A Framework to Classify and Mitigate Truck Bottlenecks to Improve Freight Mobility

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Purpose

This is a framework to classify and mitigate roadway truck bottlenecks and to improve freight mobility. This is in recognition that roadway operations for trucks are understudied; truck-only bottlenecks are often not identified, and freight-specific problem areas are therefore often overlooked.

Classification Framework

This framework follows four steps:

Step 1 (Identify) involves tools that identify and locate roadway sections that are bottlenecks. A truck freight bottleneck is defined as "any condition that acts as an impediment to efficient truck travel, leading to travel times in excess of what would normally occur" (NCHRP Report 854).

Step 2 (Classify), made possible by increasingly available truck probe data, separates the bottlenecks into those for "all vehicles" or for "truck-only." This step is necessary to isolate under-studied truck bottlenecks whose mitigation will notably impact freight mobility.

Step 3 (Evaluate Cause) guides the mitigation treatments as mainly due to operational or roadway infrastructure limitations.

Step 4 (Mitigate) supports a mitigation process by determining the cause of the bottleneck. Determination of causation is based on data analysis, professional judgement, field visits, or input from the freight community.

Mitigation of Truck Bottlenecks

Operational Deficiencies: Mitigation can involve changes such as adjusting supply and demand through pricing or technology-based methods such as retiming of traffic signals.

Roadway Infrastructure Limitations: Trucks occupy more horizontal and vertical space and

- require more room for turns,
- require more roadway to brake and stop, and
- can have notably different acceleration characteristics and performance on grades.

Two sources can provide information on roadway design characteristics and limitations that either cause or contribute to truck bottlenecks.

1. Geometric design manuals which address design standards, often using different truck design vehicles.

2. Crash/safety literature provides a perspective into roadway attributes which contribute to reduced truck performance. Our analyses of safety literature identify a number of roadway limitations including:
   - tight turns,
   - horizontal and vertical curves,
   - narrow bridges, tunnels, lanes, and shoulders,
   - up and down grades, and
   - on-ramps, merges, and intersections.

Applying the Framework

Using this framework, transportation professionals can tie an infrastructure-related truck bottleneck to roadway attributes because most agencies have asset inventories in spatial (GeoData) catalogues. Roadway attributes can be extracted and analyzed using GIS software and specific roadway attributes can be used to indirectly or directly identify possible bottleneck causation.

The figure below shows a bottleneck location in Washington state where probe GPS data indicates 38% of trucks are traveling 80% below the posted speed limit and is used by 6,000 trucks/day. GIS derived geospatial data for this location indicates roadway limitations include merges, tight curves, a narrow bridge, and other factors. This information can be used to guide mitigation actions.

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