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Life Cycle Cost Analysis

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What are we talking about?

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"LCCA is an analysis technique that builds on the well-founded principles of economic analysis to evaluate the over-all-long-term economic efficiency between competing alternative investment options."

"FHWA Policy on LCCA is that it is a decision support tool, and the results of LCCA are not decisions in and of themselves."

from:
Life-Cycle Cost Analysis, Pavement Division Interim Technical Bulletin, September 1998, FHWA

Net Present Value

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$$NPV = I.C. + \sum_{k=1}^{N} R.C._k \left[\frac{1}{(1+i)^{n_k}} \right]$$

Initial Cost

Number of Recurring Costs

Recurring Costs

Discount Rate (3-5%)

Number of Years

Net Present Value

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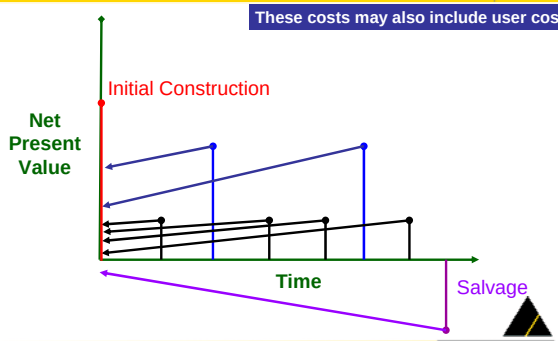
These costs may also include user costs



Key terms:

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- *"Analysis technique"*
- *"Decision support tool"*
- *"The results of LCCA are not decisions in and of themselves"*

Other Pavement Selection Factors

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- Traffic
- Soil characteristics
- Weather
- Construction considerations
- Recyclability
- Noise
- Roughness
- Safety

Treatment Selection Factors – Pavement Rehabilitation

- Available Funds
- Staged Construction
- Traffic Control
- Lane Closure
- Minimum Desired Life
- Future Maintenance
- Geometric Issues

From NHI 131063 materials, "HMA Pavement Evaluation and Rehabilitation

Treatment Selection Factors - Pavement Rehabilitation (continued)

- Present and Future Utilities
- Right-of-Way Restrictions
- Regulatory Restrictions
- Available Materials and Equipment
- Contractor Expertise and Manpower
- Agency Policies

From NHI 131063 course materials, "HMA Pavement Evaluation and Rehabilitation"

LCCA Issues

- Performance periods
  - Time to first overlay
  - Time between overlays
- Analysis period
- Comparable performance
- User costs

- Obviously, cost estimates should be appropriate and include all factors related to differences in pavement construction costs

Performance Periods

- Considerations:
  - Performance of similar existing pavements
  - Anticipated improvements from advances in binder and mixture technology

Performance Data

- Pavement management data are often used
- Factors to consider:
  - Ability to segregate pavements that were actually designed for traffic and subgrade conditions from those designed by limited funding
  - Are all "flexible" pavements the same?
  - Accounting for technological improvements and resulting performance enhancement

Are these the same pavement type?

Thin-surfaced, "flexible" pavement

Thick HMA "semi-rigid" pavement

These pavements respond to loads differently and should not be expected to perform the same.

Overlay Design Equation?

$$D_{OL} = \left(\$available \div \$ / sy / in\right) \div sy$$

- You won't find this in AASHTO, but it is certainly being used!
- Would we expect the performance of a constrained design to be the same as that of a pavement actually designed for the conditions?

Performance Periods

State/ Province	Time to 1st Overlay	Time between 1st and 2nd Overlay
Minnesota	15.5	15
Washington	12.5	11.5
Kansas	10*	17
Ontario	19**	12
Ohio	17	13
Florida	14	14
Wisconsin	18	Project specific

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Minnesota	15.5	15
Washington	12.5	11.5
Kansas	**10***	**17**
Ontario	**19****	**12**
Ohio	*** Planned stage construction**	
Florida	**** 23 years for SMA**	
Wisconsin	18	Project specific

SHRP-LTPP Data

- "The average expected service life of HMA pavements is **greater than 20 years** for both conventional and deep strength flexible pavements."
  - From *Expected Service Life and Performance Characteristics of HMA Pavements in LTPP,* draft final report, Von Quintus, et al.
- "Clearly, the majority of the AC overlays included in the LTPP database have served for **15 years or more** before the load and non-load-related distresses became sufficient to require rehabilitation. More importantly, there are a number of test sections where the overlays have less than only nominal levels of distress for more than 20 years of service."
  - From: *Publication No. FHWA-RD-00-165*

Improved Technologies: Polymers, and SMA

- Both may provide significantly extended (>25%) performance compared to conventional materials
  - Remember that most performance relationships developed from historic data were based on conventional materials
- Unless properly considered, pavements using either technology are likely to be overdesigned, i.e., have higher initial costs than necessary

Advantages of SMA

Property	Significant Improvement	Improved	Equal
Rutting Resistance	x		
Durability	x		
Fatigue Endurance	x		
Cracking Resistance	x		
Skid Resistance		x	
Water Spray			x
Noise Reduction		x	
Public Recognition	x		

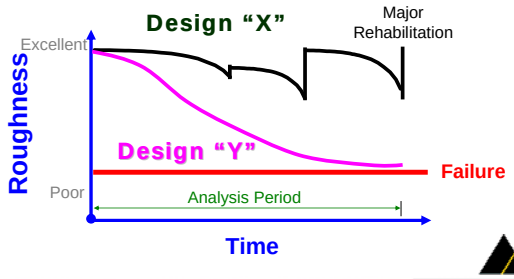
Analysis Period

Time period over which an economic comparison is made

"The analysis period for LCCA generally should extend through the time when reconstruction of the facility would be required."

FHWA Final Policy Statement, Life Cycle Cost Analysis
FHWA Docket No. 94-15

Performance Scenarios- Are these comparable?



Comparable Performance

- Unless functional characteristics are similar, differences in vehicle operating costs, etc., must be accounted for in LCCA
  - Very difficult to do
- What are the effects of different levels of quality control during construction
  - PWL specifications for some paving materials, but not for others
  - Ride quality requirements
- What is the effect of retexturing (shotblasting, diamond grinding, etc.) on surface friction where carbonate coarse aggregates are used?

What if there's no real difference in LCCA projections for alternate designs?

- Don't forget that a forward projection of LCCA is a best guess and not a precise calculation!!!
- It LCCA is a tie, shouldn't the "other factors" take priority, particularly initial cost?
- Need to develop a defensible, consistent procedure that takes these other factors into account
  - How is a "real" difference defined?
  - How are other factors weighted?

LCCA

- Definitely should be considered in pavement type selection, but it is not the only factor
- Must be "fair and balanced," with the emphasis being on taxpayers and highway users

Tonight's event

WEDNESDAY NIGHT ON THE BAYOU

BAYVIEW INN
French Settlement, Louisiana

Fish Fry
Jambalaya
Gumbo
Beer & Wine
Cajun Band
Cajun Dance Lessons

SEAUPG 2004 Conference - Baton Rouge

Night on the Bayou

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Bus departs Holiday Inn-Select at 5:30 p.m.
Bus departs Bayview Inn at 9:30 p.m.

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