

Transitioning into Lifecycle Cost Analysis

Created for NYC DOT

By NYU Wagner Capstone Team

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Agenda

- Background
- Research
- Lifecycle Cost Analysis
- LCCA Data and Methodology
- External Benefits
- Looking Ahead

Background

- PlaNYC: creating a greener, greater New York City by the year 2030
- NYCDOT seeks to evaluate costs and benefits through Lifecycle Cost Analysis

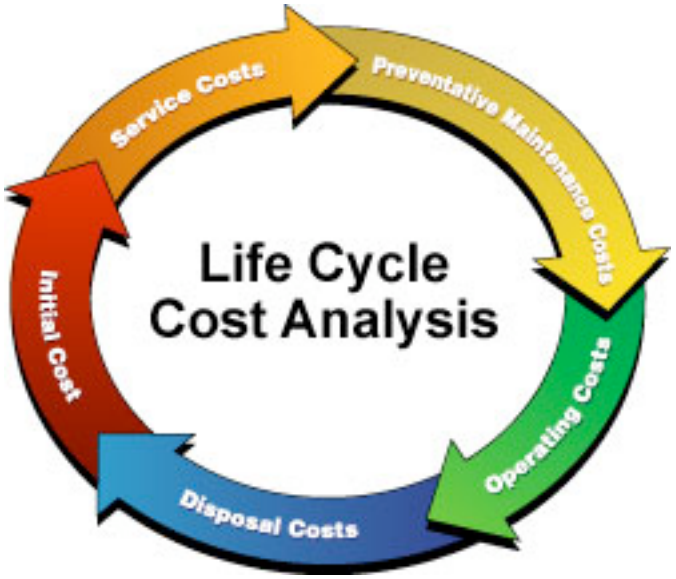
Research

- Questions to Answer:
  1. Are upgraded materials more cost effective in the long-term than their standard counterpart?
  2. Do upgraded materials add additional external benefits, not captured in the LCCA ?

- The research focuses on:
  - Conducting LCCA on several recent DOT streetscape projects
  - Developing a framework DOT can use for analyzing future streetscape projects
  - Identifying benefits of sustainable streetscape projects not currently captured by financial analysis

Lifecycle Cost Analysis (LCCA)

- Benefits of LCCA
- National Highway System (NHS) Designation Act of 1995
- Federal Highway Administration's use of LCCA

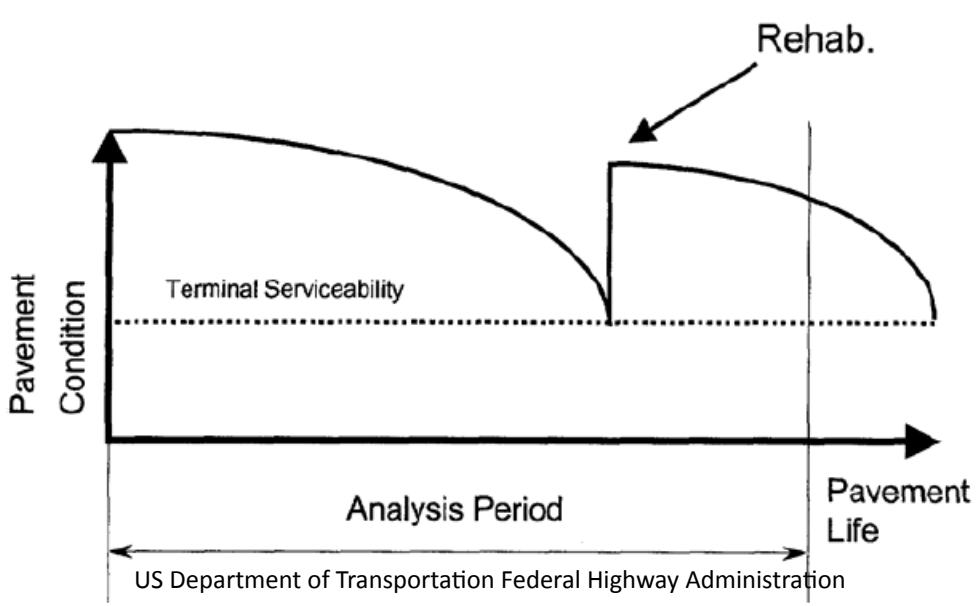


Lifecycle Cost Analysis

- Data requirements for LCCA
  - Design
  - Construction
  - Rehabilitation
  - Maintenance
  - Residual value
  - User Costs

Lifecycle Cost Analysis

- Analysis Period
- Serviceable Life



US Department of Transportation Federal Highway Administration

Lifecycle Cost Analysis

- Discount Rate
  - Opportunity cost of investment
  - Difference between high and low discount rates

Lifecycle Cost Analysis

- Limitations of LCCA
  - Discount rates difficult to predict
  - User costs difficult to quantify
  - Serviceable life and residual values
  - Utility work compromises lifespan
- Benefits:
  - Intergenerational equity
  - Sustainability
  - Fiscally accountability to taxpayers

LCCA Calculation

- Initial Cost = Construction Cost + Material Cost
- Rehab Cost = Maintenance Cost + Rehab Cost
- Discount Rate = 3, 5, 7 Percent
- Analysis Period = 20, 30, 40 Years

$$NPV = initial\ \ cost + \sum_{k=1}^{N} Rehab\ \ cost_k \left[\frac{1}{(1+i)^{n_k}}\right]$$

where:

i = discount rate

n = year of expenditure

$\left[\frac{1}{(1+i)^{n_k}}\right]$ = present value (PV) factor

LCCA Data Methodology

- Upgraded design versus standard design
- Three main variables used in calculation:
  - Construction cost
  - Material cost
  - Maintenance cost
- Additional calculation needed to capture difference in material lifespan
  - Annuity Factor

LCCA Calculation Template

SAMPLE

Design Element:		West Houston			
		3%	5%	7%	
NPV: Standard Cost		$ 9,362,443.53	$ 6,373,055.84	$ 4,369,765.70	Twenty Years
Discount rate:		3.00%	5.00%	7.00%	
Analysis Period:		20.00	20.00	20.00	
One-Time costs:		$9,990,016.22	9,990,016.22	9,990,016.22	
Recurring Cost:		6,919,598.22	6,919,598.22	6,919,598.22	
Lifespan Calculation:	Years	Annuity Factor	Annuity Factor	Annuity Factor	
Ex Standard Material	20	$ 629,303.27	$ 511,390.49	$ 412,474.97	
NPV: Upgraded Cost		$ 10,272,830.37	$ 6,992,760.10	$ 4,794,673.70	
Discount rate:		3.00%	5.00%	7.00%	
Analysis Period:		20.00	20.00	20.00	
One-Time costs:		$10,538,102.85	10,538,102.85	10,538,102.85	
Recurring Cost:		8,015,771.48	8,015,771.48	8,015,771.48	
Lifespan Calculation:	Years	Annuity Factor	Annuity Factor	Annuity Factor	
Ex Upgraded Material	25	$ 537,665.20	$ 452,183.97	$ 374,971.85	
AF % Difference		-14.56%	-11.58%	-9.09%	

This is a sample calculation using loosely estimated figures for unavailable costs. This is not intended to represent actual figures from data provided.

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DOT Data Limitations

- The following data was limited or missing:
  - Maintenance costs
  - Material lifespan
  - Actual project cost

External Benefits of Streetscapes

- Mobility/Accessibility
- Safety
- Environmental Health and Sustainability
- Economic Vitality

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Benefit Matrix

Qualitative Benefits for Treatments/Design Elements

General qualitative assessments are outlined according to benefit categories, material and maintenance costs, and lifespan. This matrix is not intended to be comprehensive of all designs and treatments, nor is it intended to be comprehensive of all benefi from each design/treatment

	Benefits				Costs		Lifespan
Design Element/Treatment	**Mobility/Accessibility**	**Safety**	**Environmental Health & Sustainability**	**Economic Vitality**	**Material**	**Maintenance**	**Years**
Bikes							
Class I Bike Path	Improved bicycle mobility and accessibility	Strong improvement in cyclist and pedestrian safety; Helps reduce traffic speeds; on road bike lanes reduce accidents by 50%	Reduces energy consumption by increasing bicycle use	Increased foot traffic due to traffic calming; Decreased transportation costs for employees/customers now accessing area by bike	*n/a	*n/a	*n/a
Class II Bike Lane	Improved bicycle mobility and accessibility	Moderate improvement in cyclist and pedestrian safety; Helps reduce traffic speeds; on road bike lanes reduce accidents by 50%	Reduces energy consumption by increasing bicycle use	Increased foot traffic due to traffic calming; Decreased transportation costs for employees/customers now accessing area by bike	*n/a	*n/a	*n/a
Sidewalks & Medians							
Curb Extension/Neckdown	Improves pedestrian mobility for seniors / people with limited mobility	Improves pedestrian safety; Helps reduce traffic speeds; Shortens crossing distances;	May encourage more walking by establishing safer pedestrian environment	Improved pedestrian environment and calmer traffic, which could lead to increased property values and retail sales by 20- 40%	*n/a	*n/a	*n/a
Curb Extension w/ Vegetation	Improves pedestrian mobility for seniors / people with limited mobility	Improves pedestrian safety; Helps reduce traffic speeds; Shortens crossing distances	Increases vegetation thus reducing pollution and urban heat island effect; Reduces negative environmental impact; May encourage more walking by establishing safer pedestrian environment	Improved pedestrian environment and calmer traffic, which could lead to increased property values and retail sales by 20-40%	*n/a	*n/a	*n/a
Median (no plantings)	Improves pedestrian accessibility in crossing the street	Improves pedestrian safety and helps calm traffic	--	Improved pedestrian environment and calmer traffic, which could lead to increased property values and retail sales by 20-40%	*n/a	*n/a	*n/a
Planted Median	Improves pedestrian accessibility in crossing the street	Improves pedestrian safety and helps calm traffic	Increases vegetation; increase water absorption reducing storm water runoff	Improved pedestrian environment and calmer traffic, which could lead to increased property values and retail sales 20-40%	*n/a	*n/a	*n/a
Standard Sidewalk	Standard pedestrian infrastructure	Standard Pedestrian infrastructure	--	--	$8.13 SF for 4" Thick $10.18 SF for 7" Thick	*n/a	15

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Benefits Matrix Database: Spotlight on Bike Lanes

- Mobility and Accessibility
  - Bike lanes help cyclists move through street
  - In London, there was a 24 percent increase in bicycle flows

- Safety
  - Reduces injury by 50%
  - London's Bike Superhighway increased commuter safety by 60%

Benefits Matrix Database: Spotlight on Bike Lanes Continued

- Environmental Health/Sustainability
  - Bicycling reduces energy consumption and CO_2 emissions
  - London's Bike Superhighway is correlated with improvement of air quality measures, and decreases in traffic and noise

- Economic Vitality
  - Bike lanes can help alleviate $78 billion of fuel wasted in traffic
  - London's Barclay's Cycle Hire attracts tourists and saves money for commuters

Looking Ahead

- Moving towards LCCA, it is imperative that:
  - Data is collected through a centralized and categorized system
  - Maintenance data reported in line item, not in aggregate
  - NYCDOT incorporates a maintenance plan into the planning process
  - NYCDOT reassesses street construction permit process
  - Inter-agency cooperation is increased to better manage maintenance plan and data collection

Questions?

- Thank you for your time
- Questions?