amec foster wheeler

Factors Affecting the Performance of Pavement Preservation Treatments

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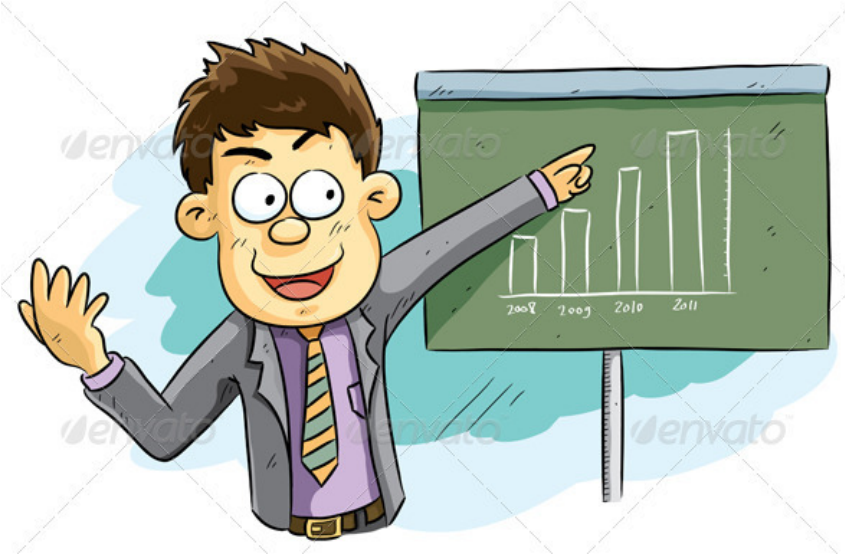
VDOT Virginia Department of Transportation

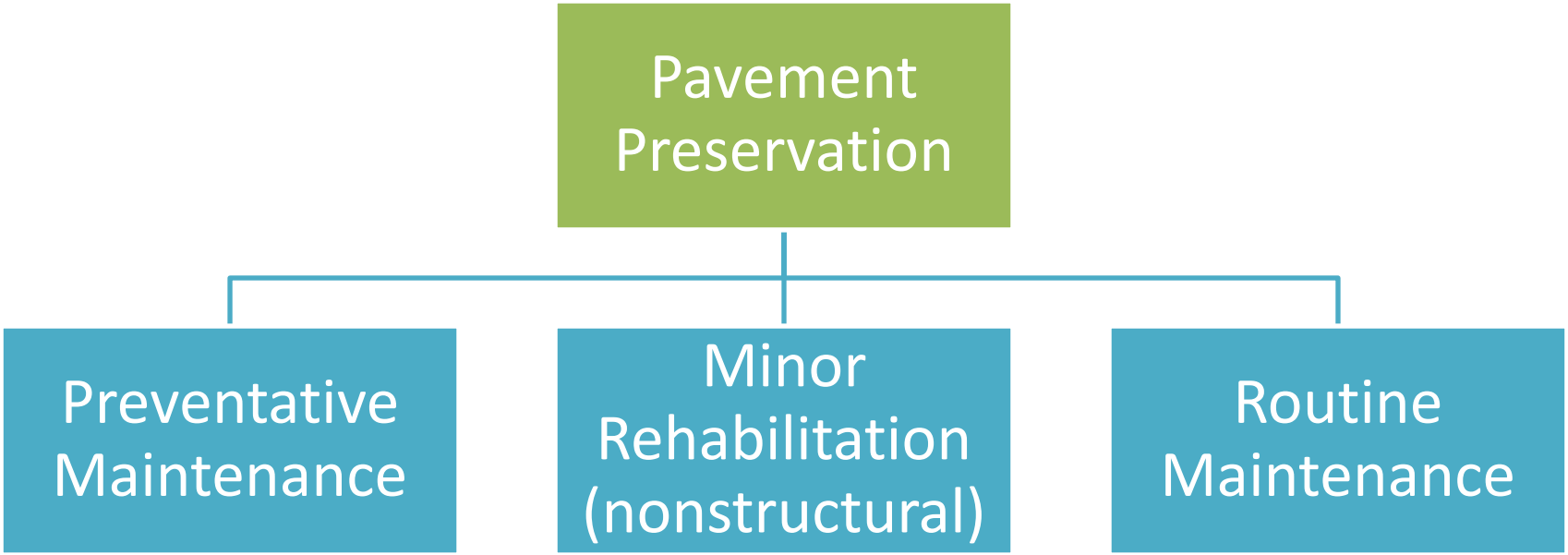
Presentation Outline

- Introduction
- Data Gathering
- Sensitivity Analysis
- Economic Analysis



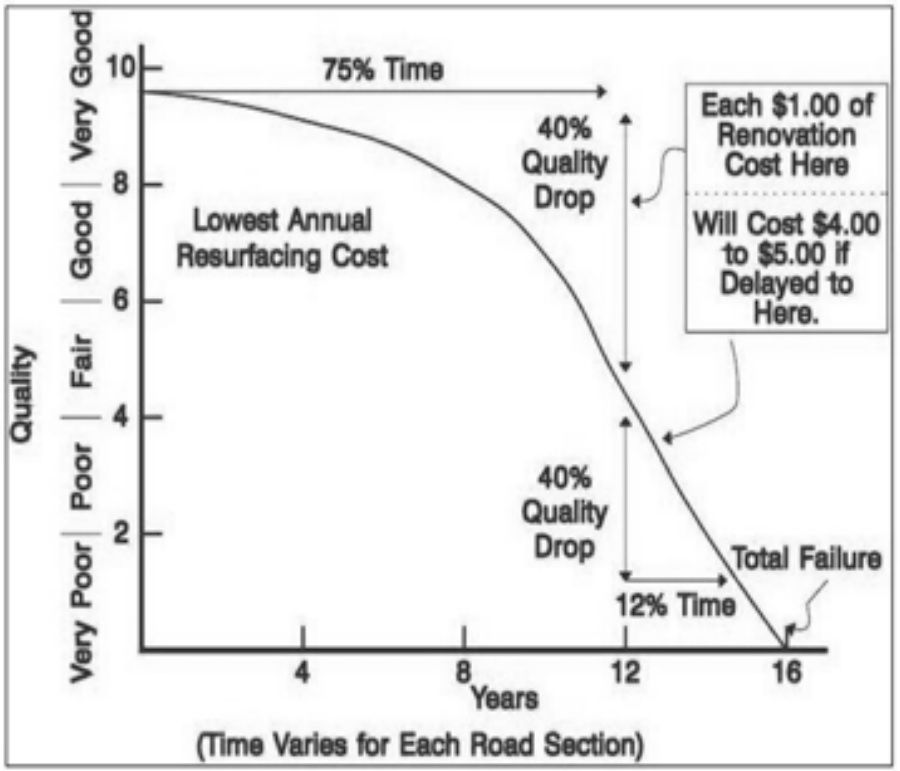
Pavement Preservation

- **Represents proactive approach to maintaining existing highways**



Why Pavement Preservation?

- **Extend pavement's effective service life**
- **Improve pavement service condition**
- **Provide a cost efficient approach in general climate and traffic conditions**



Challenges

- Proof that preventive maintenance treatments can perform and are cost effective
- Factors most affecting the performance of preservation treatments
- Guidance to identify roadway candidates for preservation treatment (i.e. when treatments should be applied)
- What treatment should be applied and its expected life extension of the treatment under varying conditions and climates

Project Objectives

- Assess how the uncertainty in the output of a model (such as the performance of a treatment or the costs) can be apportioned to different factors such as:
  - Pavement condition
  - Construction quality
  - Quality of materials
  - Traffic and climate

Literature Review

- Pre-existing pavement condition
- Construction process
- Materials
- Traffic levels
- Climate

Survey of Experts

- Condition of pavement prior to treatment
- Quality of construction
- Quality of materials
- Design of preservation treatment
- Traffic volume
- Climate

Treatment Types

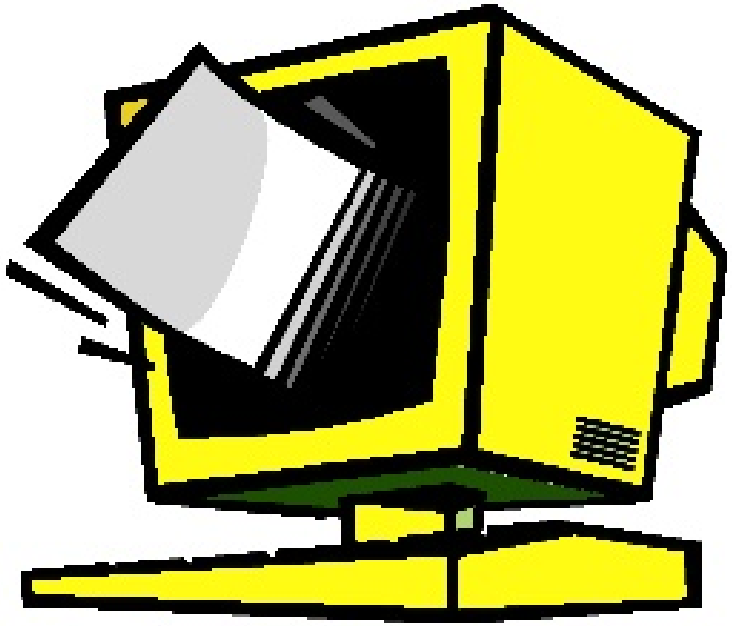
- AC pavements
  - HMA overlay
  - Chip seals
  - Slurry seals
  - Crack sealing

- Concrete pavements
  - Diamond grinding
  - Dowel bar retrofit
  - Crack/joint sealing

Photo: IGGA

Databases

- Support investigation of sensitivity of factors affecting the performance of PP treatments.
- Use of field data considered very important



Viability of Databases

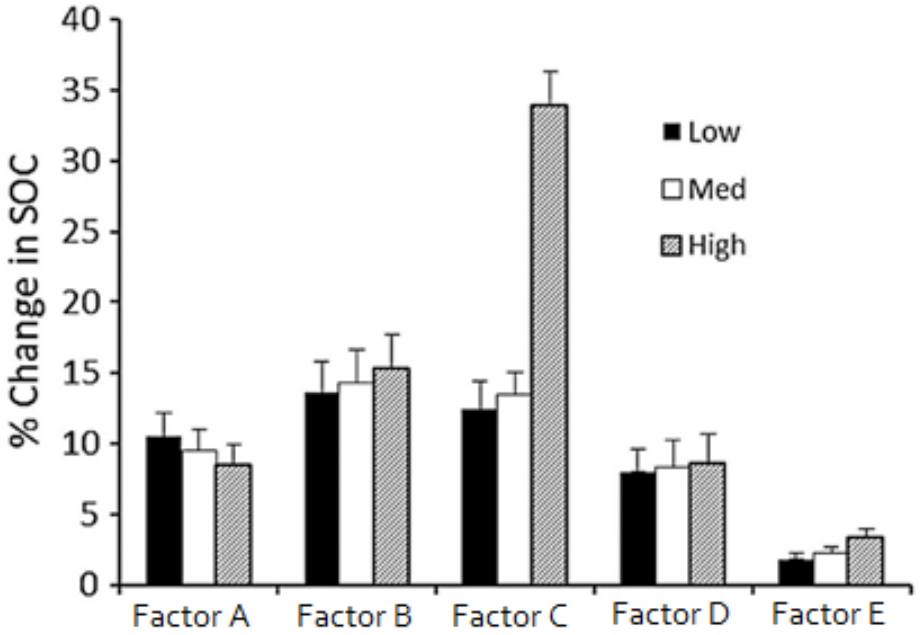
- NCHRP Project 1-48, MEPDG
- 2012 NCHRP Project 14-31, “Developing a Pavement-Maintenance Database”
- LTPP database

Sensitivity Input

- Current databases do not contain adequate information to provide answers relative to the importance of various factors on the resulting performance of preservation treatments.
- Relied on the survey of experts

Sensitivity Analysis

- Identify the expected life of the various treatments
- Develop performance curves
- Risk of failure



Expected Life of Treatment

Treatment Life, Years	Average	Standard Deviation	Lowest	Highest
Thin HMA Overlays (< 1.5")	9	3	4	18
Chip Seals	7	1.9	4	10
Slurry Surfacings	6	1.8	4	12
Crack Sealing	5	2.4	2	12
Diamond Grinding	12	4.3	4	20
Dowel Bar Retrofit	15	3.8	5	20
Joint and Crack Sealing	7	4.1	2	15

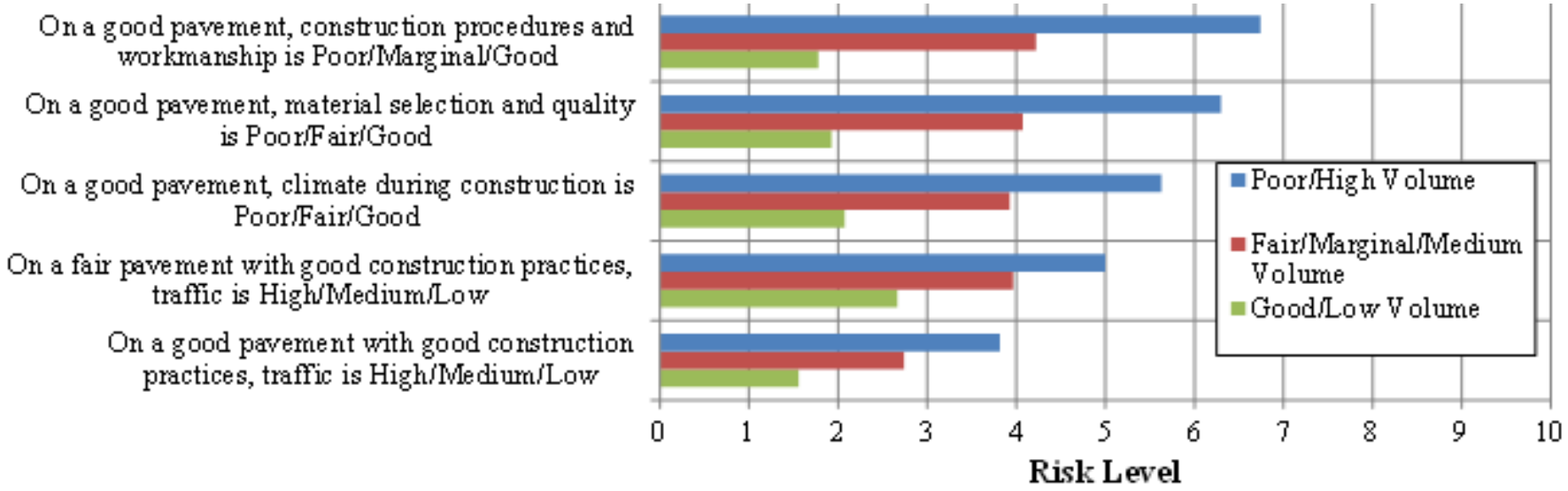
Percent Reduction in Life

Treatment Life Reduction Percentage, %		Thin HMA Overlay	Chip Seal	Slurry Surfacings	DBR	Joint and Crack Sealing
Pretreatment Pavement Condition	Fair	36%	31%	35%	26%	N/A
	Poor	64%	62%	62%	N/A	N/A
Materials Selection and Quality	Marginal	36%	40%	38%	30%	40%
	Poor	57%	64%	62%	53%	60%
Construction and Workmanship	Marginal	45%	46%	44%	42%	44%
	Poor	61%	68%	65%	67%	67%
Mix and Structural Design	Marginal	35%	31%	40%	N/A	N/A
	Poor	57%	51%	62%	N/A	N/A
Traffic Level	Medium	22%	26%	23%	11%	11%
	High	45%	48%	44%	32%	27%
Climate During and Immediately After Construction	Marginal	33%	44%	44%	21%	29%
	Poor	50%	66%	65%	38%	53%

Sensitivity Levels

Factor	Thin HMA Overlay	Chip Seal	Slurry Surfacings	DBR	Joint Sealing
Pretreatment Pavement Condition	1	4	3	5	N/A
Materials Selection and Quality	3	3	5	2	2
Construction and Workmanship	2	1	1	1	1
Mix and Structural Design	4	5	4	N/A	N/A
Traffic Level	6	6	6	4	4
Climate During and Immediately After Construction	5	2	2	3	3

Risk of Early Failure



Highest Risk of Failure – AC

- Thin HMA Overlay
  - Existing pavement in poor condition
  - Poor construction practices and workmanship
- Chip Seal, Slurry Surfacings, and Crack Sealing
  - Existing pavements in poor condition
  - Using poor construction practices or materials, or placing it in poor climate

Highest Risk of Failure – PCC

- Diamond Grinding and Joint and Crack Sealing (PCC)
  - Existing pavement in poor condition
  - Poor construction practices and workmanship
- DBR
  - Poor construction practices and workmanship
  - Poor materials selection and quality

Economic Analysis

- RealCost 2.5
  - Comparison of up to six alternatives
    - Up to 24 activities
- Inputs held constant
  - Traffic, project length, and discount rate
- Inputs varied
  - Type, number and cost of treatments
- Deterministic approach

LCC Comparison

Factor	Condition	Thin HMA Overlay	Chip Seal	Slurry Surfacings	DBR	Joint and Crack Sealing
Pretreatment Pavement Condition	Fair	45%	39%	46%	16%	N/A
	Poor	151%	138%	142%	N/A	N/A
Material Selection and Quality	Marginal	45%	58%	55%	19%	53%
	Poor	107%	156%	142%	36%	124%
Construction and Workmanship	Marginal	66%	73%	67%	26%	65%
	Poor	130%	190%	165%	47%	171%
Mix and Structural Design	Marginal	43%	39%	59%	N/A	N/A
	Poor	107%	92%	142%	N/A	N/A
Traffic Level	Medium	23%	30%	27%	7%	12%
	High	66%	82%	67%	21%	29%
Climate During and Immediately After Construction	Marginal	41%	67%	67%	12%	29%
	Poor	83%	167%	165%	25%	94%

Summary

- Determined how the uncertainty in the output of a model can be apportioned to the different factors
- Variation from good conditions can have a dramatic effect on the life of the pavement preservation treatments and associated costs to the agencies


MAY 18-21, 2015
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Thank you!