Life-Cycle Cost Analysis

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Objective

FHWA Updates & LCCA

1. FHWA Updates
2. LCCA program status
3. State Example

FHWA Updates

Keeping Good Roads Good

2010-2011

Corridor assessment

- I-95 corridor
- What data are states using to manage “conditions” of I-95
- Common performance indicators
- Good, Fair or Poor
- MD-DE-VA
- “Evaluation of Highway Performance Measures for a Multi-Study Corridor - A Pilot Study” http://www.fhwa.dot.gov/asset/hif10015/

Keeping Good Roads Good

Infrastructure Health Project

- 2 objectives

1. Identify performance indicators
   - Good, fair & poor
   - Condition Data needed
   - Reported

2. Identify pavement health indicators
   - What do we need to measure

Maintenance Leadership Academy

- Four-week training, blended learning
- Target audience: state and local maintenance supervisors
- Strong emphasis on preservation and performance improvement

Maintenance Leadership Academy

Six Modules

- ✓ Maintenance Management
- ✓ System Preservation
- ✓ Roadsides and Drainage
- ✓ Weather-related Operations
- ✓ Safety and Workzones

Life-Cycle Cost Analysis

LCCA Program Status

- Distance Learning Course
- Onsite RealCost LCCA Workshop
- RealCost User Manual
- Technical Bulletin
- Bridge LCCA

Life-Cycle Cost Analysis Definition

- Life-Cycle Cost Analysis is a **process** for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future costs, such as maintenance, user, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project segment.

Source: Transportation Equity Act for the 21st Century

Pavement Preservation vs. Reconstruction

State Examples

Arizona State DOT

Washington State DOT

Pavement Preservation vs. Reconstruction

Arizona Department of Transportation

- Continuous weakening of substructure material
- Cost & performance
- Sponsored a Study - *Cost-Benefit Analysis of Continuous Pavement Preservation Design Strategies Versus Reconstruction Final Report 491*

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Arizona Department of Transportation

- Break-even
- Continuous preservation
- Rehabilitation treatments

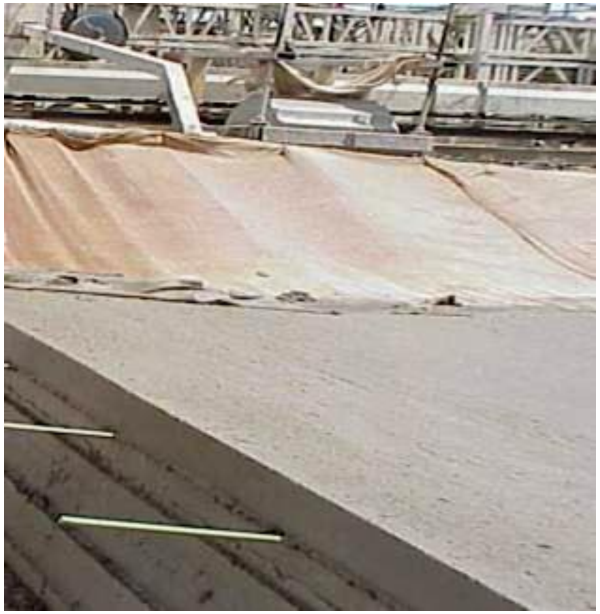
Arizona Department of Transportation

Life-Cycle cost Analysis (LCCA)

- Probabilistic approach
- FHWA's LCCA spreadsheet program
- RealCost, Version 2.1 (FHWA, 2004)

Input Analysis

- ✓ Pavement performance
- ✓ Service life estimates
- ✓ Best estimates of unit costs
- ✓ Work zone-related user cost
- ✓ Discount rates
- ✓ Analysis period



Alternative Strategies

- Life Cycle Cost
  - 4 strategies
  - 15 commonly occurring pavement scenarios

Traffic Info Used in LCCA

Project ID	AADT, veh/day [a]	Cars as Percentage of AADT, %	Percent Single Trucks [b]	Percent Combo Unit Trucks [b]	Annual Growth of Traffic, %	Speed Limit, mi/hr	Lanes Open [c]	Free Flow Capacity, vphpl	Rural or Urban?[d]	Queue Dissipation Capacity, vphpl	Maximum AADT, veh/day [e]	Maximum Queue Length, mi
Cell 1	10,000	77	13	10	2.5	70	2	2,200	Rural	1,800	100,000	4
Cell 2	18,000	72	18	10	2.5	70	2	2,200	Rural	1,800	100,000	4
Cell 3	13,000	85	5	10	2.5	55	1	2,200	Rural	1,800	100,000	4
Cell 4	6,000	84	6	10	2.5	55	2	2,200	Rural	1,800	100,000	4
Cell 5	7,500	83	7	10	2.5	55	2	2,200	Rural	1,800	100,000	4
Cell 6	17,000	66	24	10	2.5	70	2	2,200	Rural	1,800	100,000	4
Cell 7	23,000	75	15	10	2.5	70	2	2,200	Rural	1,800	100,000	4
Cell 8	9,000	79	11	10	2.5	55	2	2,200	Rural	1,800	100,000	4
Cell 9	14,000	80	10	10	2.5	55	1	2,200	Rural	1,800	100,000	4
Cell 10	1,400	83	7	10	2.5	55	1	2,200	Rural	1,800	100,000	4
Cell 11	17,000	66	24	10	2.5	70	2	2,200	Rural	1,800	100,000	4
Cell 12	80,000	85	5	10	2.5	55	3	2,200	Urban	1,800	100,000	4
Cell 13	25,000	75	15	10	2.5	70	2	2,200	Rural	1,800	100,000	4
Cell 14	240,000	81	9	10	2.5	55	5	2,200	Urban	1,800	100,000	4
Cell 15	75,000	86	4	10	2.5	55	3	2,200	Urban	1,800	100,000	4

Agency Construction Cost

Bid Item	Unit	Description Bid Item Components	Unit Price	Quantity Per Day
Asphalt Concrete Friction Course (FC)	ton	Asphalt Concrete Friction Course	$28.13	2,000
	ton	Asphalt Cement for ACFC	$154.03	
	ton	Mineral Admixture for ACFC	$97.42	
Asphalt Rubber AC Friction Course (FR)	ton	Asphalt Rubber AC Friction Course	$29.44	2,000
	ton	Asphalt Cement for AR-ACFC	$274.99	
	ton	Mineral Admixture for AR-ACFC	$97.42	
Asphalt Concrete (AC)	ton	Asphalt Concrete (3/4" Mix)	$22.09	2,000
	ton	Asphalt Cement for AC (3/4" Mix)	$154.03	
	ton	Mineral Admixture for AC (3/4" Mix)	$97.42	
Asphalt Rubber AC (AR)	ton	Asphalt Rubber AC	$25.65	2,000
	ton	Asphalt Cement for AR-AC	$260.48	
	ton	Mineral Admixture for AR-AC	$97.42	
Continued….				

Agency Construction Cost

Bid Item	Unit	Description Bid Item Components	Unit Price	Quantity Per Day
Bituminous Pavement (milling)	yd^2	Milling depth = 0.5"	$0.54	20,000
	yd^2	Milling depth = 1.0"	$0.76	18,000
	yd^2	Milling depth = 2.0"	$1.10	16,000
	yd^2	Milling depth = 2.5"	$1.25	15,000
	yd^2	Milling depth = 3.0"	$1.35	14,000
	yd^2	Milling depth = 3.5"	$1.40	13,500
	yd^2	Milling depth = 4.0"	$1.50	13,000
	yd^2	Milling depth = 4.5"	$1.60	12,500
	yd^2	Milling depth = 5.0"	$1.70	12,000
JPC (nondoweled PCC)	yd^2	11.0-in PCC	$27.00	2,500
	yd^2	12.0-in PCC	$29.00	
	yd^2	12.5-in PCC	$30.00	
	yd^2	13.0-in PCC	$31.00	
	yd^2	13.5-in PCC	$32.00	
Continued…				

Value of Time

Parameter	Cost
Value of Time for Passenger Cars ($/hour)	$3.08
Value of Time for Single Unit Trucks ($/hour)	$20.95
Value of Time for Combination Trucks ($/hour)	$25.21

Final results

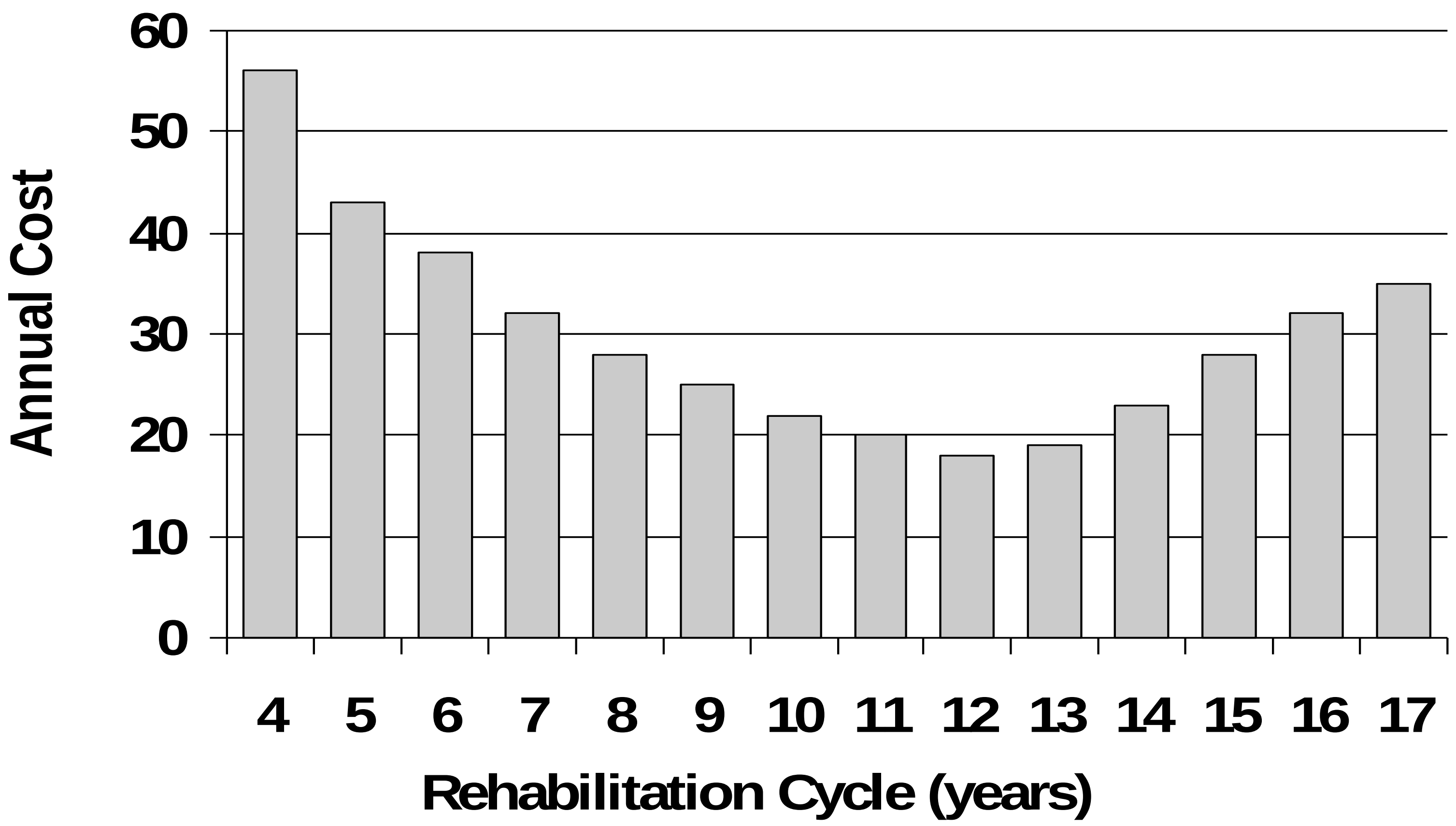
- Reduction in total LCC
- Increase (from 0 to 2) in the number of rehabs between original construction and the first reconstruction events
- 9 of the 15 scenarios
- Break-even point
  - Occurs after 2 to 3 cycles of rehab

Pavement Preservation vs. Reconstruction

Washington State DOT

- 1993 Revised Code WA
  - Required project selection be based on the lowest life cycle cost concept
  - Optimal timing (opportunity window) 2 to 3 yrs

Washington State DOT



Washington State DOT

Network level Economic Analysis

- Design life yielded the most benefits

- Pavement Management System (PMS)
  - Pavements
  - Anticipated deterioration curves
  - Rehabilitation activity cycles
  - Anticipated costs in the year the activity would occur

Washington State DOT

- “worst first” to “ a needs based approach”.

- 3 performance measures of pavement distress.

  1. Pavement Structural Condition (PSC)
  2. International Roughness Index (IRI)
  3. Rutting

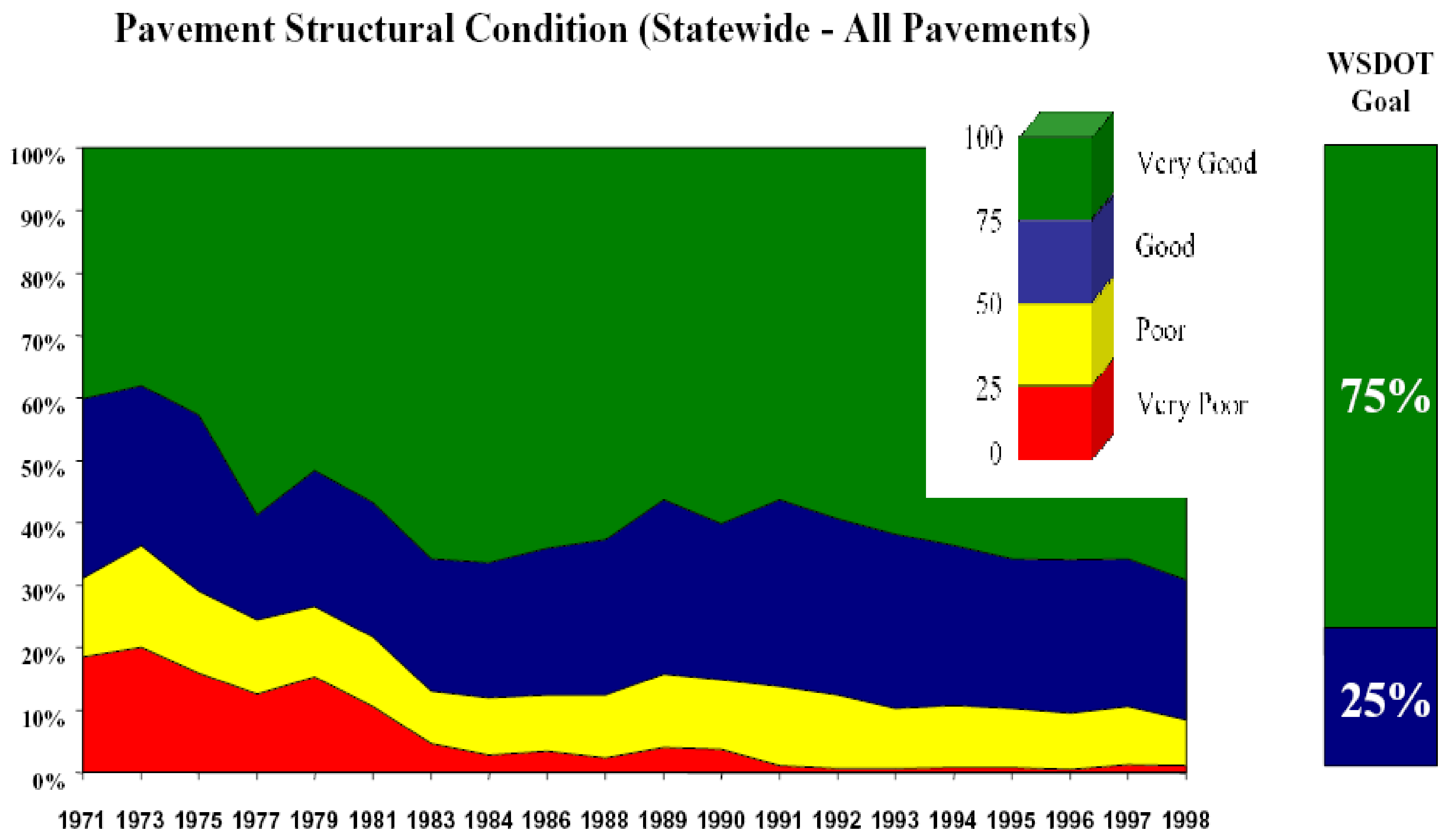
Washington State DOT

Minimum Rating

- 50 for PSC
- 220 inches/mile for IRI
- 10 mm (.4 in) for rutting

- The LCCA validation process was conducted again in 2000

Washington State DOT



Washington State DOT

- Lowest LCC by conducting preservation activities
  - Early stages of deterioration to prolong their life
  - Need for major rehabilitation

Washington State DOT

- Success is measured by network condition of their pavements
- In 1971
  - 50% poor conditions
- Today
  - Less 10% are in poor condition

Resource Documentation

- **Arizona report**

  Cost-Benefit Analysis of Continuous Pavement Preservation Design Strategies Versus Reconstruction

http://www.fhwa.dot.gov/infrastructure/asstmgmt/lcca.cfm

- **FHWA Case Study**

  Pavement Management Systems

  The Washington State Experience

http://www.fhwa.dot.gov/pavement/pub_details.cfm?id=626

Resources

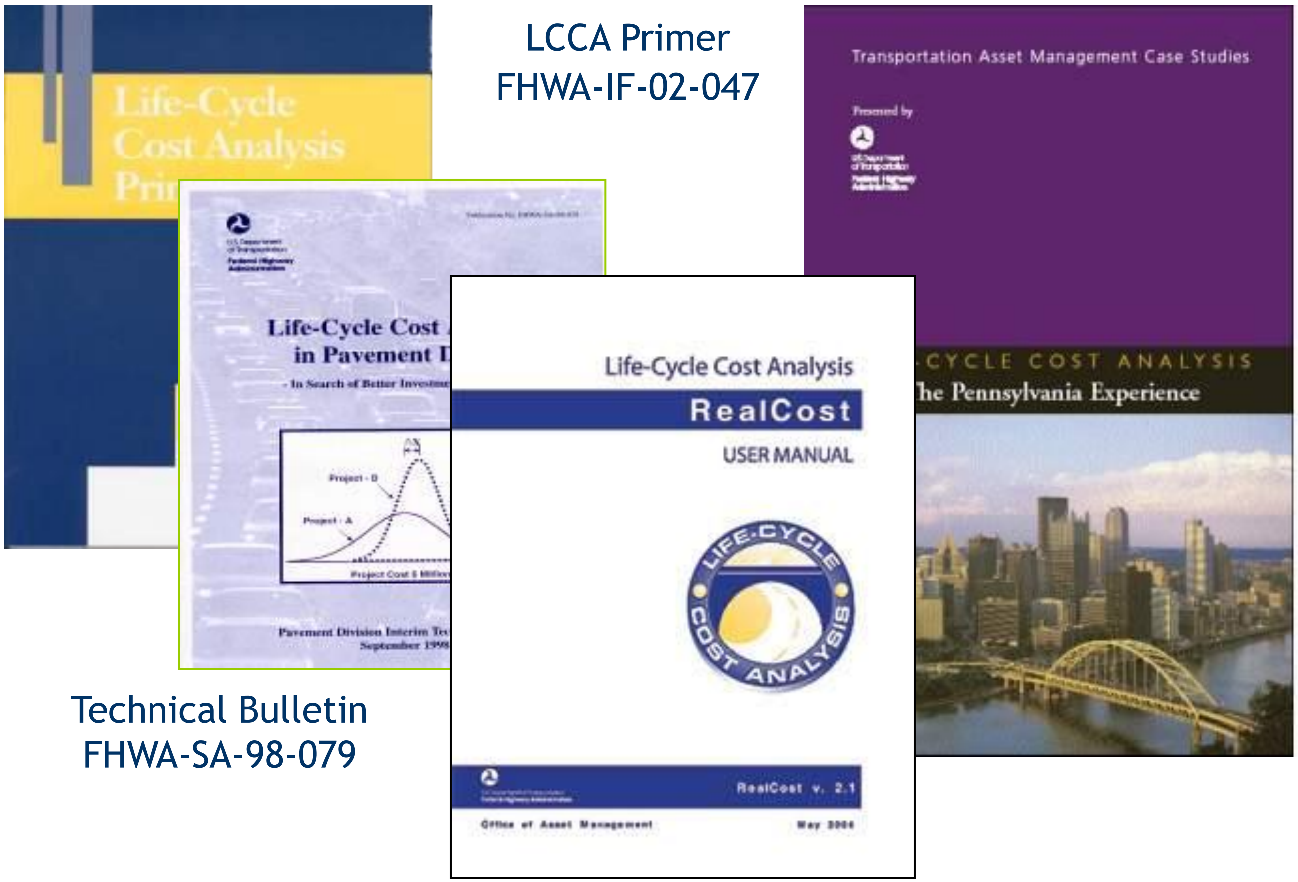
Training

Fundamentals of Life Cycle Cost Analysis Live Instructor Led Distance Learning Course

Onsite RealCost Life-Cycle Cost Analysis (LCCA) Software Workshop

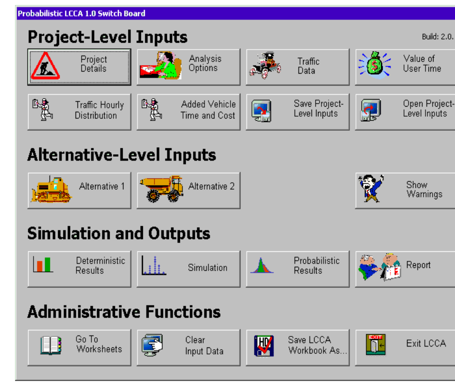
http://www.fhwa.dot.gov/infrastructure/asstmgmt/lcca.cfm

Resources



LCCA Primer
FHWA-IF-02-047

Technical Bulletin
FHWA-SA-98-079



LCCA Software
RealCost 2.5
and
User Manual

http://www.fhwa.dot.gov/infrastructure/asstmgmt/lcca.cfm

Thank you

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http://www.fhwa.dot.gov/infrastructure/asstmgmt/lcca.htm