

# CTS Catalyst

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Accelerating the pace of transportation innovation

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Photo courtesy Robin Elstad, MnDOT

## Transportation investments: study shines light on economic impacts

Transportation investment has long been a popular strategy for promoting economic development at the state and local levels. As funding has become tighter in recent years, however, DOTs and other public works organizations have begun to sharpen their focus to determine where and how resources should be deployed to yield the greatest returns. In a study funded by the Minnesota Department of Transportation, U of M researchers examined two highway improvement projects to evaluate the potential of transportation investment for boosting private economic activity.

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## Keeping roadsides green with salt-tolerant turfgrass

Road salt is an important weapon for fighting ice and snow, but it also can be deadly to roadside turfgrass. After a number of failed sod installations in recent years, the Minnesota Department of Transportation turned to researchers in the Department of Horticultural Science to identify turfgrass mixes that could tolerate the salt and harsh conditions on Minnesota roadsides.

“What we see happening on these roadsides that don’t have salt-tolerant grasses is [that] public agencies are continually spending money to redo their initial project,” says Associate Professor Eric Watkins, the lead researcher. “That’s where there could not only be some

*Turfgrass continued on page 7*



# Games in the classroom: teaching transportation planning with board games

A graduate-level transportation planning class may be the last place you would expect to find board games—but according to University of Minnesota researchers, using games in the classroom can actually help students learn. In a new *Transportation Research Record* article, Arthur Huang and David Levinson of the Department of Civil Engineering show how they have incorporated transportation board games in their classrooms to help students learn key transportation planning concepts.

“This is an exciting time in civil engineering education,” says Levinson, the R.P. Braun/CTS Chair in Transportation Engineering. “Traditional chalk-and-talk teaching is gradually being replaced with active learning. This type of instruction focuses on going beyond rote memorization by encouraging students with innovative teaching methods and tools such as simulations and board games.”

This type of active learning can be especially beneficial for engineering students, who typically have a more visual, sensory, and sequential learning style; when instructors of these students rely solely on a lecture-based approach, it can result in a mismatch between teaching and learning styles. While many engineering instructors have started adding computer simulations and games to their curriculums to prevent this disconnect, other forms of games—such as board games—have not yet been widely evaluated and adopted in transportation planning courses, Levinson says.

To study the effectiveness of teaching transportation planning concepts with board games, the researchers organized one “game night” each semester for students enrolled in several graduate-level transportation planning courses during a four-year period. The games included Rail Tycoon, Empire Builder, China Rails, and several others: the aim of each game is building a transportation network. Students participating in the game night were surveyed both before and after the game to gain insight into their learning styles and their opinions of the game’s effectiveness as a learning tool.

In addition to the survey, students wrote essays summarizing what they learned

about the concepts of demand, supply, and incentives and disincentives for network growth while playing the game. Many of the essays demonstrated a strong grasp of the relation between the concepts and the board games; several even linked the game with real transportation experiences. For example, one student who played the Metro game wrote, “In the 19th century, the actual Paris Metro spent years in dispute and disagreement. With its rules restricting how a tunnel connection card may be laid, the game in some ways mimics the complexity early planners, engineers, and developers experienced.”

Analysis of the survey data identified clear benefits to using board games in the classroom. “We discovered that the games were a particularly good fit for the active learning style that is most common among engineering students,” says Levinson. “In addition, transportation board games are a useful tool for teaching students how to understand the transportation network-building process along with the game economy and its implications for transportation planning.”

Levinson and Huang offer several tips to maximize the effectiveness of teaching with transportation board games: clearly state the game rules, hold a debrief session to reinforce the concepts learned, and consider the students’ learning characteristics. Overall, this research suggests that properly incorporating board games into the curriculum can enhance students’ learning in transportation planning.



*Board games are a useful tool for teaching planning concepts to engineering students.*

# Developers and business leaders share ideas for transit-oriented development

The ability of transitways to create sustainable regional development hinges on location decisions made by the private sector. What can policymakers do to spur this development? University researchers interviewed Twin Cities developers and business leaders to find out.

The research is being led by Assistant Professor Yingling Fan and research fellow Andrew Guthrie of the Humphrey School of Public Affairs. It is funded by Corridors of Opportunity, a broad-based initiative to accelerate the build-out of a regional transit system for the Twin Cities in ways that advance economic development and ensure people of all incomes and backgrounds share in the resulting opportunities.

For the project, the research team interviewed developers working in the central cities, inner suburbs, and outer/developing suburbs. Both residential and commercial developers are represented, including firms that develop both types of projects.

Multiple participants identified efforts to make transit-accessible housing affordable by *design* rather than by *subsidy* as crucial to the promotion of mixed-income neighborhoods in station areas, Guthrie says. Several also said that transit access itself—by dramatically reducing household transportation costs—makes all housing inherently more affordable. One Minneapolis developer put it this way: “What’s the best way to build affordable housing?... You don’t have to subsidize the unit or do anything—just put it on transit.”

The interviews, Guthrie continues, point to an important conclusion: transit-oriented development is possible and in demand in the Twin Cities metro area, but tract homes on cul-de-sacs, strip malls, and office parks are simply easier. “Interview participants [found] land entitlement and permitting processes to be problematic in general, but especially so for any projects that depart from traditional zoning and auto-oriented design, or those that seek to build at sufficiently high densities to turn a profit on high-value land around stations,” he says. “Developers strongly wish local governments to act less as regulators of all developments and more as advocates for desirable development.”

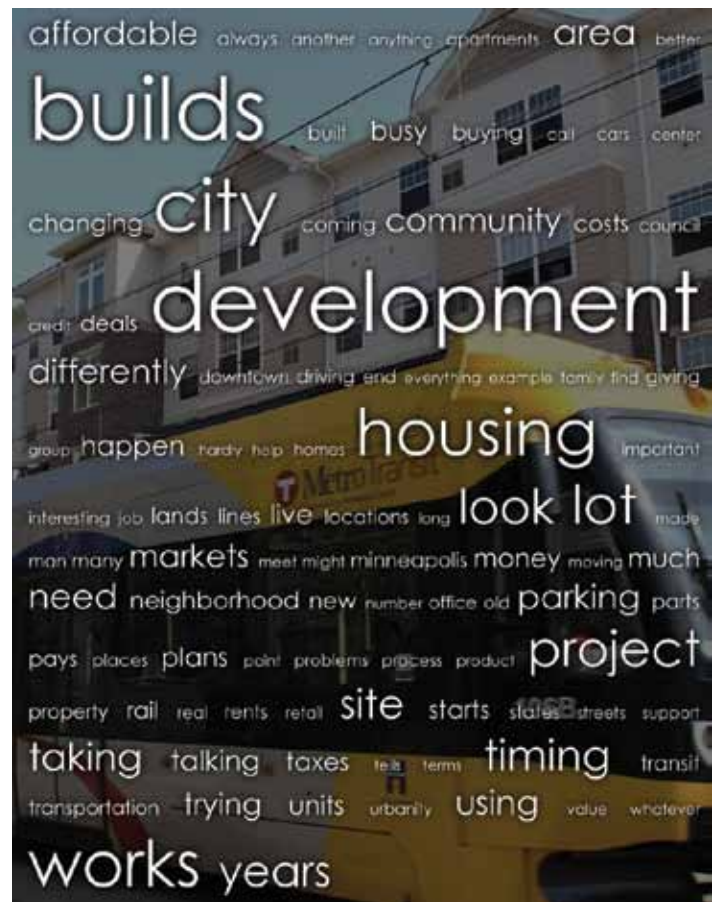
The researchers suggest these possible strategies for encouraging beneficial developments:

- Zoning reforms allowing projects with high enough densities and low enough parking ratios to be both truly transit-oriented and profitable.
- Implementation (at least on a trial basis) of a true form-based code in transit station areas—regulating only appearance and externalities, rather than uses—to ease implementation of mixed-use development.
- Building code reforms intended to allow for more flexibility in mixed-use projects as well as adaptive reuse of existing properties.

The researchers (including research assistants Chris Berrens, Brent Oltz, and Jill Smith) are wrapping up their interviews with metro employers. A full project report will be available in coming months.

Corridors of Opportunity is supported by funding from two national initiatives as well as local sources. The three-year initiative began in 2011.

(Reprinted and edited from a January 24, 2013, post by Guthrie on the Corridors of Opportunity blog, [CorridorsofOpportunity.org](#).)



This “cloud” shows the words most commonly cited by developers during interviews. The most prominent transportation term is parking—developers cited it as a major cost driver for multi-family and mixed-use developments, particularly on urban sites.



## READ CATALYST ONLINE

for links to research reports and other resources.

# Legislators come to campus for transportation finance seminar

CTS held a special transportation seminar on January 31 for Minnesota state legislators and their staffs.

The educational seminar, “Future Approaches for Transportation Finance in Minnesota,” featured presentations by three CTS Scholars: Zhirong (Jerry) Zhao, associate professor, Humphrey School of Public Affairs; David Levinson, professor, Department of Civil Engineering and R.P. Braun/CTS Chair in Transportation Engineering; and Lee Munnich, director, State and Local Policy Program, Humphrey School. They discussed their research and recent thinking in these areas:

- Transportation Funding in Minnesota: Past, Present, and Future Prospects (Zhao)
- Potential for Public-Private Partnerships (Zhao)
- Utilizing Value Capture Strategies (Levinson)
- Pricing Strategies from the U.S. and Other Countries (Munnich)

CTS has arranged similar educational seminars in previous legislative sessions in its role as an objective resource for policymakers.

Many legislators and staff from the three transportation committees attended—including Scott Dibble, chair of the Senate Transportation and Public Safety Committee (and a member of the CTS Executive Committee); Frank Hornstein, chair of the House Transportation Finance Committee; and Ron Erhardt, chair of the House Transportation Policy Committee.

After the seminar, legislators commented on how helpful the information will be during the session. “Great transportation discussion between House and Senate members thanks to CTS,” tweeted Senator Melissa Franzen.

**20**  
**SENATORS AND**  
**42**  
**HOUSE MEMBERS**  
are serving their first terms this session.



*Zhirong (Jerry) Zhao (left) shared his expertise with legislators and their staffs.*

## Advancing the science of composite pavements

In the world of pavement engineering, it’s an age-old battle: asphalt versus concrete. On one hand, asphalt pavements offer a smooth ride and easy resurfacing, but they are also prone to rutting and cracking and don’t last as long as their concrete counterparts. On the other hand, concrete pavements last significantly longer but can be more challenging to repair, noisier and rougher to drive on, and more expensive to build. However, a new wave of pavement design—known as composite pavements—aims to capture the best of both worlds.

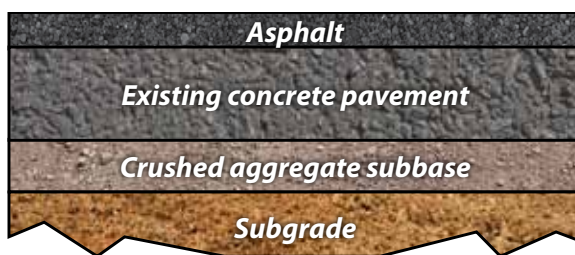
A comprehensive, pool-funded project led by a team of researchers from the University of Minnesota and the University of California has significantly advanced knowledge about composite pavements. The research takes an in-depth look at one specific type of composite pavement: thermally insulated concrete pavement (TICP), which features a base of concrete pavement topped with an asphalt pavement layer.

“The objective with TICP is that you can combine the structural longevity of concrete pavements with the serviceability of asphalt,” says Lev

Khazanovich, associate professor in the U of M Department of Civil Engineering and the principal investigator. “Additional benefits are also possible, including a simpler design and construction process as well as reduced stress on the concrete due to the insulating effect of the asphalt layer.”

One of the most significant and immediately actionable products of the research is an in-depth evaluation of how accurately the most widely used pavement engineering computer models predict the performance of composite pavements. The researchers found the current models did not accurately take into account the dual stresses of temperature and heavy traffic loads on the top asphalt layer of composite pavements. To address this deficiency, they developed a framework that can be used to modify the existing model and improve its accuracy.

In addition, the researchers examined how the computer models predict another common problem of composite pavements known as reflective cracking—cracks in the top asphalt layer of the pavement that appear above the joints in the concrete base layer. They then



*An example of the layers in one type of composite pavement*

**Pavement continued on page 5**

## Creating safer roads with vehicle communication

Imagine driving down the road on a snowy day when a warning sign flashes—“Snowplow 0.8 Miles Ahead.” You gradually apply your brakes and sure enough, traffic slows down ahead of you just a minute later. By eliminating your need to brake quickly on a potentially slick roadway, it’s easy to see how this type of accurate, timely information could prevent crashes and save lives.

Thanks to research by the University of Minnesota, this vision is closer than ever to reality. “In the past 50 years we’ve made great strides in reducing traffic fatalities with technologies that save lives in crashes, like airbags and seat belts,” says M. Imram Hayee, electrical and computer engineering professor at the U of M Duluth. “The next wave of lifesaving technologies is what we’re focusing on with this research—technologies that prevent crashes from occurring in the first place.”

In this latest study, Hayee and research assistant Umair Ibrahim examined how dedicated short-range communication (DSRC) can allow vehicles to communicate critical safety information about snowplow operation and work zones to both each other and to roadway infrastructure such as portable changeable message signs. Currently, a diverse group of stakeholders—including automakers, highway safety groups, and government organizations—is working on developing and researching DSRC technology for U.S. vehicles. However, even after adoption of DSRC begins, it will be a long time before it’s available in most vehicles—which is why this research is important.

“If we want to reap the maximum safety benefits in the early stages of DSRC adoption, we’ll need an effective way to get the valuable information being transmitted by the DSRC-equipped vehicles to drivers that don’t yet have access to this technology,” Hayee says.

To accomplish this goal, researchers developed and successfully field-tested a hybrid traffic information system that allows the traffic data being transmitted by vehicles with DSRC (about travel time, starting location of congestion, and the location of snowplows) to be received seamlessly and securely by portable changeable message signs placed along the roadside. The research was sponsored by the Intelligent Transportation Systems Institute, a part of CTS.



*The technology gives drivers advance warning of upcoming work zones.*

“We designed a fully portable traffic information system that can be placed on any road to monitor the congestion buildup around a work zone or display advisory messages to drivers while snowplow operation is in process,” Hayee explains.

This information can also be communicated to other vehicles in the vicinity and to permanent roadway infrastructure equipped with DSRC technology.

Once this system was developed, an important question remained: What percentage of vehicles must have DSRC in order for the system to be effective? To answer this question, researchers conducted a rigorous analysis to determine the minimum market penetration needed for the system to successfully acquire and disseminate information about travel time and starting location of congestion for a work zone. The results indicate that just 20 to 35 percent of vehicles need to be equipped with DSRC for the system to work reliably.

“The concept of DSRC-based technology would be beneficial for improving traffic safety and mobility for motorists,” says Sithya S. Khieu, roadway maintenance services business lab manager with 3M’s Traffic Safety and Security Division. “3M is intrigued with Professor Hayee’s recent research. As with all new technologies, adoption will take time, so the sooner it becomes standardized and available, the better.”

### *Pavement from page 4*

developed more advanced models to predict this problem and created a way to integrate their improved model into the most common modeling program quickly and easily.

“Better accounting for the effects of variables like traffic loads and environmental factors on composite pavements will ultimately allow pavement engineers to design better, longer-lasting, and more sustainable pavements,” Khazanovich says.

The research is supported by the Federal Highway Administration (FHWA) and funded by the Minnesota Department of Transportation (MnDOT), the California and

Washington DOTs, and the FHWA.

“The work provides valuable information on the design and construction of composite pavements on both new and rehabilitated pavements,” says Timothy R. Clyne, materials and program delivery engineer with MnDOT Metro District. “Significant results from the research include guidance for mitigating reflective cracking in the asphalt overlay, controlling traffic during TICP construction, and lowering the costs of composite pavements through staged construction, material selection, and preventive maintenance.”

## Impacts from page 1

The researchers, led by Mike Iacono, a research fellow in the Department of Civil Engineering, studied two Minnesota projects: the expansion of U.S. 71/TH 23 (including the Willmar Bypass) near Willmar, from 1999 to 2003, and the expansion of TH 371 (including the Brainerd Bypass) between Little Falls and the Brainerd/Baxter area, completed in various phases between 1998 and 2005.

The analysis focused on county-level earnings by the construction, manufacturing, retail, and wholesale industries. Earnings data from 1991 to 2009 were collected for the county (or counties, as in the case for the TH 371 project) in which the project was located, along with neighboring counties.

The results? “None of the industries studied in either of the case study locations show evidence of statistically significant increases in earnings following completion of the respective improvements, once population and macroeconomic trends are controlled for,” Iacono says.

A second part of the analysis examined whether the projects might have induced changes in growth rates at the sub-county level. (Data from a third project, the expansion of St. Louis County/U.S. Highway 53, was included in this part.) Iacono’s team used city-level data on total employment for municipalities within the county where the project was located. As in the industry analysis, he says, the results indicate “little evidence of statistically significant impacts” on employment in the towns most directly affected by the projects.

Iacono notes that the research cannot rule out that the highway projects had a positive yet statistically indistinguishable effect on employment due to variance in the data. He also notes that despite efforts to control for macroeconomic trends, the results may have been affected by the recession, which coincided with the latter years of the data.

Overall, Iacono concludes, two broad trends could explain the modest economic impact of transportation investment. First, non-transportation factors—such as labor quality, taxation, and quality-of-life contributors—may increasingly



Photo courtesy Robin Elstad, MnDOT

*The analysis studied the economic impacts of projects such as this highway expansion near Brainerd.*

overshadow transportation infrastructure as sources of growth.

Second, the findings from this and other recent studies suggest that the returns of transportation investment have generally been declining as many types of networks have matured. The introduction of interstate highways, for example, often provided order-of-magnitude-type improvements in travel times between large cities, but most contemporary projects are generally smaller and seem unlikely to be major catalysts to economic development by themselves, he explains.

Moving forward, Iacono suggests that highway projects should be evaluated more on explicit benefit-cost criteria rather than their effects on local employment.

“This study provides valuable insight,” says Matt Shands, coordinator of the Transportation and Economic Development (TED) Program, a partnership of MnDOT and the Department of Employment and Economic Development. He adds that the analysis did not include projects such as those in the TED program, which leverages private and public funds to support and target improvements to specific economic development needs. “In its first two years, the TED program has provided matching funds for 24 projects statewide and will help to create or retain more than 7,000 jobs,” he says.

## NEW RESEARCH REPORTS

Recently published reports on transportation-related research at the University of Minnesota explore:

**INTERSECTION CRASH CAUSATION**  
(CTS 2013-05)

**MONITORING THE USE OF HOV AND HOT LANES**  
(CTS 2013-07)

**IMPLEMENTATION OF SMART SIGNAL**  
(MnDOT 2013-06)

Research reports are available at [cts.umn.edu/Publications/ResearchReports](https://cts.umn.edu/Publications/ResearchReports).

## Turfgrass from page 1

environmental benefits, but also quite a bit of money to be saved by some of these municipalities and local governments.”

Under a four-year grant from the Minnesota Local Road Research Board (LRRB), the research team, including graduate research assistant Joshua Friell, has been testing hundreds of grasses and mixtures of grasses at an indoor facility and on roadside plots provided by MnDOT. The researchers have already discovered better grasses than those currently in use. The best grasses, Watkins says, are those that can survive heavy salt exposure, cold winter conditions, and hot and humid summer weather.

The ultimate goal is to develop seed mixtures that produce salt-tolerant sod. Watkins and the Minnesota Crop Improvement Association (MCIA) worked with MnDOT and the Minnesota Sod Producers Association to develop seed mixes as well as an associated sod certification program to ensure that quality sod of verified composition is

delivered to buyers. Sod produced from the original seed mix they developed has been used on roadside projects the past two years, says Ben Lang, MCIA president/CEO.

Sod grown from a new seed mix that was refined using Watkins’s research findings should be available in late 2013. The new seed mix will be reviewed at the end of the year to determine whether modifications are needed. “Again, Dr. Watkins’ research will be key to making any decisions to modify the mix,” Lang says. He anticipates that sod products developed through this program will continually evolve and improve as better-suited turf seed varieties become available.

MnDOT has specified salt-tolerant sod for road and bridge projects and expects to use the new seed mix to stabilize difficult soils during the 2013 construction season, says Dwayne Stenlund of the department’s Office of Environmental Services.

Watkins’s success has attracted additional funding. In a new project

**IN THE TWIN CITIES**  
metro area alone, about  
**350,000**  
**TONS OF SALT**  
are used each winter  
on roads, sidewalks,  
and parking lots.

approved by the LRRB in December, the researchers will create best management practices for installing and establishing salt-tolerant grasses on roadsides. In addition, Watkins, along with his team and scientists from Rutgers University and the University of Wisconsin-Madison, have launched a five-year project investigating how to develop turfgrasses that will require less water and mowing and that can remain green without fertilizers and pesticides. The project is funded by a \$2.1 million grant from the U.S. Department of Agriculture.



Eric Watkins and his team have tested hundreds of mixes at an indoor facility.

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# Catalyst

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are taking root along  
**ROADSIDES.**

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