Western Traffic Data Workshop: Successful Strategies in Data Collection for Corridors and Planning

Assembling Quality Traffic Data

presented by
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Cambridge Systematics, Inc.

Transportation leadership you can trust.

April 10, 2008
What is driving the need for high quality, properly assembled traffic data?

Traffic Data Trends

Assembling Quality Traffic Data – What do we mean?

Assemble Quality Traffic Data
National Drivers/Trends

- Congestion
- Safety
- Finance
- Environmental
- Accountability
- Private sector
- SAFETEA-LU Reauthorization
Let's look at what's happening in our world today
Alan Pisarski – April 2008

- Finance
- The System
- The broader world
What’s happening in our world

**Finance**

- **Trust Fund Insolvency**
  - Fuel costs
  - VMT stagnant
  - Feds/States “can’t touch gas tax”

- **Other Pressures**
  - Inflation
  - New alternatives

- **Public Private Partnerships threats and opportunities**
What’s happening in our world

The System

- Congestion
- Infrastructure gaps and weaknesses
- Major Reconstruction looming; both highways and transit
- Safety concerns
- Global Warming Threats to system
What’s happening
In the broader world

- Competition for resources in the world
- International economic competition
- Nationalized oil/gas as weapons
- Housing market collapse
- Recession coming/here?
What role does data play in these?

**CREDIBILITY**  Quality Info is the anti-arbitrary route to credibility

**VISION**  Vision is enhanced and supported

**PLANNING**  Data are the basis for all serious plans

**FINANCE**  Finance needs and justification must be data based
Opportunities – they do exist!

- All new ideas are very data intensive
  - B/C
  - Performance Driven
  - GHG, etc
  - Public/Private Tolling/Pricing
  - Infrastructure renewal
  - Transportation and ???

- Can we capitalize on this reality?
State Drivers/Trends

- Caltrans Corridors approach
- Florida Operations Approach
- State Data Business Plans
Governor Arnold Schwarzenegger’s Strategic Growth Plan: *Transportation Investments for Mobility*, September 2006.
Caltrans Corridor Systems Management Plans (CSMP)

- Spawned by recent legislation
- Three CSMP projects currently are underway for north, south, and statewide corridors
- Data needs are overwhelming, other data hungry initiatives
  - Accountability Executive Order
  - Transportation Management System (TMS) Master Plan,
  - Smart Corridors, Integrated Corridor Management,
    Integrated Corridor Mobility
  - Major Investment Studies (MIS)
- Data Framework For Freeway Corridor Performance
The 21st Century Operations Oriented State DOT
The Premise
Transportation Future

- Auto transportation will remain dominant
- Highway delay, unreliability and crashes are increasing
- Capacity expansion is constrained
- New capacity does not directly respond to many of the major sources of delay
An Operations Oriented DOT

- Focuses on
  - Real time
  - Customers
  - Mobility and Safety

- They are
  - Proactive
  - Aggressive
  - Integrated
  - Automated
The Cost of Congestion

- In 2004 the cost of congestion was $73.1 billion
- In 2005 congestion cost about $78.2 billion
- The average cost per traveler was $707 in 2005, up from $680 in 2004
- The cost ranged from $1,041 per traveler in very large urban areas down to $318 per traveler in small areas.
The Cost of Congestion

Annual Cost (billions of 2005$)

- Other
- Small
- Medium
- Large
- Very Large

Year
- 1982
- 1985
- 1988
- 1991
- 1994
- 1997
- 2000
- 2003
### Key Institutional Transformations

<table>
<thead>
<tr>
<th>20TH CENTURY DOT</th>
<th>21ST CENTURY DOT</th>
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<tbody>
<tr>
<td><strong>Infrastructure Developer</strong></td>
<td><strong>Service Provider</strong></td>
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<tr>
<td>Relationship of delay / safety to operations not clear</td>
<td>Leverage of SOM understood by agency and stakeholders</td>
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<tr>
<td>Limited performance accountability</td>
<td>Districts accountable to top management for performance</td>
</tr>
<tr>
<td>Priority to capacity and preservation</td>
<td><strong>Planning &amp; Programming</strong></td>
</tr>
<tr>
<td>Jurisdictional focus</td>
<td><strong>Agency Role With Partners</strong></td>
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<tr>
<td>Focused on output: on time/on budget</td>
<td><strong>Measures of Effectiveness</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Focused on performance outcomes</strong></td>
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State DOTs – Moving to Operations Oriented

- Making adjustments in policy, programs, roles & responsibilities and commitment
- Becoming serious about performance measures
  - Link to business plans
- Mainstreaming Operations
  - Funding categories
  - Decisions based on performance measures
State DOTs – Moving to Operations Oriented

- Taking the data seriously
  - Resource allocation for real time data collection, assessment and dissemination
- Staying on top of and ahead of Technology
- Continuing with private/public partnerships
State Traffic Data Business Plans

- Transportation agencies have recognized that traffic data programs support a growing variety of functions within their agencies

- Potential for conflicting requests from a variety of customers as well as competing needs for more, higher quality traffic data

- Needs must be balanced against available resources to implement the traffic data program

- An approach to systematically identify all existing and future customer needs and make recommendations as to how to balance these needs with available resources is being used by many agencies
Alaska ADOT&PF
Outline

10,000 Foot View – What is driving the need for high quality, properly assembled traffic data?
  - National
  - State
  - Metropolitan

Traffic Data Trends

Assembling Quality Traffic Data – What do we mean?
  - Assemble
  - Quality
  - Traffic
  - Data
Travel Monitoring Survey
Summarizing the Results and Final Report

Contact
Elizabeth Stolz
Traffic Analysis Unit Manager
Colorado Department of Transportation
The Survey

- **Purpose** – To learn more about managing traffic data programs
- **Questions developed together by CDOT and FHWA**
- **Available On-line – Survey Monkey Tool**
- **31 Questions Total, Organized by Short-duration, Permanent, Year-end Processing, staffing and Software System Categories**

Questions 1 - 2

Questions 3 - 4

Question 5

Etc.
The Literature Review

Industry Documents

- Traffic Monitoring Guide (TMG)
- AASHTO Guidelines for Traffic Data Programs
- NCHRP Report 509, Equipment for Collecting Traffic Load Data, TRB, 2004
- NCHRP Report 538, Traffic Data Collection, Analysis, and Forecasting for Mechanistic Pavement Design, TRB, 2005
- Archived Data Management Systems, A cross-Cutting Study Linking Operations and Planning Data, FHWA, December, 2005
- State of the Art Report on Non-Traditional Traffic Counting Methods, National Transportation Library, October, 2001
- Transportation Research Circular, Challenges of Data for Performance Measures, A Workshop, TRB, July, 2006
- Advance Questions for Departments of Transportation: Traffic Monitoring Data Workshop: Successful Strategies in Collection and Analysis
- Transportation Research Record No. 1572, highway Operations, Capacity, and Traffic Control, Highway Capacity Issues and Analysis, TRB, 1997

DOT Agency Specific Documents

- Ohio DOT TKO System Requirements Documentation
- Nebraska DOT Traffic Monitoring System (TMS) Traffic Data Collection, Analysis, and Forecasting System Documentation
- Traffic Data Edit Procedures Pooled Fund Study Documentation, MNDOT, Mark Flinner
The Participants

- 48 out of 50 State DOT Agencies
- One City (Washington DC)
The Results

Short-Duration Programs

Short-term Data Collection

(Days of the week)

100% - Tues, Wed, Thurs
95% - Monday and 39% Friday
15% - Saturday and Sunday

(Days of the week)

59% - Collect Traffic all Year
41% - Have Defined Collection seasons
The Results, cont.

**Continuous Count Programs**

**ATR – Automated Polling**

- 16% - Centurion (Diamond)
- 48% - TOPS ( Peek)
- 5% - wElCoMe (ECM)
- 32% - IRD

**Data Collection Intervals**

- 15 Minute: 17%
- 30 Minute: 2%
- 60 Minute: 80%
- Other: 13%
The Results, cont.

Software Programs

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<tr>
<th>Language</th>
<th>Percentage</th>
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<tr>
<td>Visual Basic</td>
<td>37%</td>
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<tr>
<td>Java</td>
<td>11%</td>
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<tr>
<td>C++</td>
<td>13%</td>
</tr>
<tr>
<td>.net</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>63%</td>
</tr>
</tbody>
</table>

Software Solutions

<table>
<thead>
<tr>
<th>Solution Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customized Product</td>
<td>63%</td>
</tr>
<tr>
<td>Off-the-shelf Product</td>
<td>11%</td>
</tr>
<tr>
<td>Vendor Specific Product</td>
<td>35%</td>
</tr>
</tbody>
</table>
The Results, cont.

Centerline Miles of Roadway

- Largest Program = New York DOT with 115,000
- Smallest Program = Hawaii DOT with 940
- Total number of Large (>20,000) Programs = 11
- Total number of Medium (>10,000) Programs = 14
- Total number of Small (<9,999) Programs = 19
Summary of Results

- Only 35% of respondents have formal data quality inspection program

- High variability in number of count stations
  - Short term – 300 in Vermont to 80,000 in Virginia
  - Permanent – 31 in Tennessee to 2,728 in California
CDOT Survey Recommendations

- Need standardization across states
  - Site selection
  - Number of required sites needed for quality data
  - Processing software
  - Business processes
  - Tools

- Continue survey annually through AASHTO

- Provide mechanism for sharing results across states

- Provide results to decision makers to continue to improve travel monitoring programs
The Final Report

http://www.dot.state.co.us/App_DTD_DataAccess/traffic/survey.cfm
Outline

- **10,000 Foot View** – What is driving the need for high quality, properly assembled traffic data?
  - National
  - State
  - Metropolitan

- **Traffic Data Trends**

- **Assembling Quality Traffic Data** – What do we mean?
  - Assemble
  - Quality
  - Traffic
  - Data
Assembling Quality Traffic Data

- Data Trends – Turning data into information
- Sources
- Guidelines
A Revolutionary Vision

Knowledge Management

- Knowledge comprises strategy, practice, method, or approach
- Getting people the information they need, in the form they need it, when they need it.

Wisdom: The capacity to choose worthwhile objectives
Knowledge: The ability to use information to achieve objectives
Information: Structured data
Data: Pure and simple facts

http://www.systems-thinking.org/dikw/dikw.htm
With on-demand access to managed knowledge, every situation is addressed with the sum total of everything anyone in the organization has ever learned about a situation of a similar nature.

Gene Bellinger

http://www.systems-thinking.org/kmgmt/kmgmt.htm

What is Knowledge Management?

Leni Oman Dec. 17, 2007
Traffic Data Sources

- **Point Detector**
  - Sensors
  - Video Image
  - Microwave radar
  - Infrared
  - Acoustic

- **Beacon-based Vehicle Probes**
  - Toll tag reader

- **Non-traditional Methods**
Non-traditional Methods

- Cell phone tracking
- GPS device tracking
- Remote sensing
Non-traditional Vehicle Probes

- Cell phone tracking
  - E-911 mandated by FCC
  - Holds promise for area wide vehicle speed monitoring

- Currently not well proven
  - Several business venture failures to date
  - NCHRP 70-01 – currently following existing tests
  - Cost / performance of cell phones is unknown

- Other private and public/private efforts (IVI – VII) may provide other cost-effective solutions in the near future
Non-Traditional Vehicle Probes

- Note that all current probe efforts are designed to yield speed / travel time / delay information – NOT vehicle volumes
- Thus additional data collection is needed to obtain volumes
Non-Traditional Data Collection

- GPS tracking
  - Currently done by many long-haul trucks
  - FHWA is currently working on bringing some of that data to highway agencies

- Remote sensing (airplane / drone / satellite)
  - Technology exists – currently too expensive
  - Drone technology may change this in the near future
Revised AASHTO Traffic Data Guidelines

Figure 1.1 Summary of Traffic Data Programs

State Planning and Design/Federal Requirements

Traffic Data Program

Data
- Volume
- Classification
- Weight
- Speed

Components
- Planning
- Design
- Collection
- Analysis
- Reporting
- Maintenance

Customers
- State DOT
  - Planning
  - Design
  - Project Development
  - Safety
- Federal
  - HPMS
    - Policy
    - Freight
    - Safety
    - Design, etc.
- Public
  - Local partners
  - Developers/Realtors

Guidance
- AASHTO Guidelines
- TMG
- HPMS Field Manual
- Other
New AASHTO Traffic Data Guideline Objectives

- **Improve the quality of the traffic information**
  - Supports decisions at all levels of the transportation profession
  - Supports capital investment programs and budgets, as well as effective design and maintenance programs

- **Provide practical “how-to” information for data program managers and practitioners to update and enhance current procedures**
  - Continue to provide quality data
  - Take advantage of modern technology to improve accuracy, efficiency, effectiveness, and responsiveness to users needs
Guideline Objectives (con’t)

- Document common and best practices for establishing and operating a traffic-monitoring program
- Provide practical implementation to allow agencies to easily apply some or all portions to their program
- Oriented toward providing quality data for decision-making
- Cover all aspects
  - Collection, Processing, Management, Analysis, Dissemination
Guideline Highlights

- **Data Business Plans to identify changing needs**
  - Performance monitoring and asset management
  - Conflicting requests from a variety of customers as well as competing needs for more, higher quality traffic data
  - Balance with available resources

- **Quality Assurance**
  - Throughout design, implementation, operation, and maintenance of the traffic-monitoring program
  - Address root cause of poor data quality

- Expand scope of traffic monitoring programs beyond volume, class, weight
Quality Assurance Chapter – New Guidance

- Quality Control and Editing Traffic Data

- Emphasis on quality assurance (improving data quality at the source) as opposed to simply editing low quality data once it has been collected

- Integration of quality assurance throughout a traffic monitoring program
  - Equipment procurement and installation, acceptance testing, routine maintenance and verification, staff training, and routine customer feedback

- Contract considerations relating to purchase of traffic monitoring data from private contractors

- Definitions and measures of data quality
Quality Assurance Chapter

Figure 4.1  Missing Data Patterns in Archived Operations Data from Austin, Texas
Percent Complete for Hourly Volume Data

*Austin, Texas – January 1 to December 31, 2002*
AASHTO Guidelines Future Research Needs

- Improve vehicle-classification procedures for use under variable-speed (congested) conditions, especially in urban areas
  - Include evaluation of the pros/cons of classifying vehicles based on length or axle spacing

- Develop reporting system that allows agencies to identify various types of WIM malfunctions
  - Include calibration errors
  - Specify physical cause of the malfunction
  - Use data to develop analytical quality control checks that predict equipment malfunction
Future Research Needs (con’t)

- Develop standardized validation criteria for traffic counts, classification counts, and WIM data

- Develop information about the range of precision that can be expected for various types of traffic statistics (AADT, AADT by VC, etc.) for short-count sites belonging to specific types of factor group (urban, rural Interstate, rural other, etc.)

- Quantify the impacts on precision of randomly and systematically missing data

- Better procedures for developing and applying axle-correction factors
  - How axle-to-vehicle ratios at a given site vary seasonally and by day of week, and by type of roadway
Future Research Needs (con’t)

- Further develop and standardize quality control and quality assessment procedures for archived operations data

- Further develop data imputation and alternative summarization procedures to account for small gaps of missing data in archived operations data

- Identify and evaluate traffic data collection equipment that can serve multiple purposes (real-time operations applications as well as historical traffic analysis and planning)
Issues From Recent TRB Data Section Retreat

- Ensuring Support for National Data Programs
  - Funding for Transportation Data Collection

- Meeting Data Needs for Emerging & Evolving Problems
  - Data for Performance Measurements
  - Data Needs—Routing and Navigation

- National Standards and Strategies for Organizing Traffic and Safety Data
  - Assembling Quality Traffic Data
  - Business Process and Data Standardization of Travel Monitoring Programs
Recent TRB Data Section Retreat

- Innovative Technologies and Methods for Data Collection, Analysis and Management
  - Continuous vs. Sporadic Data Collection
  - Emerging Technologies for Traffic Data
  - Privacy Issues in Data Use
  - Extracting knowledge from intensively monitored transportation systems

- Freight Data Issues

- Data Stewardship, Sharing and Standards
  - Stewardship: What Guidelines are Needed to Treat Data as an Asset?
  - Institutional Integration of Transportation Data
Across the Board

- Too much data
- Not enough quality
- Private sources
- Archives
- Partners
Questions to Ponder

1. What are the different sources for traffic data?

2. Who are the primary partners for sharing traffic data?

3. What are the barriers that exist today for collecting traffic data from other sources?
   a. How are different data formats handled?
   b. Who develops and affirms the data quality from the different sources?
   c. What type of system(s) accumulate the data?
   d. How can the other customers gain access?
Questions to Ponder

4. What are the current traffic data gaps?
   a. What methods of imputation have been developed and employed?
   b. How are the metadata communicated?
   c. Are the traffic data gaps affecting the quality of corridor management plans?
   d. Who has successfully deployed automated editing?