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New Travel Demand Modeling for our Evolving Mobility Landscape

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Conventional four-step travel demand modeling is overdue for a major update. The latest NITC report from University of Utah offers planners a better predictive accuracy through an improved model, allowing for much greater sensitivity to new variables that affect travel behavior. Specifically, it accounts for varying rates of vehicle ownership, intrazonal travel, and multimodal mode choices.

Used by nearly all metropolitan planning organizations (MPOs), state departments of transportation, and local planning agencies in the United States, the importance of travel demand modeling for project selection cannot be overstated: They are the basis for forecasting future travel patterns and developing long-range regional plans.

THE TRADITIONAL FOUR-STEP TRAVEL DEMAND MODEL

1. Trip Generation tells us the number of trips generated in each traffic analysis zone (TAZ), usually based on some prediction of vehicle ownership.

2. Trip Distribution tells us where the trips go, matching trip productions to trip attractions. Particularly tricky are predictions of trips that remain within the same zone.

3. Mode Choice tells us which mode of travel is used for these trips.

4. Route Assignment tells us what routes are taken, assigning trips to networks that are specific to each mode.

A major flaw of the traditional four-step model is its relative insensitivity to the so-called "**D variables**," or characteristics of the built environment that are known to affect travel behavior. The D variables are:

- Development density
- Land use diversity
- Street network design
- Destination accessibility
- Distance to transit

WHAT DOES THE NEW MODEL ACCOMPLISH?

This report introduces a **vehicle ownership model**, an **intrazonal travel model**, and a **mode choice model** that considers all of the D variables based on household travel surveys and built environmental data. These models were calibrated with data from the University of Utah's 32-region household travel database, the largest household travel database of its sort ever assembled. This database has been linked to built environmental data as well.

Vehicle ownership is often treated as a function of sociodemographic variables only. But in reality, a phenomenon known as "car shedding" means that vehicle ownership rates go down as the built environment becomes denser. Researchers pooled regional household travel survey data from 32 diverse regions of the United States and generated consistent measures for all regions, then modeled vehicle ownership (see Section 2 of the final report for more details).

Results suggest that areas with high population and employment density, good street connections, great transit service, and high accessibility allow direct substitution of transit, walk, and bike travel for automobile travel.

Intrazonal travel is hard to predict accurately using conventional models. Researchers offer a new method which accounts for important built-environment related measures like activity density, street connectivity, and mixed land uses and how they impact intrazonal trip making. They also use discrete choice modeling, a significant improvement over standard intrazonal modeling efforts, since it more accurately represents the behavioral aspects inherent in individual travel decision making. See section 3 of the final report for more details.

Multimodal mode choice is also more accurately predicted by the new model. Many traditional models focus exclusively on vehicle trips. Bicycling, in particular, is seldom treated as a separate transportation mode. Compared to the traditional walk/bike mode choice model which only controls for the trip distance, in this study researchers were able to control for most of the critical sociodemographic and built environment variables. Results confirm that in all models, some D variables will reduce the share of vehicle trips and will encourage travelers to use non-motorized modes of travel, as well as transit.

IMPLEMENTATION OF THE NEW MODEL

Researchers calibrated the new model and validated its results by comparing its predicted trips to actual travel survey data. The new model was found to consistently outperform and offer far better predictive accuracy than WFRC and MAG's current models. Going forward, both MPOs will incorporate this into their existing four-step modeling process.

This model will also be made available to MPOs across the nation, the vast majority of whom still use four-step models. All MPOs will be sent copies of the NITC final report and all peer-reviewed publications to arise from this project, in an effort to reduce barriers and actively promote innovation to enhance the performance of the nation's transportation system.

ABOUT THE AUTHORS

Led by Reid Ewing, Director of the Metropolitan Research Center at the University of Utah, the research team included University of Utah doctoral student Sadegh Sabouri, and UU alumni Keunhyun Park (now at Utah State), Guang Tian (now at the University of New Orleans) and former NITC fellow Torrey Lyons (now at the University of North Carolina at Chapel Hill).

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THE FULL REPORT and ONLINE RESOURCES

For more details about the study, download the full report **Key Enhancements to the WFRC/MAG Four-Step Travel Demand Model** at nitc.trec.pdx.edu/research/project/1086

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