
Title of host publication: Konferencerapport 2
Place of publication: Aalborg
Main Research Area: Technical/natural sciences
Conference: Traffik på AUC’97, Aalborg, 01/01/1997
Source: orbit
Source-ID: 168301
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

Et ekspertsystem til etablering af krydsdata

General information
State: Published
Organisations: Department of Planning, Tetraplan A/S
Authors: Nielsen, O. A. (Intern), Simonsen, N. (Intern), Frederikse, R. D. (Ekstern)
Pages: 251-262
Publication date: 1997

Host publication information
Title of host publication: Supplementary report
Main Research Area: Technical/natural sciences
Conference: Trafikdage på AUC’97, Aalborg, 01/01/1997
Source: orbit
Source-ID: 168832
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

GIS-based methods for establishing the datafoundation for traffic models

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1997

Host publication information
Title of host publication: GIS-based methods for establishing the datafoundation for traffic models
Main Research Area: Technical/natural sciences
Conference: 17th Annual ESRI USer Conference, San Diego, USA, 01/01/1997
Source: orbit
Source-ID: 168268
Publication: Research - peer-review › Book chapter – Annual report year: 1997

Multi-Path OD-Matrix Estimation (MPME) based on Stochastic User Equilibrium Traffic Assignment

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1997

Host publication information
Title of host publication: Multi-Path OD-Matrix Estimation (MPME) based on Stochastic User Equilibrium Traffic Assignment
Main Research Area: Technical/natural sciences
Conference: Transportation Research Board (TRB) - Annual Meeting, Washington, 01/01/1997
On the distribution of the stochastic component in SUE traffic assignment models

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Pages: 77-94
Publication date: 1997

Host publication information
Title of host publication: Seminar F, Transportation Planning Methods
Main Research Area: Technical/natural sciences
Conference: 25th European Transport Forum (PTRC Annual Meeting), Uxbridge, UK, 01/01/1997
Source: orbit
Source-ID: 168269
Publication: Research - peer-review › Book chapter – Annual report year: 1997

Stochastic User Equilibrium Traffic Assignment with Turn-delays in Intersections

General information
State: Published
Organisations: Department of Planning, Tetraplan A/S
Authors: Nielsen, O. A. (Intern), Simonsen, N. (Intern), Frederiksen, R. D. (Ekstern)
Publication date: 1997

Host publication information
Title of host publication: Stochastic User Equilibrium Traffic Assignment with Turn-delays in Intersections
Main Research Area: Technical/natural sciences
Conference: Seventh International Conference on Informations Systems in Logistic and Transport, Goteborg, 01/01/1997
Source: orbit
Source-ID: 167755
Publication: Research - peer-review › Book chapter – Annual report year: 1997

SUE-rutevalgsmodel med krydsmodellering

General information
State: Published
Organisations: Department of Planning, Tetraplan A/S
Authors: Nielsen, O. A. (Intern), Simonsen, N. (Intern), Frederiksen, R. (Ekstern)
Pages: 263-274
Publication date: 1997

Host publication information
Title of host publication: Supplementsrapport
Place of publication: Aalborg
Main Research Area: Technical/natural sciences
Conference: Traffikdage på AUC'97, Aalborg, 01/01/1997
Source: orbit
Source-ID: 168302
Publication: Research - peer-review › Article in proceedings – Annual report year: 1997

Trafikmodelberegninger for tunnelen under Københavns havn

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Israelsen, T. (Intern), Nielsen, E. R. (Intern)
Pages: 307-220
Publication date: 1997
Using Expert System Rules to establish data on Intersections and Turns in Road Networks

General information
State: Published
Organisations: Department of Planning, Tetraplan A/S
 Authors: Nielsen, O. A. (Intern), Simonsen, N. (Intern), Frederiksen, R. D. (Ekstern)
Publication date: 1997

A better tool for traffic planning

General information
State: Published
Organisations: Department of Planning, Technical University of Denmark
Authors: Nielsen, O. A. (Intern), Bohn, M. (Ekstern)
Publication date: 1996
Main Research Area: Technical/natural sciences

A discussion of mode choice models

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996

Description of travel behaviour in the traffic model - a critical review

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Do Stochastic Traffic Assignment Models Consider Differences in Road Users Utility Functions?

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166141
Publication: Research - peer-review › Book – Annual report year: 1996

Improved GIS-based Methods for Traffic Noise Impact Assessment
When vector-based GIS-packages are used for traffic noise impact assessments, the buffer-technique is usually employed for the study: 1. For each road segment buffer-zones representing different noise-intervals are generated, 2. The buffers from all road segments are smoothed together, and 3. The number of buildings within the buffers are enumerated. This technique provides an inaccurate assessment of the noise diffusion since it does not correct for buildings barrier and reflection to noise. The paper presents the results from a research project where the traditional noise buffer technique was compared with a new method which includes these corrections. Both methods follow the Common Nordic Noise Calculation Model, although the traditional buffer technique ignores parts of the model. The basis for the work was a digital map of roads and building polygons, combined with a traffic- and road database and the Danish Building- and Residence Register (BBR). In order to test the methods, a total noise impact assessment was made for the municipality of Middelfart (20,000 inhabitants). As the new method considers buildings barrier to noise diffusion, efforts were made to synthetically create a 3D-model from the 2D digital map by utilising the information in the BBR-register. Thus, the method can also estimate the noise on each floor and it takes care of the differences in barriers from tall buildings versus low buildings. The practical testing of the methods in Middelfart showed that the traditional noise buffer technique compared with the new method systematically overestimated noise affected residences by 17% and overestimated strongly affected residences by 282%. Thus, the study showed that the traditional buffer technique provides unreliable results in urban areas compared with the more detailed method.

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern), Bloch, K. S. (Ekstern)
Publication date: 1996

Publication information
Original language: English
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166228
Publication: Research - peer-review › Book – Annual report year: 1996

New Route Choice Models

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996
NTF-Conference on Person Transport Models - Summary, State-of-the-art and Perspectives

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996

Publication information
Place of publication: Copenhagen
Publisher: NTF
Original language: Undefined/Unknown
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166144
Publication: Research - peer-review › Book – Annual report year: 1996

Quality Control of traffic models

General information
State: Published
Organisations: Department of Planning, Tetraplan Ltd.
Authors: Nielsen, O. A. (Intern), Hansen, C. O. (Ekstern)
Publication date: 1996

Publication information
Place of publication: Copenhagen
Publisher: NTF
Original language: Undefined/Unknown
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166138
Publication: Research - peer-review › Book – Annual report year: 1996

Quarterly report, FU 91-033, Fourth quarter 1996, The GIS-T project

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996

Publication information
Original language: Danish
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 166154
Publication: Research - peer-review › Report – Annual report year: 1996

Quarterly report, FU 94-033, First quarter 1996, The GIS-T project

General information
State: Published
Organisations: Department of Planning
Quarterly report, FU 94-033, Second quarter 1996, The GIS-T project

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996

Quarterly report, FU 94-033, Third quarter 1996, The GIS-T project

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996

Technical documentation for the simulation for the distribution of truck traffic in the Copenhagen Region.

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996

Traffic Models for Municipalities - State-of-the-art and perspectives

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Pages: 22-27
Publication date: 1996
Main Research Area: Technical/natural sciences

Publication information
Journal: The City and Harbour Engineer
Issue number: 5
Original language: Danish
Source: orbit
Source-ID: 166128
Publication: Research - peer-review › Journal article – Annual report year: 1996

Use of GIS in Traffic Planning and Decision Support (GIS-T)

General information
State: Published
Organisations: Department of Planning
Authors: Nielsen, O. A. (Intern)
Publication date: 1996
Main Research Area: Technical/natural sciences

Publication information
Journal: International Association for Travel Behaviour Research
Original language: English
Source: orbit
Source-ID: 166132
Publication: Research › Journal article – Annual report year: 1996

Projects:

Mesoscopic Simulation of Multi-Model Urban Traffic
Department of Management Engineering
Period: 01/07/2017 → 30/06/2020
Number of participants: 3
Phd Student:
Paulsen, Mads (Intern)
Supervisor:
Rasmussen, Thomas Kjær (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansieret - Andet
Project: PhD

The architectural transition between stations and urban spaces, seen from a safety point of view
Department of Civil Engineering
Period: 01/10/2015 → 06/07/2019
Number of participants: 4
Phd Student:
Strandbygaard, Sofie Kirt (Intern)
Supervisor:
Jørgensen, Jan (Ekstern)
Nielsen, Otto Anker (Intern)
Main Supervisor:
Jensen, Lotte Bjerregaard (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Industrial PhD
Project: PhD
Intelligent Composition of Buffer Times in Railway Scheduling
Department of Management Engineering
Period: 15/12/2014 → 04/01/2018
Number of participants: 3
Phd Student:
Cerreto, Fabrizio (Intern)
Supervisor:
Harrod, Steven (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU)
Project: PhD

Attractiveness of Public Transport Systems in a Metropolitan Setting
Department of Management Engineering
Period: 01/10/2014 → 30/09/2017
Number of participants: 3
Phd Student:
Ingvardson, Jesper Bláfoss (Intern)
Supervisor:
Kaplan, Sigal (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD

Assessment and Traffic Modelling of Bottlenecks and Queues in Road Networks
Department of Transport
Period: 15/12/2013 → 29/02/2016
Number of participants: 3
Phd Student:
Prameswari, Niken (Intern)
Supervisor:
Prato, Carlo Giacomo (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samfinansierede - Virksomhed
Project: PhD

Optimization of Rail Operations with regard to Passenger Benefit
Department of Transport
Period: 01/12/2012 → 25/02/2016
Number of participants: 6
Phd Student:
Jensen, Jens Parbo (Intern)
Supervisor:
Prato, Carlo Giacomo (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Røpke, Stefan (Intern)
Bierlaire, Michel (Ekstern)
Kroon, Leo (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Network Effects within Railway Networks
Department of Transport
Period: 01/10/2012 → 07/04/2016
Number of participants: 6
Phd Student:
Jensen, Lars Wittrup (Intern)
Supervisor:
Landex, Alex (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Larsen, Allan (Intern)
Goverde, Rob M. P. (Ekstern)
Preston, John (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Dynamic Route Choice Models: Representing congestion and queue spillbacks
Department of Transport
Period: 01/09/2012 → 30/04/2014
Number of participants: 3
Phd Student:
Raovic, Nevena (Intern)
Supervisor:
Prato, Carlo Giacomo (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Rejseplanen - Next Generation
Department of Management Engineering
Period: 15/12/2011 → 14/03/2012
Number of participants: 4
Phd Student:
Lins, Thomas Vermehren (Intern)
Supervisor:
Nielsen, Otto Anker (Intern)
Nielsen, Hanne Riis (Intern)
Main Supervisor:
Pisinger, David (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Development Process of "best-in-class" high-speed railway line Copenhagen-Ringsted

Department of Transport
Period: 01/07/2011 → 30/06/2014
Number of participants: 4
Phd Student:
Trabo, Inara (Intern)
Supervisor:
Salling, Kim Bang (Intern)
Schneider-Tilli, Jan Erik (Ekstern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

Disaggregate activity-based traffic assignment modelling

Department of Transport
Period: 01/05/2011 → 23/02/2015
Number of participants: 7
Phd Student:
Rasmussen, Thomas Kjær (Intern)
Supervisor:
Frederiksen, Rasmus Dyhr (Intern)
Prato, Carlo Giacomo (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Larsen, Allan (Intern)
Bekhar, Shlomo (Ekstern)
Cantarella, Giulio Erberto (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Optimering af kørselsafgifter

Department of Transport
Period: 15/12/2010 → 07/10/2015
Number of participants: 3
Phd Student:
Pedersen, Thomas Ross (Intern)
Supervisor:
Fosgerau, Mogens (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
The effect of cycling policies

Department of Transport
Period: 15/12/2010 → 25/02/2016
Number of participants: 6
Phd Student: Halldórsdóttir, Katrín (Intern)
Supervisor: Prato, Carlo Giacomo (Intern)
Main Supervisor: Nielsen, Otto Anker (Intern)
Examiner: Nielsen, Thomas Alexander Sick (Intern)
Geurs, Karst T. (Ekstern)
Shiftan, Yoram (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Uncertainty calculation in Transport forecasts and models

Department of Transport
Period: 01/09/2010 → 19/12/2014
Number of participants: 5
Phd Student: Manzo, Stefano (Intern)
Main Supervisor: Nielsen, Otto Anker (Intern)
Examiner: Overgaard, Christian (Ekstern)
Brundell-Freij, Karin (Ekstern)
Jong, Gerard C. de (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut stipendie (DTU) Samf.
Project: PhD

Intelligent Road User Charging

Transport policy and behaviour

Department of Management Engineering

Department of Transport
Traffic modelling and planning
Period: 01/01/2010 → 31/12/2015
Number of participants: 6
Acronym: IRUC
Project participant: Hop, Jack Zagha (Intern)
Hjorth, Katrine (Intern)
Nielsen, Otto Anker (Intern)
Mabit, Stefan Lindhard (Intern)
Ranjan, Abhishek (Intern)
Project Manager, academic:
Fosgerau, Mogens (Intern)

**Financing sources**
Source: Public research council
Name of research programme: Strategic Research Council
Project

**Kvantitative metoder til vurdering af fremtidige køreplaner**
Department of Transport
Period: 01/02/2008 → 27/01/2014
Number of participants: 6
Phd Student:
Schittenhelm, Bernd Hermann (Intern)
Supervisor:
Landex, Alex (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Madsen, Oli B.G. (Intern)
Preston, John (Ekstern)
Weidmann, Ulrich Alois B. (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Ansat eksternt
Project: PhD

**Adfærdsmodeller for passagerers rutevalg**
Department of Transport
Period: 01/05/2007 → 25/08/2014
Number of participants: 6
Phd Student:
Anderson, Marie Karen (Intern)
Supervisor:
Prato, Carlo Giacomo (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Rich, Jeppe (Intern)
Bekhar, Shlomo (Ekstern)
Börjesson, Maria (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

**GNSS-based Road Charging Systems**
Department of Transport
Period: 01/02/2007 → 22/02/2012
Number of participants: 5
Phd Student:
Zabic, Martina (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Madsen, Oli B.G. (Intern)
Axhausen, Kay W. (Ekstern)
Tretvik, Terje (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: Eksternt finansieret virksomhed
Project: PhD

**Trafikmodellering af lange rejser**
Department of Transport
Period: 01/02/2007 → 19/12/2014
Number of participants: 6
Phd Student:
Knudsen, Mette Aagaard (Intern)
Supervisor:
Rich, Jeppe (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Prato, Carlo Giacomo (Intern)
Axhausen, Kay W. (Ekstern)
Börjesson, Maria (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

**Hurtigere tog i Danmark**
Department of Transport
Københavns Kommune
Odense Kommune
Esbjerg kommune
Aarhus Kommune
Randers kommune
Aalborg Kommune

Number of participants: 3
Project participant:
Nielsen, Otto Anker (Intern)
Project Manager, organisational:
Landex, Alex (Intern)
Sylvan, Henrik (Ekstern)

**Financing sources**
Source: Sam.arb.aftaler - Amter og kommuner
Name of research programme: Sam.arb.aftaler - Amter og kommuner
Amount: 25,000.00 Danish Kroner
Project

**MOTOS - Transport Modelling: Towards Operational Standards in Europe**
EU-project which based on a state-of-the-art review and user survey develops guidelines and standards of transport modelling with special focus on the new member states in EU. Partners are Goudappel Goudappel (NL), consortia leader, TNO (NL), CTT/DTI, DTF(DK, Obet (PL), Transman (HU), KTH (S), SUDOP (CZ), VGTU (LT). Leader of CTT’s part of the project, and the work package on state-of-the-art review (WP2). Funding: EU.
Department of Transport
Period: 29/09/2006 → 31/05/2007
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forsk. EU - Andre EU-midler
Name of research programme: Forsk. EU - Andre EU-midler
Amount: 573,000.00 Danish Kroner

Copenhagen Congestion monitoring
The project develops methods to monitor the development of congestion in the Copenhagen Region by analysing data from a fleet of cars equipped with GPS. Project manager. Funded by the Municipality of Copenhagen.

Department of Transport
Period: 16/01/2006 → 31/12/2007
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Sam.arb.aftaler - Amter og kommuner
Name of research programme: Sam.arb.aftaler - Amter og kommuner
Amount: 50,000.00 Danish Kroner

Application of passenger matrix estimation methods in the Copenhagen Rail system
The project aims at the full-scale estimation, calibration and implementation of methods that can estimate passenger travel data from counting and weighting trains. Project leader. Department of Mathematical Modelling at DTU and Rapidis ltd. were subcontractors. Funding: The Copenhagen Urban Rail Company.

Department of Transport
Number of participants: 2
Project ID: 35100
Project participant:
Landex, Alex (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Sam.arb.aftaler, Private danske - Andre virksomheder
Name of research programme: Sam.arb.aftaler, Private danske - Andre virksomheder
Amount: 231,500.00 Danish Kroner

Justering af bilmatricer til Ørestadens Trafikmodel (OTM)

Department of Transport
Period: 04/11/2005 → 31/03/2006
Number of participants: 6
Project ID: 35111
Project participant:
Rich, Jeppe (Intern)
Landex, Alex (Intern)
Zabic, Martina (Intern)
Hansen, Stephen (Intern)
Andersen, Jonas Lohmann Elkjær (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)
Scenarios for transport in Denmark – 2030
The project develops and discusses different scenarios for the development in the transport sector in Denmark – 2030. Project leader: Jens Rørbech consult contributed to the project as well. Funding: the weekly engineering journal.

Traffic Plan for Greenland: Decision Support Tool TGB
Department of Transport
Period: 06/06/2005 → 31/12/2005
Number of participants: 8
Acronym: TGB
Project ID: 35105
Project participant:
Jensen, Anders Vestergaard (Intern)
Salling, Kim Bang (Intern)
Nielsen, Otto Anker (Intern)
Hansen, Stephen (Intern)
Larsen, Allan (Intern)
Knudsen, Mette Aagaard (Intern)
Project Manager, organisational:
Leleur, Steen (Intern)
Rich, Jeppe (Intern)

Aggregated roadpricing and speed-calculations
The project aggregated average speeds in large zones with and with out road pricing as input to an economic analyses of roadpricing. Funding (and use of the traffic results); the Danish Economic Council.

Financing sources
Source: Sam.arb.aftaler, Private danske - Andre virksomheder
Name of research programme: Sam.arb.aftaler, Private danske - Andre virksomheder
Amount: 75,000.00 Danish Kroner
Project
Opdatering af turmatricer og Ørestadens Trafik Model (OTM)

Department of Transport
Period: 16/03/2005 → 31/10/2005
Number of participants: 6
Project ID: 35104
Project participant:
Rich, Jeppe (Intern)
Landex, Alex (Intern)
Zabic, Martina (Intern)
Hansen, Stephen (Intern)
Andersen, Jonas Lohmann Elkjær (Intern)

Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Sam.arb.aftaler, Private danske - Andre virksomheder
Name of research programme: Sam.arb.aftaler, Private danske - Andre virksomheder
Amount: 630,000.00 Danish Kroner

SPEEDMONITOR2

Department of Transport
Period: 31/01/2005 → 31/12/2005
Number of participants: 1
Project ID: 35103
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Sam.arb.aftaler - Statslige danske
Name of research programme: Sam.arb.aftaler - Statslige danske
Amount: 215,340.00 Danish Kroner

Vurdering af kørselsafgifter i København

Administration
Department of Transport
Period: 26/11/2004 → 31/07/2005
Number of participants: 6
Project ID: 35101
Project participant:
Landex, Alex (Intern)
Zabic, Martina (Intern)
Hansen, Stephen (Intern)
Rich, Jeppe (Intern)
Andersen, Jonas Lohmann Elkjær (Intern)

Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Sam.arb.aftaler - Statslige danske
Name of research programme: Sam.arb.aftaler - Statslige danske
Amount: 800,000.00 Danish Kroner
Marie Curie Joint European transport Research network (JET)
The proposed network will arrange a series of seminars and Ph.D.-schools within transport modelling and optimisation. Members are – among others – TØI, SINTEF, MOLDE, Linkjöbing, KTH, LTH, ITS Leeds, Imperial College London, ETH Zurich, IDSIA Lugano, Univ. of Rome, Reggio Calabria, Brescia, TU Delft, Eindhoven Tech. Univ., TRAIL, National Tech. Univ. of Athens, Univ. of Hamburg, RWTH Aachen. These are among the leading universities in transport within Europe. CTT is leading partner. The network is planned to be jointly chaired by Oli B.G. Madsen and Otto Anker Nielsen. Jeppe Husted Rich is project leader. Funds for application (JET) have been obtained from the national research foundation (STVF)

Department of Transport
Number of participants: 3
Project participant:
Nielsen, Otto Anker (Intern)
Madsen, Oli B.G. (Intern)
Project Manager, organisational:
Rich, Jeppe (Intern)

Financing sources
Source: Sam.arb.aftaler - Statslige danske
Name of research programme: Sam.arb.aftaler - Statslige danske
Amount: 150,000.00 Danish Kroner

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.

Department of Transport
Netherlands Organisation for Applied Scientific Research - TNO
NEA Transport Research and Training
TRT Transporti e Territorio SRL
University of Karlsruhe
Istituto di Studi per l'Integrazione dei Sistemi
Christian-Albrechts-Universität zu Kiel

European Commission - Joint Research Center
Number of participants: 14
Project ID: 35094
Contact person:
Burgess, Amaud (Ekstern)
Vilcan, Adrian (Ekstern)
Martino, Angelo (Ekstern)
Schade, Wolfgang (Ekstern)
Ricci, Andrea (Ekstern)
Broecker, Johannes (Ekstern)
Christidis, Panayotis (Ekstern)
Project participant:
Würtz, Christian Juul (Intern)
Nielsen, Otto Anker (Intern)
Leleur, Steen (Intern)
Hansen, Stephen (Intern)
Andersen, Jonas Lohmann Elkjær (Intern)
Zabic, Martina (Intern)
Project Manager, organisational:
Overgård, Christian Hansen (Intern)

Financing sources
Source: Forsk. EU - Rammeprogram
Name of research programme: Forsk. EU - Rammeprogram
Amount: 1,400,000.00 Danish Kroner
Project

Liniebåren trafik

Department of Transport
Period: 01/07/2004 → 19/12/2008
Number of participants: 6
Phd Student:
Landex, Alex (Intern)
Supervisor:
Kaas, Anders H. (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Madsen, Oli B.G. (Intern)
Radtke, Alfons (Ekstern)
Weidmann, Ulrich Alois B. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Institut/centerfinansieret
Project: PhD

En national godtrafikmodel, fase 2

Department of Transport
Period: 29/06/2004 → 31/05/2005
Number of participants: 3
Project ID: 459-35089
Project participant:
Overgård, Christian Hansen (Intern)
Würtz, Christian Juul (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forsk. Andre statslige danske i øvrigt
Name of research programme: Forsk. Andre statslige danske i øvrigt
Amount: 470,190.00 Danish Kroner
Project

VIKING ASTRID AKTA
Department of Transport
Period: 28/05/2004 → 31/12/2004
Number of participants: 3
Project ID: 449-35086
Project participant:
Overgård, Christian Hansen (Intern)
Würtz, Christian Juul (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forskningsprojekter - Andre ministerier og styrelser
Name of research programme: Forskningsprojekter - Andre ministerier og styrelser
Amount: 215,000.00 Danish Kroner
Project

Modellering af S-tog passagerregul.
Department of Transport
Period: 10/04/2004 → 30/06/2004
Number of participants: 2
Project ID: 000-35083
Project participant:
Landex, Alex (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Udenfor rammen
Name of research programme: Ukendt
Amount: 420,000.00 Danish Kroner
Project

Aktivitetsbaseret trafikmodellering af roadpricing
Department of Transport
Period: 01/09/2003 → 07/03/2008
Number of participants: 6
Phd Student:
Mabit, Stefan Lindhard (Intern)
Supervisor:
Fosgerau, Mogens (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Rich, Jeppe (Intern)
Bierlaire, Michel (Ekstern)
Daly, Andrew (Ekstern)

Financing sources
CLG - ph.d. Michael B. Pedersen

Department of Transport
Period: 23/04/2003 → 31/07/2005
Number of participants: 1
Project ID: 421-35070
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 1,288,000.00 Danish Kroner

Adfærdsmodeller for passageres rutevalg

Department of Transport
Period: 01/11/2002 → 30/11/2003
Number of participants: 2
Phd Student:
Jansen, Leise Neel (Ekstern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie

Optimering af multimodale transportsystemer

Department of Transport
Period: 01/06/2002 → 09/12/2005
Number of participants: 6
Phd Student:
Pedersen, Michael Berliner (Intern)
Supervisor:
Nielsen, Otto Anker (Intern)
Main Supervisor:
Madsen, Oli B.G. (Intern)
Examiner:
Larsen, Jesper (Ekstern)
Christiansen, Marielle (Ekstern)
Tind, Jørgen (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Ansat eksternt

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 organisational 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 (derivated effects of the transport system and the external influences).

Department of Transport
Period: 25/06/2001 → 31/12/2006
Number of participants: 13
Acronym: CLG
Project ID: 421-35044
Project participant:
Madsen, Oli B.G. (Intern)
Leleur, Steen (Intern)
Overgård, Christian Hansen (Intern)
Rich, Jeppe (Intern)
Jørgensen, Rene Munk (Intern)
Larsen, Allan (Intern)
Pedersen, Michael Berliner (Intern)
Salling, Kim Bang (Intern)
Jensen, Anders Vestergaard (Intern)
Sørensen, Majken Vildrik (Intern)
Landex, Alex (Intern)
Holvad, Torben (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forskningsrådene - STVF
Name of research programme: Forskningsrådene - STVF
Amount: 15,723,006.00 Danish Kroner

Traffic Dynamic Assignment Modeling for Road Network & Optimization
Department of Transport
Period: 01/04/2001 → 23/03/2006
Number of participants: 2
Phd Student:
Jia, Mei (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Offentlig finansiering
Project: PhD

Access modes to public transport.
Department of Transport
Number of participants: 1
Project ID: 552-35023
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Program. Andre statslige danske - Miljø
Name of research programme: Program. Andre statslige danske - Miljø
Amount: 1,105,506.00 Danish Kroner
Strategic models
Department of Transport
Number of participants: 1
Project ID: 552-35024
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Program. Andre statslige danske - Miljø
Name of research programme: Program. Andre statslige danske - Miljø
Amount: 444,960.00 Danish Kroner
Project

Value of time in traffic models
Department of Transport
Number of participants: 1
Project ID: 552-35022
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Program. Andre statslige danske - Miljø
Name of research programme: Program. Andre statslige danske - Miljø
Amount: 516,513.00 Danish Kroner
Project

Ikke-differentiabel optimering i heltalsprogrammering
Department of Transport
Period: 01/08/2000 → 22/05/2006
Number of participants: 7
Phd Student:
Kallehauge, Brian (Intern)
Supervisor:
Larsen, Jesper (Intern)
Madsen, Kaj (Intern)
Main Supervisor:
Madsen, Oli B.G. (Intern)
Examiner:
Nielsen, Otto Anker (Intern)
Lübbecke, Marco (Ekstern)
Pisinger, David (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-lønnet stipendie
Project: PhD

PROGRESS/AKTA
Department of Transport
Period: 08/05/2000 → 31/12/2004
Number of participants: 3
Project ID: 481-35018
Project participant:
Landex, Alex (Intern)
Würtz, Christian Juul (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forsk. EU - Rammeprogram
Name of research programme: Forsk. EU - Rammeprogram
Amount: 347,584.00 Danish Kroner

Spotlights
Department of Transport
Period: 03/02/2000 → 30/06/2002
Number of participants: 1
Project ID: 481-35016
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forsk. EU - Rammeprogram
Name of research programme: Forsk. EU - Rammeprogram
Amount: 244,000.00 Danish Kroner

A microeconomic model for car ownership, resident and work location
The research project - following the Ph.D.-study by Jeppe Rich - develops a 3-component model for car ownership, resident and work location. 1: A strategic microeconomic model based on a refined random utility framework, in which residential location, work location for up to two workers in the household and car ownership is considered. 2: An equilibrium framework for the housing market, leading to endogenous bid-rents, and 3: A short-term tactic micro model for mode and route choice. Funding: The Transport Council combined with the TRIPS Centre.

Department of Planning
Period: 01/01/2000 → …
Number of participants: 2
Project participant:
Rich, Jeppe (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Description and evaluation of Danish Traffic Models and their data foundation
Funding: Danish Transport Research (DTF)

Department of Planning
Period: 01/01/2000 → …
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Development of an evaluation framework for urban transit projects
The project aimed at the development of socio-economic evaluation methods for urban transit projects. Funding: The Danish Transport Council

Department of Planning
Period: 01/01/2000 → …
Number of participants: 2
Project participant:
Gissel, Stine (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)
Modelling access modes to public transport
The project focuses on methods for large-scale modelling of mode-chains including both public transport (chains of sub-modes with different service levels e.g. buses, local and regional trains) and feeder modes (walk, bicycles, car). The aim of the project is to develop a methodological framework for such models, to develop appropriate estimation techniques and to demonstrate the methods on a full-scale case. The project is part of the TRIP Centre.

Hague Consulting Group
Atkins Denmark A/S
Period: 01/01/2000 → ...
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Strategic traffic models
The project is part of the new TRIP-centre (Research Centre for Transport environment and health Impacts and Policy) under the Strategic Environmental Research Programme (SMP)

Rand Europe
COWI A/S
Period: 01/01/2000 → ...
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Trafikmodeller for passagertrafik med bane
Department of Transport
Period: 01/01/2000 → 29/09/2003
Number of participants: 4
Phd Student:
Sørensen, Majken Vildrik (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Brundell-Freij, Karin (Ekstern)
Larsen, Odd I. (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Samarbejdsaftalefinans
Project: PhD

Transport Object Platform (TOP)
Development and implementation of a GIS-based Transport Object Platform within the ARC/INFO environment.

Department of Planning
Atkins Denmark A/S
Period: 01/01/2000 → 31/12/2001
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)
Valuation of External costs of Air Pollution
The objective of this project is to improve existing Danish monetary estimates of the costs of transport related air pollution.

Department of Planning
COWI A/S
Period: 01/01/2000 → …
Number of participants: 1
Project Manager, organisational: Nielsen, Otto Anker (Intern)

Value of time in traffic models
The objective of the project is to improve estimation techniques concerning Value of Time (VoT) distributions and non-linear VoT in traffic models. The proposed methods are tested empirically on existing case studies. Following this, methods to transfer VoT-components from traffic models to socio-economic appraisal methods are developed. The project is part of the TRIP Centre.

Department of Planning
RAND
KOWI
Atkins Denmark A/S
Period: 01/01/2000 → …
Number of participants: 1
Project Manager, organisational: Nielsen, Otto Anker (Intern)

PORTAL
Dissemination of 4th framework research, PORTAL. The projects purpose is to pinpoint the main research results from the 4th framework programme, and disseminate these in EU. Manager for the Danish part of the project, with ScanRail and a Dutch Research Institute, NHTV, as subcontractors.

Department of Planning
Several international partners
Period: 01/10/1999 → …
Number of participants: 2
Project participant: Jensen, Peder (Intern)
Project Manager, organisational: Nielsen, Otto Anker (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 600,000.00 Danish Kroner

Risikomodeller for jernbanetrafik
Department of Transport
Period: 01/10/1999 → 26/03/2001
Number of participants: 4
Phd Student: Grevy, Bo (Intern)
Supervisor: Petersen, Kurt (Intern) Thyregod, Poul (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: **Blandet Finansiering**
Project: PhD

**SPOTLIGHT**
The project focuses on the exchange of traffic modelling and GIS-data, and their use for strategic planning purposes. In addition, the project formulate a set of guidelines for model evaluation. Member of the projects scientific committee.

Department of Planning
Several international partners
Period: 01/10/1999 → 01/10/2002
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

**Financing sources**
Source: Unknown
Name of research programme: **Ukendt**
Amount: 250,000.00 Danish Kroner
Project

**Traffic Models micro-economic foundation**
The project provides an overview of traffic models microeconomic foundation. Funding: the Danish Transport Council. Project responsible

Department of Planning
Period: 01/07/1999 → 31/12/1999
Number of participants: 2
Project participant:
Mortensen, Lone Hedegaard (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

**Financing sources**
Source: Unknown
Name of research programme: **Ukendt**
Amount: 250,000.00 Danish Kroner
Project

**Planlægning for samkørsel af behovstyret persontransport ved hjælp af Dial-a-ride metoder**
Department of Transport
Period: 01/03/1999 → 13/10/2003
Number of participants: 5
Phd Student:
Jørgensen, Rene Munk (Intern)
Main Supervisor:
Madsen, Oli B.G. (Intern)
Examiner:
Nielsen, Otto Anker (Intern)
Hasle, Geir (Ekstern)
Tind, Jørgen (Ekstern)

**Financing sources**
Source: Internal funding (public)
Name of research programme: **DTU-lønnet stipendie**
Project: PhD
Modeller for trafik- og lokaliseringsadfærd

Department of Transport
Period: 01/10/1998 → 12/12/2001
Number of participants: 5
Phd Student: Rich, Jeppe (Intern)
Main Supervisor: Nielsen, Otto Anker (Intern)
Examiner: Algers, Staffan (Ekstern)
Brundell-Freij, Karin (Ekstern)
Madsen, Bjarne (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskerakademiets Samfinansier
Project: PhD

The new Harbour Tunnel Project
The project improves and calculates more thorough the transport impacts of the proposed Harbour Tunnel in Copenhagen. This includes improvement of the lorry matrix, development of a freight transport model, improvement of the Ørestad Model, describing induced traffic and the effect of car owner-ship, SP- and RP-interviews, re-calibration of the Assignment Model and adjustment of it to consider tunnel toll, and scenario calculations. The project is carried out in co-operation with ScanRail Consult, TetraPlan Ltd. and Hague Consult. The project is funded by the Danish Ministry of Transport with a Steering Group of several Danish authorities. DTU part of the project is tasks concerning the estimation of the lorry matrix and the Assignment Model.

Department of Planning
ScanRail Consult
Tetraplan A/S
Hague Consulting Group
Period: 01/01/1998 → 31/12/1999
Number of participants: 1
Project Manager, organisational: Nielsen, Otto Anker (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 200,000.00 Danish Kroner
Project

Impacts of railway infrastructure projects
The aim of the project is to develop methods to quantify the consequences of railway infrastructure to society, to operators and to customers. The project will examine one or more consequences in detail. The focus will be on traffic-related effects, primarily time effects and the relation to time-tables, train frequency etc.

Department of Planning
ScanRail Consult
Period: 01/10/1997 → 28/02/2001
Number of participants: 3
Project participant: Nielsen, Otto Anker (Intern)
Hansen, Sten (Intern)
Project Manager, organisational: Jørgensen, N O (Intern)

Financing sources
Metoder i infrastrukturplanlægning med særligt henblik på jernbaner

Department of Transport
Period: 01/10/1997 → 19/08/2004
Number of participants: 6
PhD Student:
Hansen, Sten (Intern)
Supervisor:
Leleur, Steen (Intern)
Main Supervisor:
Nielsen, Otto Anker (Intern)
Examiner:
Madsen, Oli B.G. (Intern)
Larsen, Odd I. (Ekstern)
Nielsen, Lise Drewes (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Anden Sektorministeriel Fin-SU
Project: PhD

Ph.d. Sten Hansen

Department of Transport
Period: 18/09/1997 → 24/05/2004
Number of participants: 1
Project ID: 449-35011
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Forskningsprojekter - Andre ministerier og styrelser
Name of research programme: Forskningsprojekter - Andre ministerier og styrelser
Amount: 800,000.00 Danish Kroner

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 central 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

Department of Planning
Route Choice Models for Car Traffic in the Ørestad Model

The purpose of this project is 1) To improve the laying concerning expenses as well as differences in the motorists’ preferences and knowledge of the road network. 2) To include calculation of delays in crossroads in the model. 3) To enable laying out the car traffic referring to different criteria (Multi-class assignment). Among other things this includes possibility of modelling different preferences (useful functioning) for different vehicles, excursion choice and time of the day. 4) To secure a consistent and improved feedback from the new route choice model to the rest of the model levels (excursion dispersion and choice of transportation means).

Department of Planning

Tetraplan A/S

Hague Consult

Ørestadselskabet

Period: 01/08/1997 → 01/08/1998
Number of participants: 4

Project participant:
Nielsen, Erik Rude (Intern)
Israelsen, Thomas (Intern)
Simonsen, Nikolaj (Intern)

Project Manager, organisational:
Nielsen, Otto Anker (Intern)
The toll ring project
Assessment of the traffic consequences of a payment ring including calculation of the model and adaptation of an assignment model.

Department of Planning
The Transportation Council
Tetraplan A/S
Period: 01/05/1997 → 01/09/1997
Number of participants: 3
Project participant:
Nielsen, Erik Rude (Intern)
Israelsen, Thomas (Intern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

The Ørestad model
Consultance concerning the Ørestad model's restrictions and improvements of car traffic. Subsequent proposals for further development of the model.

Department of Planning
Tetraplan A/S
Ørestadsselskabet
Period: 24/01/1997 → 01/07/1997
Number of participants: 1
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

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 (WP6) and interfaces to traffic models (WP7). 3)Decision support (WP8) and validation of models (WP10) in a GIS-environment.

Department of Planning
Tetraplan A/S
MultiCriteria Consulting
National Technical University of Athens
The BASISNET-project: Analyses of different public transportation solutions in Copenhagen (basis networks)

The main purpose of the BASISNET-project is to map future demands and needs for public transport of high quality in Copenhagen, and to suggest specific solutions to meet these demands. The perspective is the period until 2010. Thus, it is examined which future traffic problems, the backbone public transport system must solve (basis network). The whole region of Copenhagen is dealt with and different system-solution, e.g. fast busses, trams, light rail and mini-metro are dealt with. The project includes traffic forecasts, impact analyses, sketch plans and economic estimates. It does not only consider technical solutions and analyses but also the infrastructures lay out within the city, including architecture and aesthetics. IFP’s role is to coordinate GIS-data, carry through GIS-analyses and visualisations and to contribute to assessment and discussions of the results of runs with traffic models. Both the Greater Copenhagen Traffic Model and the Ørestads’ Model are used for the study in order to get a more broad evaluation of traffic impacts.
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 the 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.

Department of Planning
Department of Civil Engineering

Tetraplan A/S
Period: 01/09/1996 → 01/06/1997
Number of participants: 12
Project participant:
Leleur, Steen (Intern)
Brems, Camilla Riff (Intern)
Nielsen, Erik Rude (Intern)
Grevy, Bo (Intern)
Israelen, Thomas (Intern)
Thorlacius, Per (Intern)
Hansen, Christian Overgaard (Ekstern)
Bloch, Karsten Sand (Ekstern)
Nielsen, Jan (Ekstern)
Nielsen, Mogens (Ekstern)
Petersen, Jens Møller (Ekstern)
Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1.00 Danish Kroner
Project

The Copenhagen Harbour Tunnel Project

The initial stages of the planning process concerning large infrastructure projects are often based on rather simplified modelling efforts - if any. Based on this, large-scale traffic modelling studies are often agreed upon. However, even though traffic models are becoming more and more complex, a number of simplifications are often decided upon in the early stage of the study, e.g. whether to model induced traffic and land use interaction. Even if the best practice is followed, the forecasts may turn out far from the actual flows. In addition, the work is often so comprehen-sive, that only few alternatives are examined thoroughly (although the GIS-technology has eased the work process). As a result, the reasonableness of using traffic models in the planning process has often been debated. The Harbour Tunnel project is an early GIS-based assessment of the impacts of a proposed road-tunnel under the harbour of Copenhagen. Besides relying as much as possible on existing models, the study has used a minimum-maximum strategy to search for critical and non-critical traffic components. As an example induced traffic may be difficult to assess, but the 'maximum reasonable induced traffic' could clarify whether it is relevant to consider induced traffic at all. In the same manner recommendations could be given to the need for detailed investigations of e.g. land-use interaction, truck-traffic, detailed route choices, traffic calming, trip distribution and mode choice. A large number of alternatives were examined, several of which could clearly be rejected. In addition, the study provided useful recommenda-tions for a subsequent full-scale modelling study (not yet started). Some of these recommendations were surprising even for experienced modellers.

Department of Planning
Department of Civil Engineering
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

Simulation of truck-traffic to the Harbour of Copenhagen

In connection with the work 'Environmental impacts of freight transport by truck and ship - A pilot project for the Copenhagen Metropolitan area' done by Copenhagen Business University, Otto Anker Nielsen was hired to do a
simulation of the distribution and routes of truck-traffic on the road network in Copenhagen. Truck flows were investigated within 3 categories to- and from Copenhagen: International traffic, traffic to- and from the harbour and national traffic.

Traffic surveys delivered by the Business Univ. were split up in a more detailed level by a sketch method. Hereafter the traffic was assigned onto a road network earlier implemented at IFP by a probit-based route choice model. Beside the practical part of the work, the study gave some interesting insight to truck driver's route choices: 1. Truck drivers have a less stochastic behaviour than personal car drivers. 2. Truck drivers have a large preference for big roads (especially motorways) and little preference for small roads. Thus, weighted speeds (perceived costs) can advantiously be used in the model in stead of the real speeds. In addition the preference seems to be better described by using travel time rather than travel cost (or length) as explanatory variable. 3. It is less important to use a traffic dependent model (User Equilibrium) than for personal car traffic (under the premise that the traffic network is medium loaded as in Copenhagen).

Department of Planning

Department of Civil Engineering

Copenhagen Business School

Danish Environmental Survey

Period: 01/03/1996 → 01/06/1996
Number of participants: 3
Project participant:
Nedergaard, Kristen (Ekstern)
Marskell, Peter (Ekstern)

Project Manager, organisational:
Nielsen, Otto Anker (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1.00 Danish Kroner

GIS-T; Sub-project on methods for quality control of data and model results

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.

Department of Planning

Department of Civil Engineering

Tetraplan A/S

Period: 02/01/1996 → 01/06/1997
Number of participants: 12
Project participant:
Leleur, Steen (Intern)
Brems, Camilla Riff (Intern)
Thorlacius, Per (Intern)
Greby, Bo (Intern)
Nielsen, Erik Rude (Intern)
Israelsen, Thomas (Intern)
Hansen, Christian Overgaard (Ekstern)
Bloch, Karsten Sand (Ekstern)
Nielsen, Jan (Ekstern)
Nielsen, Mogens (Ekstern)
Petersen, Jens Møller (Ekstern)
**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.

**Department of Planning**

**Period:** 01/05/1995 → 01/05/1998

**Number of participants:** 3

**Project participant:**

Leleur, Steen (Intern)

Nielsen, Otto Anker (Intern)

**Project Manager, organisational:**

Moshøj, Claus Rehfeld (Intern)

**Financing sources**

Source: Unknown

Name of research programme: Ukendt

Amount: 1,000,000.00 Danish Kroner

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**Traffic models for public transport**

The study concerns the possibilities for better planning of public transport by the use of improved traffic models. Among other things, the transfers in public transport based on the restriction in departure time and lines are emphasised. The three main parts of the work deal with the mode choice, the route choice, and the trip chains. In the latter part a group of new models is developed.

**Department of Planning**

**Period:** 01/05/1995 → 01/07/1999

**Number of participants:** 3

**Project participant:**

Nielsen, Otto Anker (Intern)

Jørgensen, N O (Intern)

**Project Manager, organisational:**

Brems, Camilla Riff (Intern)

**Financing sources**

Source: Unknown

Name of research programme: Ukendt

Amount: 1,200,000.00 Danish Kroner

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**Trafikmodeler med særlig vægt på kollektiv trafik**

**Department of Transport**

**Period:** 01/05/1995 → 22/01/2002

**Number of participants:** 6

**Phd Student:**

Brems, Camilla Riff (Intern)

**Supervisor:**

Jørgensen, N O (Intern)
Trafikplanlægning med særlig vægt på anvendelse af GIS-T til beslutningsstøtte

Department of Transport
Period: 01/05/1995 → 08/09/1998
Number of participants: 4
Phd Student:
Moshøj, Claus Rehfeld (Intern)
Supervisor:
Nielsen, Otto Anker (Intern)
Main Supervisor:
Leleur, Steen (Intern)
Examiner:
Jørgensen, N O (Intern)

Financing sources
Source: Internal funding (public)
Name of research programme: Sektorministerium, Stip-SU
Project: PhD

Noise Impact Analyses based on GIS- and BBR-registers

When standard GIS are used for traffic noise impact assessment, this has usually been done by using the built-in buffer- and overlay tools. However, recent research by IFP and TetraPlan Ltd. shows that the use of these tools can result in a crude and systematic misestimation of the noise level along building facades and thereby also the number of residences affected by noise of certain levels. New methods developed by TetraPlan Ltd. consider the barriers of different buildings as well as noise reflections. As part of the work a methodology for creating a ‘synthetic’ 3-D model based on GIS-maps and the Danish Building register has been developed. The work builds on two pilot projects ("Svendborg" & 'Middelfart') named after the concerned cities. In the second phase of the GIS-T programme, the evaluation of traffic noise based on detailed map and register data are continued. A method to split buildings in floors and apartments has been developed. Based on this, analyses of coherence between noise and different socioeconomic data from the Danish Building Register (BBR) and personal register (CPR) are carried through. This provides a first step in the direction of analyses of traffic noise's relationship with socioeconomic data.

Department of Planning
Department of Civil Engineering
The Danish Map and Land Register Agency, KMS
The Danish Environmental Agency
The municipality of Middelfart
DELTA
Tetraplan A/S
Period: 01/04/1995 → 31/12/1996
Number of participants: 10
Project participant:
Israelsen, Thomas (Intern)
Nielsen, Erik Rude (Intern)
Simonsen, Arne (Ekstern)
Lind, Morten (Ekstern)
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).

Department of Planning
Period: 01/10/1994 → 01/07/1998
Number of participants: 3
Project participant:
Leleur, Steen (Intern)
Nielsen, Otto Anker (Intern)

Project Manager, organisational:
Kronbak, Jacob (Intern)

Financing sources
Source: Unknown
Name of research programme: Ukendt
Amount: 1,000,000.00 Danish Kroner
Project

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’.

Department of Planning
Department of Civil Engineering
Tetraplan A/S
Period: 01/09/1994 → 07/12/1997
Number of participants: 12
Project participant:
Brems, Camilla Riff (Intern)
Leleur, Steen (Intern)
Thorlacius, Per (Intern)
Grevy, Bo (Intern)
Israelsen, Thomas (Intern)
Nielsen, Erik Rude (Intern)
Hansen, Christian Overgaard (Ekstern)
Bloch, Karsten Sand (Ekstern)
Nielsen, Jan (Ekstern)
Nielsen, Mogens (Ekstern)
Petersen, Jens Møller (Ekstern)
Project Manager, organisational: 
Nielsen, Otto Anker (Intern)

Financing sources
Source: Unknown
Name of research programme: Uudendt
Amount: 1.00 Danish Kroner

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 simplicity 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 independence 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. For organizational details on the traffic model sub-projects; see the GIS-T programme.

Department of Planning
Department of Civil Engineering
Tetraplan A/S
Period: 01/09/1994 → 01/09/1999
Number of participants: 12
Project participant:
Brems, Camilla Riff (Intern)
Grevy, Bo (Intern)
Israelsen, Thomas (Intern)
Leleur, Steen (Intern)
Nielsen, Erik Rude (Intern)
Thorlacius, Per (Intern)
Route Choice Models and Traffic Assignment

Route choice models are critical as they provide 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 have proven successful in several applied projects. Sub-projects have carried out together with Tetraplan and Hague Consulting. Issues concerning passengers' route choices in public transport, multiple-class assignment and methods to enumerate cost from assignment models are now being developed.

Department of Planning

Department of Civil Engineering

Tetraplan A/S

Period: 01/09/1994 → 01/09/1999

Number of participants: 12

Project participant:

Brems, Camilla Riff (Intern)

Leleur, Steen (Intern)

Thorlacius, Per (Intern)

Grevey, Bo (Intern)

Nielsen, Erik Rude (Intern)

Israelsen, Thomas (Intern)

Hansen, Christian Overgaard (Ekstern)

Bloch, Karsten Sand (Ekstern)

Nielsen, Jan (Ekstern)

Nielsen, Mogens (Ekstern)

Petersen, Jens Møller (Ekstern)

Project Manager, organisational:

Nielsen, Otto Anker (Intern)

Financing sources

Source: Unknown

Name of research programme: Ukendt

Amount: 1.00 Danish Kroner

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.

**Department of Planning**

**Department of Civil Engineering**

Tetraplan A/S  
Period: 01/09/1994 → 01/06/1997  
Number of participants: 14  
Project participant:  
Leluer, Steen (Intern)  
Kronbak, Jacob (Intern)  
Brems, Camilla Riff (Intern)  
Thorlacius, Per (Intern)  
Grevy, Bo (Intern)  
Nielsen, Erik Rude (Intern)  
Israelsen, Thomas (Intern)  
Moshøj, Claus Rehfeld (Intern)  
Hansen, Christian Overgaard (Ekstern)  
Bloch, Karsten Sand (Ekstern)  
Nielsen, Jan (Ekstern)  
Nielsen, Mogens (Ekstern)  
Petersen, Jens Møller (Ekstern)  
Project Manager, organisational:  
Nielsen, Otto Anker (Intern)

**Financing sources**  
Source: Unknown  
Name of research programme: Ukendt  
Amount: 3,300,000.00 Danish Kroner  
Project

**Use of GIS-T for traffic planning in developing countries**  
It is widely recognised that developing countries face huge problems regarding traffic and infrastructures. This is not only the case in rural areas - the traditional focus of developing projects - but also in the urban areas. The traffic congestion causes that large resources in form of manpower, vehicles and goods are tied up in the traffic. This in turn results in less economic development, prohibitive pollution and a high rate of traffic accidents. If the traffic planners had better and more accessible tools for analyzing impacts of different project proposals, the scarce means in the developing countries could be used more efficiently. However, the existing research in traffic models mainly addresses issues and travel patterns in industrial countries. Due to among other things differences in standard of infrastructure, types of modes, economy, driving behaviour, available data, these models cannot directly be used in developing countries. The joint research programme between IFP, DTU and Bandung Institute of Technology, ITB, will contribute to the development of such models. IFP has had a long-term relationship with ITB. The City of Bandung, Indonesia (5 mil. inhabitants) has so far been used as case for the work.

**Department of Planning**

**Department of Civil Engineering**

Bandung Institute of Technology  
Period: 01/09/1994 → 01/12/1996  
Number of participants: 3  
Project participant:  
Israelsen, Thomas (Intern)  
Nielsen, Erik Rude (Intern)  
Project Manager, organisational:  
Nielsen, Otto Anker (Intern)  
Project
Optimal brug af trafikmodeller- en analyse af regionale persontrafikmodeller med henblik på dataøkonomi og validitet

Department of Transport
Period: 01/08/1992 → 20/03/1995
Number of participants: 3
Phd Student:
Nielsen, Otto Anker (Intern)
Main Supervisor:
Laursen, Jan Grubb (Intern)
Examiner:
Overgaard, Knud Rask (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: DTU-stipendium
Project: PhD

Activities:

Modelling production-consumption flows of goods in Europe: the trade model within Transtools 3
Period: 5 Oct 2016
Gerard de Jong (Speaker)
Reto Tanner (Other)
Jeppe Rich (Other)
Mikkel Thorhauge (Other)
Otto Anker Nielsen (Other)
John Bates (Other)

Department of Management Engineering
Transport DTU
Transport Modelling

Description
Estimation results and elasticities are presented for the trade model within the European transport model Transtools3. We also explain how the outcomes of this model are used in the overall freight model.

Degree of recognition: International
Documents:
Trademodel TT3 ETC_2016_v1

Related event
European Transport Conference 2016
05/10/2016 → 05/10/2016
Barcelona, Spain
Activity: Talks and presentations › Conference presentations

A model for freight transport chain choice in Europe
Period: 14 Sep 2016 → 16 Sep 2016
Anders Fjendbo Jensen (Speaker)
Mikkel Thorhauge (Other)
Gerard de Jong (Speaker)
Jeppe Rich (Other)
Thijs Dekker (Other)
Daniel Johnson (Other)
Manuel Ojeda Cabral (Other)
John Bates (Other)
Otto Anker Nielsen (Other)

Department of Management Engineering
This paper describes the structure of the Transtools3 freight transport chain choice model for Europe and the data at the shipment level that were used in estimation, and presents the estimation results and resulting elasticities. It also discusses the structure of the overall freight model and how production-consumption matrices from a trade model are combined with the transport chain choice model in model application. In the estimation of the transport chain choice model on the available disaggregate data sources (the Swedish Commodity Flow Survey 2009 and the French ECHO survey) we tested several options for the specification of transport costs in the model and various nesting structures.

Degree of recognition: International
Documents:
- TT3 transport chain choice hEART 2016 v5

Related event
- heart 2016
  14/09/2016 → 16/09/2016
  Delft, Netherlands
  Activity: Talks and presentations › Conference presentations