Using GPS Data to Identify Traffic Bottlenecks for Trucks

What Was the Need?
Highways are a critical component of Minnesota’s freight transportation network. For example, I-94 between the Twin Cities and Chicago is forecast to carry nearly 20,000 heavy commercial trucks per day by 2020. Delays in freight shipments caused by highway bottlenecks can negatively affect a region’s economy and productivity.

MnDOT already collects data about the performance of its highway network. Much of that information, however, is gathered by loop detectors, which do not distinguish between trucks and passenger vehicles. Automatic traffic recorders and weigh-in-motion systems do collect some truck volume and speed information, but they are only installed at selected locations.

To improve freight management and planning and to guide decision-making on infrastructure development and investment, MnDOT needed information specific to heavy truck traffic.

What Was Our Goal?
The goal of this project was to integrate commercial data about heavy truck movement along the Twin Cities freight corridors with MnDOT’s existing data to create freight mobility and reliability measures and to identify significant freight bottlenecks.

What Did We Do?
After a literature review that identified performance measures used for surface freight movement, researchers analyzed data from several sources. The primary source for this analysis was 12 months of truck data collected by the American Transportation Research Institute using GPS on 38 freight corridors in the Twin Cities.

While ATRI’s data was the most thorough information available about freight activity, it was not exhaustive. To validate ATRI’s GPS data as representative of truck traffic over the year, researchers supplemented it with data from several Federal Highway Administration and MnDOT sources, including the National Corridors Analysis and Speed Tool (N-CAST), the National Performance Management Research Data Set, MnDOT weigh-in-motion data from four Twin Cities stations and MnDOT automatic traffic recorder data.

Next, researchers processed raw truck data and used it to derive freight performance measures. With these performance measures, they identified and ranked the truck bottlenecks in the Twin Cities.

What Did We Learn?
Performance measures identified include:

- **Corridor target speed**, typically 45 mph in the core of the Twin Cities metropolitan area and 55 mph or higher on corridors outside the metro area. Within the TCMA, 12.4 percent of miles had a speed below the 45 mph target during the morning peak (5-10 a.m.), and 19.0 percent of miles failed to meet the target during the afternoon peak (2-7 p.m.).
Heavy Commercial Annual Average Daily Traffic volume. Interstate 94 carries the most truck traffic: 36.8 percent of its miles have an HCAADT over 7,500 and 28.7 percent of its miles have an HCAADT per lane over 1,500. I-35W, I-494 and I-694 carry the next highest truck volume.

Truck mobility, measured as the number of hours during a peak period where the average speed for a given segment is below the corridor target speed.

Total hours of truck delay per day, calculated using a segment’s HCAADT, average truck speed and target speed.

80th percentile truck travel time reliability, defined as the ratio of travel time when volume is at the 80th percentile to the travel time at the target speed. Corridors can be defined as reliable (ratio under 1.5), moderately reliable (ratio between 1.5 and 2.0) or unreliable (ratio over 2.0).

Researchers identified bottlenecks using two measures: average truck delay per mile and number of hours during peaks when truck speeds were below the corridor target. They ranked bottlenecks for both measures during both a.m. and p.m. peaks, creating four bottleneck lists. Each list included at least 12 road segments, mostly located near interchanges. Contrary to prior assumptions, the analysis showed that trucks sometimes face delays due to road curvature, grade or geometry.

What’s Next?

This research offers a wealth of information that will complement data already being collected for transportation planning to ultimately improve truck movement on Twin Cities highways and to develop a statewide freight system plan. The project report identifies issues that may shape future investments; for example, MnDOT may eventually look to areas with high levels of trucking activity to identify where there is a need for increased truck parking capacity.

While this research does not suggest solutions for truck traffic congestion, it does show where trucks are highly concentrated. These areas are likely to be fruitful sites for further study and eventual efforts to reduce congestion and delays. However, it will take time to evaluate the information generated by this project before any implementation occurs.