Defining and Quantifying Rural Congestion

Mandar Khanal

2011 NRITS Conference
Coeur d’Alene, ID

August 31, 2011
Congestion Sources

- Other (10%)
- Work Zones (10%)
- Weather (15%)
- Traffic Incidents (25%)
- Capacity (40%)
Study Focus

Two-lane roads away from intersections

Operating Characteristics:
1. Volume
2. Traffic Mix
3. Speed Limit

Roadway Geometry

Access Density
Measuring Congestion

- Mean Time
- Planning Time (95th Percentile)
- Buffer Index (% of MT)
Data Collection Technology

Bluetooth Technology by Traffax Inc.

Bluetooth Sensors

2 miles

Time = 8:05:58 AM

Bluetooth Signal *
Time = 8:03:26 AM

Travel Time = 2:32 Minutes
Speed = 51.7 MPH

* Bluetooth signals come from cell phones, PDAs, laptops, GPS, car radios...
** Provisional patent received
Segment Selection

1 Road In Each District

2 Consecutive Segments
Control environment, land use, traffic

Short Segments
Control of Geometry

Close to ITD’s ATRs
(Automatic Traffic Recorders)
US 20

Near Ashton, ID
Travel Times – US 20

![Travel Time Distribution Graph]

- **Frequency**
- **Cumulative %**
- **Min Travel Time**

**Travel Time (min/mile):**

0.74, 0.79, 0.84, 0.88, 0.93, 0.98, 1.02, 1.07, 1.11, 1.16, 1.21

**Frequency:**

0, 50, 100, 150, 200, 250, 300, 350, 400

**Cumulative %:**

0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%
Weekday Volume – SH 55

Weekday Average

Time of Day

Vehicle per 15 min

ASCENDING

DESCENDING

Free Flow Cutoff
Travel Times – SH 55

![Graph showing travel times](image)

- Frequency bars for different travel time intervals (0.88 to 1.72 min/mile).
- Cumulative percentage line indicating the percentage of travel times.
- Min travel time points marked on the graph.
Congestion Measures – US 20

Weekday Average - 65 mph Speed Limit

- Minutes/Mile
- Time of Day
- Average 30 minute Volume

- Passenger Volume
- Long Vehicle Volume
- Mean
- Planning Time
Model attempts fits to PT with 4 variables

- **None** of the 4 variables were significant predictors of PT
- Likely reasons:
  - Volumes are too low
  - PT variations are minimal
- Using data from nearby Automated Traffic Recorders can give misleading results
Model attempts fits to Congestion Measures with 4 variables

- Largest predictor of MT is 1 (cars on your side), but explains only 16.4%

- Largest predictor of PT is 2 (large vehicles on your side), but only 6.5%

- So there must be other more influential factors
Geometric Model – US 20

8 Geometric Variables

- 3 Grade Variables
- 2 Curve Variables (# right, # left)
- # of right access points
- # of left access points
- Presence of extra lane

**Results**

- MT **89%** inversely dependent on # of left access points
- PT **96%** inversely dependent on # of left access points
- Interaction of Extra lane and left access points
8 Geometric Variables

- 3 Grade Variables
- 2 Curve Variables (# right, # left)
- # of right access points
- # of left access points
- Presence of extra lane

Results
- PT 75% dependent on extra lane
- BI 86% dependent on extra lane
- Both PT and BI are reduced
Geometric Model – Statewide

Results

• MT **83%** dependent on speed limits and # of right access points
• 60 mph and 65 mph **reduced** MT
• # of right access points **increased** MT but the increase was very small

• 2 segments on US89: variable speed limits
• 6 segments: 60 mph
• 14 segments: 65 mph & 55 mph
Take Aways

Thorough modeling of congestion sources allows the state to make more quantitative decisions on highway design improvements.

Current volumes on Idaho rural roads have less effect on travel times relative to geometric characteristics and speed limits.

Portable Bluetooth readers are an effective tool to collect travel time data on rural roads.

Volume data must be taken in the study segment for accurate modeling.
## Acknowledgements

**Project Sponsor**
Idaho Transportation Department (ITD)

**Project Management**
Bob Koeberlein, ITD

**Data Collection**
Scott Fugit, ITD

**Research Assistants**
Greg Taddicken, Boise State University
Will Thornton, Boise State University