

The Economic Costs of Pavement Deterioration

Presented by:

**Chandler Duncan
Economic Development Research Group, Inc.**

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Introduction

- Pavement and Bridge Preservation often overlooked when assessing economic benefits of transportation investment
- Account for a significant share of overall transportation outlays
- Benefits often understood only as internal agency savings (life cycle costs)
- Increasing interest in showing user benefits of pavement quality in the larger economy

Objective and Scope

- Evaluate the current state of the practice in quantifying user benefits of pavement preservation
- Demonstrate how research on the user costs and benefits of different pavement quality can accrue in terms of travel time and operating cost
- Provide Examples of “real world” applications of this type of analysis in economic benefit and impact analysis
- Suggest improvements to the state of the practice

Literature Review

- Barnes and Langworthy
 - Deteriorating pavement affects “...maintenance, tire, repair, and depreciation costs”
 - Implied an extra O&M cost of 2.6 cents per mile (5.5 cents per mile for trucks)
- Papagiannakis and Delwar
 - a unit increase in IRI (in m/km) leads to a \$200 per year increase in maintenance & repair costs (3.3 cents/mile)
- Kansas DOT
 - “5.5% increase in per-mile vehicle operating cost due to pavement deterioration”

Interviews

- American Trucking Association
- American Trucking Research Institute
- Kansas Department of Transportation
- Tioga Group
 - Categories affected by adverse conditions: Tires, Wheel Alignment, Sheet Metal/Electric Wiring, & Suspension
 - Deteriorating pavement conditions estimated to raise vehicle operating costs by \$.01 to \$.02 per mile.

Comparing Methods

- HERS-ST Methodology & Barns and Langworthy (B&L)
 - Categories of operating costs: Maintenance & repair, Tire wear, and Depreciation (Fuel not included in B&L study)
 - Vehicle Types: Automobiles, Vans/Suv's, and Trucks
 - “Good pavement” was categorized as a PSR of 3.5 or an IRI of 83 in/mi
 - “Poor pavement” was categorized with a PSR of 2.0 or an IRI of 213 in/mi

Contrasting Methods

- Barns & Langworthy Method More Consistent
 - Most comprehensive source of information
 - In line with results from Papagiannakis & Delwar and Interviews
 - Cost estimates primarily in the middle of the range

Cost Increases for Poor Pavement	Maint. & Repair		Tire Wear		Depreciation	
	Autos	Trucks	Autos	Trucks	Autos	Trucks
HERS-ST	64%	30%	62%	28%	6%	15%
B&L	25%	25%	22%	26%	26%	25%
NCHRP 720	4%	4%	2%	2%	N/A	N/A

Contrasting Methods

- Barns & Langworthy Method More Consistent
 - Conservative estimates for Car and Truck vehicle operating cost increase due to Poor Pavement conditions

Mode	V.O.C per Mile Increase	Pavement Condition
Car	\$0.026	Poor
	\$0.010	Fair
	\$0.000	Good
Truck	\$0.055	Poor
	\$0.028	Fair
	\$0.000	Good

Practical Applications

- Vermont Programmatic Analysis
 - \$677M in additional costs due to deteriorating pavement conditions, reducing labor income by \$231M, and losing 380 jobs.
- Colorado Case Studies
 - Reconstruction of U.S. 287: \$57M in benefits, \$4M in output, and three new jobs.
- 28 Rural Projects in Idaho
 - Pavement Condition improvements: \$31M in business output, \$10M in wages, and 26 jobs in the year 2030.

Findings and Conclusions

- Literature to date support inclusion of pavement preservation benefits in planning and Business processes such as:
 - Project and Programmatic Scoring
 - Benefit Cost & Economic Impact Analysis
- Inclusion can help articulate rationale and importance of highway preservation investment

Areas for Future Research

- Updates on cost estimates keeping pace with pavement technology
- Further testing to establish methods to assess additional factors such as:
 - Climate
 - Urban-Rural Character of Roads & Terrain
 - Vehicle Types (including LCV's)
 - Fuel Economy & Fuel Prices
 - Safety & Travel Speeds