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The Potential of HERS-ST for Welfare Analysis of Highway Spending: An Application to Texas

Dr. David Luskin University of Texas in Austin

Transportation Research Forum - Annual Forum 2004 March 23, 2004

PROJECT OBJECTIVES

Assess the benefits and costs of investment in Texas transportation to identify warranted changes in:

- * The amount Texas spends on Texas transportation infrastructure
- * The optimal allocation of this expenditure among alternative investment categories

To estimate the net benefits that would result from implementation of these changes.

HERS-ST

- *Optimal programming of highway capital expenditures at state level
- *FHWA committed to maintenance and further development
- ★Seven other States are using the model − esp. IN, OR, FL and WI

FHWA's Road Classification System

ARTERIALS	COLLECTORS	LOCAL ROADS				
	RURAL ROADS					
Interstate Highways	Major Collectors	Local Roads				
Other Principal Arterials	Minor Collectors					
Minor Arterials						
	URBAN ROADS					
Interstate Highways	Collectors	Local Roads				
Freeways and Expressways						
Other Principal Arterials						
Minor Arterials						

KEY TO FIGURE:

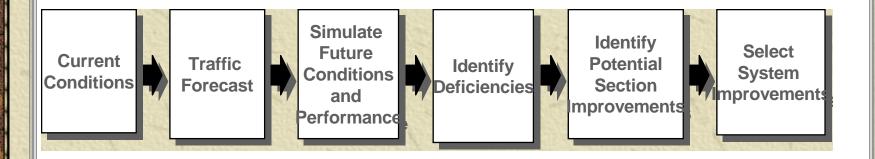
Covered by the HERS

Model

Not Covered by the

HERS Model

Simplified Representation of the HERS Modeling Process

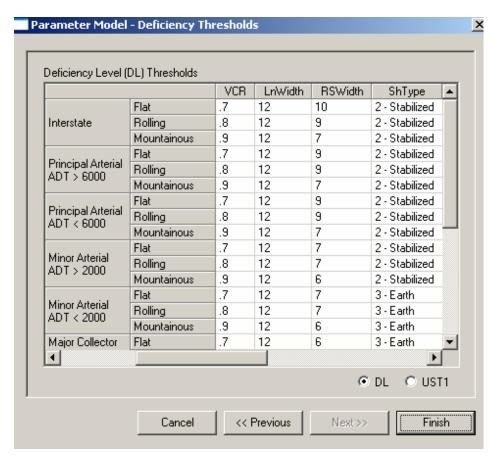


Source: Ron Hagquist' Presentation, TxDOT Multimodal Section/TPP, July 2002

Highway Data - HPMS Database

- *Contains a sample of highway sections for each state with detailed information on traffic, pavement conditions, etc.
- ★HERS-ST is designed to run with sample in HPMS format
- ***HPMS** sample for Texas:
 - >5,386 on-system sections
 - >1,954 off-system sections

Parameter Data Deficiency Thresholds



Highway Improvement Types in HERS

Pavement Reconstruction

and add high-cost lanes **RCHC**

and add normal-cost lanes **RCNC**

with wider lanes **RCWL**

only

RC

Pavement Resurfacing

and add normal cost lanes

RSNC

with wider lanes

RSWL

and improve shoulders

RSSH

only

RS

HERS-ST Coverage of Highway Work

Includes

- * Reconstruction
- **₩**"3R"
- * Major widening

Excludes

- * New roads and bridges
- ***** Bridge preservation
- * Operational improvements (e.g. ramp meters, signals)
- * System enhancement (e.g. safety projects, pedestrian facilities)
- Local roads & minor rural collectors

HERS-ST Cost-Benefit Coverage

Includes

Benefits from:

- ** Travel time savings
- * Vehicle operating cost savings
- ** Pollution reductions
- ** Road maintenance cost savings

Excludes

Costs from:

** Traffic disruption during construction

Capital Outlay Data from 'FHWA Highway Statistics'

- *For on-system highways by:
 - > State
 - > Highway functional class and
 - > Type of improvement
- **For off-system highways, only the total by state

TxDOT Capital Outlay Estimate for the Types of Improvements in HERS-ST - FY 2000

(\$ millions)

RURAL ROADS	Interstates	Other Principal Arterials	Minor Arterials	Major Collectors		SUBTOTAL
RUADS	211	416	154	335		1,117
URBAN ROADS	Interstates	Other Freeways and Expressways	Other Principal Arterials	Minor Arterials	Collectors	SUBTOTAL
RUADS	444	307	301	78	4	1,134

TOTAL = 2,250

The total is about two-thirds of TxDOT's capital outlays on highways

Funding Scenarios

Scenario 1:

- ***** Unconstrained funding
- ***** BCR ≥ 1.0

Scenario 2:

- Constrained funding for the whole system at FY 2000 level
- * \$11,251 million per funding period (\$2,250 million/year)
- \star BCR ≥ 0.0

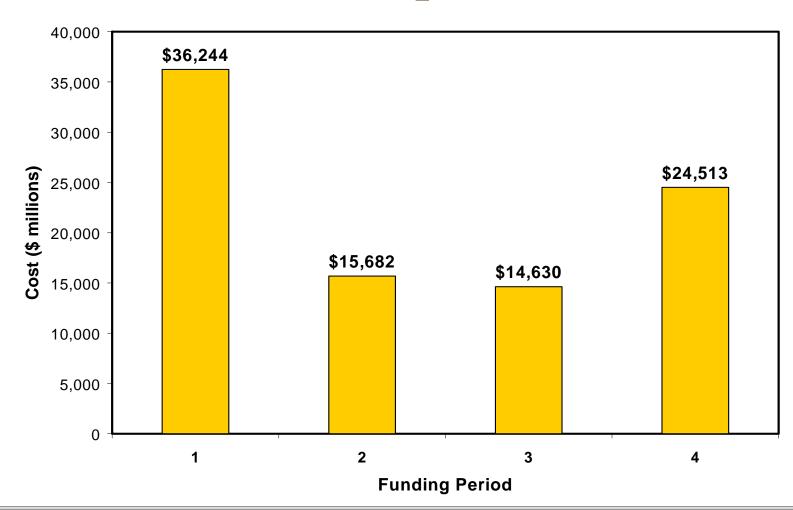
Scenario 3:

- * Constrained Funding for area at FY 2000 level
- * Rural Area = \$5,583 million per funding period (\$1,117 million/year)
- We Urban Area = \$5,668 million per funding period (\$1,134 million/year)
- # BCR ≥ 0.0

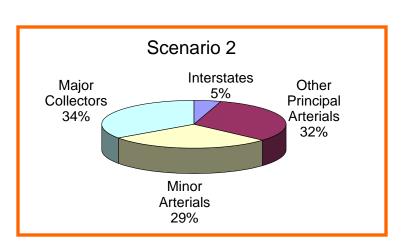
Scenario 4:

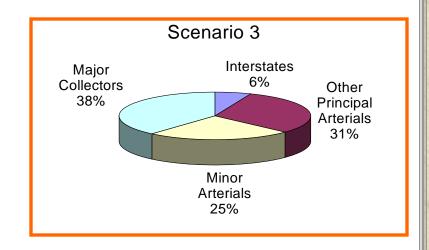
- Constrained Funding for each highway functional class at FY 2000 level
- # BCR ≥ 0.0

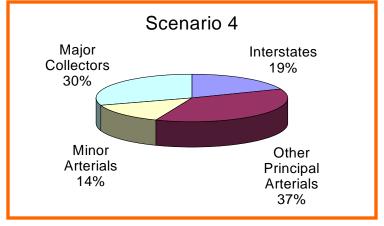
Scenario 1 – Capital Cost of Selected Improvements



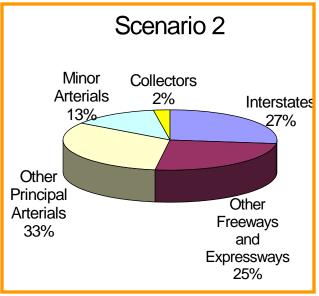
Capital Cost of Selected Improvements (%) in First Funding Period - Rural Areas

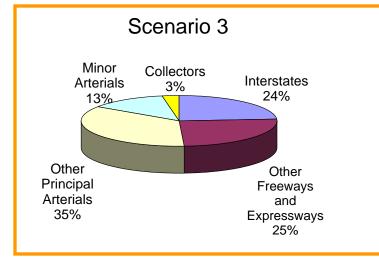


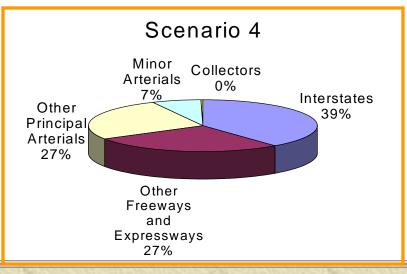




Capital Cost of Selected Improvements (%) in First Funding Period - Urban Areas







Marginal Benefit-Cost Ratios for the First Funding Period (FY 2000-FY2004)

Scenario 1	Scenario 2	Scenario 3	
1	0.6	Rural	Urban
	9.0	5.9 12.	12.3

Scenario 4						
Urban Highway	Interstates	Other Principal Arterials	Minor Arterials	Major C	ollectors	
Classes	0.8	3.4	27.5	8.5		
Rural Highway	Interstates	Other Freeways/ Expressways	Other Principal Arterials	Minor Arterials	Collectors	
Classes	8.4	11.7	15	22.8	79.2	

Benefits from Programmed Capital Outlays in First Funding Period (FY 2000 – FY 2004)

Scenario	Average Benefit-Cost Ratio (BCR)	Total Capital Outlays (\$ millions)	Total Benefits (\$ millions)
1 1	13.3	36,244	483,495
2	33.5	11,247	376,437
3	33.0	11,284	372,936
4	31.5	11,369	358,237

Benefits per Texas Resident in First Funding Period (FY 2000 – FY 2004)

Texas Population				
2000 Census 20,736,000				
2005 (estimate)	21,487,000			
Average 21,111,500				

	FY 2000	PER YEAR	
Scenario	Total Benefits Benefits per capita		Benefits per capita
	(\$ millions)	(\$ millions)	(\$)
1	483,495	22,902	4,580
2	376,437	17,831	3,566
3	372,936	17,665	3,533
4	358,237	16,969	3,394

Benefits from economically more efficient allocation of capital outlays: Scenario 2 instead of Scenario 3

Present value sum of the benefits in fiscal years 2004, 2009,2014, 2019

(the last years in the funding periods)

(\$millions in FY 20004 value)						
Highway Category						
	User Costs	Total				
Rural	-4,597	-43	53	-4,587		
Urban	13,228	-24	-10	13,193		
Total	8,630 -67 43		8,606			
Funding Period						
1	998	-32	20	986		
2	2,373	-13	15	2,374		
3	2,746	-13	6	2,740		
4	2,513	-9	3	2,506		
Total	8,630	-67	43	8,606		

Benefits from economically more efficient allocation of capital outlays: Scenario 2 instead of Scenario 4

Present	Present value sum of the benefits in fiscal years 2004, 2009,2014, 2019 (the last years in the funding periods)						
		(\$millions in FY 20004	value)				
Highway Category		Benefit Category					
	User Costs	TxDOT Maintenance Costs	Pollution Costs	Total			
Rural	-4,201	-25	94	-4,132			
Urban	12,126	-14	-1	12,111			
Total	7,925	-39	93	7,978			
Funding Period							
1	-191	-5	63	-133			
2	1,863	-7	22	1,877			
3	2,709	-10	6	2,705			
4	3,543	-16	2	3,529			
Total	7,925	-39	93	7,978			

Exaggeration?

*Average benefit-cost ratios are high:

Scenario 1 13.3

Scenario 2 22.7

Scenario 2 21.6

- ** Possibly exaggerated by:
 - Limitations of pavement modeling
 - Specification of base case

Understatement?

- **Additional opportunities for improved allocation of TxDOT capital outlays:
 - within highway functional classes (e.g. preservation versus capacity enhancement)
 - and among years
- ** About one-third of TxDOT capital outlays not represented in the HERS model

Future Improvements to HERS-ST

***** Current:

- > Pavement deterioration model
- > Section-specific truck forecasts
- ➤ Traffic disruption costs from highway work

☀ Planned:

- ➤ Optimization of timing of investment
- >Improved summary measures of benefit