PennDOT’s Pavement Asset Management System (PAMS)

Quality Assurance Workshop
Hershey, PA
February 8th, 2017

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What is Asset Management?

• Strategic framework for managing transportation infrastructure, aligning resource allocation to maintain and/or improve the system to a specific level
• Predictive, not reactive (making informed decisions)
• Principals:
  o Policy Driven (Strategic)
  o Performance Based
  o Option Oriented
  o Data Driven
  o Transparent – Getting public’s trust
Pennsylvania Assets

• PA maintains the Nation’s:
  – 5th largest roadway network
  – 4th largest number of interstate miles

• Four Business Plan Networks (BPNs):
  – Interstates
  – National Highway System (NHS) Non-Interstate
  – Non-NHS (> 2,000 ADT)
  – Non-NHS (< 2,000 ADT)
Pennsylvania’s Roadway Network

- Interstate
- NHS Non-Interstate
- Non-NHS > 2,000 ADT
- Non-NHS < 2,000 ADT
Pennsylvania’s Roadway Network

Interstate, NHS, and Non-NHS (>2000 ADT)

Note: Local Roads Not Shown
Pennsylvania’s Roadway Network

Interstate, NHS, and Non-NHS

Interstate
NHS
Non-NHS (> 2000 ADT)
Non-NHS (< 2000 ADT)

Note: Local Roads Not Shown
Why PAMS at PennDOT

• Data for more than 43,000 segment miles of state roadways stored in Roadway Management System (RMS) & analyzed in spreadsheets to manage the data for reporting and decision making.
Why PAMS at PennDOT

• No consistent forecasting means

• Lack of communication between systems

• No funding optimization

• No standard project selection process

• No easy way to determine cost estimates
Why PAMS at PennDOT

- No Means of modeling a section of pavement for deterioration
- Political influence and personnel preference outweigh data driven decisions
- Not centered around long term goals
- Determine if treatment selection was cost effective
MAP 21 and FAST Act

- Establish performance targets for pavement condition based on specific measures like IRI, rutting, cracking and faulting
- Submit biennial performance reports
- Meet minimum condition levels
- Make significant progress toward meeting the state established targets
PAMS Targets

- Project optimization based on funding
- Future prediction of deterioration and benefits from proposed projects
- Bring together data from multiple systems for analysis and reporting
Selecting a Pavement Management System

• Roadway Data Management Study (2010)
  – COTS (Consumer off the shelf solution)

• Request for Proposal (2013)

• Selected Deighton’s dTIMs Product
Deighton has been producing asset management solutions since 1986.

Pennsylvania is Deighton’s 20th state in order to implement dTIMS.

Configuration is user driven, not application driven.
Pavement Asset Management System

- Utilizes information from existing systems – including treatments and decision criteria already agreed upon in RMS.
Deterioration Models

- 54 Model Families
- Deterministic Models for IRI and OPI
- Transition Probability Matrices
  - all other distresses i.e. Fatigue cracking, raveling, Left edge joint deterioration
Performance models

- Overall Pavement Index (OPI)- Pavement Performance Models from data available in PennDOT’s Roadway Management System (RMS) to simulate future changes

- 54 Pavement families made by combinations of categories including pavement type, route class, location and traffic level

**PPM Process**

- Data Pre-Processing *(Identifying and Removing Outliers)*
- Curve Fitting Analysis
- Regression Analysis
  - Ordinary Regression
  - Clusterwise Regression
- Model Validation
  - Residual Analysis
• Example of a segment from HMA pavement family
Pavement Performance Model for Roughness

- Deighton developed roughness models for PennDOT implementation of dTIMS using historic roughness data
- Roughness models against the independent variable of pavement age
- 54 model families evaluated
- Trend lines were fitted through each of the pavement family datasets with exponential and polynomial 2nd and 3rd order forms of the equation
Pavement Performance Model for Roughness

- Example HMA interstate

HMA Interstate
Deterioration Models

• Transition Probability Matrices (TPM’s)
  - Condition data in RMS (based on extent and severity)
  - 54 Model Families
  - 350 TPM’s

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Deterioration Models

- Modeling individual distresses
  - HMA
    - Fatigue Cracking
    - Transverse Cracking
    - Miscellaneous Cracking
    - Edge Deterioration
    - Raveling/Weathering
    - Left Edge Joint Deterioration
    - Rut depth
    - Roughness
    - Bituminous patch (not modeled)
• Modeling individual distresses
  – Composite
    • Fatigue Cracking
    • Transverse Cracking
    • Miscellaneous Cracking
    • Edge Deterioration
    • Raveling/Weathering
    • Left Edge Joint Deterioration
    • Rut depth
    • Roughness
    • Bituminous patch (not modeled)
• Modeling individual distresses
  – Jointed concrete pavement
    • Faulted joints
    • Broken Slabs
    • Transverse Joint Spalling
    • Transverse Cracking
    • Longitudinal Cracking
    • Longitudinal Joint Spalling
    • Bituminous Patch (not modeled)
    • Concrete Patch (not modeled)
    • Rut Depth
    • Roughness
2_Fatigue Cracking

YR00 YR01 YR02 YR03 YR04 YR05 YR06 YR07 YR08 YR09 YR10 YR11 YR12 YR13 YR14 YR15 YR16 YR17 YR18 YR19 YR20 YR21 YR22 YR23 YR24 YR25 YR26 YR27 YR28 YR29 YR30 YR31 YR32 YR33 YR34 YR35 YR36 YR37 YR38 YR39 YR40

NULL L M H
Many District’s sectioned projects themselves in RMS

PAMS will section the roadways not already grouped
  - Business Plan Network must be the same
  - County must be the same
  - District must be the same
  - OPI condition must be within 10
  - Year Resurfacing must be within 5 years
  - Surface Types must be similar
  - Minimum length = 0
  - Maximum length = 10 miles
• 34 Pavement treatments

• Pavement treatment Determination
  - Pavement treatment matrices based on roadway type and condition
  - Cost benefit
PAMS Treatment Selection


Strategy Treatments

Efficiency Chart | Analysis Variables | Analysis Variables Chart | Strategies Chart | Budget Chart

Strategies (Benefit/Cost)