Use Big Data and Modeling Tools To Decipher Traffic Patterns: Case Studies in Virginia
Agenda

- Need for O-D Data
- O-D Data Collection – A Primer
- Big Data and StreetLight Data
- Use Modeling Tool for O-D Estimation
- Applications in Transportation Planning
- Lessons Learned and Future Research
# Need for O-D Data

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<th>Performance Metrics</th>
<th>Why of Interest?</th>
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<td>Point-to-point traffic flow patterns</td>
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<td>Zonal activities</td>
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<td>Select link analysis</td>
<td>Determine origins and destinations</td>
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O-D Data Collection

Field-Collected Data
- Bluetooth, License Plate Recognition
- Customized approach, expensive limited samples

Regional Model
- Less validation on routes and peak hours
- Good for developing growth rates

Big Data
- StreetLight, AirSage, TomTom
- Covers longer time periods, large data set, analytics
# O-D Data Comparison

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<th>StreetLight Data</th>
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<td>O-D routes, speed</td>
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StreetLight Data

1. Process geospatial data points with contextual info
2. Normalize the trips and aggregate the trips into analytics
3. Users apply analytics to infer key trends

Use Navigational GPS (INRIX) and Location-Based Services Data
Integrate Big Data with Modeling Tools

- Validation, monitoring, and prediction
- Regional travel demand models
  - O-D and speed validation
  - External and through traffic estimation
  - Freight analysis
- Traffic simulation and mesoscopic models
  - Route level O-Ds
  - Travel times and speeds
Overview of Modeling Process

- VISSIM
- CORSIM
- SimTraffic

- VISUM
- Dynameq
- DTALite

- TransCAD Cube
- VISUM

- Corridor or Intersection Simulation

- Subarea or Corridor Model

- Regional Model
**VISUM ODME Process**

- **Matrix correction:** adjusting a demand matrix so that assignment results match target conditions

**O-D Data Source**
- StreetLight Data

**Demand Matrix**

**VISUM**

**Assignment TFlowFuzzy**

**O-D Routes**
- Export to VISSIM

ODME: Origin-Destination Matrix Estimation
Case Studies of O-D Data Applications in Planning

- Freeway Corridor O-D Estimation (I-95 Corridor, Chesterfield County and Richmond)
- Traffic Flow Patterns at a Weaving Area (STARS Route 7, Loudoun County)
- Understand Traffic Patterns (Fairfax County)
Case 1: I-95 Corridor

- I-95 in Chesterfield County and Richmond, VA
- 13 miles, 9 interchanges, 55 ramps, and 23 intersections (including 2 IMRs)

Purpose and need
- Understand existing traffic operations
- Use model for existing and future studies
StreetLight Data

- Users establish desired origin and destination zones to evaluate travel patterns
StreetLight Data - Outputs

- Downloadable OD tables for personal (cars) and commercial (trucks) trip index

- Data example
  - 13-mile segment of I-95; 7 interchanges
  - 2015 data; average weekday (M-Th)

20,444 data points!

How do we manipulate this data to get O-Ds for peak hour trips?
# StreetLight Data Processing

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Trip Index of Each O-D Pair
StreetLight Data – Overall Process

1. Create trip index O-D matrix based on raw StreetLight data
2. Review matrix for feasibility and reasonableness (remove unlikely O-D pairs)
3. Convert to percentage O-D table (% of each origin to each destination)
4. Combine with target volumes at origins
5. Import seeding table into VISUM

Complete process separately for car and truck results
O-D Matrix Reasonableness

- Traffic volume targets
- Local travel patterns
- Trip length distributions

**Between Interchanges and Route 288**
- 1-2 miles

**Chippenham Parkway to North and South**
- 7-8 miles

**I-95 Through Traffic**
- 13-14 miles

![Diagram showing travel patterns and trip lengths](chart)
Case 2: Route 7 Weaving – Loudoun County and Leesburg

- Heavy traffic congestion at weave area
- >2 mile queue on northbound Dulles Greenway (Route 267) in PM
Lessons Learned

- Capture rate
  - ALPR: 40% to 60%
  - Bluetooth: 8%
  - StreetLight Data: to be determined

- Data results more consistent between ALPR and Bluetooth, but comparable among the three methods

- Evaluation underway by VDOT/VRTC

- A solid understanding of weaving patterns helps identify issues
Case 3: Study Traffic Patterns in Fairfax County

- Cut-through traffic
- Origin-Midpoint-Destination (O-M-D) from StreetLight Data
- Visualize select link analysis

Legend:
- Origin Zone
- Destination Zone
- Zone ID Number
- Lawnsville Road Select Link (Westbound Direction)
- O-M-D Midpoint Roadway Analysis Segment
- Direction of flow through Midpoint Segment
- Percentage of peak hour flow from Midpoint Segment
- Peak Hour Volume Through Directional Midpoint Segment
StreetLight Midpoint Filter Zone

- Allows for evaluation of traffic movements through specific intersections or segments
  - Directional
  - O-M-D for each feasible combination
Integrate StreetLight Data to VISUM
Fine-Tune Visualization in GIS

- Select link analysis example with percentage distribution from midpoint zone of interest
Summary and Future Research

- Understand the strengths and weakness/limitations of each data type
  - Reasonableness check
  - Defendable process (qualitative vs. quantitative)
- At scoping meeting, establish data needs
  - Field data
  - Supplemented by big data
  - Approvable assumptions
- Decipher the results
- Big data is evolving
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<th>Contact Us</th>
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<tr>
<td><strong>MARK HERMAN, EIT</strong></td>
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<td><a href="mailto:mark.herman@kimley-horn.com">mark.herman@kimley-horn.com</a></td>
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<td><a href="mailto:jiaxin.tong@kimley-horn.com">jiaxin.tong@kimley-horn.com</a></td>
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