Mobility Performance Measures for Arterial Streets

What Was the Need?
Minnesota uses a variety of performance measures to evaluate its freeway system, with data collected by a well-established instrumentation network that includes cameras and vehicle detectors. However, arterial streets generally lack this instrumentation, so collecting data on those streets has involved manually conducting travel time and speed runs. The cost and expense make this practical only for limited applications.

Smartphones and GPS devices, however, make it feasible to collect this data on a large scale. MnDOT needed to develop a way to best analyze this data to support context-sensitive mobility performance measures. The analysis would have to consider the surrounding land use (such as high-density business districts vs. lower-density residential or suburban development).

What Was Our Goal?
This project aimed to develop context-sensitive mobility performance measures for arterial streets in the Twin Cities Metropolitan Area using commercially available travel speed data.

How Did We Do It?
Researchers began by acquiring more than 3 gigabytes of travel speed data from INRIX, a commercial traffic data provider. The data included roadway location references; time and date ranges; and average speed, reference speed and distribution percentiles of speed. Researchers then aggregated and summarized the data to create a more manageable data set of fewer than 20,000 records that fit into an Excel spreadsheet.

Next, they reviewed mobility performance measures from MnDOT policy documents as well as those from other states and regions.

Developing performance measures for arterial street mobility was the most significant step undertaken. Researchers defined 360 directional reporting segments and 38 corridors, merged the commercial speed data with MnDOT’s GIS and traffic volume networks, defined appropriate performance measures and target values based on context and land use for these performance measures, and calculated current performance measures.

Arterial streets encompass a wide range of roads, from urban streets that provide access to dense activity to rural streets that primarily support mobility. Traffic speeds and congestion levels will naturally vary on these types of roads. To set performance goals, researchers used intersection density (measured in number of intersections per square mile) to distinguish between these roads since it was the most readily available factor to quantify street context.

What Did We Learn?
According to this study, the best mobility performance measure would be a comparison of actual operating speeds to prevailing traffic speeds during light traffic, consistent with...
the federal Highway Capacity Manual. Specific components included congestion delay per mile (at peak periods and a daily total), percentage of travel in congestion during peak periods, travel speed relative to free-flow speeds and reliability (expressed as 80th percentile travel time index or percentage of trips exceeding a travel time index of 2.50). All of these measures were calculated relative to a quantitative congestion threshold.

Researchers suggested target values for these performance measures, keeping in mind that while congestion cannot be eliminated, it can be mitigated with strategic investment, multimodal alternatives, changing travel demand patterns and appropriate land use. Target values, measured as a percentage of prevailing light traffic speed, ranged from 100 percent for road segments with less than two intersections per square mile to 75 percent for segments with more than eight intersections per mile.

Using these performance measures, the project report identified the 20 most congested arterial segments in the Metro District overall and during morning and evening peak periods.

This project demonstrated that travel speed data for arterial streets can feasibly be acquired from private sector data providers.

What’s Next?

Performance monitoring on arterial streets is an emerging practice for both MnDOT and the Metropolitan Council, and performance measures and target values are likely to evolve as agencies gain experience monitoring performance on arterial streets. Researchers recommend that MnDOT track multiple measures in the future to help determine which will most effectively improve agency decisions rather than focusing on a single “best” measure.

While this project evaluated arterial road congestion in and near the Twin Cities Metropolitan Area, the approach would likely be applicable and valuable statewide on inter-regional corridors.

Additionally, while arterial streets serve a variety of multimodal functions, this project focused on motor vehicle based mobility performance measures. Performance measures that support complete streets, including total volume of users, injury rates for all users and provision of facilities for all users, are worthy of future consideration.