

# CTS Catalyst

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Accelerating the pace of transportation innovation

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## Highly obese truck drivers have higher crash risk, according to new research

Highly obese commercial truck drivers have a much higher crash rate in their first two years on the job than their normal-weight counterparts, according to research from the University of Minnesota Morris (UMM). The findings come from a multi-year study led by Stephen Burks, an associate professor of economics and management at Morris and a former truck driver.

Burks's research team collected height and weight data from 744 new drivers during their training with a cooperating trucking firm, Schneider National, Inc., and calculated the body mass

*Obesity continued on page 6*

## Portable weigh-in-motion system helps monitor local roads

In recent years, state, county, city, and township transportation authorities have grown more concerned about damage to local roads and bridges caused by an increase in larger, heavier vehicle traffic. But monitoring this traffic can be difficult, especially in rural areas.

For local roads with low average daily traffic (ADT) volumes, installing permanent in-pavement weigh-in-motion (WIM) stations can be expensive and difficult to justify. However, low ADT does not indicate fewer overweight violations or diminish the need to protect roadways from overweight vehicles.

*Weigh continued on page 5*



# Designing to avoid disaster

What do recent catastrophic events—such as the I-35W bridge collapse, hurricane flooding, BP oil spill, Fukushima nuclear plant devastation, and Wall Street investment bank failures—have in common? They all stem from what Thomas Fisher calls fracture-critical design. This is design in which structures and systems have so little redundancy and so much interconnectedness and misguided efficiency that they fail completely if any one part does not perform as intended.

In his new book, *Designing to Avoid Disaster: The Nature of Fracture Critical Design*, Fisher discusses the context and cultural assumptions that have led to a number of disasters worldwide, describing the nature of fracture-critical design and why it has become so prevalent. He then suggests how to avoid future disasters by designing systems with more redundancy and

resiliency.

Fisher is dean of the College of Design and a member of the CTS Executive Committee.

In his book, Fisher traces the impact of fracture-critical thinking on everything from the economy to infrastructure systems to the communities and buildings in which we live. And he shows how the natural environment and human population have both begun to move on a path toward a fracture-critical collapse, with scientific evidence pointing to climate-related disasters occurring with ever-greater frequency in the near future.

Hurricane Katrina is one case in point. While the hurricane stressed the New Orleans levee system, Fisher writes, the weakened levees gave way after the storm had already begun to subside. “This was no ‘natural’ disaster,” he says. “It resulted from the same error

in thinking that led to the I-35W Bridge collapse and that has led to the series of failures we have had to deal with in recent years. While no one intentionally designed the New Orleans levee system to cause such catastrophic damage, we did not design it to ensure that it would not happen either.”

To predict and prepare for the next disaster, Fisher writes, we need to recognize this error in our thinking and understand how design thinking provides a way to anticipate unintended failures and increase resiliency.

One step, he says, is to assume that efforts to control nature through technology will ultimately fail. For example, building a \$6 billion sea barrier at the mouth of New York’s Harbor—which has been discussed in the wake of superstorm Sandy—is the exact thing not to do, as it would create the same sort of fracture-critical infrastructure that just failed. Instead, infrastructure should be made more resilient, in part by designing systems to withstand the strongest storms and by breaking down the scale of systems so that failure in any one part causes the least amount of damage.

“We designed our way to such disasters,” Fisher says, “and we can design our way out of them.”

The 258-page book is published by Routledge and is available from major booksellers. Fisher, a regular contributor to the online news site the *Huffington Post*, discusses key points from the book in a December 5, 2012, blog post titled “Are Hurricanes Our Next Dust Bowl?”



Severe flooding in June 2012 knocked out key infrastructure in northern Minnesota.

## Students encouraged to attend career expo

The 2013 Transportation Career Expo will be held March 5 from 4:30 to 7:15 p.m. at Coffman Memorial Union on the Minneapolis campus. The expo connects companies, agencies, and professional organizations with students and recent graduates. It includes presentations, employer exhibits, networking opportunities, free resume reviews, and complimentary food and beverages. For more information, visit [cts.umn.edu/Events/CareerExpo](http://cts.umn.edu/Events/CareerExpo).

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# Future trends and their impact on transportation

CTS culminated its 25th anniversary celebration with a look at the road ahead in a November luncheon presentation by Frank A. Stasiowski, president and founder of PSMJ Resources. Stasiowski, a futurist who predicts the direction of design and construction worldwide, described trends that could define the next decade and have a direct impact on transportation.

Stasiowski began by sketching the current landscape. Our world is one of exhausted resources, massive migration to cities, and deteriorating infrastructure. A powerful and inescapable trend, he said, is demographics: A “birth explosion” is expected to increase worldwide population from 7 billion to 14 billion within a generation or two.

In light of the next decade’s unprecedented change, Stasiowski shared three major predictions for 2020 and recommended actions to take today:

**Roaring 20s again.** World economic growth will come back stronger than expected, Stasiowski said. Undergirding this growth in the U.S. will be a housing recovery starting in 2013 and continuing for the next decade. With this growth will come new schools, retail development, and more—all connected by transportation infrastructure.

Aging baby boomers will spend millions in their final years, and corporations will invest the billions currently held on the sideline. Inflation will raise asset values and reduce national debt: within five years, U.S. inflation will be in double digits, and the value of housing will triple, Stasiowski predicted.

What should we do now to prepare? Firms should buy infrastructure assets while they’re cheap, or at least enter into public-private partnerships. “Buy all the bridges. Own them for the next 100 years,” Stasiowski said.

Stasiowski also recommends benchmarking the pricing of infrastructure to its value, not its cost—for example, measuring the economic impact of light-rail transit in a community rather than just its price tag.

**Non-retiring baby boomers.** The expected massive wave of retirees may not be so big after all, Stasiowski said, largely because of the recent decline in retirement accounts.

How should the transportation industry take advantage of this trend? Team retirees with Generation Y workers, Stasiowski said. Retirees struggle with technology while Gen Y lacks history and experience. Don’t let boomers walk away: sign them up as casual employees or let them take a gradual slide into retirement.

Worldwide population is expected to grow from

**7 BILLION  
TO  
14 BILLION**

within a generation or two.

The future workforce will have more independent contractors coming together in teams to do projects—or “finding gigs” on Facebook, he said.

**Real shortages of natural resources.** Water, petroleum, food, metals, clean air—all will become scarce. What should we all do now? “Get involved in conservation everywhere,” Stasiowski said. Develop financial modeling to understand the impact of infrastructure investments on scarce resources. “Invest energy and resources in outside-the-box thinking that addresses global shortages—for example, mining asteroids, or mining on Mars,” he said.

In closing, Stasiowski said the role for CTS and research institutions is to bring disciplines together to address not just technology but also economic and policy issues. And educators need to teach students how to change fast. “Our job is to teach kids how to adapt,” he said. “We don’t have time for non-performers.”

## Winter luncheon: Mapping the way to a better driving experience

Much has changed since GPS navigation devices hit the consumer market in 1995: many more people are using them, in many more places. At the same time, the mobile phone marketplace and infrastructure have grown dramatically, making it possible to gather vast amounts of data from innovative in-vehicle sensors.

Jane MacFarlane, head of research location and commerce with Nokia, will discuss what’s needed to leverage these technologies to better understand driver behavior—and map the way to a better driving experience. She will make her

remarks at the CTS Winter Luncheon on February 28 in Minneapolis.

Pairing the extensive roadway knowledge available in navigation systems with aggregate data from vehicle sensors will allow us to spot shared behavior, MacFarlane says. This “behavioral map” will reveal how drivers dynamically experience and adapt to road networks—behavior that may differ from driver to driver, and from how the roads were designed to be driven.

The goal of the work, MacFarlane says, is to learn from this shared behavior and relay information back to drivers



in a format they can easily use—and help them toward a safe and successful journey.

The luncheon is cosponsored by the ITS Institute, a part of CTS.

More details and registration are online at [cts.umn.edu/Events](http://cts.umn.edu/Events).



# Can parking flexibility and incentives influence commuters' mode choice?

Most strategies to manage parking demand, such as charging high prices for parking contracts, aim to discourage commuters from following a drive-and-park routine.

Instead of depending on such disincentives, researchers from the Humphrey School of Public Affairs have investigated a different strategy—adding flexibility and incentives to monthly parking contracts that encourage commuters to use other modes of transportation.

At a November 8 CTS Research Seminar, Adeel Lari explained that people who purchase parking contracts are less likely to use alternate modes. “After you have paid for it, the parking contract itself is a disincentive to use other modes. It’s a sunk cost, and the additional incremental costs of driving are relatively low,” Lari said.

To see if drivers would change their mode choice with the addition of flexibility and incentives, the research team conducted a study on downtown Minneapolis commuters. Lari, director of innovative financing at the Humphrey School’s State and Local Policy Program, was the project’s principal investigator.

The researchers tested several parking modules that added

varying levels of flexibility and incentives to drivers’ parking contracts. In the “marginal rebate” module, participants were given a free transit pass and received a partial rebate on days they used transit. Another module, “PayGo flex-pass rebate,” presented drivers with a free transit pass and allowed them to earn back up to half the cost of their parking contract by using any alternate modes. The “disincentive removal” module simply gave participants a free unlimited ride transit pass in addition to their contract.

Overall findings indicate that the propensity for a shift in mode choice is directly connected to the level of incentive, Lari said. The PayGo module saw the greatest shift in mode choice because it had the highest level of incentive. The disincentive removal module, with no added incentives, didn’t significantly affect mode choice.

The researchers also found that study incentives did not necessarily prompt drivers to choose transit, even though all modules included a transit pass. Participants used modes other than transit—such as biking, walking, and telecommuting—on a significant portion of their non-driving commute days.

“In order to shift mode choice, an incentive beyond a free transit pass is required,” Lari said. For instance, he suggested adding carpooling incentives in future parking flexibility research.

The study was conducted in partnership with Metro Transit and sponsored by the Minnesota Department of Transportation and the Federal Highway Administration.



**READ  
CATALYST  
ONLINE**

for links to research reports and other resources.

## NEW RESEARCH REPORTS

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

**PREDICTING AND  
PREVENTING  
TRIPPED ROLLOVERS**  
(CTS 12-33)

**INEXPENSIVE OPTICAL  
SENSORS  
FOR GPS AUGMENTATION**  
(CTS 12-37)

**HYDROGEN-BASED  
POWER SYSTEMS  
FOR ITS APPLICATIONS**  
(CTS 12-38)

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

## Weigh from page 1

To bring WIM technology to local roads without the cost of a permanent station, University of Minnesota Duluth electrical engineering professor Taek Kwon has developed a portable WIM system. Research to develop the system was sponsored by the Minnesota Department of Transportation (MnDOT) and supported by MnDOT State Aid and the Minnesota County Engineers Association.

The portable WIM system consists of two 24-foot-long, one-foot-wide weigh pads—pressure sensor strips encased in reinforced rubber—and a console box with electronic components. The battery-operated system can be reused in multiple locations, covers two lanes, and costs about \$25,000.

In addition to measuring vehicle weight, the system also collects data on vehicle class, axle spacing, and speed—which has applications far beyond identifying overweight vehicles. For example, this information could be used to create estimates of annual heavy vehicle traffic, says Ben Timerson, weight data and engineering coordinator at MnDOT.

“This would give us a better idea of where heavy commercial traffic is and where freight is going,” he says.

To install the system, the two weigh pads are placed across a traffic lane and fastened to the pavement surface with screws and bonding tape. Installation takes only 15 minutes per lane, and data downloaded from the system is compatible with the standard WIM tool currently used by MnDOT.

To compare the performance of the portable system with an in-pavement system, the researchers conducted a test at an existing WIM site on Minnesota Trunk Highway 53. Results indicate that the portable WIM system successfully provides data with a similar quality to the permanent system. Axle spacing and speed measurements were nearly identical,



It costs about  
**\$220,000**

to install a permanent WIM station on a four-lane highway.

while gross vehicle measurements showed a difference of approximately 4 percent. Vehicle type classification had a difference of only 1.5 percent.

The system's accuracy could be improved by adjusting the design of the weigh pad, the researchers suggest. Installing vibration-damping material in the slot where the pressure sensor touches the outer rubber material could help reduce errors caused by excessive vibration, for example.

Future work will also focus on extending the system's battery life, determining the usable life of the weigh pads' rubber exterior, and finding low-cost pad replacement solutions. Eventually, the plan is to contract with a manufacturer to produce a commercial version of the system.

## Snow and ice control handbook **updated**

To keep roads passable in the winter, agencies and drivers need to prepare before storms even begin. One resource for them is the *Minnesota Snow and Ice Control: Field Handbook for Snowplow Operators*.

The handbook helps promote the understanding of the tools, best practices, and limitations for snow and ice control. It also helps users understand when to use and when not to use these tools and practices. In addition, it encourages progressive changes in snow and ice control

practices that will help agencies reduce salt/sand use and environmental impacts while meeting the safety and mobility needs of roadway users.

The handbook was updated last fall with new data and other changes since the original was published in 2005. Its publishers are the Minnesota Local Technical Assistance Program (a part of CTS), the Minnesota Department of Transportation, and the Minnesota Local Road Research Board. It's available for download at [mnltp.umn.edu](http://mnltp.umn.edu).



## Obesity from page 1

index (BMI) for each. Using the firm's job records, the researchers tracked the drivers' performance during their first two years on the road. They then used statistical models to estimate the relationship between crash risk and BMI, controlling for demographic characteristics and for variations in the drivers' exposure to risks on the road.

The researchers found that drivers who are severely obese are about 50 percent more likely to be involved in a crash than drivers who have a BMI within the normal range. Drivers who were overweight but not severely obese did not appear to be at higher risk for a crash.

The study did not determine the cause for the increased crash risk, but Burks suggests the causes may include fatigue due to obstructive sleep apnea (OSA), daytime sleepiness sometimes experienced by obese individuals who don't have OSA, and limited agility. OSA is common among commercial drivers, with prevalence estimated as high as 17 to 28 percent. "This research is a kind of prequel to the study of obstructive sleep apnea in truckers we are currently doing," he says.

Although most crashes new drivers have are minor, the study found that a minor crash predicts a greater risk of a more serious one later. As a truckload motor carrier, Schneider National operates within a high turnover part of the driver labor market, and new drivers are always a significant fraction of the work force at firms in this large industry segment. This suggests that driver health has significant implications for public safety, the researchers say.

"We have long been aware of the correlation between BMI and work-related injuries, but seeing the correlation to crash risk caused us to redouble our efforts to address commercial driver wellness," says Don Osterberg, senior vice president of safety and security with Schneider National. "We now have a comprehensive sleep disorder testing and treatment program and a multifaceted wellness program to address the longer-term health of our commercial drivers as a way to mitigate risk. By proactively addressing the issue of obesity, we are able to reduce healthcare and other safety costs," he says.

The research was published in the November issue of *Accident Analysis & Prevention* and was covered on the "breaking science news" website of *Science* on October 26.

The work is part of the Truckers & Turnover Project, a multi-year study in the field of behavioral personnel economics conducted by a team of UMM faculty and students as well as faculty at other institutions in the U.S. and abroad, in cooperation with Schneider National and other firms. Work is expected to continue for several more years. More is online at [morris.umn.edu/academics/truckingproject](http://morris.umn.edu/academics/truckingproject).

Commercial drivers are involved in more than **4,000** fatal crashes each year, and more than **13% OF THOSE ARE DUE TO FATIGUE** and other physical issues, according to a 2007 study by the U.S. Federal Motor Carrier Safety Administration.

## Moving toward 'active transport' in Minnesota

"Active" forms of transportation such as bicycling can have health benefits for individuals and for the environment. What would it take for more Minnesota commuters to choose the bikeway over the highway? CTS Scholar Ingrid Schneider shared insights and ideas at an October 31 lecture hosted by the U's Institute on the Environment (IonE). Schneider is a professor in the Department of Forest Resources and director of the University of Minnesota Tourism Center.

Efforts to encourage active living are gaining steam at the local, state, and national levels, Schneider said, in part due to rising obesity rates. Since 1995, the percentage of Minnesotans who self-identify as obese has risen from 15 to 25 percent—and transportation is one of the components contributing to this change, she noted.

Schneider recently worked with the Minnesota Department of Transportation in a study that asked Minnesotans what factors are important to their quality of life. Using focus groups and surveys, the statewide study identified 11 main categories, including transportation (an article about the study appeared in the August 2012 *Catalyst*).

Since 1995, the percentage of Minnesotans who self-identify as obese has risen from

**15 TO 25 PERCENT.**

The active transport project was part of this larger study, Schneider said.

Schneider's team used the survey data to analyze Minnesotans' views about biking, particularly biking safety. The researchers found that most Minnesotans perceive their communities as safe for biking, but there were some inconsistencies between bikers and non-bikers in different regions of the state. The team then did a deeper analysis of the Twin Cities metro area (for which they had the largest survey sample size) and looked at three types of commuters: those who never bike, those who drive to work and bike recreationally, and those who bike to work. "To our surprise," she said, "there were no differences in these groups in perceived safety."

**Active continued on page 7**



# Minnesota safety efforts recognized nationally

Minnesota's collaborative efforts to drive down serious traffic injuries and fatalities are receiving national recognition and attention.

In November, the Minnesota Department of Transportation (MnDOT) was one of two state DOTs to receive the 2012 Safety Leadership Award from the American Association of State Highway and Transportation Officials (AASHTO). MnDOT was chosen in part for its work under the Toward Zero Deaths (TZD) statewide safety program.

TZD is a collaborative effort and partnership with the Department of Public Safety and the Department of Health, in cooperation with the Minnesota State Patrol, the Federal Highway Administration, Minnesota county engineers, and many other transportation organizations, including CTS. (More at [minnesotatzd.org](http://minnesotatzd.org).)

In choosing recipients, AASHTO looked for strong partnerships between state and local governments as well as aggressive safety targets to reduce fatalities and serious injuries. AASHTO also noted MnDOT's support of research to improve teen driver safety and

emergency medical response.

"Our vision in Minnesota is zero deaths, and the progress we made could not have been achieved without our many safety partners throughout the state," said Bernie Arseneau, deputy commissioner/chief engineer with MnDOT. "We are deeply grateful for the collaboration efforts as we move forward to achieve our safety goal to eliminate all deaths on our roadways."

Minnesota's safety leadership was also recognized at a conference sponsored by the Transportation Research Board (TRB) of the National Academies. The conference—Improving Roadway Safety Programs Through University-Agency Partnerships—looked at the challenges and opportunities associated with improving roadway safety and identified promising directions for research.

"Partnerships between universities and agencies are critical in moving toward a world with fewer roadway fatalities," said Arseneau, one of the conference presenters. "Major advances in safety will come about through basic research." He cited a number of research

From the launch of the TZD program in 2003 through 2011, **FATALITIES HAVE DROPPED MORE THAN 43 PERCENT.**

areas MnDOT is funding at the U of M, such as intersection collision-avoidance technology.

Another conference speaker was Max Donath, director of the Intelligent Transportation Systems (ITS) Institute, a part of CTS. Donath discussed the relationships between university transportation centers and state DOTs, other agencies, and groups. He also provided examples of U of M research projects involving multiple partners, including deployment of driver-assist technology on buses in the Twin Cities metro area.

The conference proceedings, published in 2012, is online at [onlinepubs.trb.org](http://onlinepubs.trb.org).

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If safety perceptions aren't keeping people from commuting by bike, what might be? Schneider suggested other constraints: some people will never bike because of personal preferences or situations (for example, having a disability); some may need mentoring or support from friends or others; some may lack awareness of transportation options and costs. New tools such as Cyclopath, an online routing and mapping system developed by U of M researchers, could help fill this information need, she said.

Regardless of inconclusive safety results, there is an opportunity to increase the percentage of people involved in active transport, Schneider said. The Twin Cities metro has an award-winning trail system, and Minneapolis was named the most bike-friendly city in the country by *Bicycling* magazine. In addition, a 2012 survey by the Metropolitan Council found that while 3 percent of people commute by bicycle in the Twin Cities metro area, 20 percent are "somewhat" or "very likely" to consider commuting by bike in the future.

Schneider's lecture is archived on the IonE website, and a research report is forthcoming.



## EVENTS CALENDAR

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Portable

## WEIGH-IN-MOTION

system could help traffic engineers protect  
**LOCAL ROADS.**

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The role of  
**FRACTURE-CRITICAL DESIGN**  
in recent catastrophes is explained in  
a new book:

## DESIGNING TO AVOID DISASTER.

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## PREDICTIONS

for 2020: a booming economy  
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## Study finds link between obesity and crash risk for truck drivers.

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