CMAP’s experience with the National Performance Management Research Dataset (NPMRDS)

April 8, 2015
Presented by Tom Murtha and Todd Schmidt
Inductive loops provide excellent operations data that we can use for analyses such as CMAP’s congestion scans (right)....

Image: CMAP
... but such data is only available for the region’s expressway system.

The National Performance Management Research Dataset (NPMRDS) fills part of this gap.
NPMRDS: Today’s Agenda

- Basic information about the NPMRDS
- Database and Data Processing
- Geography
- What we’re doing with the data
NPMRDS: Basics: Who

- The NPMRDS is provided to States and MPOs through an FHWA contract with HERE, the Chicago-based navigation data company.
- The data is collected by HERE from mobile phones, navigation device, and vehicle transponder probes; truck probe data is provided through the American Transportation Research Institute (ATRI).
- NPMRDS is available for work on IDOT and MPO contracts.
- Related probe data is available for purchase from HERE resellers and HERE’S competitors (TomTom, INRIX).
NPMRDS: Basics: What’s in the Dataset?

- NPMRDS provides average travel time in seconds by Traffic Message Channel Code segment by direction every five minutes.

- TMC Code
  - What’s a Traffic Message Channel (TMC)? A means of radio communication for traffic and travel data to and from motorists. TMC location tables are typically integrated into vehicle navigation systems.
  - TMC Codes are maintained by an industry committee

- Date
NPMRDS: Basics: What’s in the Dataset?

- Five-minute time slices are coded to 288 epochs per day.
- Vehicle travel times are reported for trucks, passenger cars, and all vehicles.
- Data is provided for each state every month (not real-time).
- Data is only provided when there is vehicle data (no imputation of speeds).
NPMRDS: Basics: What’s Not in the Dataset?

- Sample size is not in the dataset.
- The dataset has no information about the distribution of speeds.
- No traffic volume estimates are in the dataset.
- No incident data is in the dataset.
- No transit or bike/ped data is in the dataset.
NPMRDS: Basics: Dates

- Full dataset is available monthly from July, 2013.
- A Interstate system archive is available.
- The contract is four one-year options, extending to June 2017.
- Data provided under license may be used in perpetuity.
NPMRDS: Basics: Highway System

- Data is provided only for the National Highway System.
- The National Highway System consists of:
  - Interstate System;
  - Other Principal Arterials;
  - Certain roads important to Defense activities; and
  - Intermodal Connectors.
- Some NHS roads were found not to have TMC codes; these are being addressed. Also, NHS changes were approved last month. So the NPMRDS geography changes.
NPMRDS Basics: How Data Is Collected

- Vehicle probes data provides vector data: position, speed, and direction of travel.
- The probes are matched to road segments.
- These pieces are then strung together into the system of highways.
- Not calculated with capture/recapture methods (as with Bluetooth measurement).
- No vectors, no data....
NPMRDS Data: How Data Is Collected
NPMRDS Basics: How Data is Collected
NPMRDS Basics: How Data Is Collected
NPMRDS Basics: Why

- Facilitate performance metrics using a nationally consistent database.
- Systems operations planning
  - First arterial dataset to really give us great data for use in reliability planning and incident management.
- Freight operations focus
- For CMAP: Performance-based programming
- For CMAP: CMAQ project evaluations
NPMRDS: Today’s Agenda

- Basic information about the NPMRDS
- **Database and Data Processing**
- Geography
- What we’re doing with the data
NPMRDS: Database Development

- Historical travel time released monthly
  - National Highway System on TMC network
  - Passenger, freight, and combined travel times
- 3 file types available
  - Travel time data, spatial data, and documentation
- Travel time data for IL ~1 gb per month with 25 million records
NPMRDS: Database Development

- PostgreSQL with PostGIS
  - Why PostgreSQL
    - Regional Transportation Data Archive Project
    - Open source
    - Geoprocessing capabilities

- Remote machine
  - 24 GB RAM
  - 1 TB disc space
  - Current database ~289 GB
NPMRDS: Data Processing

- Travel time in 5 minute increments (epochs)
- Outliers are included
- Invalid data points discarded
- No travel time estimation

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<th>TMC</th>
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NPMRDS: Data Processing

- Create full dataset with all epochs
- Add geographic data to main data table
- Convert travel time data to speed
- Flag outlier data
  - Currently set at travel time > 7200 seconds (2 hours) or speed > 100 mph
- Append to master data set
- Calculate performance measures and stats
NPMRDS: Today’s Agenda

- Basic information about the NPMRDS
- Database and Data Processing
- Geography
- What we’re doing with the data
NPMRDS Geography

- National Highway System on TMC network
- Shapefile updates
- Spatial data files
  - HERE Shapefile, TMC static file, TMC lookup table
- HERE Shapefile
  - GIS shapefile with roadway geometry
- TMC static file
  - Descriptive information about segment
- TMC lookup table
  - Lookup table to assign link ids a TMC
NPMRDS Geography

- Geoprocessing in PostgreSQL database
  - Identify TMC located in IL
  - Query TMC lookup table for link ids with a TMC identified in first step
  - Create spatial table with only IL links
  - Join IL spatial table with IL TMC look up table
  - Convert multi-line geometry to single-line geometry
  - Create parallel lines for display purpose
NPMRDS Geography

- Important geography note
  - HERE Link_ID to TMC relationship
    - Many link ids to one TMC
      - Divided roadways (dual carriageway)
    - Many link ids to Many TMCs
      - Undivided roadways
  - Few links assigned to more than 2 TMC's
  - Displaying data
    - Develop process to properly offset lines
NPMRDS Geography

- Conflation to IRIS
  - Iterative process to match HERE links to IRIS links
    - String matching on street name
    - Functional classification
    - Bearing (direction) of links

- Valuable tool
  - Add congestion performance data to IRIS
  - Project to score NHS network on IRIS
NPMRDS Geography

- Next steps
  - Conflate IRIS volumes to TMC geography
  - Add time of day profile from sensor data
  - Etc.
NPMRDS: Today’s Agenda

- Basic information about the NPMRDS
- Database and Data Processing
- Geography
- What we’re doing with the data
Uses of performance measures (FHWA):

- Set goals and standards
- Detect and correct problems
- Manage, describe, and improve processes
- Document accomplishments
Benefits of performance measurement (FHWA):

- Greater accountability
- Improved transparency
- Facilitates assessment of system performance
- Refocus decision-making on outcomes
- Cost effectiveness
NPMRDS: What We’re Doing With the Data: Performance Measurement

CMAP’s performance categorizations:

- Safety
- System Preservation
- Mobility
- Reliability
- Accessibility
- Equity
- Livability
Travel modes addressed:

- Auto
- Transit
- Freight
- Walking and Cycling
## NPMRDS: What We’re Doing with the Data: Performance Measurement

### Where can we apply the NPMRDS?

<table>
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<tr>
<th>Performance Category</th>
<th>Auto</th>
<th>Transit</th>
<th>Freight</th>
<th>Walking Cycling</th>
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<tr>
<td>Livability</td>
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</table>
NPMRDS: What We’re Doing with the Data: Performance Measurement

- **Travel Time Index:**
  
  \[
  \text{Average Congested Travel Time} \quad \frac{\text{Free} - \text{Flow Travel Time}}{\text{Peak periods for measuring congested travel time: 6am – 9am and 4pm – 7 pm}}
  \]

- **Planning Time Index:**
  
  \[
  \text{95th Percentile Travel Time} \quad \frac{\text{Free} - \text{Flow Travel Time}}{\text{Free-flow travel time is average travel time measured from 8pm to 5:30 am, where samples > 10 [calculated using alternate dataset where samples were available].}}
  \]

- **Congested Hours:** Average Number of Hours per Weekday where Travel Time > (congestion factor X Free Flow Travel Time).
  
  \[
  \text{For link level analyses, above processes are suitable. For regional-scale performance tracking, data must be weighted by VMT}.
  \]
NPMRDS: What We’re Doing with the Data: Performance Measurement

- Regional Performance Mapping
- Quarterly Performance Reports in Development
- Anticipate that federal rules will require application of NPMRDS to a calculation of congestion and/or delay (requires conflation with a database containing highway traffic volumes).
NPMRDS: What We’re Doing with the Data: IDOT Collaboration

- Sharing database development with IDOT and IDOT congestion consultants.
- Anticipate that this will be an on-going collaboration.
As part of effort to improve CMAQ project scoring process, planning time index data was used to evaluate the project submittals for the FY 2016-2020 program development process.

Aside from measurement processing, this element of the CMAQ evaluations took only a few hours.
NPMRDS: What We’re Doing with the Data: Analytical Deployment

- Analytical deployment of performance measures for performance-based programming
- Work of Research and Analysis at CMAP
- Perhaps subject of future CATMUG?
NPMRDS: What We’re Doing with the Data: Project Evaluations

East-bound I-94 Edens Expressway at Elston Ave:
Speed, Standard Deviation, and Samples by Time of Day for Weekdays, 2012

Data Source: Midwest Software Solutions. Analysis by CMAP. Prepared May, 2014
Thank you.

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