Preservation on High Traffic Volume Roadways (SHRP 2 Project R26)

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Presentation Overview

- Background
- Project objectives
- Work approach
- Information gathering and analysis
- Guidelines development
- Implementation
- Questions

Background

- Preservation Definition: Cost-effective non-structural practices that extend pavement life, improve safety, and reduce costly, time-consuming rehab and reconstruction projects and their associated traffic disruptions.

Pavement Preservation Guidelines

	Type of Activity	Increase Capacity	Increase Strength	Reduce Aging	Restore Serviceability
	New Construction	X	X	X	X
	Reconstruction	X	X	X	X
	Major (Heavy) Rehabilitation		X	X	X
	Structural Overlay		X	X	X
Pavement Preservation	Minor (Light) Rehabilitation			X	X
	Preventive Maintenance			X	X
	Routine Maintenance				X
	Corrective (Reactive) Maintenance				X
	Catastrophic Maintenance				X

FHWA Memo (Geiger 2005)

Background (cont)

- Practice of pavement preservation is growing.
- Use on high traffic volume (HTV) roadways is not as widely accepted and is poorly documented.
- Formal guidelines being developed by many agencies do not include pavements with higher average daily traffic (ADT).

Project Objectives

- Develop preservation guidelines for HTV roads.
- Identify promising preservation strategies for HTV roads.

Work Approach

- Information gathering and analysis (Phase I)
  - Conduct literature review
  - Perform comprehensive survey of highway agency practices
- Guidelines development (Phase II)
  - Identify state-of-the-practice
  - Develop detailed guidelines on preservation strategies for HTV roadways

State of the Practice

- Types of treatments that can be successfully used on HTV roads
  - Per literature review and agency surveys

State of the Practice (cont)

- Factors that can influence selection of treatments
  - Performance attributes
    - Effect of existing pavement condition on treatment performance
    - Effect of traffic volume on treatment performance
    - Effect of climate (direct and indirect) on treatment performance
    - Effect of treatment on pavement condition, serviceability, safety, and noise

State of the Practice (cont)

– Constructability issues
  - Costs (agency and user)
  - Complexity of construction
  - Availability of skilled and experienced contractors
  - Need for specialized equipment or materials
  - Availability of quality materials
  - Environmental constraints
  - Traffic disruption
  - Traffic control constraints
  - Restrictions on available time for lane closures to complete the work

Guidelines for the Preservation of HTV Roadways

- Treatment Selection Process/Framework
  - Sequential approach for evaluating possible preservation treatments for an existing pavement and identifying the preferred one
  - Key components
    - Treatment feasibility matrices
    - Cost-effectiveness analysis
    - Treatment decision matrix
- Treatment Summaries
- Example Application

Treatment Selection Process/ Framework (Part 1)

Evaluate Current and Historical Pavement Performance Data
(from field surveys and testing and/or agency PMS database)

- Overall Condition Indicator (PCI, PSR, etc.)
- Distress Types, Severities, and Extents
- Smoothness (IRI, PI)
- Surface and Subsurface Drainage Characteristics
- Safety Characteristics
  - friction/texture (FN, MPD/MTD, IFI)
  - crashes
- Pavement–Tire Noise

Review Historical Design, Construction, and Maintenance and Rehabilitation (M&R) Data

- Pavement Type and Cross-Sectional Design
- Materials and As-Built Construction
- M&R Treatments (materials, thicknesses, etc.)

Decision–Preservation??

Develop Preliminary Set of Feasible Preservation Treatments

Treatment Selection Process/ Framework (Part 2)

Develop Preliminary Set of Feasible Preservation Treatments

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Assess Specific Needs and Constraints of Project

Performance Needs

- Treatment Life
  - ➢ traffic effects (functional class, traffic level)
  - ➢ climate/environment effects
- Risk
  - ➢ Availability of qualified contractors, quality mtls

Construction Constraints

- Funding
- Time (of year) of construction
- Geometrics
- Work duration (facility downtime)
- Traffic accommodation

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Develop Final Set of Feasible Preservation Treatments

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Select the Preferred Preservation Treatment

- Conduct Cost-Effectiveness Analysis
  - ➢ Benefit-Cost Analysis
  - ➢ Life-Cycle Cost Analysis (LCCA)
- Evaluate Economic and Non-Economic Factors

Preliminary ID of Feasible Treatments

Preservation Treatment	Window of Opportunity PCI/PCR	Window of Opportunity Age (yr)	Distress Types and Severity Levels (L = Low, M = Medium, H = High)														Characteristics Issues		
			Surface Distress					Cracking Distress					Deformation Distress						
			Ravel/ Weather	Bleed/ Flush	Polish	Segre-gation	Water Bleed/ Pump[a]	Fatigue/ Long WP/ Slippage	Block	Trans Therm	Joint Reflect	Long/ Edge	Wear/ Stable Rutting[b]	Corrug/ Shove[c]	Bumps/ Sags	Patches	Ride Quality	Friction	Noise
			L/M/H	—	—	L/M/H	—	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	L/M/H	—	—	—
Crack fill	75–90	3–6[d]						×××	⊙○×	○××	○××	●⊙○							
Crack seal	80–95	2–5[d]						×××	⊙○×	●⊙○	●⊙○	○××							
Slurry seal (Type III)	70–85	5–8	⊙●⊙	×	⊙	⊙○×	⊙	⊙○×	●⊙○	⊙○×	⊙○×	⊙○×	○××	×××	×××	⊙○×	×	⊙	⊙
Microsurfacing: Single	70–85	5–8	⊙●⊙	×	⊙	●⊙○	⊙	⊙○×	●⊙○	⊙○×	⊙○×	⊙○×	⊙○×	○××	×××	⊙○×	○	●	⊙
Microsurfacing: Double	70–85	5–8	⊙●⊙	×	⊙	●⊙○	○	⊙○×	●⊙○	●⊙○	●⊙○	●⊙○	●⊙○	○○×	○○×	●⊙○	⊙	●	⊙
Chip seal: Single Conventional Polymer modified	70–85	5–8	⊙●⊙	○	●	●⊙○	⊙	⊙××	●⊙○	●⊙○	●⊙○	●⊙○	⊙○×	○○×	○○×	⊙⊙○	○	●	×
Chip seal: Double Conventional Polymer modified	70–85	5–8	○⊙⊙	×	⊙	⊙⊙○	×	⊙○×	●⊙⊙	●⊙⊙	●⊙⊙	●⊙⊙	●⊙○	⊙○×	⊙○×	●⊙⊙	⊙	⊙	○
Ultra-thin bonded wearing course	65–85	5–10	⊙●⊙	×	●	⊙⊙○	○	⊙○×	⊙⊙○	⊙⊙○	⊙⊙○	⊙⊙○	⊙○×	⊙○×	⊙○×	⊙⊙○	⊙	●	⊙
Ultra-thin HMAOL	65–85	5–10	⊙●⊙	×	●	⊙⊙○	○	⊙○×	⊙⊙×	⊙⊙×	⊙⊙×	⊙⊙×	⊙○×	⊙○×	⊙○×	⊙⊙○	⊙	●	●
Thin HMAOL	60–80	6–12	⊙●⊙	○	●	⊙⊙○	○	⊙●×	●●⊙	⊙●⊙	⊙●⊙	⊙⊙●	⊙●⊙	●⊙○	●⊙○	●●⊙	●	●	●
Cold milling and thin HMAOL	60–75	7–12	○⊙●	○	○	⊙●⊙	○	⊙⊙○	○⊙⊙	⊙⊙●	⊙⊙●	○⊙●	⊙●⊙	●⊙⊙	●⊙○	●●⊙	●	⊙	○
Hot in-place recycling Surf recycle/HMAOL	70–85	5–8	○⊙●	○	○	⊙●○	○	⊙⊙○	●⊙○	○⊙●	○⊙●	⊙⊙○	⊙●⊙	⊙⊙○	⊙⊙○	⊙⊙○	⊙	⊙	○
Remixing/HMAOL	60–75	7–12	×○○	○	○	×○⊙	×	⊙●⊙	⊙●⊙	⊙●⊙	⊙●⊙	⊙●⊙	⊙●●	⊙●●	○⊙●	○⊙⊙	●	⊙	○
Repaving																			
Cold in-place recycling and HMAOL	60–75	7–12	××○	○	○	×○⊙	×	⊙●⊙	⊙●⊙	⊙●⊙	⊙●⊙	⊙●⊙	⊙●●	⊙●●	○⊙●	○⊙⊙	●	⊙	○
Profile milling	80–90	3–6	○⊙⊙	⊙	○	×○○	×	×××	×××	×××	×××	×××	●⊙○	○××	⊙⊙○[e]	⊙⊙○[e]	⊙	○	×
Ultra-thin whitetopping	60–80	6–12	××○	○	⊙	×○⊙	×	○⊙⊙	○⊙⊙	○⊙⊙	○⊙⊙	○⊙●	○⊙⊙	○⊙⊙	×○○	○⊙⊙	⊙	○	×

● Highly Recommended ◉ Generally Recommended
○ Provisionally Recommended × Not Recommended

Treatment Candidates—Raveling/Weathering

	L/M/H
Crack Fill	
Crack Seal	
Slurry Seal (Type III)	⦿●⦿
Microsurfacing-Single	⦿●⦿
Microsurfacing-Double	⦿●⦿
Chip Seal-Single	
Conventional	⦿●⦿
Polymer-modified	○⦿⦿
Chip Seal-Double	
Conventional	○⦿⦿
Polymer-modified	○○⦿
Ultra-Thin Bonded Wearing Course	⦿●⦿
Ultra-Thin HMAOL	⦿●⦿
Thin HMAOL	⦿●⦿
Cold Milling and Thin HMAOL	○⦿●
Hot In-place Recycling	
Surf Recycle/HMAOL	○⦿●
Remixing/HMAOL	×○○
Repaving	×○○
Cold In-place Recycling and HMAOL	××○
Profile Milling	○⦿⦿
Ultra-Thin Whitetopping	××○

●Highly Recommended
⦿ Generally Recommended
○Provisionally Recommended
× Not Recommended

Final ID of Candidate Treatments

Preservation Treatment	Treatment Durability: Rural Roads: High Traffic ADT >5,000 vpd	Rural Roads: Climatic Zone: Deep Freeze	Rural Roads: Climatic Zone: Moderate Freeze	Rural Roads: Climatic Zone: Nonfreeze	Urban Roads: High Traffic ADT >10,000 vpd	Urban Roads: Climatic Zone: Deep Freeze	Urban Roads: Climatic Zone: Moderate Freeze	Urban Roads: Climatic Zone: Nonfreeze	Work Zone Duration Restrictions: Overnight or Single Shift	Work Zone Duration Restrictions: Weekend	Work Zone Duration Restrictions: Longer	Expected Performance on High-Volume Facility (yr)	Relative Cost
Crack fill	●	●	●	●	●	●	●	●	●			2–3	$
Crack seal	●	●	●	●	●	●	●	●	●			2–6	$
Slurry seal (Type III)	○	×	◉	◉	○	×	◉	◉	●			3–5	$$
Microsurfacing: Single	◉	◉	●	◉	◉	◉	●	◉	●			3–5	$$
Microsurfacing: Double	◉	◉	●	◉	◉	◉	●	◉	●			4–6	$$/$$$
Chip Seal: Single													
Conventional	◉	●	◉	◉	◉	◉	◉	◉	●			4–6	$$
Polymer modified													$$$
Chip Seal: Double													
Conventional	◉	●	◉	◉	◉	◉	◉	◉	●			6–8	$$/$$$
Polymer modified													$$$
Ultra-thin bonded wearing course	◉	◉	●	◉	◉	◉	●	◉	●			5–8	$$$
Ultra-thin HMAOL	○	○	◉	×	◉	◉	●	○	●			4–7	$$
Thin HMAOL	●	●	●	◉	●	●	●	◉	●			5–10	$$$
Cold milling and thin HMAOL	●	●	●	◉	●	●	●	●	●			6–11	$$$
Hot in-place recycling													
Surf recycle and HMAOL												5–8	$$$
Remixing and HMAOL	○	○	×		○	○	◉	○	●			6–12	$$$
Repaving												6–12	$$$
Cold in-place recycling and HMAOL	◉	◉	◉	○	◉	◉	◉	◉	●			5–11	$$$
Profile milling	◉	○	◉	◉	◉	○	●	◉	●			2–4	$
Ultra-thin whitetopping	○	○	○	○	○	○	◉	○	×	○	◉	NA	$$$$

HMA-Surfaced Pavements

● Highly Recommended ◉ Generally Recommended
○ Provisionally Recommended × Not Recommended

Treatment Candidates—Rural Roads, Deep-Freeze Climate

Crack Fill	●
Crack Seal	●
Slurry Seal (Type III)	×
Microsurfacing-Single	⦿
Microsurfacing-Double	⦿
Chip Seal-Single **Conventional** **Polymer-modified**	 ● ●
Chip Seal-Double **Conventional** **Polymer-modified**	 ● ●
Ultra-Thin Bonded Wearing Course	⦿
Ultra-Thin HMAOL	○
Thin HMAOL	●
Cold Milling and Thin HMAOL	●
Hot In-place Recycling **Surf Recycle/HMAOL** **Remixing/HMAOL** **Repaving**	 ○ ○ ○
Cold In-place Recycling and HMAOL	⦿
Profile Milling	○
Ultra-Thin Whitetopping	○

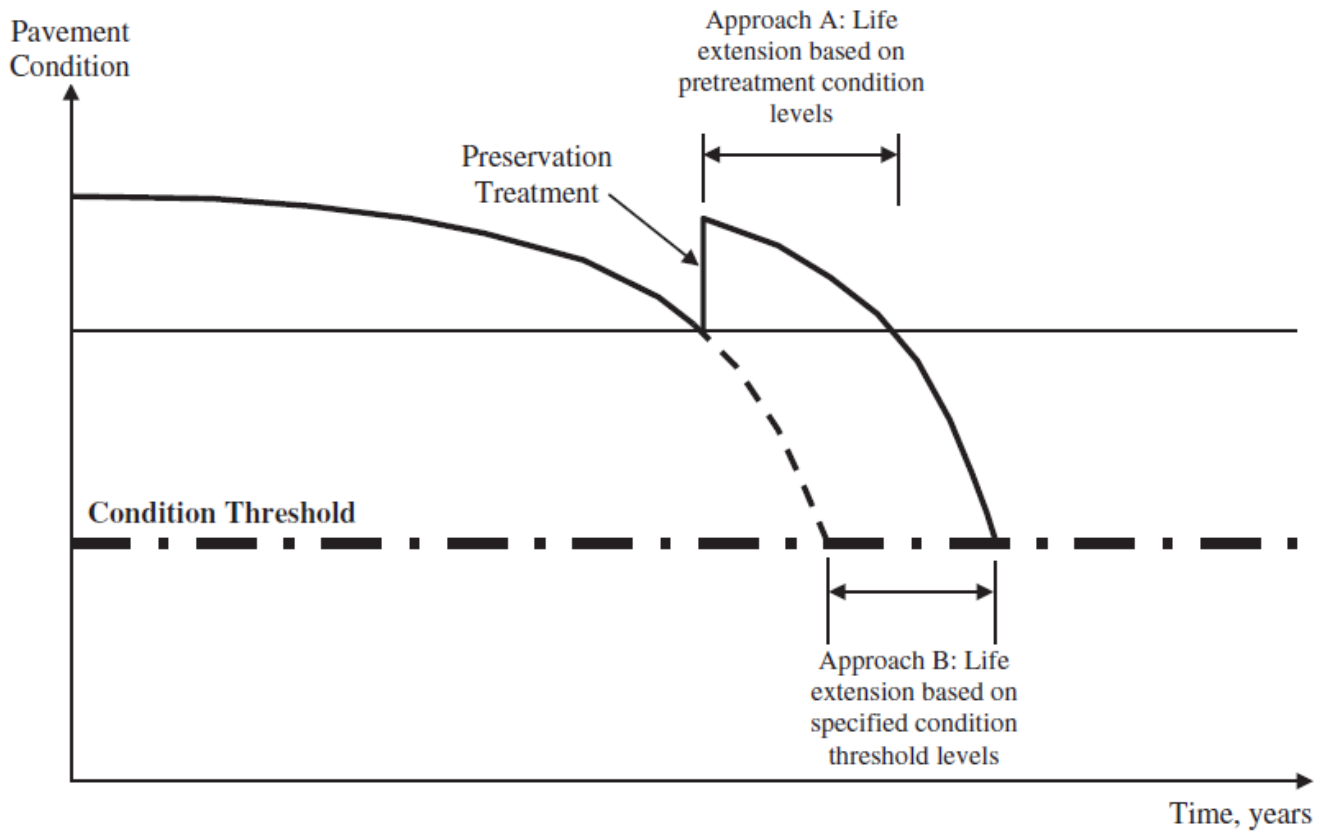
●Highly Recommended
⦿ Generally Recommended
○Provisionally Recommended
× Not Recommended

Treatment Cost-Effectiveness Analysis

- Two analysis approaches
  - Equivalent annual cost (EAC) (simplest)
  - Benefit-cost ratio (BCR) (more detailed)
- Treatment performance and cost estimates required for both

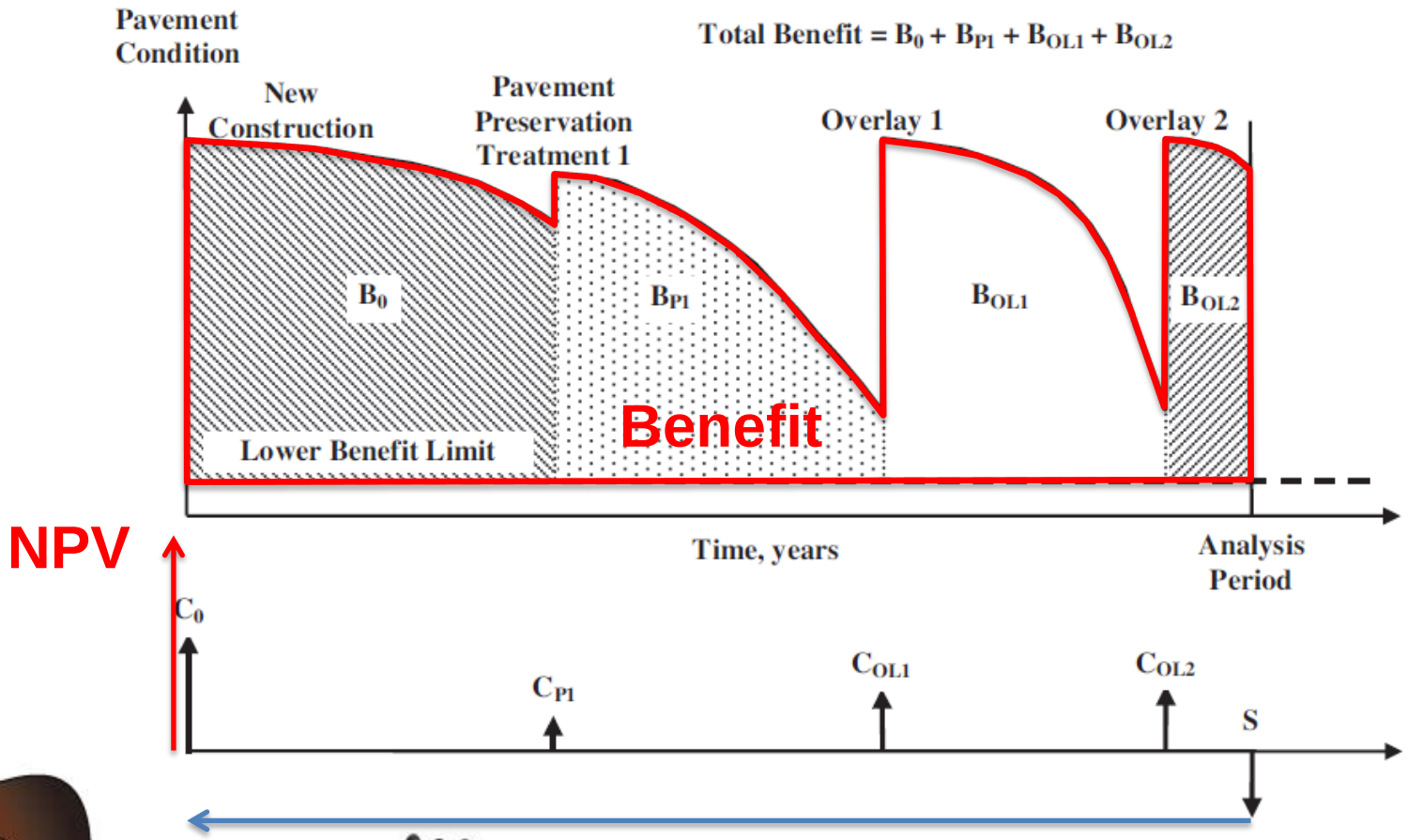
Equivalent Annual Cost

EAC = Treatment Unit Cost / Expected Performance



Benefit-Cost Ratio

BCR = Benefit / NPV

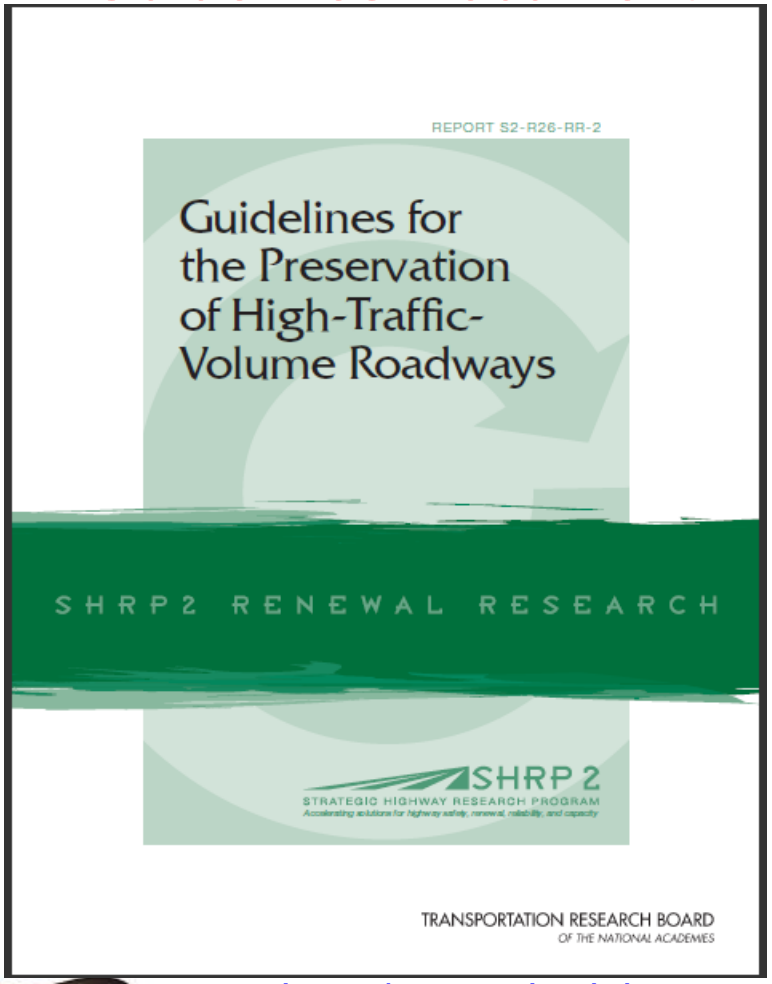


Treatment Decision Matrix

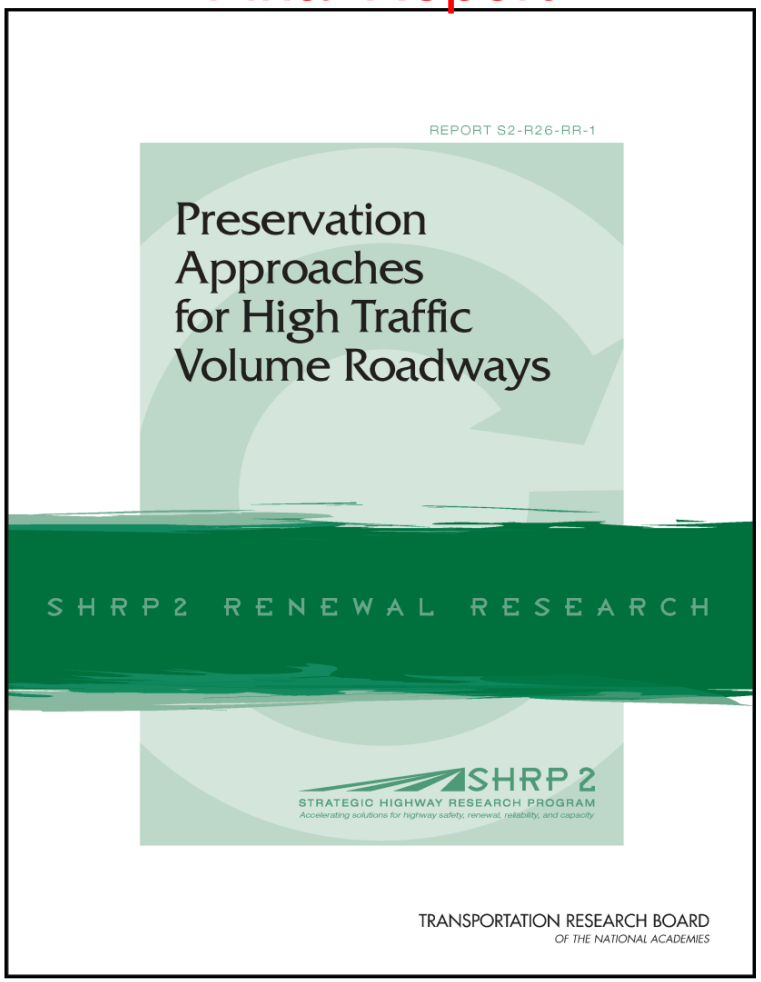
Attribute and Selection Factor	Attribute Weight	Factor Weight	Combined Weight	Treatment 1		Treatment 2	
				Rating Score	Weighted Score	Rating Score	Weighted Score
Economic	40						
Initial cost		30	12.0				
Cost-effectiveness		30	12.0				
Agency cost		10	4.0				
User cost		30	12.0				
Total		100					
Construction/materials	25						
Availability of qualified contractors		20	5.0				
Availability of quality materials		20	5.0				
Conservation of materials/energy		30	7.5				
Weather limitations		30	7.5				
Total		100					
Customer satisfaction	25						
Traffic disruption		40	10.0				
Safety issues		40	10.0				
Ride quality and noise issues		20	5.0				
Total		100					
Agency policy/preference	10						
Continuity of adjacent pavements		20	2.0				
Continuity of adjacent lanes		20	2.0				
Local preference		60	6.0				
Total		100					
			Cumulative Weighted Score				

Implementation

Guidelines Document



Final Report



www.trb.org/StrategicHighwayResearchProgram2SHRP2/Pages/Pavements_490.aspx

Implementation (cont)

- AASHTO/FHWA *Program Management Contract for SHRP 2*
  - Initiated: Spring 2012
  - Objective: Provide program support to assist FHWA, AASHTO, TRB, NHTSA, and State DOTs in implementing SHRP 2 products. Provide Program Management services, with a focus on efficiency, that will help facilitate product deployment and reduce overall costs of the program, while getting the best products to clients quickly.

Implementation (cont)

- SHRP 2 R31, *Integrated Delivery of SHRP 2 Renewal Research Projects*
  - Initiated April 2012
  - Objective: Develop a tool or set of tools to promote and support systematic and integrated application of SHRP 2 Renewal products. The tools are expected to enhance a transportation agency's ability to consistently apply rapid renewal in the development and execution of the planning, design, construction, maintenance, and preservation of their infrastructure.

Thanks---Questions??

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