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Published in:
European Journal of Transport and Infrastructure Research

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Salling, K. B., & Nielsen, O. A. (2015). Uncertainties in Transport Project Evaluation: Editorial. European Journal of Transport and Infrastructure Research, 15(3), 282-285.

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Uncertainties in Transport Project Evaluation: Editorial

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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.

Keywords: Transport Project Evaluation, Inaccuracies of Demand forecasts and Construction Costs, Uncertainties in Transport models, Assessment of Infrastructure.

Transport is a sector of the society often with conflict between the political goals and the on-going factual development. This is especially the case with the increasing transport demand and volumes that lead to increasing congestion and CO₂ emissions. In this respect the users' responses to policy initiatives and the derived impacts are difficult to forecast due to complex causal relationships. Transport demand models and socio-economic cost-benefit analyses are recognised as important tools in the decision support for the justification of new transport infrastructure projects and policies. Thus, more accurate and less biased models will lead to a better use of the available (public) resources, and hence a better balance between the different goals in transport policy, e.g. such as improving and sustaining accessibility, economic development and travel safety while reducing CO₂ emissions, congestion and energy consumption. However, traffic forecasts, estimates of construction costs, socio-economic cost-benefit analysis and other assessment methods, which constitute an essential part of the planning and decision-making with regard to major infrastructure projects and policies, are often inadequate or imprecise and hence misleading. Consequently, projects may be designed incorrectly or decided without being cost-effective whereby the estimated user benefits can turn out to be lower than predicted and the construction cost estimates imply budget overruns.

A key issue is the presence of uncertainty in the definition and quantification of most of the inputs listed above and used to feed decision making related to transport projects. Uncertainty and variability refers to the lack of full knowledge and understanding of the processes that define these inputs, due to their complexity that prevents quantifying these inputs deterministically. Uncertainty can only be partially reduced, but different statistical methods can be implemented to describe and quantify uncertainty, for instance related to the calculation of construction costs

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or traffic forecasts. Uncertainty analysis then becomes a tool of extreme importance to feed decision making processes with the knowledge necessary to take more informed decisions. It is therefore as presented below a main concern to assess and implement model-based decision making under uncertainty and variability taking into account respectively the inaccuracies in construction cost estimations and transport models/forecasts made use of in the evaluation and decision support models.

Specifically, the aim of the UNITE project and subsequent international conference was to bring together practitioners, researchers, politicians and stakeholders to present and discuss research within the topic area of uncertainties in transport project evaluation. In this area of research contributions so far have been relatively scarce and often boiled down to the concepts of strategic misrepresentation and optimism bias where several authors have identified substantial degrees of inaccuracies in terms of cost estimations and demand forecasts. Most of the existing material, thus, conforms to the common agreement that such inaccuracy exists ex-post – but in most of the cases there is no recommendation for new ways of doing ex-ante based evaluation.

The overarching aim of the UNITE project has been to analyse uncertainty in existing models and forecasts based on an extensive quantitative before-after survey of projects in Scandinavia and the UK. The results with intent to provide recommendation to model formulation and use in the future includes also the organisational context of modelling. Moreover, the UNITE project has produced methods by which it will be possible to quantify the uncertainty of traffic forecasts, cost estimates and socio-economic analyses. The results of the project aim therefore to lead to better decision support for large transport investments and to a better understanding of project uncertainties by providing adequate tools for quantifying these. Finally, the work related to UNITE has been to identify, explain and thereby avoid the systematic biases of decision support models, leading to more valid decision support. Overall, the results from the UNITE project seek to improve the quality of the decision support tools within the transport sector, thus leading to a better use of the investments with regard to socio-economy and to a higher public acceptance of the decisions made.

In view of the UNITE objectives presented above, the following set of full papers presented at the conference have been organised into three topic areas that explore the uncertainties inherent to 1) construction costs estimations, 2) transport models and forecasts, and 3) evaluation/decision support models, which is depicted in Figure 1.

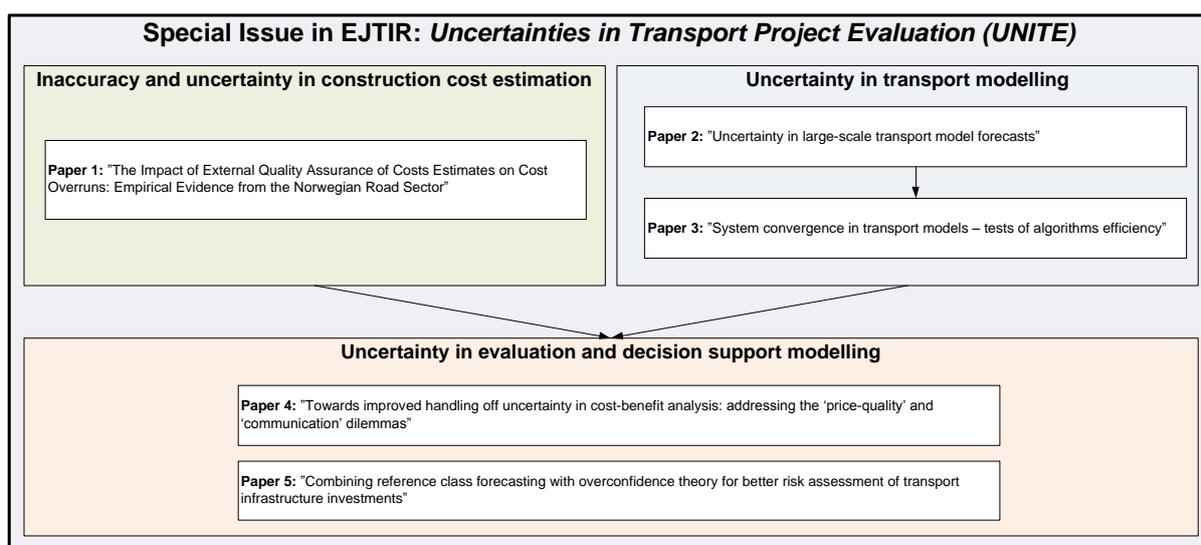


Figure 1. Organisation of papers within this special issue

The following synthesis for each of the five papers explores the findings in relation to the UNITE work, i.e. the fact that uncertainties within transport project evaluation need to be paid attention and included in any transport policy making. One main objective has been to ensure that decision makers and stakeholders are made aware of this in all three topic areas: estimation of construction cost and demand forecasts, transport modelling and finally uncertainty-based assessment/evaluation models.

The first paper by **Odeck et al.** titled "The impact of External Quality Assurance of cost estimates on cost overruns: Empirical evidence from the Norwegian Road Sector" concerns how the Norwegian government exerts efforts to reduce road infrastructure cost overruns by introducing nationwide quality assurance schemes whereby external consultants are engaged to ensure the quality of the estimates provided. The authors present examples from a set of road infrastructure projects displaying the fact that with statistical significance:

1. Quality assurance of cost estimates has led to a reduction in cost overruns.
2. Quality assurance has not led to improved accuracy of the estimates provided by the authorities; however, it has led to systematic overestimation by the authorities.
3. The estimates provided by external consultants are more accurate than those made by the authorities. External consultants also seem to overestimate costs but to a much lesser degree than the estimates provided by the authorities.

The second paper by **Manzo et al.** titled "Uncertainty in large scale transport model forecasts" delivers empirical evidence on the inaccuracy in transport model forecasts specifically related to the demand of transport over long periods of time. The paper specifically fills the gap as concerns the uncertainty propagation patterns over time, especially with respect to large-scale type of transport models. As part of the empirical analyses, the new Danish National Transport model has been applied as a case study, i.e. fed with variables of concern such as population, gross domestic product, employment, and fuel prices to quantify their uncertainty for 5 year intervals over a period of 15 years. The main findings from this paper are related to model sensitivity tests which among other things have shown how the model output uncertainty grows over time, reflecting the increase in the uncertainty of the model variables.

The third paper by **Rich and Nielsen** titled "System convergence in transport models – tests of algorithms efficiency" presents the convergence performance for the external loop relevant in most transport models. Traditionally transport models are respectively divided into an assignment and demand model that work separately, i.e. involving two different equilibrium mechanisms. This paper investigates the external loop between the latter two mechanisms through variants of the Method of Successive Averages (MSA). Eventually a weighted MSA approach is analysed through the Danish National Transport model in order to derive empirical support. The main findings reveal 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.

The final two papers deal with the inaccuracies presented in the decision support and assessment methods typically in terms of socio-economic cost-benefit analyses. Paper four by **Mouter et al.** titled "Towards improved handling of uncertainty in cost-benefit analyses: Addressing the 'price-quality' and communication dilemmas" deals with the fact that an important limitation of Cost-Benefit Analyses (CBA) is the inherent uncertainty in estimations of future welfare effects. Thus, the 'price-quality' dilemma refers to the trade-off between the quality of welfare effect estimations and the costs of providing these estimations. It is argued that specifically the CBA practitioners are not readily inclined to aim for high accuracy as this may lead to a too expensive tender. Thus, it becomes important to develop models or calculation tools which CBA practitioners can use in order to make more accurate estimations without substantial extra costs.

Moreover, the authors develop a conceptual framework of the hypothesised relationships between Personal Need for Structure, Need for Cognition, Personal Fear of Invalidity and Strategic, Absolute and Challenge Orientation in the Processing of CBA. This framework addresses the 'communication' dilemma which refers to the observation that both a poor communication and a too prominent communication of uncertainties can cause problems for decision-makers.

Finally, the fifth paper by **Leleur et al.** titled: "Combining reference class forecasting with overconfidence theory for better risk assessment of transport infrastructure projects" collects information based upon the latter papers namely the fact that both demand forecasts and construction costs are highly inaccurate. Through reference class forecasting and overconfidence theory the authors present a framework model which by the use of Monte Carlo simulation and expert judgments is able to simulate the uncertainty and provide probability-based interval results instead of the deterministic point result from conventional CBA. Specifically, the article seeks to add to progress in risk assessment methodology by flexible use of reference classes, which is demonstrated by using the developed UNITE-DSS model for assessment. Among other things the UNITE-DSS model makes use of a new project database containing information with regard to the cost and demand inaccuracies of more than 200 transport infrastructure projects.

This special issue presents specific application procedures and model-based decision making processes within transport project evaluation. From the five papers included, huge uncertainties exist within estimation of construction costs and demand forecasts, transport models and decision support/evaluation models. Main findings in UNITE concern model estimation and model uncertainties as specified in paper 1, 2 and 3. In addition the recognition of these findings for evaluation comprised in paper 4 and 5 implies that UNITE results may have a potential to influence transport policy and decision making, which may deliver better and more informed decision support in the future.