University of Minnesota
Center for Transportation Studies
Research E-News

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*CTS Research E-News brings you the latest research project milestones, published reports, and seminar coverage.*

**In this issue:**



# Policy & Planning

## Modeling the past to understand the future

Michael Iacono and David Levinson

The Twin Cities region at the beginning of the twenty-first century looks very different than it did just a few generations ago. In the last 50 years, cornfields and forests have given way to residential and commercial districts, the highway system has emerged as a shaper of development, and an ever-expanding population is driving rapid changes in land use and transportation.

Using models to understand these changes was the topic of the day at a December 11, 2007 Access to Destinations workshop. Researchers **Michael Iacono** and **David Levinson** presented findings from their ongoing project aimed at developing predictive models of land use in the Twin Cities region, which they hope will lead to a better understanding of how land use responds to historical trends, changes in neighboring land uses, and the growth of transportation networks.

Iacono, a research fellow in the civil engineering department, highlighted the criteria that the researchers sought to satisfy in developing their models. A simple structure was important, as well as the ability to analyze land use at a fine geographic scale. In addition, the researchers wanted to incorporate intrinsic qualities of urban growth such as historical land uses, the influence of neighboring parcels on land use, and the influence of transportation networks. These criteria led Iacono and Levinson to develop a series of models and test them using historical data.

Levinson and Iacono plan to apply this research to studying the Highway 610 corridor in the suburb of Brooklyn Park. The highway is currently under construction, giving the researchers an opportunity to examine the effects of a new transportation link on undeveloped land. By studying the area around the highway where transportation patterns are likely to be influenced by the new facility, they hope to refine their understanding of how land use and transportation accessibility interact.

Because a model is only as good as its input data, the researchers took pains to develop accurate data sets based on historical land use maps, including digitizing some of the data that was not yet available in digital form. They also made use of census tract data and information on the growth of transportation networks.

Levinson and Iacono started with a relatively simple approach known as Markov chain modeling. In a Markov chain model, the study area is divided into a grid of small cells—in this case, roughly 75 square meters in size. The "state" of each cell, corresponding to the dominant land use in that cell, is recorded. It is assumed that cells change over time in predictable ways, such that a cell's current state determines what its state will be in the future; model developers attempt to develop probability rules that describe how particular cell states change to other states. For example, vacant cells may remain vacant, or be converted to residential use, but residential cells are much less likely to change to an agricultural state.

The predictive power of this model was tested by "backcasting"—running historical data through the model to see how well it reproduces changes that have already occurred. As expected, the model's accuracy proved to be fairly high for short predictions, but fell off dramatically for

longer-term predictions.

The usefulness of Markov chain modeling in this context is limited, Iacono said, by several intrinsic factors, such as the inability to take into account the influence of neighboring land uses, population densities, and other significant factors influencing development. To better understand how these factors influence changes in land use, Levinson and Iacono used a different modeling approach based on statistical regression. This approach revealed that neighboring land uses exerted a strong influence on land use changes, as did the proximity of transportation networks.

To overcome these limitations, the researchers developed a new model combining certain aspects of the Markov chain approach with a more advanced approach known as cellular automata modeling. Like its predecessor, the new model is based on a grid of small cells, but it allows changes in the state of each cell to be influenced by the states of neighboring cells. Experimental results indicate that this advanced model significantly outperforms the basic Markov chain in predicting changes in land use over time.

In the next phase of their research, Iacono said, he and Levinson would begin to add accessibility factors to the modeling framework. By incorporating information on how people use the transportation system to access different types of land use, the researchers believe they can gain a more complete and nuanced understanding of land use changes over time.

A video webcast of the seminar, and presentation slides, are available on the Access to Destinations Study Web site.

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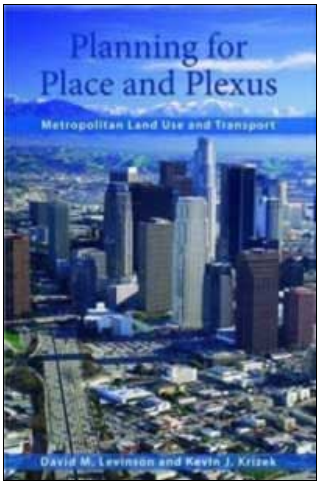
### New book examines "Place and Plexus"




Combining a holistic approach to transportation and land use issues with rigorous neo-classical economic analysis, a new book by Access to Destinations Study researchers **David Levinson** and **Kevin Krizek** aims to take many of the ideas emerging from recent research beyond the university classroom and into contemporary policy discussions.

*Planning for Place and Plexus* is Levinson and Krizek's first co-authored work, the product of an ongoing collaboration that has also resulted in two Access to Destinations Conferences and the publication of *Access to Destinations*, a co-edited collection of research papers from the first conference. Levinson and Krizek are also co-editors of the *Journal of Transport and Land Use*, an open-access electronic journal set to launch in 2008 with the support of the Center for Transportation Studies.

In their new book, the authors tackle a variety of themes that are shaping current debates on transportation and urban planning, including why people choose to live where they do, how neighborhoods grow and develop, how transportation and land use affect the economy, and the choices facing decision makers in the years ahead. Drawing from economics, traffic engineering, and public administration, the authors examine roads, transit, and alternative modes such as bicycling and walking, as well as issues such as home ownership and business location.

For anyone interested in urban planning and transportation issues, *Planning for Place and Plexus* offers an engaging perspective on historic and current issues.

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## Transportation and the Environment

### Greenhouse gas study brings national experts to Minnesota

CTS is holding a seminar series to hear from national experts and learn how their work could influence Minnesota's efforts to reduce greenhouse gases. Video of the seminars will be streamed live on the Web and archived on the CTS Web site.

This seminar series is one component of an interdisciplinary study managed by CTS with funding from the Minnesota Legislature. The study aims to assess policy and technology options for reducing greenhouse gas emissions from the transportation sector in Minnesota. The research team includes emissions researchers **David Kittleson** (Mechanical Engineering) and **Julian Marshall** (Civil Engineering), as well as policy scholar **Elizabeth Wilson** (Humphrey Institute of Public Affairs). A final report will be published in Summer 2008.

The series began with a March 12 presentation by **Robert Cervero**, chair of the city and regional planning department at the University of California, Berkeley. Cervero discussed the results of empirical research that examined the effects of compact, mixed-use development on vehicle-miles traveled and carbon dioxide emissions. Much of the traffic reduction observed in this study, Cervero said, could be traced to residential self-selection, suggesting that the codes governing building and parking should be responsive to market forces.

Future seminars in the series will cover a range of issues connected to greenhouse gas emissions and energy policy:

- On March 27, **Mark Z. Jacobson** of Stanford University will describe "A Renewable Energy Solution to Global Warming," highlighting the potential impacts of different energy sources for vehicles and electric power generation. His findings indicate that the combination of wind, solar, hydroelectric, and geothermal power can supply baseload or load-matching electric power, particularly combined with electric vehicles in a smart electric grid.
- On April 15, **Alan C. Lloyd**, president of the International Council on Clean Transportation and former secretary of the California Environmental Protection Agency, will speak on "What States Can Do to Reduce Greenhouse Gas Emissions." Drawing on experience as both a scientist and a regulator, Lloyd will address actions at all levels of government, with attention to the technical, political, and socioeconomic constraints that affect decisionmaking.
- The series will conclude May 20 with a seminar by **Stephen H. Schneider**, Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies, professor of biological sciences, and senior fellow in the Woods Institute for the Environment at Stanford University. His seminar, titled "Transportation Options in a Greenhouse: Alternative Strategies to Lowering Our Carbon Footprint" will be held at the 19th annual CTS Transportation Research Conference.

More information on the seminars is available on the CTS Web site or by contacting Shawn Haag at 612-625-5608, haag0025@cts.umn.edu.

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## Transit, Bicycling, and Walking

### TCRP research publications available online

The federal Transit Cooperative Research Program (TCRP), administered by the Transportation Research Board, provides practical transit research to address technical and operational issues. TCRP emphasizes putting research results into the hands of organizations and individuals that can use them to solve problems.
Recent TCRP publications include:

- *Use of Biodiesel in a Transit Fleet* (TCRP Synthesis 72)

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## Transportation Infrastructure

### Research supports column-supported embankments


Workers drive piles to support a roadway expansion

Minnesota road engineers faced with the task of building over areas of poor or marshy soil have recently added a new construction technique to their toolboxes. Column-supported embankments use piles driven through unstable soil into firmer strata beneath to support a load-bearing platform on which the roadway is constructed—an approach that is often significantly less expensive than a bridge over weak soil areas.

University of Minnesota civil engineering faculty members **Joe Labuz**, **Andrew Drescher**, and **Bojan Guzina** received funding from the Minnesota Department of Transportation to evaluate the performance of a column-supported embankment installed along a Minnesota highway. The researchers installed a variety of instruments during construction of the embankment in order to monitor the load-bearing performance of the structure.

Column-supported embankments for roadway support were first studied by civil engineers in the mid-1970s, according to Labuz, who reviewed earlier research findings. Although the terminology and application are relatively new, the use of deep piles to support foundations has a long history. Labuz described the engineering approach and his research findings to date at a fall 2007 CTS research seminar.

In the installation studied by Labuz, a highway section passing between a pond and a marshy area needed to be widened to accommodate increasing traffic. The soils in the area alongside the existing highway proved to be much too weak to support additional lanes, so Mn/DOT engineers decided to drive approximately 200 steel pipe piles down through it into firmer strata below. On top of these pile caps, a platform was constructed using high quality aggregate and reinforcing material to support the new road.

During the construction, the researchers installed more than 50 sensors to monitor pile deformation and earth pressure. Redundant instrumentation was critical, Labuz said in his seminar presentation, because sensors are often damaged during the construction process and, once underground, cannot be replaced. In this case, numerous sensors were rendered inoperable, but backups enabled the researchers to gather the data they needed for their analysis.

Labuz also noted the importance of properly calibrating earth-pressure cells in order to get reliable data. These cells have been the subject of considerable prior research by members of the civil engineering faculty, and Labuz expressed confidence that their calibration techniques had enabled the team to achieve accurate readings.

Analysis of the data so far shows that load transfer to the piles is "very good," Labuz said. Continuing work will include numerical modeling of the structure in order to understand pile loading in more detail, and a comparison of the data with design assumptions. A final report is now in preparation; Labuz's seminar presentation is available for viewing online.

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## Upcoming Events

### March 25

ITS Minnesota 14th Annual Meeting & Information Exchange, Continuing Education and Conference Center St. Paul, Minnesota. Contact: Carrie Alkins, 612-624-3492.

### March 27

Greenhouse Gas Seminar: A Renewable-Energy Solution to Global Warming, 1130 Mechanical Engineering Building, Minneapolis. Contact: Shawn Haag, 612-625-5608, haag0025@cts.umn.edu.

### April 7

James L. Oberstar Forum on Transportation Policy and Technology: "The Next Authorization: Transforming Transportation Policy." Radisson University Hotel, Minneapolis.

### April 15

Greenhouse Gas Seminar: What States Can Do to Reduce Greenhouse Gas Emissions, 1130 Mechanical Engineering Building, Minneapolis. Contact: Shawn Haag, 612-625-5608, haag0025@cts.umn.edu.

### May 20–21

19th Annual CTS Transportation Research Conference, St. Paul RiverCentre, Minnesota. Contact: Sara Van Essendelft, 612-624-3708, cceconf5@umn.edu.

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