Cybersecurity critical in increasingly connected and automated freight industry

Cybersecurity has become a key concern for the freight and logistics industry in our increasingly connected and automated world. A significant challenge is balancing information privacy and security with the industry’s need for usable, reliable data to produce expected benefits.

“You are more likely to experience a data breach of at least 10,000 records than you are to catch the flu this winter,” said Leo Janus, senior offering manager with IBM Watson Supply Chain. “Statistically, it’s becoming a very real thing, especially in logistics and supply chain.”

Cybersecurity critical in increasingly connected and automated freight industry

The METRO A Line, the first arterial bus rapid transit (BRT) line in the Twin Cities transit network, launched service in the summer of 2016 along the high-demand Snelling Avenue corridor. Since then, the line’s ridership has grown rapidly, and the overall response has been overwhelmingly positive. More information, however, was needed about the operations and impact of the line.

Cybersecurity critical in increasingly connected and automated freight industry

The METRO A Line, the first arterial bus rapid transit (BRT) line in the Twin Cities transit network, launched service in the summer of 2016 along the high-demand Snelling Avenue corridor. Since then, the line’s ridership has grown rapidly, and the overall response has been overwhelmingly positive. More information, however, was needed about the operations and impact of the line.
Vehicles, how we power them, and driver behavior are all changing. According to U of M researchers, these motorization trends will affect how we fund our roads.

“Understanding motorization trends is critical for policymakers to make informed decisions about how we will invest in transportation infrastructure and provide transportation services to meet public needs,” says Jerry Zhao, an associate professor in the Humphrey School of Public Affairs.

Zhao is the lead author of a report that analyzes Minnesota’s motorization trends from 1980 to 2016. “The trends we found mean that less revenue is collected from federal and state gasoline taxes.”

The number of registered vehicles in Minnesota almost doubled between 1980 and 2016, from 3 million to 5.4 million vehicles, and Minnesotans traveled more than twice as far, accounting for 60 billion miles in 2016. However, when taking population growth into account, both measures have turned downward in recent years. Since 2000, the number of vehicles per driver and per person in Minnesota has declined. In addition, the number of miles traveled per person and per vehicle dropped significantly in the 2000s. “Vehicle-miles traveled ticked back up in 2016, but it’s unlikely that the growth rate of vehicle ownership will return to pre-2000 levels,” Zhao says. “There is evidence the rapid increase in motorization that occurred over several decades until the 2000s has ended.”

Fuel use in the state follows a similar pattern. Fuel consumption in Minnesota has increased since 1980, but most of this growth came before 2000. Fuel consumption per driver and per vehicle has declined 10 and 11 percent, respectively, since 2000 due to increased fuel efficiency and decreased vehicle-miles traveled, Zhao says.

Looking ahead, increased fuel efficiency and the adoption of hybrid and electric vehicles are trends that are likely to continue. While there are currently about one million electric vehicles on U.S. roads, that number is projected to grow to more than 18 million by 2030, Zhao says. Vehicle- and ride-sharing, better public transportation options, and the prospect of automated vehicles could also speed up younger generations’ transition away from vehicle ownership.

All told, Zhao suggests policymakers look for more options to fund roads. In Minnesota, this process has already begun, with the motor vehicle sales tax and the motor vehicle registration tax making up an increasing share of revenues in recent years. The federal fuel tax was last raised in 1993, and Minnesota has increased the state’s gas tax once since then, in 2009.

Other states are also exploring options to offset decreased fuel tax revenue, Zhao says. These include raising the gas tax, tying the gas tax rate to the price of gasoline, tying the gas tax to inflation, taxing miles traveled instead of gallons of gas consumed, and finding different sources of revenue.

“This research provides us with an understanding of some very important trends surrounding vehicle ownership and travel in the state and the impact on collection of highway revenue,” says Ken Buckeye, program manager with MnDOT’s Office of Financial Management.

“Vehicle ownership and vehicle-miles of travel on a per capita basis are trending downward in the last two decades,” Buckeye says. “That, coupled with increasing fuel efficiency and vehicle electrification trends, point to the importance of considering other revenue tools such as vehicle-miles-of-travel fees if we are going to maintain Minnesota’s high-quality transportation infrastructure.”
Researchers from the University of Minnesota Duluth studied a material called fiber-reinforced concrete (FRC) that offers promise as a durable, cost-effective repair option for concrete pavement. The goal of the project was to develop best practices for using FRC in pavement—such as how to select the right fibers for a specific project and how many fibers should be added to a mix—and to create guidelines that paving agencies might refer to when pouring FRC concrete.

The material is made by adding steel or polypropylene fibers to plain concrete. Once the concrete hardens, these “structural fibers” serve the dual purpose of transferring vehicle weight from one concrete slab to the next and holding cracks and joints tightly together.

FRC is commonly used in thin concrete overlays, which are 4- to 6-inch slabs of concrete poured over existing, worn-down concrete or asphalt as a cost-effective fix. “FRC is useful because it increases the life of the roadways and is cost-effective in the long run,” says Manik Barman, assistant professor in the civil engineering department and the study’s principal investigator.

The project consisted of a literature review, survey, series of laboratory tests, and analysis. “We wanted to determine the optimal physical characteristics of fibers, the amount that should be mixed in the concrete, and products currently not on the approved products list that may be effective,” Barman says.

The literature review and survey were conducted to understand how FRC is already used by paving agencies across the country. The survey, which targeted state transportation agencies identified as leading users of FRC, found that most—94 percent—of FRC overlays are made using synthetic fibers rather than steel because synthetic fibers are lighter, less expensive, resistant to corrosion, and easier to mix.

The lab tests and analysis then went on to determine which fiber geometries, lengths, and stiffnesses are the most effective. For example, fibers that are laterally stiffer, embossed, twisted, and crimped proved to be more effective than straight, flat ones. The researchers recommend fiber lengths between 1.5 and 2.5 inches depending on traffic volume and design life.

“The project is one step forward in understanding fibers’ contribution in concrete pavements or overlays,” Barman says. The study was funded by the Minnesota Department of Transportation (MnDOT) and the Local Road Research Board.

“The study indicates that fibers can provide an alternative to dowels in thinner concrete pavements,” says Maria Masten, concrete engineer with MnDOT’s Office of Materials and Road Research. For many concrete pavements, designers recommend dowel bars to assist load transfer across slab joints, but MnDOT has found that dowel bars are not effective in a thin overlay.

Barman says more research is needed to determine best practices for using FRC. “Paving agencies now know which fibers to use, but they need to fine-tune the recipe of the concrete so that durable and long-lasting concretes can be produced,” he explains. “Agencies need guidelines for other ingredients of FRC such as air content, workability, compaction, and shrinkage.” Researchers will begin this work—also funded by MnDOT—in July 2019.

Adding fibers to concrete pavement may help it last longer

Structural fibers in concrete pavements help hold cracks and joints together.
To fill this need, U of M engineering and planning researchers teamed up to answer some key questions. Led by Alireza Khani, the team analyzed the line’s impacts on both transit capacity and traffic flow in the corridor. The researchers also studied what riders and corridor residents think of the line and which factors are most important in rider satisfaction.

The METRO A Line is designed to give Twin Cities transit users a fast, reliable, and safe transit option (see sidebar). It runs on a regular traffic lane (an arterial street) with other vehicles and stops at the curb rather than pulling into a bus bay. Off-board fare payment and all-door boarding keep stop times short.

To determine transit capacity, researchers analyzed passenger count data for the A Line and for Route 84 (the local bus service on Snelling) before and after the launch. “We found that the METRO A Line significantly increased the maximum transit capacity per hour along the Snelling corridor,” says Khani, an assistant professor in the Department of Civil, Environmental, and Geo-Engineering and the study’s principal investigator.

The A Line appears to attract additional riders, encourage trip transfers, and promote transit use for non-work trips. “Average bus occupancy on the A Line was higher than previous bus service in the same corridor for almost all stops and hours of the day, particularly during the afternoon,” Khani says.

At the same time, there was no measurable impact on general traffic. The team used video cameras at two of the busiest METRO A Line stations to record and measure traffic conditions during both regular and special event (Minnesota State Fair) traffic periods. “When an A Line bus stopped at a station, there was no significant impact on traffic flow or the number of vehicles stopped at intersections,” he says.

Perceptions of the line were largely positive. Riders were more satisfied with the overall service of the A Line than with local buses, says Professor Jason Cao of the Humphrey School of Public Affairs, the study co-investigator. Their satisfaction is equivalent to the higher ratings given to Twin Cities’ express buses, light rail, and commuter rail.

Non-riders in the corridor also had largely positive perceptions of the A Line. Some believe it improves the image of the corridor, Cao says.

The top three factors influencing overall rider satisfaction with A Line service were easy fare payment, hours of operation, and handling of concerns and complaints, Cao adds. The final report includes recommendations for prioritizing A Line improvements and planning elements of future lines.

Next up, Metro Transit plans to launch the C Line this spring on Penn Avenue North, with several additional lines in development. “The study underscores that investing in transit speed and customer experience attracts more riders,” says Katie Roth, Metro Transit’s manager of arterial BRT. “And as we continue to grow the region’s network of fast, frequent, and reliable bus transitways, this research provides key feedback on how to use tools in the street design toolbox to keep transit moving.”

The project was sponsored by the Minnesota Department of Transportation through the Transitway Impacts Research Program.

BUS RIDERSHIP
in the Snelling corridor increased more than 30 PERCENT in the first year of METRO A Line service and continued to grow with over 1.6 M RIDES IN 2018.

The METRO A Line:

- Begins in Roseville, runs south through Falcon Heights past the Green Line in Saint Paul, then travels west to the Blue Line in Minneapolis.
- Frequent, all-day service: every 10 minutes at most times of day
- Fewer stops than local bus service
- Unique, recognizable buses with wider doors and aisles
- Pre-payment of fares at stations and transit signal priority for faster travel
- Enhanced stations with more amenities
- Added security features
As the featured speaker at the 2018 Freight and Logistics Symposium, Janus highlighted the use of new technology to build trust across supply-chain networks for improved transparency, efficiency, and security.

Artificial intelligence (AI), which literally learns from data inputs, is one such technology. It ingests vast amounts of data, reasons over it, learns from interactions with that data, and then tries to mimic human interactions, Janus said. When it comes to cybersecurity, AI can analyze data networks and detect anomalies, helping organizations to better understand attacks and outthink attackers.

Another tool—blockchain—offers a private platform that encourages trust among multiple partners to share information and complete transactions. In 2018, Maersk and IBM collaborated to conceive TradeLens to apply blockchain to the world’s global supply chain. More than 90 organizations are participating in the platform, which allows partners to collaborate by establishing a single shared view of a transaction without compromising details, privacy, or confidentiality.

In addition to technology, standards and best practices can help ensure organizations are able to combat cyberattacks. The value of open collaboration between government and industry also can’t be overstated, Janus said. “We need to learn, and we need to coordinate, because the cyberattackers are coordinated.”

Following Janus, a panel of national experts further explored how the freight industry can make its data systems and processes more secure from increasing threats. Panelists highlighted the need to focus on prevention, transparency, communication and coordination, and the incorporation of security strategies into an organization’s business model.

Addressing third-party risk is an especially critical issue, according to Mike Johnson, an expert in security technologies with the U of M’s Technological Leadership Institute. “You’ve got vendors that are connected that have your data, and you can expect that 60 percent of the breaches that could occur...will come from those sources,” he said.

At C.H. Robinson, vendors complete a robust security questionnaire as part of an evaluation process. “Security is not just technology,” said technology director Brett Cooksey. “It’s people, processes, and technology.”

Jay Hietpas, executive director of the MnDOT CAV-X office, and Josh Root, MnDOT senior legal counsel and data practices compliance official, concluded the symposium with presentations focused on cybersecurity and data privacy considerations for connected and automated vehicles (CAVs).

Potential improvements in safety, efficiency, and freight flow make it critical for Minnesota to invest in CAV development, including tackling the complex cybersecurity issues that come with progress.

“We are competing in a worldwide global market,” Hietpas said. “If Minnesota doesn’t come prepared, we’re going to be at a disadvantage compared to other countries and other states that are actually enabling these technologies and using them for the benefit of their businesses.”

“Early-adopting states are going to win this race,” Root said. “If we aren’t going to lead, we’re going to end up following. Let’s get ourselves in a position where we can be part of that formulating group.”

The symposium was sponsored by CTS in cooperation with MnDOT, the Minnesota Freight Advisory Committee, the Council of Supply Chain Management Professionals, the Metropolitan Council, and the Transportation Club of Minneapolis and St. Paul.
Truck drivers who don’t follow through with employer-mandated treatment for obstructive sleep apnea (OSA) have a higher risk of serious crashes, according to U of M research. This ongoing work, which has implications for both trucking companies and policymakers, was honored with the 2019 Robert C. Johns Research Partnership Award.

“Our study examined the first-ever employer-mandated program for diagnosing and treating this dangerous disease,” says Stephen Burks, professor of economics and management at the University of Minnesota Morris (UMM). “We found a large and statistically significant association between non-adherence with OSA treatment and preventable tractor-trailer crashes.”

Researchers analyzed a program that Schneider, a major motor carrier, had initiated to screen, diagnose, and treat its drivers for OSA. Their work, sponsored by the Roadway Safety Institute, involved a mix of disciplines including economics, human factors, medicine, and statistics.

“Our findings reinforced the decision by Schneider to continue its OSA program,” Burks says. The results have also been cited by at least one other large motor carrier in its decision to institute an OSA program internally.

In addition to UMM and Schneider, partnering organizations were Harvard Medical School, Precision Sleep Solutions, the Virginia Tech Transportation Institute, and Enterprise Resources, LLC.

In ongoing research, the project team is analyzing differences in per-member, per-month medical insurance costs that are associated with the OSA program (other than those of the OSA program itself). The goal is to determine if the carrier can fund the OSA program from the savings generated in medical insurance claims, Burks says.

The Research Partnership Award was renamed this year in honor of former CTS director Robert Johns, who provided visionary leadership in recognizing that the most effective research to address today’s complex transportation challenges is often a result of interdisciplinary teamwork and partnerships. The award is presented annually to a team of individuals who have collaboratively drawn on their diverse expertise to achieve significant impacts on transportation.

“Interdisciplinary research in academia is not easy,” Johns says. “The research culture is driven by single faculty as principal investigators. They lead research projects, supported by students and at times research staff. But transportation issues often need the perspectives of multiple disciplines. I am very honored to have this award named for me—an award that reinforces the importance of interdisciplinary research and external partnerships.”

Video highlights the value of internships for the workforce pipeline

Through CTS internship programs, U of M students get real-world experience to advance their careers and employers gain fresh perspectives and access to the future workforce. A new video from CTS features current students, a former intern, and agency staff discussing the value of internships for themselves and their organizations. The video made its debut at the Annual Meeting and Awards Luncheon.

The video includes interviews with participants of the internship program CTS launched with Ramsey County in 2018. That program built on the long-standing success of the CTS-MnDOT internship program, which completed its eighth year.

The video is available at cts.umn.edu/publications/videos.
Leaders, students recognized at CTS Awards Luncheon

CTS presented the following awards at its Annual Meeting and Awards Luncheon on February 20 in Minneapolis.

Richard P. Braun Distinguished Service Award
(outstanding leadership in research and innovation)
Gary Davis, professor, Department of Civil, Environmental, and Geoenvironmenting, University of Minnesota

Ray L. Lappegaard Distinguished Service Award
(outstanding leadership, mentorship, and support for the profession)
Sue Mulvihill, deputy commissioner/chief engineer, Minnesota Department of Transportation

William K. Smith Distinguished Service Award
(leadership, mentorship, and education of future leaders in private-sector freight transportation)
Jason Craig, director of government affairs, C.H. Robinson

Distinguished Public Leadership Award
(public leaders who have influenced innovative transportation policy directions)
Jon Huseby, district engineer, MnDOT District 8

Education Awards
Matthew J. Huber Award (students in engineering, science, and technology fields)
Yunli Shao: Doctorate, mechanical engineering; advisor: Zongxuan Sun
Vinicius Taguchi: Master’s, civil engineering; advisor: John Gulliver

John S. Adams Award (students in policy and planning fields)
Colleen Peterson: Doctorate, epidemiology; advisor: Mark Peirera
Leoma Van Dort: Master’s, urban and regional planning; advisor: Ed Goetz

Richard P. Braun Scholarship (undergraduates pursuing transportation-related degrees)
Maranatha Hayes: Bachelor’s, civil engineering and statistics; advisor: Timothy LaPara

Roadway Safety Institute Outstanding Student of the Year
Jacob Achtemeier: Master’s, human factors and ergonomics; advisor: Nichole Morris

EVENTS CALENDAR
crts.umn.edu/Events

SUBSCRIBE
to e-mail announcements of upcoming events:
crts.umn.edu/Publications/Subscribe

Recycled paper with 30% postconsumer waste • The University of Minnesota is an equal opportunity educator and employer. This publication is available in alternative formats upon request.
METRO A Line increases transit capacity and ridership without slowing traffic.

page 1

SYMPOSIUM EXPLORES critical role of CYBERSECURITY in the freight industry. page 1

Minnesota's MOTORIZATION TRENDS RESHAPE roadway funding. page 2

Adding fibers to CONCRETE PAVEMENT may help it LAST LONGER. page 3