The I-84 Hartford Project

Implementation of Traffic Data in Model Development

WTS/ite Transportation Mini-Series

October 10, 2013
Agenda

• About I-84 Hartford Project
  Tom Maziarz, CTDOT

• Traffic Data Collection Methods Used for I-84
  Dave Stahnke, TranSystems

• Use of INRIX Data
  Pete Costello, INRIX

• Use of Traffic Data in Model Development
  Keir Opie, Cambridge Systematics
About I-84 Hartford Project?
Where is the Project?

- Study area and project limits still being defined
- Traffic analysis from Flatbush Avenue to I-91
- Impact analysis area fluctuates for each resource
What is the Project?

Mission:
• With active engagement of the public, to evaluate all reasonable options for the replacement of this section of I-84 through Hartford and to build the resulting project.

Phases:
I. Data collection and analysis
II. Development of design alternatives
III. Environmental documentation
IV. Design
V. Construction
Why Do We Need It?

- Viaduct is 50 years old
- Poor condition overall
- Currently 80% of project is elevated (30 acres)
- Maintenance costs are very high
Why Do We Need It?

- Busiest stretch of highway in Connecticut
  - 55,000 vehicles/day (1975)
  - 175,000 vehicles/day (2013)
- Travel delays due to...
  - Congestion
  - Accidents
  - Maintenance
Why Do We Need It?

• Obsolete design
  – Many on & off ramps
    • Some left-hand ramps
    • Close spacing
    • Merging & weaving
• Frequent accidents
  – Average of 1 daily
Opportunities

• Economic development
• Neighborhood connectivity
• Enhanced mobility
  – Bicycle
  – Pedestrian
  – Transit
  – Vehicular
• Synergies with other regional, state, and local projects
Many interrelated efforts to be coordinated:

- Engineering analysis
- Assessment of travel needs
- Alternatives analysis
- Environmental impact evaluation
- Project funding investigations
- Possible relocation of railroad through Hartford
Traffic Data Collection
Methods used for I-84
Traffic Data Collection Scope

- Traffic Counts
- Field Observations
- Vehicle License Plate Survey
- Travel Time Data – Inrix
- Travel Patterns – Skycomp & AirSage (Origin & Destination)
- Queue Lengths – Skycomp
- Truck Patterns
- Traffic Signal Data
- Accident Data
Traffic Data Collection

Traffic Counts

- Turning Movement Counts – Peak Period
  - Video Cameras
  - 61 Locations

- Automatic Traffic Recorder Counts – 24 Hour
  - 105 Locations
Skycomp By "WAV" – Wide Area Aerial Video

Wednesday, Nov 14, 2012
7:30 – 9:00AM and 3:00 – 4:30PM
Skycomp "WAV" – Wide Area Aerial Video
One Camera Configuration

1.75 miles

1.25 miles

1.75 miles
Assigned Field-Of-View (FOV) Of Center Camera “C” (Aboard Helicopter 2)
Camera C View (North is “Up”)
Assigned FOV’s Of Three Western Cameras G, A, B (Aboard Helicopter 1)
Assigned FOV’s Of Three Eastern Cameras D, E, F (Aboard Helicopter 3)
Required Integration of Simultaneous Ground Cameras
Ground Camera View (East of Tunnel Entrance)
Maximum “Zoom” Before Entering The Tunnel
Maximum “Zoom” After Existing The Tunnel
Paste-Up Board, 7 Cameras at One Instant
5,400 AM + 5,400 PM Paste-Up Boards Were Produced
West Overlay Codes VIC. Asylum Ave./St.
Findings/Deliverables

- Volume Table
- O-D Tables
- I-84 Mainline Congested Zones
- I-84 Exit Ramp Queuing
- Video Clips
- Methodology Summary Report
### Volume Tables

- **I-84 Entrance Ramps & Mainline Entry Points**
- **15 Minute Sets by Class; 90 Minute Periods**
- **Linked to O-D Tables**
### Table A-3: Allocation of Origin Volumes to Destinations

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<tr>
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</tr>
</tbody>
</table>

**EXPECTED DESTINATION VOLUME**

| 253 | 721 | 493 | 350 | 196 | 113 | 13 | 40 | 56 | 183 | 378 | 985 | 1294 | 661 | 326 | 1586 | 351 | 276 | 249 |
### I-84 Mainline Congestion (Westbound) - Morning

<table>
<thead>
<tr>
<th>Time</th>
<th>Direction</th>
<th>From</th>
<th>To</th>
<th>Distance (miles)</th>
<th>Est. Speed (mph)</th>
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</thead>
<tbody>
<tr>
<td>7:30 a.m.</td>
<td>Westbound</td>
<td>Governor St NB exit ramp</td>
<td>I-91 NB exit ramp</td>
<td>1.0</td>
<td>20-30</td>
</tr>
<tr>
<td>7:30 a.m.</td>
<td>Westbound</td>
<td>Tunnel exit</td>
<td>Walnut St entrance ramp</td>
<td>0.3</td>
<td>20-30</td>
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<tr>
<td>7:45 a.m.</td>
<td>Westbound</td>
<td>Main St (US 5)</td>
<td>Connecticut Blvd entrance ramp</td>
<td>1.0</td>
<td>10-20</td>
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<tr>
<td>7:45 a.m.</td>
<td>Westbound</td>
<td>Connecticut Blvd entrance ramp</td>
<td>I-91 NB exit ramp</td>
<td>0.3</td>
<td>20-30</td>
</tr>
<tr>
<td>7:45 a.m.</td>
<td>Westbound</td>
<td>Tunnel exit</td>
<td>Walnut St entrance ramp</td>
<td>0.3</td>
<td>30-40</td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td>Westbound</td>
<td>Main St (US 5)</td>
<td>Connecticut Blvd entrance ramp</td>
<td>1.0</td>
<td>10-20</td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td>Westbound</td>
<td>Connecticut Blvd entrance ramp</td>
<td>I-91 NB exit ramp</td>
<td>0.3</td>
<td>30-40</td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td>Westbound</td>
<td>Tunnel exit</td>
<td>Walnut St entrance ramp</td>
<td>0.3</td>
<td>30-40</td>
</tr>
<tr>
<td>8:15 a.m.</td>
<td>Westbound</td>
<td>Governor St NB exit ramp</td>
<td>Connecticut Blvd entrance ramp</td>
<td>0.8</td>
<td>10-20</td>
</tr>
<tr>
<td>8:15 a.m.</td>
<td>Westbound</td>
<td>Connecticut Blvd entrance ramp</td>
<td>I-91 NB exit ramp</td>
<td>0.3</td>
<td>30-40</td>
</tr>
<tr>
<td>8:15 a.m.</td>
<td>Westbound</td>
<td>Tunnel exit</td>
<td>Walnut St entrance ramp</td>
<td>0.3</td>
<td>30-40</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>Westbound</td>
<td>Governor St NB overpass</td>
<td>Connecticut Blvd entrance ramp</td>
<td>0.6</td>
<td>10-20</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>Westbound</td>
<td>Connecticut Blvd entrance ramp</td>
<td>I-91 NB exit ramp</td>
<td>0.3</td>
<td>30-40</td>
</tr>
<tr>
<td>8:45 a.m.</td>
<td>Westbound</td>
<td>Governor St SB entrance ramp</td>
<td>I-91 NB exit ramp</td>
<td>0.6</td>
<td>30-40</td>
</tr>
</tbody>
</table>

Note: No westbound congestion (< 40 mph) at 9:00 a.m.
# Morning Exit Ramp Queues

<table>
<thead>
<tr>
<th>Time (Photo)</th>
<th>Location</th>
<th>Queue</th>
<th>Direction</th>
<th>Queue Length (feet)</th>
<th>Note</th>
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<tbody>
<tr>
<td>7:35:00</td>
<td>Sigourney St</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>400</td>
<td></td>
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<tr>
<td>7:55:00</td>
<td>Sigourney St</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>1300</td>
<td></td>
</tr>
<tr>
<td>8:10:00</td>
<td>Sigourney St</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>600</td>
<td>The ramp queue extended back into the right lane on I-84</td>
</tr>
<tr>
<td>7:40:00</td>
<td>Asylum Ave</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>1800</td>
<td>The ramp queue extended back into the right lane on I-84</td>
</tr>
<tr>
<td>7:45:00</td>
<td>Asylum Ave</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>2300</td>
<td>The ramp queue extended back into the right lane on I-84</td>
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<tr>
<td>7:50:00</td>
<td>Asylum Ave</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>1300</td>
<td>The ramp queue extended back into the right lane on I-84</td>
</tr>
<tr>
<td>7:55:00</td>
<td>Asylum Ave</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>2350</td>
<td>The ramp queue extended back into the right lane on I-84</td>
</tr>
<tr>
<td>8:00:00</td>
<td>Asylum Ave</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>1300</td>
<td>The ramp queue extended back into the right lane on I-84</td>
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<tr>
<td>8:05:00</td>
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<td>Westbound</td>
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<td>8:10:00</td>
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<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>2050</td>
<td>The ramp queue extended back into the right lane on I-84</td>
</tr>
<tr>
<td>8:15:00</td>
<td>Asylum Ave</td>
<td>I-84 exit ramp (right lane)</td>
<td>Westbound</td>
<td>2300</td>
<td>The ramp queue extended back into the right lane on I-84</td>
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<tr>
<td>8:20:00</td>
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<td>I-84 exit ramp (right lane)</td>
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<td>Westbound</td>
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<tr>
<td>7:35:00</td>
<td>SR 2</td>
<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>1050</td>
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<tr>
<td>7:45:00</td>
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<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>1300</td>
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</tr>
<tr>
<td>7:50:00</td>
<td>SR 2</td>
<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>2200</td>
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<tr>
<td>7:55:00</td>
<td>SR 2</td>
<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>2200</td>
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<tr>
<td>8:00:00</td>
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<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>2300</td>
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<tr>
<td>8:05:00</td>
<td>SR 2</td>
<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>2300</td>
<td></td>
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<tr>
<td>8:10:00</td>
<td>SR 2</td>
<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>2300</td>
<td></td>
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<tr>
<td>8:15:00</td>
<td>SR 2</td>
<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>2300</td>
<td></td>
</tr>
<tr>
<td>8:20:00</td>
<td>SR 2</td>
<td>I-84 entrance ramp (from NB SR 2)</td>
<td>Westbound</td>
<td>2300</td>
<td>(cleared quickly / gone by 8:25 a.m.)</td>
</tr>
</tbody>
</table>
GPS/Cell Phone Based Traffic Data

- INRIX – Real Time and Historic Travel Speed/Travel Time Data
- AirSage – Origin and Destination Analysis
  - Confidential and Proprietary
  - Specifically Developed Software
- TranSystems Has License Agreements with Both Firms
The I-84 Hartford Project

Use of INRIX DATA
Traffic Data in Connecticut and around the World

October 10, 2013
Introduction – Pete Costello

• Since 2008: INRIX – Director Business Development, Public Sector covering the Americas

• Starting in 2002: PBS&J (now ATKINS) – ITS Group Manager
  ▪ Supported AASHTO’s 511 Deployment Coalition and North Carolina 511 Project Manager

• Starting in 1998: ITS America – Director, Telematics & Special Projects
  ▪ Including traffic management, traveler information, public transit, rural ITS, electronic payment systems, etc.
The INRIX Traffic Intelligence Platform

Massive input data
- Mobile data
- Incident data
- Road sensors
- Weather data
- Consumer vehicle GPS data
- Historical traffic data
- Fleet data
- Event data
- Parking data
- Historical traffic data
- Big data
- Event data

Technology Platform
- Predictive
- Real-time
- Big data
- Analytics
- Crowd tech
- Cloud-based

Products & Optimized Solutions
- Ubiquitous
- Accurate
- Predictive
- Actionable
Crowdsourced with Fleets

- Long Haul Trucks
- Local Sales, Service & Delivery
- Taxis
- Airport Shuttles
Crowdsourcing: Free Apps – starting 2009

Available on the App Store
Download for Android
Download for Windows Phone
BlackBerry 6.0

www.inrixtraffic.com

Windows 8

INRIX
The leading provider of traffic & navigation services

TRUSTe
Crowdsource with Connected Devices and Vehicles
Proven Automotive Grade Connected Solutions

INRIX

TRAFFIC
ROUTING
APPS
HOSTING

Single Platform
Single Interface
Single Protocol
Globally

Many service providers are struggling to deliver, but INRIX is on its second generation of auto/carrier-grade connected services.
GPS Probe Points – June 2013
Coverage – North America

- 950,000+ roadway miles
Coverage – Connecticut

• 4,243 Centerline Miles
Real-Time & Predictive Traffic Flow

- Road segment by road segment, INRIX provides:
  - Segment information (code, road name, cross streets, direction, length)
  - Speed information (current speed, typical speed, free flow speed)
  - Travel time (in minutes through segment)
  - Congestion level (percentage of free flow)
  - Predictive traffic (speed and congestion forecast in 15 minute increments)
Analytics: Connecticut Bottlenecks

I-95 @ CT-25/CT-8/EXIT 27
Analytics: Connecticut Bottlenecks

I-84W @ CT-71 NEW BRITAIN AVE/EXIT 40
## September, 2013

#### I-95

**Analytics: Connecticut User Delay**

**Warning:** The volume data used to generate this report may not be precise enough for your analysis. [Read more...](#)

**Report parameters**
- **Vehicle costs**
  - 2013 - Passenger: $16.79 Commercial: $86.81
  - Percentage of vehicle
    - Passenger: 75%
    - Commercial: 25%
- Delay calculated against the freeflow speed for segments whose speeds fall 20 mph or more below freeflow.

### Vehicle Type

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### Total Cost

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[15]
Analytics: Connecticut User Delay

Fri Sep 20 2013 17:00:00

Delay cost:
- Total: $232,461.56
- Per vehicle: $67.76
- Per person: $57.06

Hours of delay:
- Person-hours: 7,372.46 hours
- Vehicle-hours: 6,208.39 hours
- Per vehicle: 1.81 hours

Volume:
- Passenger: 2147 vph
- Commercial: 715 vph

Data validity: 100.00%

Click the table cell to see links to congestion scans.

Grand Total
- $15,286,511.96
INRIX Smart Driver Network

Cellular network data in some countries

GPS Vehicle Probe
Mobile / Smartphone Probe
User Generated Report
Road Sensor
Traffic Camera
Incident
Construction
Event
How can we help Connecticut DOT with its mission to provide a safe, efficient, and cost-effective transportation system that meets the mobility needs of its users?

Pete Costello pete@inrix.com (202) 550-5795
www.linkedin.com/in/petecostello
The I-84 Hartford Project

Use of Traffic Data in Model Development
Big Data Supporting I-84 Modeling Efforts

Presented to:

7th Annual WTS & ITE Transportation Mini-Series

Presented by:

10/10/2013

Keir Opie, Cambridge Systematics

Transportation leadership you can trust.
I-84 Modeling Efforts

• Regional Travel Demand modeling
  – Update of CRCOG Time of Day model

• Operations simulation of immediate influence area
  – Freeway & Arterials
I-84 Hartford Simulation Study Limits

- Extraction from the CRCOG TOD model
- 3 hour peak periods
- Details:
  - TransModeler Microscopic (Dynamic route choice)
  - Freeway and Arterial congestion focus
  - Include alternative route paths
  - SOV, HOV, & Trucks trip tables
Microscopic Details
Calibration Requirements

• Simulation is Data Hungry
• Must calibrate model to validate:
  – Volumes (constrained flow)
  – Origin Destination (OD) Demands
  – Route Choices
  – Congested operations (speeds, queues, travel times)
Data Sources

• Volumes: Traditional Counts
  – CT DOT count stations
  – Turning movement counts
  – ATR (Tube & Radar counts)

• Speed: INRIX

• Airsage: Regional OD travel patterns

• Skycomp: Queues, local ODs, operations details
INRIX Data

- 2012 Data
- Five minute bins of observed speeds under recurring congestion
- 514 TMC links available in study area
  - Freeway & Arterials
- Estimates of free-flow speed conditions (speed at off peak hours)
Detail of TMC links on I-84

- Overlapping TMC links
- Selection of TMC links to best replicate ‘sensor’ locations
Filtering to ‘Typical’ Days

- Excluded:
  - Sun, Mon, Fri, Sat
  - Inclement weather days (snow or heavy rain)
  - Seasonal outliers (Jan, Jul, Aug, Nov, Dec)
  - Incident or non-recurring events
    - Statistical identification of outliers from mean
    - Entire days with > 20 outlier bins
- Summarize AM and PM peak periods
Speed Profiles: I-84 WB (AM)
Speed Profiles: I-84 EB (AM)
Speed Profiles: I-84 WB (PM)
Speed Profiles: I-84 EB (PM)
Data Tells Us…

- Bottleneck Location and severity
- Duration of congestion
- Extents of queues
- Free-Flow conditions
Model Validation

- Bottleneck location, severity, and duration
- Model replication of observed conditions

(NOTE: Calibration not yet finalized)
Use on Arterials

- Spans multiple blocks
- Not always in line with intersections
- Coverage not complete
- Signal Delays included
TMC Links (Downtown)
Arterial Speeds

- Relative Observed Speeds (Observed / Free Flow Speed)
  - 6:00 – 9:00 AM (1 frame = 15 minutes)
AirSage Travel Patterns

• Provides OD travel patterns based on cell phone data (anonymous)
  – Scaled to represent entire population
• More regional OD travel patterns
• Very useful in calibrating & validating Travel Demand models
AirSage Zones for ODs
Skycomp Imagery

• Aerial Surveillance of Study area

• Pros & Cons:
  – Pros:
    • Comprehensive details of area wide operations and network impacts
    • Hard data extraction
  – Cons:
    • Single day observation
    • Can be expensive
Skycomp Methods

- Helicopter(s) hover in place and capture image every second
- Align imagery for each view
- Data Extraction process
  - Establish limits of capture (portals to study area)
  - Sample vehicles on entry/exit/roadway
  - Trace each vehicle through imagery to establish movement patterns
Skycomp Capture Areas
Data Extraction (I-84 ODs)

-Observed Local OD Patterns (7:30-9:00 AM)
Questions?

• Contact Info:
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  Cambridge Systematics
  New York, NY
  kopie@camsys.com
  (212) 209-6640