ABC’s of Life Cycle Cost Analysis

Statewide Conference on Local Bridges

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ABC’s of Life Cycle Cost Analysis

What is it?

• It is a process of evaluating total costs over the life of an asset

• Total costs include initial costs and projected future costs

Why Needed?

• Helps in making cost-effectiveness comparisons of available alternatives
ABC’s of Life Cycle Cost Analysis

Shopping for a Car?

• It is not just the monthly payment…right?

• Learning about all the costs of owning a car, such as fuel, insurance and repairs can help you make a better choice

• Need to take a holistic approach to buying a car
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True Cost of Owning a Car

• Costs to consider: Total cash price, depreciation, financing, insurance, fuel economy, maintenance & repair costs, etc.

• Edmunds.com and Kelley Blue Book, two independent auto information providers - total cost of ownership calculators are available on their web sites
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True Cost of Owning a Car

• **Car “A”:** 2006 Honda Accord Hybrid, four door sedan with a 3 liter, 6 cylinder gas/electric hybrid engine:
  
  Total cash price = $31,914

• **Car “B”:** 2006 Toyota 4Runner Limited, four door SUV with a 4 liter, 6 cylinder engine:
  
  Total cash price = $34,163

• **Analysis Period/Time Horizon:** Five Years
ABC’s of Life Cycle Cost Analysis

According to Edmunds.com True Cost to Own Calculator:

<table>
<thead>
<tr>
<th></th>
<th>Car “A”</th>
<th>Car “B”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cash Price</td>
<td>$31,914</td>
<td>$34,163</td>
</tr>
<tr>
<td>Depreciation</td>
<td>17,140</td>
<td>17,089</td>
</tr>
<tr>
<td>Financing</td>
<td>6,041</td>
<td>6,410</td>
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<tr>
<td>Insurance</td>
<td>6,922</td>
<td>6,709</td>
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<tr>
<td>Taxes/Fees</td>
<td>2,522</td>
<td>2,780</td>
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<tr>
<td>Fuel</td>
<td>7,396</td>
<td>11,325</td>
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<tr>
<td>Maintenance</td>
<td>4,211</td>
<td>4,455</td>
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<tr>
<td>Repairs</td>
<td>618</td>
<td>618</td>
</tr>
<tr>
<td><strong>Total 5-Year Cost</strong></td>
<td><strong>$44,850</strong></td>
<td><strong>$49,386</strong></td>
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</table>
Bridge Life Cycle Cost Analysis (BLCCA)

What is it?

• It is a process of evaluating the total costs over the life of a bridge

• Total costs include initial costs and projected future costs such as maintenance, repair, rehabilitation and reconstruction (discounted to today’s dollars)
Bridge Life Cycle Cost Analysis (BLCCA)

Why Needed?

• Larger bridge inventories and aging bridge population

• Increasing bridge rehabilitation and replacement needs

• Large percentage of these on local roads

• Never enough money

• Increasing public demands and scrutiny
Why Needed?

• Need to make cost-effective comparisons of alternatives (bridge activity and type)

• Public expectation of longer bridge life (50 to 75 years) at optimum life-time costs

• Increasing focus on longer term planning for the network/groups of bridges
Bridge Life Cycle Cost Analysis (BLCCA)

Some Commonly Used Terms

1. Analysis Period
2. Service Life
3. Discount Rate
4. Present Value
5. Sensitivity Analysis
Bridge Life Cycle Cost Analysis (BLCCA)

Analysis Period:

• Should be the same for all alternatives

• Bridges are designed for 75 year life and, therefore, analysis should use 75 years for either rehab or replacement alternatives
Bridge Life Cycle Cost Analysis (BLCCA)

**Service Life:**

- The estimated number of years the bridge will be serviceable.
- Service life beyond the end of analysis period must be accounted for through inclusion of a “Residual Value” for the bridge.
Discount Rate:

- All economic resources have a time value
- Parameter used to calculate equivalent worth of economic resources used or received now or in the future
- Discounting future costs places a present worth or value on funds being spent in the future
Bridge Life Cycle Cost Analysis (BLCCA)

Present Value:

\[ PV = \frac{FVN}{(1 + DR)^N} \]

where,

- **PV** = Present Value of the expenditure
- **FVN** = Future Value of an expenditure made @ time N
- **DR** = Discount Rate
- **N** = Number of periods (generally years) between the present and future times
Bridge Life Cycle Cost Analysis (BLCCA)

Sensitivity Analysis:

• Technique that systematically determines how the outcome may change by varying any one assumption in the analysis

e.g., if the actual bridge rehabilitation cost turns out to be 10% higher or lower, how would the outcome (total life cycle cost) change; what is the probability of such an event?
Bridge Life Cycle Cost Analysis (BLCCA)

What costs?*

Agency Costs:

• Design, new construction, maintenance & repair, rehabilitation, demolition and reconstruction during the analysis period

User Costs:

• Traffic detour and delay costs

* All costs should reflect base year estimate (No inflation factor should be used)
Bridge Life Cycle Cost Analysis (BLCCA)

Simplifying Assumptions*

- New construction costs
- Analysis period (planning horizon)
- Projected service life, MR&R strategy
- Maintenance & repair types, frequency and costs
- Projected rehab needs, frequency and costs
- Discount Rate and Present Value calculation

* Document
Bridge Life Cycle Cost Analysis (BLCCA)

Example

- Bridge XYZ has a Sufficiency Rating of 56.2 and is classified structurally deficient
- It is eligible for rehabilitation and may qualify for replacement
- BLCCA indicates that it is more economical to replace the bridge than to rehabilitate it
- Alternatives: Rehab now, then Replace, or Replace now with new bridge
Example

- Analysis Period: 75 years, (design life of new bridge is to be 75 years)
- Service Life: 38 years for Rehab & Replace, 75 years for Replacement
- Base Year: 2001
- Discount Rate: 4% (set by OMB)
- Inflation Factor: None (all costs to reflect base year costs)
Bridge Life Cycle Cost Analysis (BLCCA)

Example

Assumptions:

• Maintenance, repair, rehab & replacement costs are based on bridge inspection reports, average bridge rehab and replacement costs for similar structures in the area and adjusted for site conditions.

• Projected Service Life of existing bridge is based on inspection reports. Structure is nearing end of its service life.
Example

Assumptions (cont’d):

• Existing bridge will require sizeable annual maintenance expenditure and some repair to achieve 38 years of service life. Strategy: Good annual and planned M&R

• New Bridge will have design features that will eliminate many high maintenance costs and will be constructed with proper QA/QC to achieve 75 year service life.
Example

Assumptions (cont’d):

• Bridge supports a small rural community with no economic development planned in the foreseeable future. ADT and use will see only a minor increase.

• Bridge is in rural setting and detour bridge will be available during construction. No user delays will be encountered. No user costs.
Example

- Rehab Alternative: Est. cost = $459,888. Service life = 38 years, then replace existing 2 span steel girder bridge with a single span steel girder bridge @ a cost of $552,038 in year 38.

- Replacement Alternative: Replace existing 2 span steel girder bridge with a single span steel girder bridge @ a cost of $552,038 now.
## Bridge Life Cycle Cost Analysis (BLCCA)

### Alternative A - Rehabilitate Now, then Replace

<table>
<thead>
<tr>
<th>Activities</th>
<th>PV</th>
<th>YR</th>
<th>Expenditure in dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehab</td>
<td>$459,888</td>
<td>0</td>
<td>$459,888</td>
</tr>
<tr>
<td>Annual Maintenance</td>
<td>$57,428</td>
<td>37</td>
<td>$3,000</td>
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<tr>
<td>Special M &amp; R</td>
<td>$91,277</td>
<td>20</td>
<td>$200,000</td>
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<tr>
<td>Replacement</td>
<td>$124,366</td>
<td>38</td>
<td>$552,038</td>
</tr>
<tr>
<td>Annual Maintenance</td>
<td>$4,313</td>
<td>38</td>
<td>$1,000</td>
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<tr>
<td>Special M &amp; R</td>
<td>$5,347</td>
<td>57</td>
<td>$50,000</td>
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<tr>
<td>&quot;Salvage/Residual Value&quot;</td>
<td>($14,375)</td>
<td>75</td>
<td>($272,339)</td>
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<tr>
<td><strong>Sum of PV</strong></td>
<td><strong>$728,244</strong></td>
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</table>
## Bridge Life Cycle Cost Analysis (BLCCA)
### Alternative B - Replace Now with New Structure

<table>
<thead>
<tr>
<th>Activities</th>
<th>PV</th>
<th>YR</th>
<th>Expenditure in dollars</th>
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<tbody>
<tr>
<td>Initial New Construction</td>
<td>$552,038</td>
<td>0</td>
<td>$552,038</td>
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<tr>
<td>Annual Maintenance</td>
<td>$23,680</td>
<td>75</td>
<td>$1,000</td>
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<td>Special M &amp; R</td>
<td>$22,819</td>
<td>20</td>
<td>$50,000</td>
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<tr>
<td>Rehab: re-decking, etc.</td>
<td>$101,378</td>
<td>38</td>
<td>$450,000</td>
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<tr>
<td>Special M &amp; R</td>
<td>$5,141</td>
<td>58</td>
<td>$50,000</td>
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<tr>
<td>&quot;Salvage/Residual Value&quot;</td>
<td>$0</td>
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<td>$0</td>
</tr>
<tr>
<td>Sum of PV</td>
<td>$705,056</td>
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</table>
ABC’s of Life Cycle Cost Analysis

• An informed decision is a responsible decision

• Life Cycle Cost Analysis is a process of evaluating total costs over the life of an asset

• The analysis provides a means to compare the costs of alternatives

• Reasonable assumptions can simplify the analysis and still result in a useful comparison

• Stay tuned…the FHWA will be issuing guidance to promote the use of BLCCA

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