

CTS Catalyst

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Accelerating the pace of transportation innovation

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One industry cluster important to northwestern Minnesota is recreational vehicle production.

Transportation drives growth of industry clusters

From recreational vehicles in the northwest to Mayo Clinic in the southeast, Minnesota has a diverse and changing set of industry clusters. What do such clusters need to grow and prosper? Recent U of M studies take a look at the vital role of transportation.

Industry clusters are geographically concentrated groups of interconnected companies, universities, and related institutions. As a critical mass, clusters promote efficiencies that individual businesses or industries cannot, and they tend to have a large economic impact on a region.

Clusters continued on page 6

New crash report interface will improve usability and data quality

The data collected at the scene of a crash by law enforcement officers are important for more than just drivers and their insurance companies. The information is also used on a much larger scale by state agencies and researchers to analyze and evaluate crashes, trends, and potential countermeasures.

“Big decisions get made based on that data—million-dollar decisions,” says Nichole Morris, a research associate at the U of M’s HumanFIRST Laboratory. “So you have to be sure that what goes

Crash reports continued on page 5



New systems monitor stormwater runoff from road construction sites

Transportation practitioners have new tools to help keep road construction runoff out of our waters, thanks to research from the University of Minnesota.

During a rainfall, eroded sediment from a site can be quickly transported to nearby lakes or rivers. Because of these negative impacts, the Minnesota Pollution Control Agency requires that the owner and operator create a stormwater pollution prevention plan explaining the practices to be used to limit sediment discharge from their sites.

The amount of eroded sediment in construction runoff is typically gauged using turbidity values, which measure the cloudiness of a fluid. However, the usefulness of measured turbidities rests upon how representative the data are of runoff at construction sites and the reliability of the relationship between turbidity and sediment concentration.

“There is extensive variability in the soils, slopes, compactions, and erosion control methods among construction sites, which increases the difficulty of calibrating turbidity probes and selecting sites for data collection,” says Bruce Wilson, a professor in the Department of Bioproducts and Biosystems Engineering and the principal investigator of the research. “In addition, the rapidly changing conditions of a construction site mean the long-term monitoring of turbidity from a single location throughout the construction project is rarely possible.”

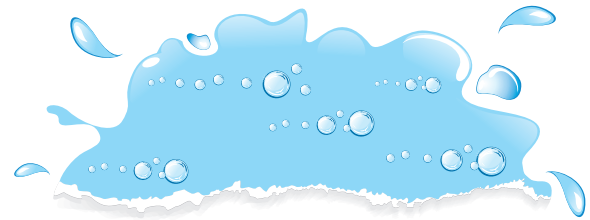
Along with these logistical challenges, turbidity monitoring also has the potential to be expensive; costs include equipment and personnel to install and monitor the data-collection systems. “This is especially true for linear highway construction projects where the flow is often discharged at many locations,” Wilson says.

The research project, sponsored by the Minnesota Department of Transportation (MnDOT), gives insight into overcoming the challenges and reducing the costs of turbidity monitoring at construction sites.

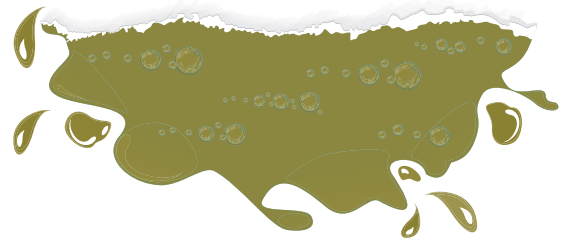
“There is a correlation of properly selected, sequentially timed, installed, and maintained best management practices (BMPs) and brown water discharge from construction activities,” says Dwayne Stenlund, MnDOT erosion control engineering specialist. “Turbidity monitoring helps answer why BMPs are required by permit and contract.”

The project had two main goals: investigating turbidity relationships for the conditions found at Minnesota construction projects, and developing protocols for the design and installation of cost-effective turbidity monitoring systems.

Researchers began their study by bringing soil samples from 14 different construction sites across Minnesota to their



TURBIDITY



With higher turbidities, water temperature increases, the amount of available oxygen decreases, less light reaches aquatic plants, and sediment accumulation reduces water storage capacity—degrading the quality of our waters.

lab, where they used a rainfall simulator to generate runoff and turbidity values for the soil samples. They used these tests to determine how the measure of turbidity relates to the actual sediment concentration in the runoff. In addition, they evaluated five different turbidity sensors on five different soil textures to determine how soil texture and probe configuration affected turbidity readings.

After the laboratory work was complete, researchers measured the turbidity of runoff at two construction sites. These field studies were then used to develop two different turbidity monitoring systems: one for overland flows, the other for dewatering activities. The field studies also revealed that turbidity levels at the two sites were often more than three times higher than a standard suggested in 2011 by the U.S. Environmental Protection Agency.

“In the future, the two turbidity monitoring systems developed for this study can be used to help transportation agencies cost-effectively monitor the turbidity of construction site runoff,” says John Gulliver, a professor in the Department of Civil, Environmental, and Geo-Engineering and the project’s co-investigator.

New software will aid design of concrete pavements in Minnesota

The design of concrete pavements has advanced significantly in the past decade, particularly with recent updates to the American Association of State Highway and Transportation Officials (AASHTO) design guidelines for concrete pavements. To take advantage

data, along with calibrations specific to Minnesota pavements.”

Researchers closely collaborated with MnDOT engineers to determine the design inputs needed to properly account for local conditions and concerns, then built and tested a

accessed and potentially modified by MnDOT research engineers, which will help ensure the tool remains accurate and current.”

With this new tool, Minnesota’s state and local engineers will be able to incorporate the latest design



Photo courtesy MnDOT

Construction of a concrete test cell at the MnROAD pavement research facility

of these advancements, the Minnesota Department of Transportation (MnDOT) determined that it needed a new design tool tailored to Minnesota’s unique conditions.

“Prior to this project, MnDOT had designed concrete pavements using a tool based on AASHTO’s 1993 design procedure, which has since become outdated,” says Lev Khazanovich, associate professor in the Department of Civil, Environmental, and Geo-Engineering. “Our research team set out to create a new tool based on the latest design procedures, and modified to meet MnDOT’s needs through the incorporation of local climate and traffic

database of past concrete pavement projects whose characteristics would be used to represent Minnesota pavements for the new software program. Next, researchers developed a Windows-based database and software program known as MnPCC-ME, a design tool for rigid pavements in Minnesota.

According to Khazanovich, the new software has many benefits for MnDOT and Minnesota pavements. “The software is portable, accessible, and produces results instantaneously. In addition, it requires that users modify only critical input parameters, which makes it simple to use. Finally, both the software and database are easily

procedures when designing their concrete pavements in order to create pavements that are cost-effective, longer-lasting, and better suited to Minnesota conditions.

“This software allows pavement designers to use sophisticated mechanistic-empirical design procedures in a simple format, while still providing robust results,” says Luke Johanneck, MnDOT research project engineer.

Full implementation of the software began in November with the release of the new version of MnDOT’s pavement design manual.

University of Minnesota reception at TRB

The University of Minnesota is hosting a reception for friends and alumni during the Transportation Research Board 94th Annual Meeting in Washington, DC. The reception will be held in the Capitol Room of the Marriott Marquis on Sunday, January 11, 2015, from 5:30 to 7:00 p.m.

Details are available at cts.umn.edu/Events/TRBreception.

Max Donath receives award for leadership in traffic safety

Photo: David Gonzalez, MnDOT



At the Minnesota Toward Zero Deaths Statewide Conference in November, Max Donath was honored with the 2014 Kathy Swanson Outstanding Service Award. Donath, director of the Roadway Safety Institute and professor of mechanical engineering, has been at the U of M for 36 years.

The award was given in recognition of Donath's exceptional leadership in efforts to improve traffic safety in Minnesota, build partnerships, and mentor others in the field.

"I wouldn't be here if it weren't for the creativity, passion, dedication, and effort that all of you put into pursuing safety and reducing crashes," Donath said when accepting his award at the conference.

During his tenure at the U, Donath has been dedicated to finding new ways to improve safety. In addition to conducting numerous safety-focused research projects, he has worked with local, state, and national safety partners to ensure that his work produces real-world results that can be put into practice. Largely as a result of his efforts, the U of M is recognized nationally as one of the top universities in transportation safety.

Donath addresses texting and driving in CTS blog post

In a recent post on the CTS *Conversations* blog, Donath stressed the need for an immediate solution to address the safety risks posed by texting and driving.

"We need the industry, including the vehicle manufacturers, to work together to create a system that prevents the driver and only the driver from texting," Donath said. "There is no doubt that a workable, deployable solution is possible."

In the post, Donath highlighted existing cooperative agreement mechanisms for industry to work together and explained that solutions don't need to take decades to work out—they can be accomplished in one "smartphone generation."

To learn more, read Donath's post at blog.cts.umn.edu.



READ CATALYST ONLINE

for links to research reports and other resources.



Exhibitors sought for career expo

The 2015 Transportation Career Expo will be held February 17 from 4:30 to 7:15 p.m. in Coffman Memorial Union's Great Hall on the Minneapolis campus.

The expo allows companies and agencies to network with students and recent graduates and tell them about their organizations and job opportunities. It also offers an opportunity for professional organizations to reach out to students as potential members.

If your organization would like to exhibit at the expo, please register online by January 16. For more information, contact Kylie Bivins, bivins@umn.edu or 612-625-5608, or visit cts.umn.edu/events/careerexpo.

in to that report is high quality and reflects what actually happened at the scene of the crash.”

As part of an effort to improve this data quality in Minnesota, Morris is leading a team of HumanFIRST researchers in a project to redesign the electronic crash report interface used by law enforcement officers. The team’s goal is to create a new interface that improves the accuracy, speed, reliability, and meaningfulness of crash report data.

The project is occurring in conjunction with a redesign of Minnesota’s crash records database and is being sponsored by the Traffic Records Coordinating Committee (TRCC) at the Minnesota Department of Public Safety (DPS) and by the Minnesota Department of Transportation (MnDOT).

“In industry, they do this work all the time, looking at usability and design. But when you think about what a state does in terms of usability, nothing like this to our knowledge has ever been done. This makes it a very exciting and revolutionary project for Minnesota,” Morris says.

In the first phase of the project, the researchers completed a human factors analysis on the existing crash report interface to identify potential problem areas. This included a hierarchical task analysis, which broke down the reporting process step by step, and in-depth interviews and card sorting activities with law enforcement officers.

During this process, the researchers identified several areas they hoped to improve. For instance, they wanted the new interface to be smarter, making better use of autofill features to reduce the amount of data entry for the officer. Based on feedback from officer interviews, the researchers also decided to change the order in which data are entered to make the process more intuitive.

Following the analysis, the team built two versions of a mock crash report interface for usability testing: a wizard and a form. The wizard prompts the user with a limited number of questions, one screen at a time, similar to the interface users see when installing new computer software. The form is similar to the current crash report interface and contains many questions and data entry points on each page.

In both versions, the researchers added decision aids to ease usability. For example, they embedded hyperlinks and information bubbles to display special rules in areas that caused confusion for officers. They also significantly improved the system’s autofill capabilities, reducing the ratio of officer to system data entry from 6:1 to nearly 1:1.



The researchers then conducted four rounds of usability testing with law enforcement officers for both the wizard and the form. Results were split: half the officers preferred the wizard and half preferred the form.

Because of these findings, the TRCC is planning to build full versions of both, Morris says, which will allow officers to use the version they prefer.

Going forward, the researchers plan to make a few more adjustments to the research prototype before handing it off to the state vendor, Appriss, which will build the new system. The team will then work collaboratively with Appriss to complete additional beta and usability testing before the new interface launches in January 2016.

“The results of the HumanFIRST prototypes are being combined with the vendor’s prior experience for a best-of-breed approach,” says Kathleen Haney, traffic records coordinator at DPS. “This is a fantastic project, and the results will be relevant for years to come.”

Officers from
73 LAW ENFORCEMENT AGENCIES
 across Minnesota participated in the
REDESIGN
 and usability testing process.



Project team receives national award

The crash report usability and design project recently received the Best Practices in Traffic Records Project Award from the Association of Transportation Safety Information Professionals. The award honors projects that improve data capture, manipulation, and evaluation related to traffic records.

Morris and Haney accepted the award along with Katie Fleming of MnDOT at the 2014 Traffic Records Forum in St. Louis on October 28.

Clusters from page 1

One recently completed study of competitive industry clusters in the greater Minneapolis–St. Paul (MSP) region revealed that some important new clusters—water technology, robotics, 3D printing, and biorenewables—are emerging in the region from existing competitive clusters. “These are industries to watch, and they may be areas where we need to spend more time in the future,” advised Lee Munnich, director of the State and Local Policy Program (SLPP) at the Humphrey School of Public Affairs.

A second cluster study, for the Minnesota Department of Transportation (MnDOT), leveraged quantitative data from the U.S. Cluster Mapping Portal (see page 7), in addition to information gained through interviews with several companies in varied clusters throughout Minnesota (glass, granite, processed food, and printing/publishing), to learn what issues are most important to them. Major transportation issues identified were weather-related delays, rail capacity and equipment issues, truck driver workforce and regulatory issues, regional air access, congestion delays in the MSP metro area, and carrier availability.

Researchers also used what are called location quotients to quantify how concentrated a particular industry is in an area relative to the nation as a whole. For example, Munnich explains, the medical devices industry in the MSP region has a location quotient of 3.96—that is, a concentration almost four times the national average in that same industry.

One industry particularly important to northwestern Minnesota is recreational vehicle production, which has a location quotient of 17.22, or more than 17 times the national average for that industry. Recreational vehicle manufacturing has two main players: Arctic Cat and Polaris. These are two very competitive firms in one of the most sparsely populated areas of the state, Munnich says, and both face major

transportation issues related to inclement weather and difficulty in finding skilled workers.

Moving to the other end of the state, Munnich’s team found that Mayo Clinic in Rochester also has major transportation problems. Mayo Medical Laboratories, for example, receives approximately 30,000 specimens daily from all over the world—most of which require time-sensitive processing. But on average, planes cannot fly into Rochester 9 or 10 days a year because of bad weather. On these days, the specimens have to be trucked from the MSP International Airport, losing critical processing time. “While there has been increased transportation service to Rochester and to Mayo Clinic, they are looking for more ways to improve this area,” Munnich says.

SLPP researchers also completed a cluster-related project in southwestern Minnesota for MnDOT’s District 8 (see the December 2013 *Catalyst*). “We interviewed manufacturing firms in the clusters most important to this area, as well as area freight carriers, about their specific transportation needs in efforts to come up with some low-cost improvement strategies that could be implemented in the short term,” Munnich says. A similar project for MnDOT District 4 in west central Minnesota is under way.

“Findings from cluster-based studies like these can be used to shape transportation policy, planning, and implementation to better direct Minnesota’s economic successes,” Munnich says.

Munnich’s remarks were part of a two-day forum about industry clusters hosted in September by the U’s Transportation Policy and Economic Competitiveness Program (TPEC). Please visit the TPEC website—tpec.umn.edu—to read more from the event.



Mayo Clinic anchors an industry cluster in southeastern Minnesota..

Cluster mapping portal **launched at forum**

The U.S. Cluster Mapping Portal—**clustermapping.us**—was launched as part of a two-day forum at the University of Minnesota in September.

The portal is a national economic initiative that provides open data about regional clusters and economics to support business, innovation, and policy in the United States. The project is based on research led by Professor Michael Porter through the Institute for Strategy and Competitiveness (ISC) at Harvard Business School, in partnership with the U.S. Department of Commerce and U.S. Economic Development Administration (EDA) and with support from a number of academic and regional partners, including the University of Minnesota.

The portal's data are a detailed composition of regional economies (since 1998) that enables users to look at any region and clearly see those areas with a critical mass. The portal provides,

for the first time, “a roadmap that allows us to see where a region is competing, where it is winning, where it is growing and sprouting new businesses and technologies, and where it is not,” said Porter, the forum keynote speaker.

Recent research shows that strong traded clusters (those that serve markets in other regions or nations) have higher wages, breed innovation, and accelerate new business. What this says, Porter explained, is that economies grow by building on strengths and moving into related fields. The cluster framework allows users to understand how to take advantage of the spillovers, linkages, connections, and relatedness to drive innovation and entrepreneurship and pull new businesses into our economy. “We now finally have the opportunity to do this in a rigorous, systematic, data-driven way—that’s what the [U.S. Cluster

Mapping] portal is all about,” he said.

Forum sponsors were the U.S. EDA, ISC, The Council of State Governments Midwest, GREATER MSP, the Canadian Consulate General in Minneapolis, and the Humphrey School.

The forum was held by the Transportation Policy and Economic Competitiveness Program (TPEC), a five-year program managed by the State and Local Policy Program at the Humphrey School of Public Affairs. TPEC researchers are examining how freight transportation, infrastructure, and other factors contribute to the success of clusters and enhance the competitiveness of the region.

A report summarizing selected forum sessions is at **tpec.umn.edu**.

DIVE INTO THE DATA

By Region
Examine a location's clusters and economic performance.

- How does the average private wage in **Miami** compare against that of other U.S. cities? →
- Which clusters generated the most jobs in the **Los Angeles** economy from 2009-2012? →

EXPLORE DATA BY REGION

By Cluster
Focus on a specific cluster across all regions.

- Which U.S. cities have specialized the most in **Automotive** manufacturing over the past decade? →
- Which counties have had the highest rate of employment growth in **Oil and Gas Production**? →

EXPLORE DATA BY CLUSTER

The portal allows users to examine industry clusters for regions throughout the country.

Commerce secretary champions portal

“Our cluster mapping tool gives us the ability to reinvent and modernize economic development strategies—all driven by open data. Local officials are using it to make strategic investments, recruit new companies, and lay the groundwork for new industries.”

—Penny Pritzker, U.S. Secretary of Commerce

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A new
CRASH REPORT INTERFACE
 will improve
**USABILITY AND DATA
 QUALITY.**
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**New systems monitor
 STORMWATER RUNOFF**
 from road construction sites.
 page 2

New software will
**aid design of
 CONCRETE PAVEMENTS**
 in Minnesota.
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**Transportation drives growth
 of industry clusters.**