

0-6754: Review of Tolling Approaches for Implementation within TxDOT's Travel Demand Models

Background

The urban travel demand models developed and applied by the Transportation Planning and Programming Division of the Texas Department of Transportation (TxDOT-TPP) are daily three-step models without feedback. In other words, trip generation, trip distribution, and traffic assignment are sequentially invoked for a single, full-day (24-hour) trip assignment. Estimates of highway travel times are used as the exclusive measure of impedance to travel, rather than travel costs or tolls.

TxDOT-TPP does not yet have a procedure to account for existing or planned toll roads in the regional models, and has been operating under the guidance established when toll roads existed as planned facility improvements only. Toll roads have been implemented only recently in a few small- to medium-sized urban areas still under the purview of TxDOT-TPP's modeling team. To calibrate base-year travel models with operational toll roads or anticipate demands along planned tolled facilities, TxDOT-TPP needs a procedure to account for facilities that charge user fees.

What the Researchers Did

Researchers:

- Reviewed relevant travel demand model (TDM) literature.
- Interviewed a number of leading transportation modelers who practice in the public and/or private sectors around the nation.
- Conducted in-person interviews with modelers.
- Reviewed supporting TDM documentation that the Austin, San Antonio, Dallas-Fort Worth, and Houston metropolitan planning organizations (MPOs) provided.
- Reviewed national and state toll modeling practices in the context of TxDOT's current modeling process and demand specifications to highlight challenges and potential opportunities for consideration.

Researchers evaluated modeling enhancements with potential to improve TxDOT's current framework and procedures in a series of case studies using TxDOT's Tyler 2002 model. Specific model enhancements were tested in different combinations to determine which TDM modeling strategies offer the most effective accounting of travel behavior. The researchers identified contextual factors for identifying and evaluating demand for tolled facilities along with travel demand modeling enhancements for TxDOT-TPP's implementation.

What They Found

The team identified eight components for improving TxDOT's regional models:

- Data relevance.
- Network and link attributes.
- Toll choice models and trip assignment.
- Times of day and other temporal considerations.
- Traveler classes and values of time.
- Mode choice and non-motorized travel.
- Outer feedback loops and convergence.
- Model validation.

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The method of generalized-cost traffic assignment allows TxDOT to segment travelers and travel demand at various levels. The use of sophisticated tolling approaches in larger regions of the United States presents challenges if these same tolling approaches are used in small- and medium-sized regions in Texas. In addition, the use of these types of approaches in small- and medium-sized regions is currently not available for current or near-term scenario analysis.

As networks become more congested in future-year applications, additional enhancements may be needed, including:

- The use of congestible links with time-of-day assignment to reflect peak versus off-peak conditions.
- Full feedback of travel times and costs to the trip distribution stage for consistency in key model outputs and inputs.
- The allowing of a mode-choice modeling step to acknowledge the distinction of carpooling, especially along managed-lane sections of the networks.
- Possible inclusion of time-of-day choice models to reflect users shifting to shoulder periods or off-peak periods as networks grow more congested over time.

Case studies revealed that time-of-day and traveler-class segmentations, addition of a mode choice sub-model, and congestion feedback capability were the model improvements producing the greatest vehicle hours of travel and vehicle miles of travel changes on the tolled corridor and entire roadway network. The analysis suggests that selecting a single set of modeling strategies to address toll demand estimation based on regional measurements is difficult. Modeling techniques can be implemented on a case-by-case basis or can be adopted uniformly, or universally, to promote ease of use and technology transfer to the MPOs.

What This Means

Road tolling is likely to eventually exist in most small- and medium-sized regions in Texas, and many opportunities for enhancing modeling practice now exist. Improvements in the TxDOT-TPP models will be helpful for bringing these small- and medium-sized regions up to the practice levels of models in similar settings at the national level that are used in the analysis of toll and other levels of disaggregated demand. Time-of-day generalized cost traffic assignment improvements reflect monetary travel costs alongside time costs, and acknowledge differences between peak and off-peak travel costs. This approach can be implemented to segment among auto and commercial trucks to distinguish between different markets in terms of toll costs and values of time. Among those regions expected to experience congestion over multiple hours of a day, consideration should be given to iterative feedback to foster consistency among congested assignment travel costs and travel costs measures used in trip distribution. Fortunately, modeling software enables most of the strategies examined and can be adopted relatively quickly.

When introducing model enhancements, consider the desirability of uniform modeling architecture and the ease with which end users can understand and apply the new techniques, and then interpret the results. The most appropriate next step may be development of an implementation strategy that considers these technical, organizational, and staff capability factors, while demonstrating application in one or more Texas regions.

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