2018-15TS
Published July 2018

DEPARTMENT OF TRANSPORTATION

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TECHNICAL SUMMARY

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PROJECT COST:
$87,760

Congestion along TCMA corridors causes problems for freight traffic.

Measuring Truck Delay and Reliability at the Corridor Level

What Was the Need?

The corridors of the Twin Cities metropolitan area (TCMA) provide a freight transportation network that allows regional businesses to be competitive in the Upper Midwest. However, traffic volumes on many of these roadways are facing overcapacity during peak travel periods. Heavy truck traffic is only expected to increase, and delays will continue to disrupt freight schedules.

A 2013 study by MnDOT and the Metropolitan Council suggested the need to identify when and where truck congestion and bottlenecks developed in the TCMA. Previous research funded by MnDOT examined heavy truck movement along 38 Twin Cities freight corridors. Researchers created freight mobility and reliability measures, and worked to identify significant bottlenecks. Further research was needed to extract more precise data to better understand TCMA freight traffic congestion.

Researchers used detailed and specific data sets as tools to investigate freight truck mobility, reliability and extent of congestion delays on Twin Cities metropolitan area corridors. Precise locations and times of recurrent delays will help to mitigate future traffic bottlenecks.

What Was Our Goal?

The aim of this project was to combine data from the U.S. DOT National Performance Management Research Data Set (NPMRDS) with information from other sources to build on the previous study's analyses of mobility, reliability and delay along key TCMA freight corridors. New performance measures would more clearly identify the extent of system impediments for freight vehicles during peak periods in selected corridors, allowing researchers to identify causes and recommend mitigation strategies.

What Did We Do?

Researchers worked with stakeholders to prioritize a list of TCMA freight corridors with NPMRDS data coverage. The NPMRDS includes travel time data from probe vehicles at five-minute intervals for all National Highway System facilities. The travel times are reported based upon Traffic Message Channel (TMC) segments with link lengths varying from less than 1 mile to several miles. Researchers worked with 24 months of NPMRDS data from the selected corridors.

Because of varying TMC segment lengths, researchers used geographic information system (GIS)–based data to georeference the NPMRDS data to relevant maps. Combining these with average travel time data from passenger and freight vehicles, researchers used their data analysis framework to generate measures of truck mobility, reliability and delay at the corridor level.

A truck mobility analysis of all the selected corridors was performed using the truck-to-car travel time ratio (TTR) for each TMC segment of each five-minute interval computed in AM (6-10 a.m.), midday (10 a.m.-4 p.m.) and PM (4-8 p.m.) peak periods using the 24-month NPMRDS data. A TTR of 1 describes a truck and a car traveling a distance in the same amount of time. On average, trucks are known to travel 10 percent slower than cars on freeways: a TTR of 1.1. A truck traveling 20 percent slower would have a TTR of 1.2.

continued

"This research provided tools and metrics with new levels of precision concerning truck congestion. The results will allow us to take the next steps toward future investment in addressing freight bottlenecks."

—Andrew Andrusko,
Principal Transportation Planner, MnDOT Office of Freight and Commercial Vehicle Operations

"In this and the previous study, we examined increasingly more detailed data to learn where and when congestion and delays develop within the roadway system. Now we can approach mitigation with a greater probability of success."

—Chen-Fu Liao,
Research Scholar, University of Minnesota Center for Transportation Studies

Produced by CTC & Associates for:
Minnesota Department
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AM Peak		PM Peak	
Corridor	Delay (Hours)	Corridor	Delay (Hours)
I-35W	5,464	I-94	7,519
I-94	4,659	I-35W	6,804
US-169	4,532	I-494	6,741
I-494	3,719	US-169	6,117
MN-55	3,589	I-694	3,693

The top five congested AM and PM peak corridors in the TCMA are listed above with the delay hours for each period. The large delay hours arise from heavy truck volume and speeds far below base free-flow speeds.

Reliability measures evaluated the truck travel time reliability. Researchers computed truck delay during rush hour on the GIS network by fusing truck volumes, posted speed limit and NPMRDS data.

Researchers computed a truck congestion measure by comparing truck travel time with the target travel time in each TMC segment, which provided a measure of delay (in lost hours) at the segment and corridor level.

What Did We Learn?

The truck mobility analysis revealed that roadways with intersections have a higher TTR. Trucks on U.S. and Interstate highways take about 10 percent longer to travel the same distance as cars: TTR 1.1. On state highways, the TTR reaches 1.2 and 1.4 in the AM and PM peak periods, respectively. On county roads, trucks slow considerably: midday TTR is 1.5 and spikes to 1.7 and 1.9 in the AM and PM peak periods. Intersections in a TMC segment and delays at signalized intersections could have caused the TTR increases.

All reliability measures indicated that truck travel time in the PM peak period is less reliable than in the AM peak period. Similar to the TTR measure, roadways with signalized or unsignalized intersections were less reliable for truck traffic than freeways.

Truck congestion and delay measures revealed that the top five TCMA corridors with significant congestion had an average delay of over 3,000 hours in the AM and PM peak periods, with the PM delays notably greater. Also, in the AM peak period, eight additional interchanges had average delays of over 300 hours per mile. In the PM peak period, nine interchanges and eight segments showed significant congestion.

The top six TMC noninterchange segments exhibiting recurring PM peak period delays on average weekdays had delays ranging from 495 hours to 570 hours per mile. Insufficient capacity, increasing demand, roadway geometry and density of weaving points (on- and off-ramps) were considered key causes of delay among these six bottlenecks.

What's Next?

NCHRP Research Report 854, Guide for Identifying, Classifying, Evaluating and Mitigating Truck Freight Bottlenecks, provides guidelines for identifying, classifying, evaluating and mitigating truck bottlenecks. Follow-up research by MnDOT could potentially leverage this project's effort with the NCHRP guidelines to develop mitigation strategies.

This Technical Summary pertains to Report 2018-15, "Measure of Truck Delay and Reliability at the Corridor Level," published April 2018. The full report can be accessed at mndot.gov/research/reports/2018/201815.pdf.