Pima County
Regional Surface Transportation Network Management Vision

Status update
March, 2019
Performance Context

To evaluate network performance and propose enhancements reflecting the Federal Highway Administration performance-based approach described in U.S.C. § 450.206 of Title 23, jurisdictions require an evaluation platform addressing both infrastructure and traffic.
Performance Criteria

- Mobility
- Safety
- Accessibility
- Transit
- Freight
- Social justice
- Non-vehicular modes
- Economic development catalyst
- Environmental
Performance Evaluation

Highest value enhancements to be evaluated through observation and simulation to maximize return on investment (ROI) among:

- Maintenance
- Construction/expansion of roadways
- Active demand management (ADM)
- Transportation systems management and operations (TSMO)
Performance Toolbox Components

1. Transportation Network Management System
2. Traffic Data
3. Dynamic Traffic Assignment
1. Transportation Network Management System (TNMS)

- Geographic information system (GIS) platform
- Infrastructure asset representation
- Safety elements (crashes and geometrics)
- Network screening analysis tools
- Operations management dashboard
1. TNMS Benefit

- Screen network for mobility, safety and other opportunities through regression analyses
- Evaluate and compare value and performance of assets, geometrics and other transportation infrastructure variables
- Provide an operations management dashboard to actively manage signals and road closures
- Actively manage traffic demand with live feed to navigation and traffic apps
TNMS-Pima County Platform
TNMS - Network Screening
TNMS – Assets & Features

- Assets
  - ArcGIS LRS
  - LiDAR
  - Geometrics
- GIS Features
- Traffic analytics
TNMS - Traffic Analytics

Safety
• Crashes
• LOSS—Safety Performance Functions
• USRAP
• Safety Analyst

Volume
• Traditional counting devices
• Probe

Analysis
• Regression analysis to determine statistical significance among elements
TNMS - Supply Management

- Infrastructure need and design optimization
- Intersection control optimization
- Transit/share stop/route optimization
- Freight management
- Access management
- Pavement optimization
- Construction project/special event/crash mitigation
- Flood barrier mitigation
TNMS - Active Demand Management

Mobility

- Distributed routing
- Peak-load shifting
- Mode distribution
- Economic basis for travel incentives
- Enhanced TDM program
TNMS - Active Demand Management

Safety

• Incentivize transit
• Incentivize low acceleration/deceleration
• Incentivize max speed within 10 mph of posted speed limit
• Reward not touching driver smartphone when vehicle in motion
Metropia strategies

Incentive Architecture Behavior Strategies

- Energy Saving Instant Feedback
  - When drivers are presented with energy saving feedback for their route following, they will follow the route more.

- Incentive by Congestion/Energy Profile Points
  - Incentives trigger and reinforce the adjustment of departure time. The flexibility to adjusting departure time is affected by activity purposes and socio-demographics.

- Incentive by Random/Profile Points
  - Incentives trigger and reinforce carpooling activities. The carpooling behavior is influenced by travel activities and socio-demographics.

- Incentive by Baby-Step Actions
  - Personalized mobility options info and incentives via a baby-step approach increase the user’s awareness and engagement of the non-driving mode.
Metropia-user interface

Use Incentive to Influence Departure Time
2. Advanced Traffic Data

- Locally sourced multi-modal permanent counters:
  - miovision

- Probe data through partnerships:
  - HERE
  - INRIX
  - Wayz
  - Metropia

- Purchased network flow data and analytics tools
  (Streetlight)
  - Origin-destination analysis
  - Zone analysis (visitor, home, work)
  - Traveler demographics and trip purpose
  - Segment analysis (speed, duration, length)
  - Bike/ped/freight/transit analysis
2. Advanced Traffic Data benefit

Identifies potential demand or infrastructure improvement strategies through analysis of:

- Congestion (prioritize needs)
- Mode (infrastructure to accommodate or incentivize transit or bike share program on short trip corridors)
- Trip purpose (prioritizing employment, shopping, recreation access or location)
- Special events (e.g., Gem Show ride-shares)
- Demographics (prioritize affordable housing and at-risk health populations mobility needs)
Traffic Data: Miovision

<table>
<thead>
<tr>
<th></th>
<th>Total Vehicles</th>
<th>Total Pedestrians</th>
<th>Total Bicycles</th>
<th>Truck Pct (%)</th>
<th>AM Peak</th>
<th>PM Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median Volume</td>
<td>27,501</td>
<td>207</td>
<td>45</td>
<td>2%</td>
<td>1,751</td>
<td>2,185</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>From 10:00 to 11:00 AM</td>
<td>From 4:00 to 5:00 PM</td>
</tr>
</tbody>
</table>

VOLUMES

Median Intersection Count | Thu, Mar 14th to Fri, Mar 15th, 2019
North Camino de la Tierra and West Ina Road

<table>
<thead>
<tr>
<th>Time</th>
<th>Lights</th>
<th>Vehicles</th>
<th>Single-Unit Trucks</th>
<th>Articulated Trucks</th>
<th>Buses</th>
<th>Bicycles</th>
<th>Pedestrians</th>
</tr>
</thead>
<tbody>
<tr>
<td>02:00 AM</td>
<td>100</td>
<td>200</td>
<td>150</td>
<td>50</td>
<td>30</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>04:00 AM</td>
<td>300</td>
<td>400</td>
<td>350</td>
<td>150</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>
Traffic Data: StreetLight

Mobile device data from ~23% of US and Canadian adults and ~12% of commercial truck trips.
Traffic Data: StreetLight

Unmatched accuracy, validated via permanent counters

- Trained and validated with 2,400+ permanent count stations, spanning range of road types and weather conditions
- Better than temporary counter AADT for most roadway classifications
- $R^2$ is .96
- Both absolute and root mean square error rates exceed industry targets
Traffic Data: StreetLight

<table>
<thead>
<tr>
<th>Key Characteristics of Our Locational Big Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple Types of Data</strong></td>
</tr>
<tr>
<td>• Location-Based Services records</td>
</tr>
<tr>
<td>• Navigation-GPS records</td>
</tr>
<tr>
<td><strong>Sample Size</strong></td>
</tr>
<tr>
<td>• Covers ~23% of adult population in US and Canada</td>
</tr>
<tr>
<td>• Unbiased sample backed up with automated normalization</td>
</tr>
<tr>
<td><strong>Spatial Precision and Coverage</strong></td>
</tr>
<tr>
<td>• As precise as 5-25 meters, average better than 18 meters</td>
</tr>
<tr>
<td>• 4-carrier coverage – no rural gaps</td>
</tr>
<tr>
<td><strong>Temporal Precision</strong></td>
</tr>
<tr>
<td>• One-hour intervals</td>
</tr>
<tr>
<td>• Weekends vs. weekdays</td>
</tr>
<tr>
<td><strong>Archival Data</strong></td>
</tr>
<tr>
<td>• Monthly data periods from 2014 through “month before last”</td>
</tr>
<tr>
<td><strong>Privacy Protection</strong></td>
</tr>
<tr>
<td>• All data is de-identified by our suppliers</td>
</tr>
<tr>
<td>• No personally identifying information</td>
</tr>
<tr>
<td>• Metrics are aggregated into groups</td>
</tr>
</tbody>
</table>

This image shows a location record's potential location at different levels of spatial precision. At 300m to 1000m spatial precision, records cannot provide corridor- or intersection-level insights.
Traffic Data: StreetLight

StreetLight InSight turns Big Data into actionable transportation analytics on demand
Traffic Data: StreetLight

- What is causing traffic in my community?
- Did our new policy/project actually work?
- Where should we expand transit?
- Can we engage the public more effectively?
- How do we model new modes? (TNCs, flying cars)
- What is the best allocation of resources to meet our goals?
- How can we build better travel demand models for less?
- Can we reduce cut-through trips?
- What are freight travel patterns?

GO BIGGER

SAVE TIME & MONEY

GO BEYOND!
Traffic Data: StreetLight

San Diego’s MPO Assessed the Impact and Equity of New Toll Road Pricing

Challenge

SANDAG reduced tolls on SR 125 to shift traffic from congested I-805, but lacked a way to determine if this benefitted all income groups equally.

StreetLight InSight Solution

SANDAG and Fehr & Peers analyzed the incomes of SR125 and I-805 users before and after the change, and determined all income groups were equally impacted.
Traffic Data: StreetLight

Napa’s Congestion Management Agency Invests Strategically in Transit to Mitigate Traffic Jams

Challenge

Residents blamed traffic jams on tourists and tech industry commuters, but the local transportation authority needed evidence to invest strategically.

StreetLight InSight Solution

Napa determined that internal trips and Napa’s own workers caused congestion. They began prioritizing transit for these groups, and justified their decisions to the public.
Traffic Data: StreetLight

Corridor Impact in Canada

Need: Route choice between 2 highways to measure the impact of offering a new option.
Zones: 6 routes, 3 origin zones, 6 destinations zones.
Metric: O-D with Middle Filter
Months: May, June 2016
Time to Run: 2 min for each month.
Traffic Data: StreetLight

Using StreetLight InSight for Data-Driven Infrastructure Prioritization in Northern Virginia

Challenge
Northern Virginia’s severe congestion cannot be addressed by highway expansion. VDOT needs to reduce travel in single occupancy vehicles.

StreetLight InSight Solution
VDOT compared every single regional corridor for mode-shift potential creating, which lead to far more effective cost/benefit process and expenditures of infrastructure dollars.
3. Dynamic Traffic Assignment Model

What-if simulation of network changes
- Infrastructure changes
- Demand management changes

DynusT platform
- University of Arizona development
- Accepts locally defined street network
- Accepts origin-destination data
- Accepts signalized intersection timing/phasing inputs
3. DTA Model Benefit

- Evaluate effect of potential solutions flushed out by TNMS or Advanced Traffic Data tools
- Optimize performance of different strategies (demand vs supply)
- Can evaluate future scenarios by applying growth factors to current origin-destination data
Development and calibration of the Anisotropic Mesoscopic Simulation model for uninterrupted flow facilities

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ABSTRACT

This paper presents the development, analysis, and calibration of the Anisotropic Mesoscopic Simulation (AMS) model for uninterrupted flow facilities, such as freeways. The proposed AMS model is a vehicle-based mesoscopic traffic simulation approach that explicitly considers the anisotropic property of traffic flow into the vehicle state update at each simulation step. The advantage of AMS is its ability to address a variety of uninterrupted flow conditions in a relatively simple, unified and computationally efficient manner.

The discussions focus on the key modeling concepts, the analytical properties and
DTA: DynusT

Anisotropic Mesoscopic Simulation (AMS)
DTA: DynusT

DynuStudio Visualization
Output Link
Performance Measures

Density+Flow
DTA: DynusT
DTA: DynusT
Recap
Performance Toolbox Components

1. Transportation Network Management System

2. Traffic Data

3. Dynamic Traffic Assignment
Synthesis of toolbox benefit

• Smart-Community deployment with currently available technology
• Does not require large infrastructure investment (sensors, etc.)
• Provides most connected vehicle benefits with exception of collision avoidance
• Actively manages supply and demand to maximize performance and return-on-investment
Regional Partnerships

• Managing travelers cross jurisdictional boundaries requires regional coordination
• Regional transportation mobility partners to include City of Tucson and other governments
• Coordinating agencies include law enforcement, emergency management, health, economic and community development
• Operational expertise in smart transportation infrastructure, modeling and demand management at the University of Arizona College of Engineering could be leveraged to create a regional transportation operations and research center.