Information Technology Applications in TSM&O Projects

Presented at
Annual Joint Meeting of Florida Section of ITE and ITS-FL
Theme: Mobility has no Boundaries – All play a role in TSM&O
November 2, 2017

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Presentation Overview

- History of TSM&O
- Current and emerging IT Tools
- Some Key Concepts
  - Data Management
  - Big data and Artificial Intelligence/Machine Learning Overview
- Project examples
- Q&A
Evolution of TSM&O

Traffic Operations Program to Increase Capacity and Safety (TOPICS)

Transportation System Management (TSM)

Intelligent Vehicle Highway System (IVHS)

Intelligent Transportation System (ITS)
TOPICS (Traffic Operations Program to Increase Capacity and Safety)

- The U.S. Congress established a program known as TOPICS in the 1968 Federal-Aid Highway Act.

- The TOPICS program is designed to improve capacity and safety of the existing city arterial networks by a systematic application of traffic operational types of improvements.

- The improvements must be based on an areawide plan based on prioritization of goals.

- TOPICS does not include major construction except to eliminate bottlenecks which prevent full use of existing capacity of the street.
Since 1981, FHWA and FTA have mandated that Regional Transportation Plans must have TSM element which describes how a region improves efficiency and effectiveness of the total transportation system in moving people and goods.

TSM is often used interchangeably as TCM and TDM to describe a series of techniques designed to maximize the efficiency of the existing transportation system by reducing dependence on single occupant vehicles. The concept of HOL emerged.

The goals of TSM are to reduce traffic congestion, improve air quality, and reduce or eliminate the need for new and expensive transportation infrastructure.

The TSM techniques, under this mandate, are generally low-cost measures to reduce travel demand or to improve the utilization of existing transportation facilities.
(IVHS/ITS) Intelligent Vehicle Highway System/Intelligent Transportation System

Technological advances brought many innovations in vehicles such as cruise control and then gradually transferring the control of vehicles from humans to computers inside and outside of vehicles. The progress we could see is in:

- Automated Highway System (AHS)
- Automated Vehicle Identification and Location (AVIL)
- Electronic Toll Collection (ETC)
- Intelligent Vehicle Highway System (IVHS)
- Intelligent Transportation System (ITS)
The past processes, improvements, and developments as well as emerging technologies in transportation systems are now included in:

TSM&O is an integrated program to optimize the performance of existing multimodal infrastructure through implementation of systems, services, and projects to preserve capacity and improve the security, safety and reliability of the transportation system.

Improve communications, coordination, and collaboration amongst transportation partners leading to more effective leveraging of existing infrastructure

http://www.cflsmartroads.com/tsmo.html
A walk down memory lane...

• Here is a brief overview of how things were done in the past...
Data Collection

• Data Collection such as traffic counts, turn counts at intersections, screenline counts, etc. were done manually using hand counters and people standing at intersections and screenlines.

• Input data collection for transportation models were limited to the parameters that could be analyzed manually.

Regression Analysis
Pedestrian Counts at Intersections
Technological Advancements

• Accurate and usable data is the basis for **reliable and dependable** transportation planning, traffic engineering, and transit operations.

• Higher computing capabilities brought a **revolution** in collecting, analyzing, and appropriately documenting complex and almost unlimited data for the use of decision makers.
Information Technology Tools in Transportation

Past
• CAD
• Spreadsheets/Manual Calculations
• Fortran/Mainframe Programs

Present
• GIS
• Sophisticated Micro, Meso, Macro-scale Models
• Web and Mobile Technologies
• Reactive Management based on historical data analysis

Future
• Big Data, Data Analytics
• Machine Learning/Artificial Intelligence
• Integrated Infrastructure Intelligence® (i3)
IT Innovations are Revolutionizing Transportation

Breaking down communication barriers
• Overcoming the organizational silos
• Data hoarding is no longer the norm
• Decision making based on a holistic view of infrastructure information

Learning from historical data
• Visualizing spatial and temporal patterns
• Better input data for models
• Multivariate analysis

Where do we go from here
• Predictive Tools for Proactive Infrastructure Management and Operations
• Integrated Infrastructure Intelligence (i3®)
• Automated Vehicles/Connected Vehicles
Putting Data to Use with Analytics
Potential Applications of AI/ML

• Planning
  o Predict budgets and outcomes at macro level

• Safety
  o Improve safety of transportation network

• Operations
  o Predict traffic speeds and traffic counts

• Maintenance
  o Predict infrastructure useful life/failures
Enterprise Reporting/BI/Data Analytics Solutions
Project Examples

Recent Projects
- TSM&O Architecture Development
- Active Arterial Management Dashboards
- Enterprise Data Repository
- Enterprise Information Portals
- Integrated Project Information Systems (iPro)
- Address Data Management Application (ADMA)

Upcoming Projects
- Integrated Corridor Management
- ATMS Data Integration
- Integrated Infrastructure Intelligence (i3®)
Active Arterial Management Dashboard

- Compiles near-real time data from Bluetooth Sensors
- Provides AAM Corridor Manager and Operators with access to historical and current data
- Public access to historical travel time information
- Ability to add more data sources as needed
Active Arterial Management Dashboard

Public Dashboard

Route: SR46 EB IntPkwy toArBlvd
Direction: Eastbound
Time Window: Last Year
Period: AM

Average Travel Time

Average Speed

AAM Program Summary
- Bluetooth Devices: 112
- Cameras: 20
- Miles Managed: 5,000
- Signals Managed: 200

AAM Program Benefits
- $ Saved: $200,000
- Delay Savings: $182,652
- Fuel Savings: $50,000
Integrated Corridor Management (ICM)

- Leveraging big data and analytics tools to revolutionize traffic operations
- Bringing together valuable data from multiple sources
- Facilitating communication among diverse stakeholders
- Providing near-real time signalization plans to operations staff
- Provide historical data access and analytics
ICM Data Fusion

Source: FDOT ITN-DOT-16-17-5004-ICMS
DESCRIPTION: Central Florida Regional Corridor Management System; DATE: February 16, 2017
### ICM Roles & Responsibilities

**Description:** Central Florida Regional Corridor Management System  
**Date:** February 16, 2017

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<th>FDOT Central Office</th>
<th>FDOT D5</th>
<th>FTE</th>
<th>MetroPlan</th>
<th>CFX</th>
<th>SunRail</th>
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<th>Osceola County</th>
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ICM Flush Plans

Source: FDOT ITN-DOT-16-17-5004-ICMS

DESCRIPTION: Central Florida Regional Corridor Management System; February 16, 2017

Figure 19: Corridor Diversion - Flush Plan Set Details
FTE - EDR

FTE EDR Conceptual Solution Option 1
Draft Solution 5/15/2014

Data Viewer
(built off GEV framework)

Facilities
Pavement
ITS
Roadway
Logs
Reporting
Data Export (xls/csv/kml/shp)
Structural
System/GIS
Utilities
Finance
Environmental

Existing FDOT Data Sources
New Function Module
Existing FTE Data Sources
Asset Data Module
FTE Data Creation
Finance Module
Integrated Infrastructure Intelligence (i3®)

What is it?

- The power to make intelligence decision based on a holistic view of infrastructure information
- Bridge the organizational silos
- Look at the complete life cycle of infrastructure from concept to completion and through operations and maintenance
Complete Infrastructure Lifecycle Management

- Concept
- Planning
- Design
- Construction
- Operations
- Maintenance
- Renewal
- Replacement

Complete Infrastructure Life Cycle
Integrated Infrastructure Intelligence®
Integrated Infrastructure Intelligence® (i3)

- Projects
- Documents
- Reports
- GIS
- Simplify i3®
- Work Order Management
- External Systems
- Dashboards
- Asset Management

NSF
SBIR·STTR
America's Seed Fund
EPIC
Your Work, Simplified®
## Simplify i3® Schedule View

The City of Lake Mary ▶ Major Road Program ▶ Wymore Road Improvements

<table>
<thead>
<tr>
<th>Task</th>
<th>Start Baseline</th>
<th>Start Current</th>
<th>End Baseline</th>
<th>End Current</th>
<th>FY 15-16</th>
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Document Management

The City of Lake Mary ▶ Road Improvements ▶ Wymore Road Improvements

Select a document to preview
I HAZ A QUESTION
THANK YOU!

1511 East SR 434, Ste. 3033
Winter Springs, FL 32708
Phone: 407-381-EPIC (3742)
www.epicgroupllc.com
Points

- Industry is moving to Big Data and Predictive Analytics
- Decision Making
  - Past
    - Establish goals and objectives
    - meet stakeholders
    - Measures of effectiveness
    - Communicate to stakeholders in meetings
    - Reporting (Manual)
    - Toll Collection
  - Present
    - Near-real time data analysis and metrics calculation
    - On-demand reporting
    - 24/7 communication through Dashboards
    - Sensor data capture and use
    - Electronic toll collection
  - Optimization
    - IoT
  - Integration (Data Fusion)
    - Data visualization and analytics tools
- Save Money
- Share data to all agencies seamlessly (Data Dissemination)
AI/Machine Learning

• Artificial Intelligence (AI) is the broad umbrella
  o Machine Learning
    ▪ Combines computer science with statistical methods to make machines learn from big data
  o Statistical Learning
    ▪ Is the underlying technique for machine learning. It was previously used with lesser data, hence not effective. With modern computing advancements and availability of big data, this evolved into ML.
Big Data Characteristics

**Volume**
- Data at Rest
  - Terabytes to exabytes of existing data to process

**Velocity**
- Data in Motion
  - Streaming data, milliseconds to seconds to respond

**Variety**
- Data in Many Forms
  - Structured, unstructured, text, multimedia

**Veracity**
- Data in Doubt
  - Uncertainty due to data inconsistency & incompleteness, ambiguities, latency, deception, model approximations

Source: Google Image Search
Data Analysis and Reporting

- Simple Statistical Analysis
- Present in Graphs, Bar Charts, Pie Charts, and Tables