0-6487: Development of a Performance Measurement-Based Methodology to Objectively Compare Operational Improvements with Capacity Additions

Background

Preliminary project analysis and comparison are important for agencies in funding considerations and anticipating network impacts. Agencies are presented with multiple approaches to improving network functionality but may not be able to objectively compare solutions in a straightforward or holistic manner. Few or no tools exist for transportation professionals to comprehensively quantify and compare solutions. Tools to anticipate impacts at the preliminary or sketch level of analysis are important for general planning use, to help ensure that projects with the highest merit are pursued. Such pursuits are also increasingly necessary to compete for funding programs like MAP-21's Projects of Regional and National Significance and past US DOT TIGER grants. Such project proposals must consider safety, congestion, emissions, and economic impacts. The Project Evaluation Toolkit (PET) developed under this research project does just that.

What the Researchers Did

Understanding that detailed, sketch-level software for project analysis is largely absent from transportation agencies' toolboxes, the research team developed an open source, user-friendly Project Evaluation Toolkit. PET is composed of a series of spreadsheets and executable files (coded in C++) that model project impacts in terms of network-wide congestion impacts, crash rates, emissions changes (for 14 species), fuel use, tolling revenue, and vehicle-miles traveled (VMT). PET users can create abstracted versions of their roadway networks and use PET's built-in travel demand model to directly

anticipate traveler behavior over time and thus project impacts. PET can also import external data produced by MPOs' and others' own travel demand model results (including trip tables and time and cost skims for each class of traveler and time of day), and can perform its back-end, comprehensive benefit-cost analysis (where project and policy impacts are monetized, discounted over time, and compared to a base case). PET also computes financial measures for project comparison by allowing users to monetize economic impacts to travelers from congestion, crash and emissions costs, and project cost estimates.

What They Found

PET can be used to compare a multitude of project types, ranging from capacity expansions to operational improvements, such as incident management, speed harmonization and advanced traveler information systems (ATIS), shoulder-lane use, and ramp metering. PET also allows users to model tolled facilities (both variable and flat-rate tolling), managed lanes (HOV, HOT, and reversible lanes), transit lines, fixed costs (e.g., parking and bus

fares) at specific nodes, and intersection crash counts (by severity level).

The team developed networks for four Texas regions (Austin, Dallas, Houston, and San Antonio). They ran a number of case studies on each network, estimating project impacts for three project alternatives, relative to a no-build/business-as-usual base case (over 20- to 30-year horizons). Case studies included analysis of tolling and managed lanes projects in Dallas (I-635, LBJ Expressway), Houston (US 290, Hempstead Tollway), and Austin (US 290, Manor Expressway). Complete project analysis, including network editing, rough cost estimation, and modeling, took on the order of a few days, while actual processing run time required about one hour. Subsequent runs were preformed after the initial analysis to compare impacts of toll policies with much less effort. For instance, varying tolls by time of day was coded within minutes, and PET was run once more for about one hour. Results indicated that tolling strategies (flat rate, time of day, or tolling by vehicle class) returned unique impacts on network reliability and traveler welfare. Eliminating tolls for high-occupancy vehicles (two or more occupants) in the LBJ Express model, for instance, showed greater traveler benefits (in terms of reduced congestion and reliability) compared to other toll scenarios, returning a benefit-cost (B-C) ratio of 2.9, versus 1.7 and 1.6 for variable tolling by vehicle class and flat-rate tolling, respectively. These projects represent capital-intensive projects (billions in total investment), versus operational projects, such as advanced traveler information system installation, which was modeling along a 17-mile stretch of I-10 in Houston, returning a B-C ratio of 3.0 for a much smaller initial investment of around $100 million.

Such case studies illuminate how agencies may consider alternative solutions to congestion issues and compare project impacts in quantitative terms. Throughout the development of PET, the project team considered input from MPOs and potential users to expand the focus of the software; these comments led the team to develop a *network visualization* module for network creation and editing, along with the capability to analyze impacts of travel demand model results on already established networks with thousands of links. The team presented these case studies at three major MPO offices in Texas and discussed PET's basic structure, design, and interface. Staff responses were very positive, and transportation planners, engineers, and economists across the United States are excited about PET's possibilities.

What This Means

PET was designed especially for those modeling urban regions and is available for use by any agency or group, at http://www.caee.utexas.edu/prof/kockelman/PET_Website/homepage.htm. The PET program comes with Texas' four pre-loaded networks and an extensive User's Guide for analysts' project modeling and comparison activities. This powerful and dynamic tool can model a number of project types, ranging from major network changes to operational improvements, and can provide estimates in network performance, traveler benefits, project financing and comparison metrics, emissions, and crashes. PET has been applied in a number of projects throughout its development and is ready for further implementation in sketch project modeling and analysis.