Extracting Freight Corridor Performance from Weigh-in-Motion Data

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Objectives

• Retrospectively study truck transponder data in key corridors to determine the feasibility of producing freight corridor performance measures.

• Demonstrate other freight performance measures.
Motivation

Using Federal Highway Administration (FHWA) / American Transportation Research Institute (ATRI) proprietary truck satellite data.
Data Almanac

- 22 reporting WIM sites in Oregon
  - All upstream of fixed weigh stations
  - All are CVISN sites
- PSU WIM Data Archive
  - Part of our PORTAL project
  - April 2005 – February 2009
    - 41,534,800 + trucks
  - Data quality
    - Intermittent data outages and problems
    - Focus of other research project
Weigh-in-Motion

• Single load cells
• Sensors weigh vehicles traveling at normal highway speeds
• Weight measurement affected by many factors
  – Site characteristics
  – Environmental factors
  – Truck dynamics
Weigh-in-Motion

- These WIM sites provide:
  - Axle weights
  - Gross vehicle weight
  - Axle spacing
  - Vehicle class
  - Bumper-to-bumper length
  - Speed
  - Unique transponder numbers

J. Lane, Briefing to American Association of State Highway and Transportation Officials (AASHTO), 22 February 2008
freight.transportation.org/doc/hwy/dc08/scoht_cvisn.ppt
Estimating Corridor Performance

- 2007-2008 WIM data
- Matching transponders
- Filtering through trucks
- Results
Defining Links

• At each station, find all possible downstream stations
• Calculate shortest path between stations
• Three categories
  – Primary
    • Route certain, one highway
  – Secondary
    • Route certain, more than 1 highway
  – Tertiary
    • Route uncertain
Primary – I-5NB, ASP to BOR
Secondary – US-97 NB, KFP to LWL
Tertiary – ?, ASP to BND
Tertiary – ?, ASP to BND
I-84 WB, FWB to EMH

Free flow travel time =
Distance / 55 mph =
126.4 mi / 55 mph = 2.3 hrs

Search window =
2.3 * .75 = 1.7 hrs (74 mph)
2.3 * 2 = 4.6 hrs (27 mph)
All Matched Trucks in Time Window
Filter Algorithm

- For each truck $j$ traveling on link $i$ determine the estimated travel time, $t_{j,i}$.
  - If the travel time $t_{j,i}$ is less than the free-flow time $ff_{j,i}$, denote this truck as a through truck.
  - If the travel time $t_{j,i}$ is less than the upper travel time $ut_{j,i}$ (defined as an average travel time of 50 mph).
  - Find the median travel time $mt_{j,i}$ in the sample of $X$ previous truck observations and compare that to $t_{j,i}$. If $t_{j,i}$ does not exceed $mt_{j,i}$ by a threshold of $Y$, truck $j$ is assumed to be a through vehicle.
- If none of the above criteria are met, the $t_{j,i}$ is excluded (i.e., $j$ is not a through truck).
Filtered Trucks (Green)
Through Trucks Only
I-84 WB, FWB to EMH

Pendleton NOAA
El 1493 ft

Ladd Summit RWIS
El 3619 ft
Through Trucks and Temperature
Through Trucks and Rel. Humidity
Through Trucks and Weather Type
I-84 WB, FWB to EMH, August 07
I-84 WB, FWB to EMH, Aug 07

[Graph showing data distribution over time]

Portland State University
I-84WB, Average Link Speed, by Day

Average Speed, mph

2007 2008 2009
Average Link Speed, by month
Results

\[ \text{min 1000 obs} \]
I-84 EB, LGR to ODF
Results

**Average Speed, mph**

- **205: WYT to WDS**
- **217: WDN to CSL**
- **221: WDS to KFS**
- **223: BRE to JBS**
- **229: LWL to WDN**
- **234: KFP to LWL**
- **237: JBN to BRW**

*min 500 obs*
US-97 NB, KFP to LWL
Other Freight Performance Measures

• Using the matched trucks
  – Estimated Freight Activity on Corridor
  – Freight Patterns
  – Ton Miles
  – Emissions

• Assume trucks with transponders are the same as those without
Freight Activity

227: JBS to KFS
Five-Axle Trucks, 2007 Reported Data

- Trucks Increasing Wt
- Trucks Decreasing Wt
- Difference

Cumulative Weight (kips, thousands)

Month

Number of observations = 25888

DRAFT, Portland State University, PORTAL WIM Archive, Data by ODOT Motor Carrier
Freight Activity

217 : WDN to CSL
Five-Axle Trucks, 2007 Reported Data

- Trucks Increasing Wt
- Trucks Decreasing Wt
- Difference

Cumulative Weight (kips, thousands)

Month

Production

About 3200 more truckloads produced

Consumption
Conclusions

• Procedure developed to obtain, process, load data in archive, match, and filter
  – Need to develop automated method to address data quality
• Performance monitoring
  – Average speed and other measures promising
  – Method established
  – Expandable
Acknowledgments

• Oregon Transportation Research and Education Consortium

• Oregon Department of Transportation
  – Amanda Pietz, Dave Fifer, Don Crownower, Amy Mastraccio, Becky Knudsen, Michael Buffalino

• Portland State University
  – Kristin Tufte, Michael Wolfe, Heba Alawakiel, Maisha Mahmud
Questions?

Thank You!
www.its.pdx.edu