



Pavement Preservation
within an
Integrated Asset Management Framework

A long-exposure photograph of a multi-lane highway at night. The image shows a dense flow of traffic, with the headlights and taillights of cars and trucks blurred into streaks of light, conveying a sense of speed and movement. The road surface is dark, and the lane markings are visible. In the background, there are some structures and a curved ramp on the left side of the frame.

Southeast Pavement Preservation Partnership
Louisville KY
May 28, 2014

Today's Discussion

- Introduction
- Pavement Preservation in Network Level PMS
- Historical Summary
- Current State
- Challenges
- Use within Network Level Analysis
- Summary

Pavement Preservation with PMS

- Pavement Preservation is a core feature of a network level PMS
- Preservation is modeled by modifying rather than replacing the performance prediction of a section
- Target treatments where they are most effective
 - Variable changes to improved condition
 - Variable changes to predicted performance
- Over time we have incorporated many tools to model preservation

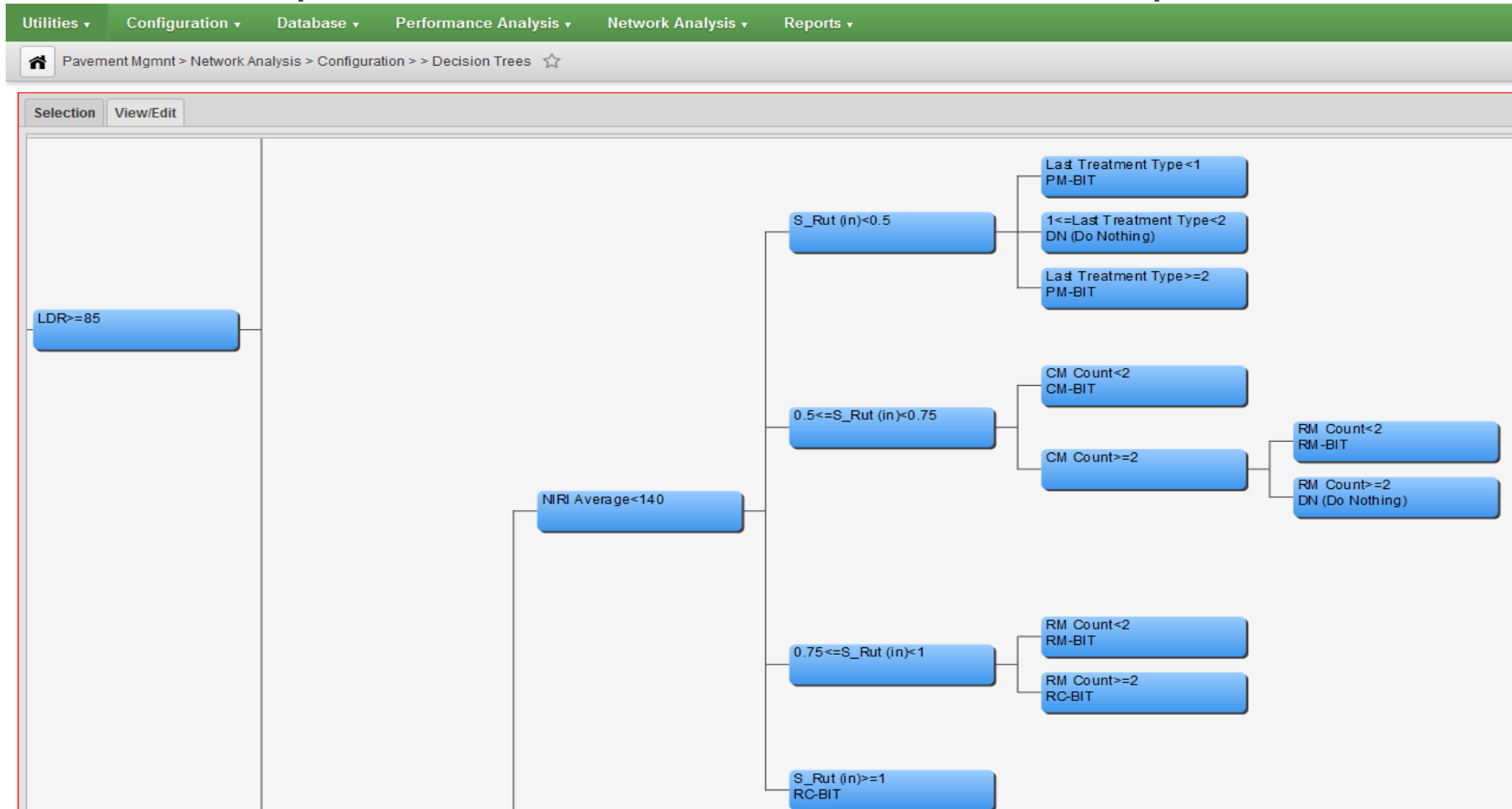
Current Situation

- All of our clients utilize preservation within the PMS analytical framework in some way
- Preservation rules coded into the decision models
- Impact of preservation mostly based on empirical judgment
- Integrated systems are allowing better data capture
 - Over time the systems have matured
 - Users comfortable with the data entry process
 - Location accuracy and data entry QA can still be a problem
- Design assumptions made are not currently utilized by the PMS systems

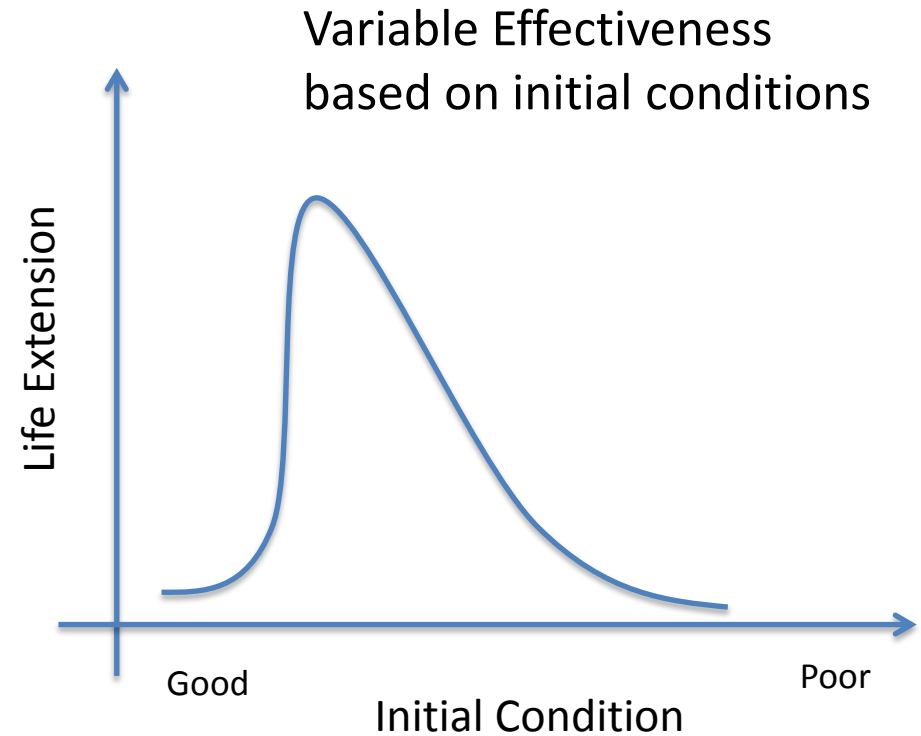
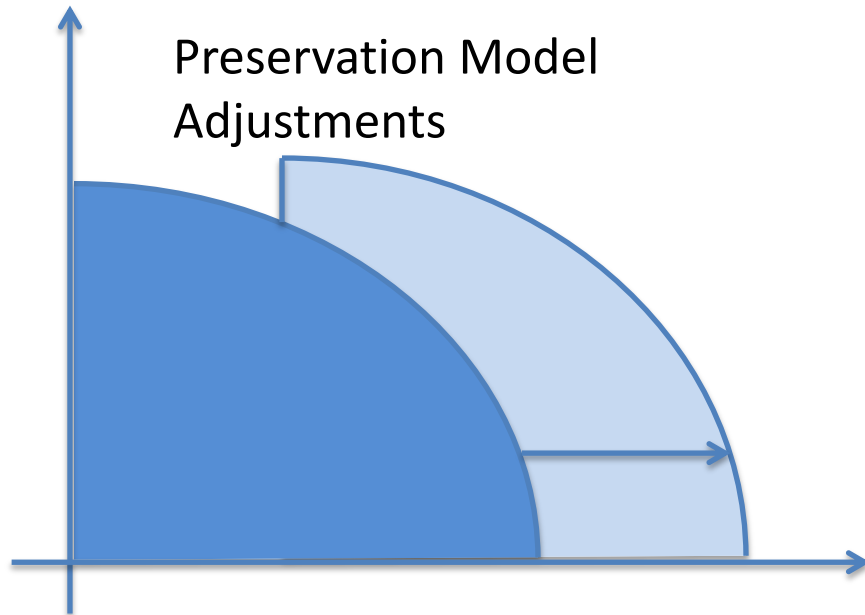


Project and Treatment Selection

- Development of Decision Trees that include preservation



Models Incorporate Preservation Influence



Challenges

- Historical Data Capture
 - Multiple data sources
 - Lack of integration
 - Difficulty with location capture
- Modeling issues
 - Each state's data is different
 - Condition data without adequate preservation history leads to flat performance
 - Models configured with engineering judgment
- Theoretical issues
 - Estimating improvements
 - Estimating changes to performance
 - Interactivity between condition measures
 - Capturing/utilizing design information at the network level

Challenges- Historical Data Capture

- Many agencies have preservation treatments arising from multiple sources
 - In-house maintenance forces
 - Contracted work
- Lack of integration between systems
 - In many agencies the systems that track and/or capture work are not integrated
 - Disparate systems capture only the information required
 - Construction systems capture line items and quantities
 - Maintenance systems tend to capture activity amounts and costs
 - Presents challenges to convert and use the information in a network PMS
- Difficulty with location capture improving with mobile devices and better use of GIS/LRS

Challenges- Historical Data Capture

- Difficulties are now being overcome
 - Integrated systems automatically transfer data between maintenance and PMS systems
 - PMS systems being utilized more for scheduling some preservation activities performed by contract and by in-house forces
 - GPS, GIS and mobile technology should make location capture much better and easier for users
- Contracting and project scheduling/payments systems still present difficulties
 - Locations captured with text descriptions and/or approximate LRS references
 - Line items and payment tracking not easily translated to formats usable by PMS system (layer thicknesses and locations)

Challenges- Modeling

- Lack of historical data has created difficulties with estimating effectiveness with an optimization framework
- Undocumented increases in pavement condition and performance due to preservation lost in the trends and not credited to preservation
- Causes historical modeling data to be “flat”
- Hard to compare pavement with and without treatments in order to objectively quantify benefits
- Many software configuration elements are done with best engineering judgment

Challenges- Modeling

- The modeling process allow the optimization systems to estimate the benefits of preservation treatments
 - Estimates when is the best time to apply a treatment
 - Estimates the benefit gained per dollar spent
- So far these settings have been largely empirical within network level systems
- All the states utilize different data collection techniques and measures
 - Make it difficult to translate lessons learned from agency to agency
 - Requires partnerships with research
 - Now that better records are being captured more opportunities for research

Challenges- Modeling

- Incomplete history shows flat deterioration trends
 - Does not allow the optimization to objectively quantify the improvements gained
 - In many cases shows unreasonable deterioration trends due to lack of information
- As better data becomes available need to partner with research teams to identify
 - Objective measures of post treatment performance
 - Objective measures of treatment effectiveness with respect to
 - Application timing
 - Multiple applications
 - Comparisons to un-treated sections
- Capture these values at the Network Level to incorporate into long range planning

Challenges – Modeling Treatment Effectiveness

- Modeling is used to set the projected “effectiveness” of preservation
- Captured as the different in performance between the treated and untreated pavement
- When analyzing strategies the systems can look at comparing overall pavement condition to budgets for the whole analysis period
- Affected by two entities
 - Improvement in condition immediately post-treatment
 - Change or reduction in predicted deterioration
- The selection of preservation treatments is greatly affected by these quantities in comparison to the performance of rehabilitation treatments

Challenges – Theoretical

- Modeling frameworks being developed have to be applied to local situations and network level data
- Dealing with interactivity
 - In the long run addressing cracking at the right time provides better long term serviceability
 - Need better models applicable to the network level that capture these interactions
- Need to incorporate planned preservation in rehabilitation and new construction into the network level systems
 - Capture the design assumptions for life cycles
 - Incorporate them into the long range planning
 - Account for variances between original designs and actual performance to be sure planned preservation is applied at the right time.

Network Level Analysis

- A PMS can model preservation as one of the tools in the management toolbox
- Investigate the effects of preservation policies and priorities by comparing scenario outputs
- Show the benefits of preservation policies compared to other methods
- Justify needs for preservation budgets
- Can show the impacts of current programs against optimal programs

Scenarios – What types of “What If”

- Evaluate network condition with and without money dedicated to preservation
- Evaluate the amount of money allocated to preservation if no constraints are placed on the allocation
 - What are the impacts on average condition
 - What happens to the network condition distribution
- Setup scenarios to maintain the network with and without criteria on maximum deficient mileage
- Quebec is evaluating palliative treatments
 - “band aid” poor roads until funding can be made available to bring those roads onto a normal life cycle
 - Allows them to keep focus on preservation for roads in good condition
 - Helps to cap poor roads without sacrificing beneficial treatments

Network Analysis - Outputs

- Educational - compare optimized work plans to:
 - worst-first,
 - ranking and other prioritization methods
- The PMS analysis allows for what-if scenarios to be generated for upper level trade-off analysis
 - Use the PMS to provide feedback for high level cross asset analysis
 - Evaluate the impacts of changed funding or policies
- Utilize generated work plans as initial estimate of the preservation program (contracted and in-house)
- Use the finalized work plan to create construction history templates to assist with data entry after the work is completed

Network Analysis Outputs

Transports Québec **Roadway** ERIC / MTQ / System Role
 AgileAssets Management System [Production (PMS_QC@AGILEDBP)] Version 7.X Build 18595
 Quick Links Settings Aide

Setup Databases Network Analysis Reports

Menu Root > Network Analysis > Multi-Constraint Optimization
Sauvegarder les données Récupérer les données

Summary Plots

Optim Graph	GRAPHREP_TYPE_ID	Y Label	Y Max Value	Y Min Value	Y Major Tic	Y Minor Tic
Treatment Cost by Pavement Type	Bar	Budget		0		
Treatment Cost by Treatment	Bar	Budget		0		
Treatment Cost by Budget Category	Bar	Budget		0		
Length by Treatments	Bar	Miles		0		
Percent Miles Treated by Pavement Type	Bar	Percent	1	0		
Percent Above 70 for IRI by Pavement Type	Bar	Percent	1	0		
Avg IRI by Functional Class	Bar	Value	100	0	10	2

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Selected Scenarios

User ID	Scenario #

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Graph Data

Optim Graph	Scenario #	Series Name	X VAL	Y Values
Treatment Cost by Budget Category	New #1601	Curatif	2020	173840608
Treatment Cost by Budget Category	New #1601	Préventif	2020	94816039
Treatment Cost by Budget Category	New #1601	Palliatif	2020	31283168
Treatment Cost by Budget Category	New #1601	Curatif	2021	194639754
Treatment Cost by Budget Category	New #1601	Préventif	2021	77768938

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Treatment Cost by Budget Category

Year	Curatif	Palliatif	Préventif
2012	220,000,000	10,000,000	70,000,000
2013	250,000,000	10,000,000	40,000,000
2014	260,000,000	10,000,000	30,000,000
2015	250,000,000	10,000,000	40,000,000
2016	120,000,000	130,000,000	50,000,000
2017	210,000,000	40,000,000	50,000,000
2018	180,000,000	20,000,000	100,000,000
2019	190,000,000	30,000,000	80,000,000
2020	170,000,000	30,000,000	100,000,000
2021	190,000,000	30,000,000	80,000,000

Impact Analysis

Evaluate Impact on Bridge, Pavement and Overall System



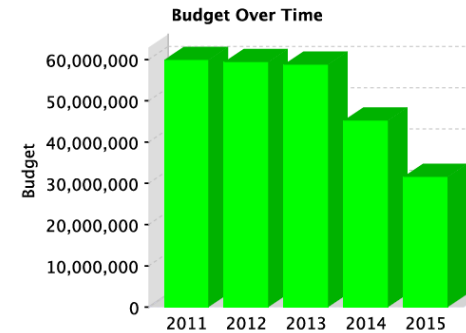
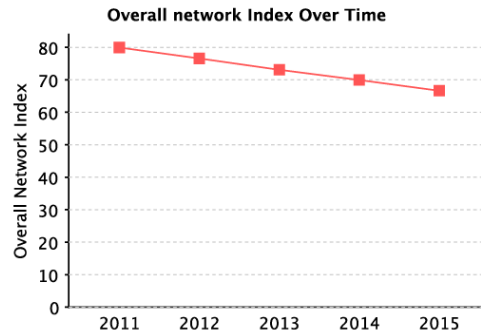
Tradeoff Analysis - Scenario: I-40 5-YRS BMS-30M PMS-30M

Date:04/16/2012

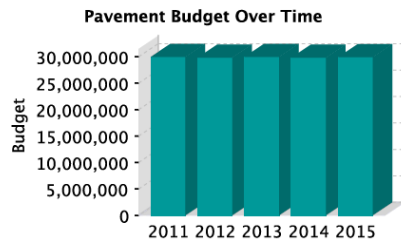
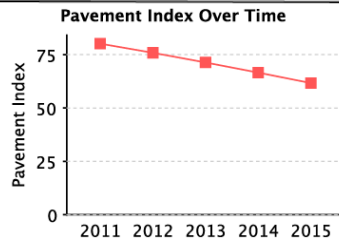
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Start Year = 2010; Number of Years = 5

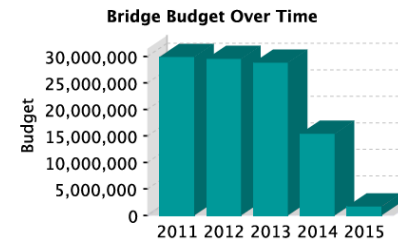
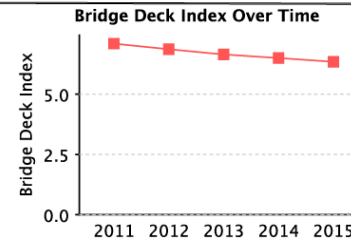
NETWORK



PAVEMENTS



BRIDGES



Summary

- The key element is modeling the preservation as a modification to the pavement performance
- Until recently provisions for gathering and keeping treatment history was difficult
- In recent years many agencies are able to gather more accurate history
- The effects of pavement preservation as modeled within network level systems has so far been mostly empirically developed

Summary

- With better integrated systems and more accurate data calibration of the models used within PMS can be improved modeling
 - Continue focus on accurate data collection of treatments
 - Automate the data collection for upload to the PMS where possible
- Better data sources can be used to research more objective calibration of the PMS
 - Better estimation of modified performance
 - Better estimation of treatment impacts
 - Better estimation of interactivity between preservation
- The PMS can be used to “bubble-up” to the larger asset management model and provide ability to estimate the impacts of funding changes across all agency assets