Project Summary

Texas Department of Transportation

0-5667: Analysis and Guidelines for Establishing Unified Urban Land-Use and Transportation System Planning Framework and Procedures

Background

Federal legislation mandates that metropolitan planning organizations (MPOs) consider the likely effects of transportation policy decisions on land use and the environment. Various tools exist to forecast elements of transportation and land use separately; however, little has been done to integrate these co-dependent processes and ascertain which integrated approaches are likely to be most effective – and practical – for various MPOs and other planning staff.

Research Performed by:

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What the Researchers Did

The CTR research team interviewed staff at 30 MPOs from around the U.S. regarding land use modeling practices and available data sets. They examined literature and experiences across a wide variety of predictive land use modeling paradigms, including gravity-based, spatial input-output, microscopic, and cellular automata methods. UTA researchers examined a more straightforward approach, called suitability analysis (including What if, UPlan, and ArcGIS's Spatial Analyst tool) and then applied several such approaches to the Waco, Texas region.

CTR researchers developed an open-source gravity-based land use model (G-LUM) using Matlab code, for calibration and application of a system of equations based on Stephen Putman's popular (but proprietary) ITLUP model. They compared the FHWA's freely available (but closed-source and somewhat inflexible) version, called TELUM, to G-LUM results using Waco data. They also ran G-LUM on the basis of Austin data under three scenarios, using 5-year time steps (for both the land use and travel demand models) and traffic analysis zone geography.

CTR researchers also coded this land use model and a streamlined travel demand model in C++ in order to appreciate how variations in predictions may impact decision-making under parameter and input uncertainty. Finally, they developed 150-meter grid cell data sets for application of the UrbanSim model, and ran four scenarios at one-year time steps. Both research teams then provided workshops to TxDOT and Texas MPO planning staff and consultants in Houston and Austin during the summer of 2008.

What They Found

Researchers concluded that the presence and complexity of any land use modeling applications are largely a function of MPO size, with the biggest and best-staffed regions typically pursuing some form of land use modeling, often via outside consultants. A great need exists for in-house capabilities, and straightforward tools.

Unfortunately, existing land use models appear to be inadequately documented, and solutions to specification questions are difficult to come by. For example, TELUM's objective function (for parameter calibration) remains something of a mystery, as do elements of its land-consumption functions. The same is true of UrbanSim's land development functions (for construction of new built space). PECAS documentation is still evolving, and complete code is not presently available to the public. For these and other reasons, well documented and highly transparent models (such as G-LUM) are valuable. Nevertheless, it appears difficult to achieve perfectly reasonable performance from zone-based models over time, as zones can depopulate or grow too fast. Many modifications to ITLUP's base equations were made in order to "rein in" certain tendencies evident via the G-LUM applications.

While UrbanSim and some others enjoy the property of strict controls on growth of total population and total jobs (helping ensure these stay in balance), limited move tendencies (helping ensure zones do not depopulate too quickly, for example), and demand for built space never able to exceed supply, the Austin UrbanSim applications demonstrated strong centralizing tendencies (in both populations and jobs) that are inconsistent with past trends and unlikely to emerge in practice, without significant changes in policy and/or behavioral preferences. Moreover, the data demands and programming skills required by current and past versions of UrbanSim appear excessive for the vast majority of regions, at least in the near term.

What This Means

For reasons discussed above, most MPOs may be very interested in making use of existing tools like TransCAD's new gravity-based land use model (as presented in the second project workshop, but currently without parameter-calibration capabilities) and land suitability analysis through ArcGIS, for subjectively scoring parcels or grid cells (on the basis of proximity to nuisances, attractions, and sensitive sites, as a function of land use type) and then allocating expected growth using simple rules. Whatever the approach, the opportunities to apply (and enhance) existing data sets are many. And the value of these and other modeling tools should be evident in the multitude of information provided staff, decision makers, and public stakeholders across the State and around the world, as they sort through the complex process of refining land use and transport policies for the local, regional, and global challenges.

For More Information:
0-5667-1 An Examination of Land Use Models, Emphasizing UrbanSim, TELUM, and Suitability Analysis

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