

# 20<sup>th</sup> International Emme Users' Conference

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## CALL FOR PAPERS

Modeling Toll Roads with EMME/2: Traffic & Revenue Study for the Montreal Region

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**Title of the paper**

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### **BIOGRAPHICAL SUMMARY FOR MAIN AUTHOR** (100 words mini-CV)

Peter Vovsha, Ph.D, is a principal professional associate and leading travel modeler with Parsons Brinckerhoff, Inc. He has 26 years of experience, international recognition, and numerous publications in such fields as discrete choice models, regional model system design, and behavioural research. He developed complete travel models for such major cities as New York, Columbus, and Jerusalem, Israel. He led pioneering applications of advanced tour-based models in New York, Columbus, Atlanta, San-Francisco Bay Area, and Montreal. He has been intensively working in the field of road pricing by managing a large-scale research project for NCHRP (8-57) and applying innovative models for the New York area pricing study and Montreal traffic and revenue study.

### **AUDIOVISUAL SUPPORT NEEDED**

(A PC with Office XP, a projector, and a microphone will be provided. Please mention any other needs.)

## ABSTRACT (500 words)

The paper describes a recent application of a model system developed for the Montreal Region. The model system was specifically designed for the Traffic & Revenue Study implemented for the Ministry of Transportation of Quebec that included large-scale toll road projects A-25 and A-30. The model system was based on the EMME/2 platform for traffic simulations (multi-class assignment and skimming procedures) that was combined with an (externally programmed) core demand model. The core demand model included mode choice with binary pre-route choice (toll vs. non-toll) at the lower level of mode hierarchy. It was implemented in an advanced tour-based micro-simulation fashion. The model system application included several global iterations between the demand generation and network simulation stages.

The paper is focused on the following general/conceptual and specific/technical issues:

- Rigorous theoretical formulations of a combined demand-network equilibrium cannot be fully implemented in large networks. An empirical iterative procedure was essentially implemented where certain steps were intentionally simplified to achieve reasonable run times.
- Construction of non-overlapping sets of toll and non-toll routes in the assignment and skimming procedures (that is an essential for the network equilibrium formulation) is impossible. Existing practices are frequently based on artificial "promotion" of toll routes by implementing toll assignment with zero tolls that can lead to significant biases in route choice when an open toll scheme with multiple points of entry and exit is considered. A practical manifestation of this problem is that if a (preferable) multi-path skimming is applied (additional options assignment) it results in fractional shares of toll and non-toll routes chosen for the same origin-destination pair that leads to a discrepancy between the toll trip table and assigned toll volumes. Different ways to restrict toll and non-toll route choice sets more properly are discussed.
- Additive-by-link skims (travel time, cost, or distance) can be used as variables in the choice model along with independent-from-route constants and variables (like toll bias). However, route-dependent but non-additive-by-link variables (like share of highway time of the total route time or maximum V/C along the route as a proxy for reliability) cannot be strictly written in the network equilibrium formulation. These variables, however, proved to be statistically significant in explaining observed behavior. The problem of incorporation of non-additive-by-link variables arises also when non-link-based pricing forms (like entry-exit toll) are modeled. Ways to accommodate these variables are discussed.
- The core demand model has more than 30 travel segments (by purpose, income, gender, etc) with distinctive VOTs and could produce highly segmented demand matrices. However, at the network simulation stage, and taking into account the region size (1,500 zones) as well as additional traffic components (commercial vehicles and trucks) the number of vehicle classes could result in infeasible run times. The adopted specification included 4 basic vehicle classes (auto, commercial, light truck, heavy truck) with additional dichotomy by toll and non-toll users that resulted in a large-scale network assignment with 8 classes. VOT values within each class were averaged. This large-scale assignment was implemented for each of the 4 time-of-day periods and at each of the 3-4 global iterations of the model system run.
- Implementation of multi-path skimming by additional options assignment for all 8 classes in turn proved to be unrealistic in terms of run time. A reasonable compromise was found in implementing a single multi-class assignment, freezing link generalized cost for each class, and creating simplified all-or-nothing skims for each class and attribute (toll, time, distance, etc).
- The results of the model system application are presented including associated problems of certain and inevitable discrepancy between the demand model and network assignment results.
- An EMME/2 Macro script for network procedures was written with a flexible functionality that allows for supporting different model application schemes.

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