Research Notes

RSN 10-04 February 2010

Developing Corridor-Level Truck Travel Time Estimates and Other Freight Performance Measures From Archived ITS Data

Performance measurement for government transportation agencies is becoming increasingly common, particularly at the state level. Measuring freight-specific performance is of key interest to many stakeholders. The existing intelligent transportation systems (ITS) infrastructure for motor carrier weight and safety enforcement in Oregon, Green Light, provides a potential opportunity to estimate freight performance measures with little additional investment. The objectives of this research were to retrospectively analyze the feasibility of using these data to produce freight corridor performance measures.

Data from each of the 22 Green Light-equipped weigh stations in Oregon (Figure 1) were assembled, processed, and uploaded to a data archives housed under the Portland Transportation Archive Listing (PORTAL) umbrella at Portland State University's Intelligent Transportation Systems Lab.

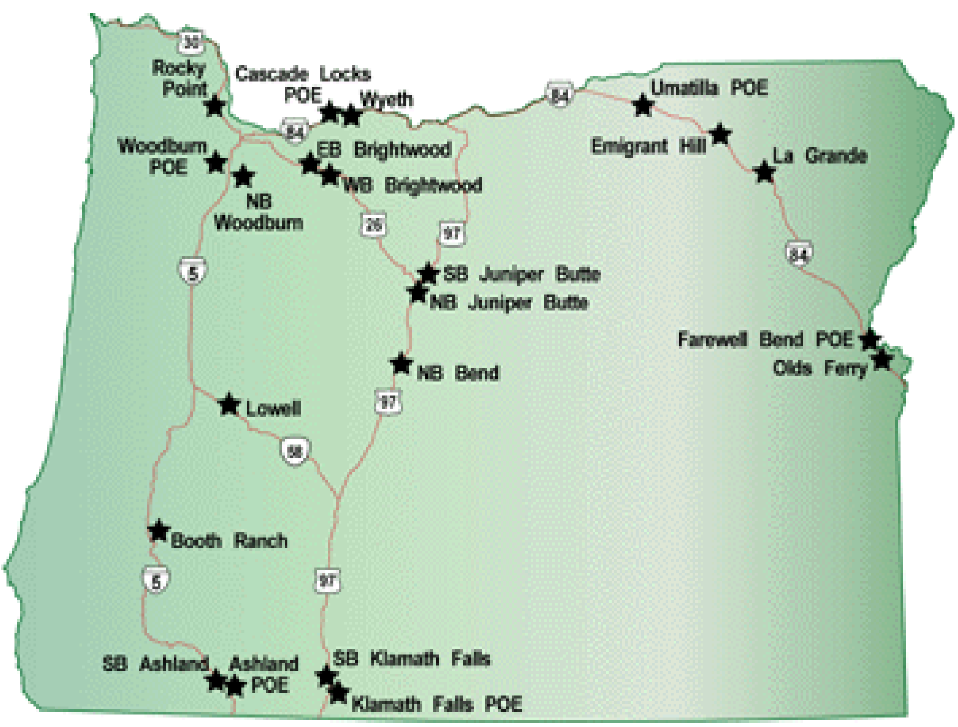
The data include axle weight and spacing, truck speed, timestamp, total length, gross vehicle weight, axle count, and transponder identification (this is a unique aspect of Oregon's system). The data archive includes adequate security measures to address privacy issues.

TRUCK TRAVEL TIME ESTIMATES

Since transponder-equipped vehicles can be uniquely identified from station to station, estimates of the vehicle's travel time can be made. Two separate algorithms were scripted, tested, and validated. The first algorithm matched transponders of all vehicles in a time window between two stations, one upstream and one downstream for all possible pairs. The second algorithm filtered these matches to identify through trucks. This step was necessary because the long distances between stations mean that not all trucks travel between the stations without stopping.

Though the penetration rate of transponder-equipped trucks varies by station, overall it is relatively high (40%). An example of corridor-level performance metrics that can be generated from these data is given in Figure 2 (next page). In the plot, the average speed (solid line) and +/- one standard deviation (dashed lines) are shown for the route between Klamath Falls and Lowell stations (US-97NB to OR-58WB). This route traverses the Cascade mountain range. The variations shown in the figure reflect the effects of winter weather on both travel time and reliability (larger standard deviations).

The research also explored if truck-derived information could be used for real-time traveler information. To do this, ground truth probe vehicle data were collected and compared to travel time estimates from the weigh in motion (WIM) data. A regression analysis found a simple linear relationship between passenger car



(Graphic from ODOT Motor Carrier)

Figure 1: Oregon Green Light Locations

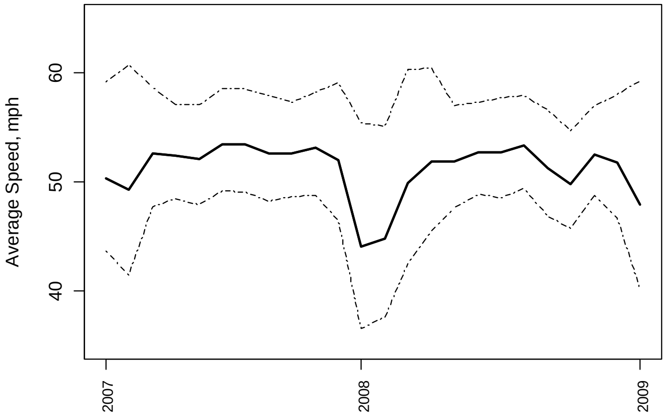


Figure 2: Average Travel Speed, Klamath Falls to Lowell (US-97NB to OR-58WB)

and truck performance. However, from the perspective of a real-time traveler information system, there are too many shortcomings to implement a system without improvements. The long distance between most station pairs implies that, for an incident or delay-causing event to be identified in the data, it must be significant. Thus, the distance between observations controls the minimum duration of an incident that could be detected. Second, the variability and thus uncertainty of through-truck travel times also increases with the distance.

Finally, because these data were not intended to generate travel times, occasional outages and quality issues were present in the data.

OTHER FREIGHT PERFORMANCE MEASURES

The WIM data archive developed for this research presents a number of interesting opportunities for truck-based performance measures. Potential performance metrics can be either: 1) observations at the station level, such as truck volumes, weights, and types by time of day, month, or season; 2) corridor level observations associated with routes between stations using the matched trucks-pairs.

One example of a metric that could be generated is shown in Figure 3. For transponder-matched, 5-axle semi-trucks, the gross vehicle weight from the upstream observation can be subtracted from the downstream observations. Vehicles with greater weight downstream can be assumed to have picked-up cargo between stations, while vehicles losing weight can be assumed to have dropped off cargo. In the plots, the difference between the downstream and upstream gross vehicle weight is summed (accumulated) and plotted. The increasing weights are shown as red circles and decreasing weight as blue squares. The addition of these cumulative lines is shown in orange. In this example, there appears to have been a net freight "loss" and that more goods are delivered than produced on this particular link.

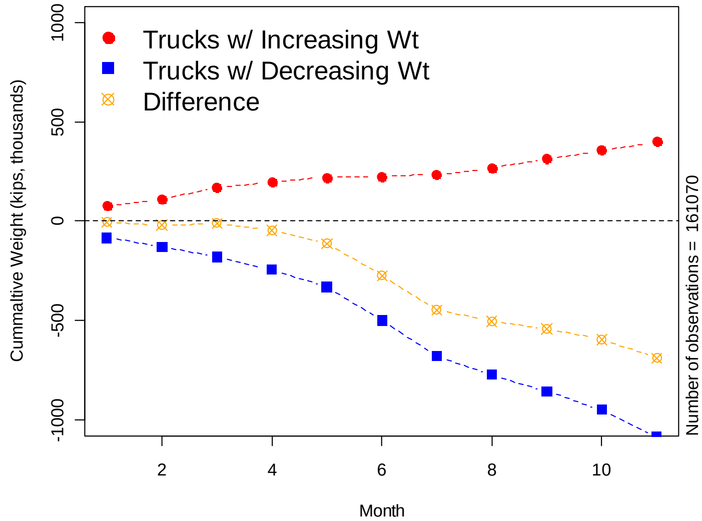


Figure 3: Cumulative Plot of Gross Vehicle Weight Differences, Ashland POE to Booth Ranch, 2007

CONCLUSIONS

This research project demonstrated that it is feasible to use the WIM data to develop long-term corridor performance monitoring of truck travel. From the perspective of a real-time traveler information system, there are too many shortcomings – mainly the large spacing of the stations – in the data to implement without additional improvements. Three solutions can solve the data shortcomings challenge. First, additional sensors to read transponders could be installed to improve the accuracy and decrease the latency of time estimates. Second, minor methodological improvements could be made to the through truck filter that could improve its accuracy to identify through vehicles. Third, additional work could be done to improve the method to relate truck travel times to cars. Advances in traffic monitoring technologies such as cell phone, navigation devices, vehicle-to-vehicle, vehicle-to-infrastructure, and in particular Media Access Control (MAC) address matching may prove to be more suitable for providing real-time traveler information.

The project also demonstrated that additional freight performance measures could be developed, especially for the use of the weight data to track corridor production and consumption.

Oregon Department of Transportation
Research Section
200 Hawthorne Ave. SE, Suite B-240
Salem, OR 97301-5192
Telephone: 503-986-2700
FAX: 503-986-2844

For more information, contact Amanda Pietz at (503) 986-2848,
or via e-mail at *Amanda.Pietz@odot.state.or.us*

The final report for this project was published in August 2009 and is available on the Research Section web page:
http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/2009/Truck_Travel_Time.pdf