

# TCRP Report 95

## Traveler Response to Transportation System Changes Handbook

presented to  
**AMPO Travel Model Working Group**  
Houston, TX

presented by  
**John (Jay) Evans, P.E., AICP**  
Cambridge Systematics, Inc.

March 21, 2006

Transportation leadership you can trust.



# TCRP Report 95

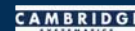
## Traveler Response to Transportation System Changes Handbook

Identified as one of the “most essential transportation publications” in a national survey of transportation professionals conducted by *The Urban Transportation Monitor*.



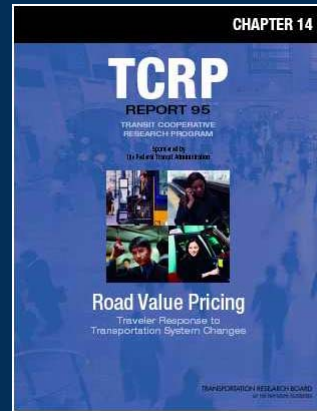
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Sources: As quoted in Feb. 3, 2006 issue. Cover images from Transportation Research Board website.



## Presentation Outline

- **Project Overview**
- Handbook Organization
- Handbook Usage
- Project Status



2

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## Project Overview Project Objective

- Provide a comprehensive, readily accessible, interpretive documentation of results and experience obtained across the United States and elsewhere from:
  - transportation system changes and policy actions
  - alternative land use and site development design approaches.
- Help answer...

How do changes/differences in transportation system design, operations and policy, and the built environment affect travel demand?

3

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## Project Overview What the Handbook Is **NOT**

- Best practices manual
- Implementation manual
- Design or operation manual



4

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## Project Overview What the Handbook **IS**

- Travel demand impact manual
- Sourcebook on results of transportation actions
- Survey of information on usage and feasibility



5

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## Project Overview Methodology

- Comprehensive literature search, review, and synthesis.
- Focus is on contemporary observations, but is seasoned with earlier experiences to identify trends, stability of findings, and to fill gaps that would otherwise exist.
- Focus is on published findings from literature and reports, but original information from individual contributors is also presented.
- Handbook authors provide further interpretation, insights, and supplemental input.

6

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## Project Overview Methodology: Emphasis on Quantitative Findings

- Travel attribute changes
- Before-and-after volumes
- Passenger demand
- Market shares
- Prior mode
- Changes in vehicle trips, VMT
- Elasticities
- Simple estimating algorithms

7

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## Project Overview

### Methodology: Emphasis on Quantitative Findings

- What we like to see...
  - Before Conditions / Situation
  - Before Usage / Travel Demand
  - After Conditions / Situation
  - After Usage / Travel Demand
- Of course, many times all of these simply aren't available in the literature.

8

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## Project Overview

### Previous Editions

- 1977 – First Edition – U.S. DOT – focus on low capital urban transportation improvement projects, both TSM and transit.
- 1981 – Second Edition – U.S. DOT – expanded emphasis on traffic operations improvements, ridesharing, HOV, transit service enhancements, variable work hours, and other TSM actions.
- 2000 – Interim Third Edition – TCRP – seven topic areas: HOV, vanpools/buspools, paratransit, transit scheduling and frequency, bus routing and coverage, transit pricing and fees, and parking pricing and fees.

9

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## Project Overview Project Panel, Staff, and Research Agency Team

### CRP Staff for TCRP Report 95

Robert J. Reilly, CRP Director  
Christopher Jenks, TCRP Manager  
Stephan A. Parker, Sr. Pgm. Officer  
Eileen P. Delaney, Dir. of Publications  
Natassja Linzau, Assoc. Editor

### Project B-12A Panel

Paul J. Larrousse (Chair)  
Patrick T. DeCorla-Souza  
Keith L. Killough  
Reza Navai  
Cynthia Ann Nordt  
Neil J. Pedersen  
G. Scott Rutherford  
Darwin G. Stuart  
Ron Fisher (FTA Liaison)  
Richard Weaver (APTA Liaison)  
Kim Fisher (TRB Liaison)

### Research Agency Team

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In Association With

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Texas Transportation Institute  
Parsons Brinckerhoff Quade &  
Douglas, Inc. / PB Consult Inc.  
J. Richard Kuzmyak, L.L.C.  
Cambridge Systematics, Inc.  
BMI-SG: A VHB Company

And Technical Area Specialist Consultants  
Mccollom Management Consulting, Inc.  
Gallop Corporation  
Herbert S. Levinson, Transportation  
Consultant  
K.T. Analytics, Inc.

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10

## Project Overview Jay Evans' Role

- Served as a Co-Principal Investigator
- Served as a Lead Author or Co-Author of nine published or forthcoming chapters:
  - HOV Facilities
  - Park-and-Ride/Pool
  - Vanpools and Buspools
  - Transit Scheduling and Frequency
  - Bus Routing and Coverage
  - Road Value Pricing
  - Pedestrian and Bicycle Facilities
  - Transit-Oriented Development
  - Travel Demand Management

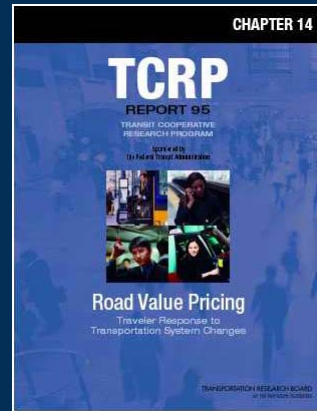


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11

## Presentation Outline

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12

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## Handbook Organization Publication Strategy

- Each chapter is being published individually as it is completed, in both paper and PDF formats.
- As of March 2006, 11 of 19 chapters are in final form.
- A final version of Chapter 1, “Introduction” will be the last chapter published as part of the Third Edition. It is expected to be accompanied by a searchable CD-ROM containing the complete Handbook.

13

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## Handbook Organization General Sections and Topic Area Chapters with Status

- |  |                   |
|--|-------------------|
| • Ch 1 – Introduction (with Appendices A, B) | Color Key         |
| ● Multimodal / Intermodal Facilities         | Final Published   |
| • Ch 2 – HOV Facilities                      |                   |
| • Ch 3 – Park-and-Ride and Park-and-Pool     | Interim Published |
| ● Transit Facilities and Services            |                   |
| • Ch 4 – Busways, BRT and Express Bus        | Not Yet Published |
| • Ch 5 – Vanpools and Buspools               |                   |
| • Ch 6 – Demand Responsive / ADA             |                   |
| • Ch 7 – Light Rail Transit                  |                   |
| • Ch 8 – Commuter Rail                       |                   |
| ● Public Transit Operations                  |                   |
| • Ch 9 – Transit Scheduling and Frequency    |                   |
| • Ch 10 – Bus Routing and Coverage           |                   |
| • Ch 11 – Transit Information and Promotion  |                   |

Continued...

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14

## Handbook Organization General Sections and Topic Area Chapters with Status

- |   |                   |
|---|-------------------|
| ● Transportation Pricing                            | Color Key         |
| • Ch 12 – Transit Pricing and Fares                 | Final Published   |
| • Ch 13 – Parking Pricing and Fees                  |                   |
| • Ch 14 – Road Value Pricing                        | Not Yet Published |
| ● Land Use and Non-Motorized Travel                 | Published         |
| • Ch 15 – Land Use and Site Design                  |                   |
| • Ch 16 – Pedestrian and Bicycle Facilities         |                   |
| • Ch 17 – Transit-Oriented Development              |                   |
| ● Transportation Demand Management                  |                   |
| • Ch 18 – Parking Management and Supply             |                   |
| • Ch 19 – Employer and Institutional TDM Strategies |                   |

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15



## Handbook Organization Topic Area Chapter Format

- Overview and Summary
  - Objectives of [the System Change]
  - Types of Programs
  - Analytical Considerations
  - Traveler Response Summary
- Response to [the System Change]
- Underlying Traveler Response Factors
- Related Information and Impacts
- Additional Resources
- Case Studies
- References

16

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## Handbook Organization Topic Area Chapter Format

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Provides a roadmap to coverage, context, and its limitations. Always important to review the Analytical Considerations section.

17

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### EXAMPLE

Ch 14 – Road Value Pricing

Types of Programs:

- Areawide
- Single Highway Corridor
- Single Highway Lane
- Vehicle Use

18

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Provides survey of observed traveler responses for each type of system change addressed in the chapter.

19

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## Handbook Organization Topic Area Chapter Format

### EXAMPLE

Table 5-1 Effectiveness of the 3M Company Employer Vanpool Program Over Time

Year	1970	1974	1977	1980	1985	1995
Employment	7,723	9,476	10,711	11,740	12,700	13,300
Method of Travel						
Drive Alone	86.4%	72.7%	75.6%	73.1%	76.4%	n/a
Carpool	13.0%	20.1%	14.0%	14.8%	14.1%	n/a
Vanpool	0.0%	6.0%	8.7%	10.3%	7.8%	3.9%
Transit	0.6%	1.2%	1.7%	1.8%	1.7%	n/a
Vehicle Trips per 100 Employees	91.6	81.3	82.0	79.9	82.7	n/a
Average Vehicle Occupancy	1.09	1.23	1.22	1.25	1.21	n/a

Sources: Kuzmyak and Schreffler (1990), Minnesota Mining & Manufacturing Co. (1998).

20

Source: From TCRP Report 95, Chapter 5

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## Handbook Organization Topic Area Chapter Format

### EXAMPLE

Table 14-5 Price Elasticities Observed in Lee County Demonstration Project

Discount Period	Midpoint Bridge				Cape Coral Bridge			
	Percent Change in Price	Change in Demand	Elasticities per source <sup>a</sup>	Log Arc Elasticities	Percent Change in Price	Change in Demand	Elasticities per source <sup>a</sup>	Log Arc Elasticities
Pre-AM peak	-50.0%	17.8%	-0.36	-0.24	-50.0%	10.0%	-0.20	-0.14
Post-AM peak	-50.0	5.6	-0.11	-0.08	-50.0	5.4	-0.11	-0.08
Pre-PM peak	-50.0	5.6	-0.11	-0.08	-50.0	5.4	-0.11	-0.08
Post PM peak	-50.0	2.7	-0.05	-0.04	-50.0	1.3	-0.03	-0.02

Note: <sup>a</sup> Percent change in traffic divided by the percent change in toll cost, a shrinkage-ratio-like measure.

Source: Cain, Burris and Pendyala (2001), with log arc elasticities computed by Handbook authors.

21

Source: From TCRP Report 95, Chapter 14

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## Handbook Organization Topic Area Chapter Format

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Examines the role of both underlying travel behavior mechanisms and external factors in producing the traveler responses. Can help give insight into how to break a project into analytical components for modeling.

22

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**EXAMPLE:** Ch 14 – Road Value Pricing  
Underlying Traveler Response Factors:  
- User Cost  
- Travel Time Savings  
- Trip Purpose  
- Characteristics of Users  
- Transportation System Context

23

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## Handbook Organization Topic Area Chapter Format

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Touches upon other subject areas pertinent to the particular system change topic, including environmental, energy, and cost considerations.

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**EXAMPLE**  
Ch 14 – Road Value Pricing  
Related Info. and Impacts:  
- Equity and User Characteristics  
- Implementation Challenges and Lessons  
- Travel Mode Impacts and Shifts  
- Impacts on Land Use  
- Impacts on Air Quality  
- Impacts on Revenue

## Handbook Organization Topic Area Chapter Format

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Highlights one or more compendia, manuals, or other documents of likely special interest to a reader delving further into the topic area in question.

26

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## Handbook Organization Topic Area Chapter Format

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Provides condensed papers, reports, and other information on system change applications. Case studies add context and detail for specific examples.

27

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## Handbook Organization Topic Area Chapter Format

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### EXAMPLE

Ch 14 – Road Value Pricing

Case Studies:

- Singapore Electronic Road Pricing
- I-15 Value Pricing Demo. Project
- SR 91 Express Lanes

28

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## Handbook Organization Topic Area Chapter Format

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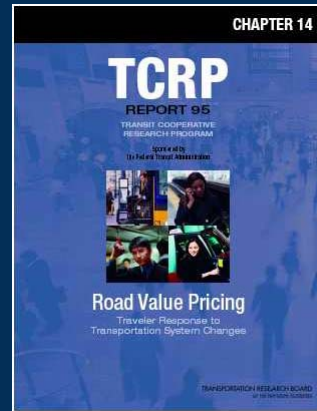
Comprehensive referencing is provided to facilitate in-depth explorations. Citations in the humanities style are present in the chapter text and full citations are at the end of each chapter.

29

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## Presentation Outline

- Project Overview
- Handbook Organization
- **Handbook Usage**
- Project Status



30

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## Handbook Usage General Recommendations

- Always proceed with care.
- Use the Handbook as a starting point. Probably best used as a screening tool.
- Must keep in mind local conditions including urban form, population, travel patterns, and system context.
- Only the source literature can provide the breadth and detail of the original work.

31

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## Handbook Usage Important Considerations

- Degree-of-Confidence Issues
- Impact Assessment Methods
- Demographic Considerations
- Concept of Elasticity

32

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## Handbook Usage Considerations: Degree-of-Confidence Issues

- Appropriate degree-of-confidence depends on:
  - Number of observations documented of the change type
  - Design and statistical soundness of the associated analyses
  - Confounding factors that may have affected reported results
  - Extent to which impacts have been successfully modeled
  - Consistency with which findings were obtained and reported.
- Findings and conclusions presented with respect to VMT, energy consumption, and emissions are relatively more dependent on estimations and modeling applications than the associated traveler response conclusions.
- Little presented in the Handbook with real meaning for travel demand assessment purposes beyond two significant figures.

33

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## Handbook Usage Considerations: Impact Assessment Methods

- **Measurement and Statistical Significance**
  - Inadequate survey controls with potential to skew results
  - Data definitions that may introduce bias or misunderstandings
  - Lack of determination that outcome was statistically significant
- **Confounding Events and Environments**
  - External transportation events
  - External other events (e.g., economy or regulatory changes)
  - Effects of testing (e.g., travelers learn options from 1st survey)
  - Maturation effects on travelers (movement towards mean)
  - Measurement inconsistencies
- **Additional Analytical Concerns**
  - Travel demand model results versus observed results
  - Cross-sectional or comparative analyses challenges
  - Effects of inflation

34

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## Handbook Usage Considerations: Demographics / Context

- **Factors external to transportation systems are crucial determinants of travel behavior:**
  - Fewer trips and higher transit usage associated with:
    - Lower income
    - Lower automobile ownership
  - Trip generation and distribution largely determined by:
    - Location and concentration of residences, employment, commercial activity, recreational areas, and other land uses.
- **Good idea to distinguish between “mobility choices” and “travel choices”:**
  - Mobility choices include residential location choice, automobile ownership, and employment location.
  - Travel choices cover the day-to-day trip frequency, distribution, time-of-day, mode, and route choices.

35

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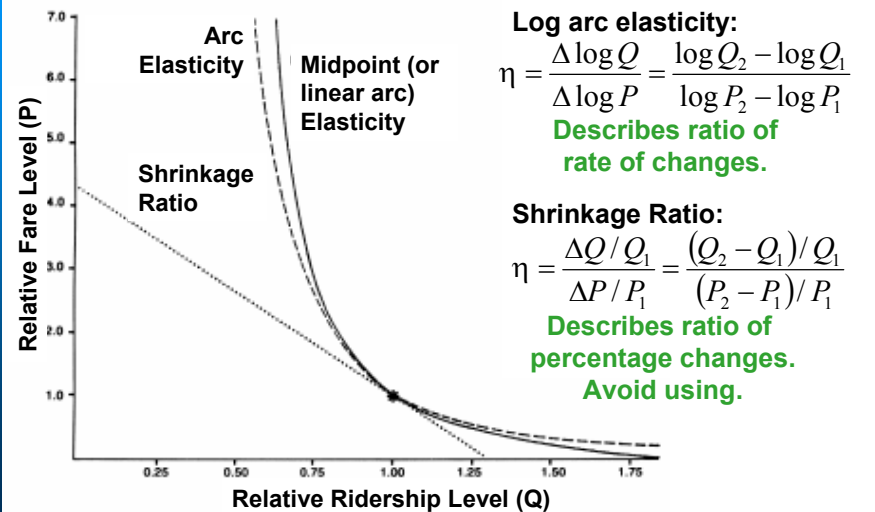
## Handbook Usage Considerations: Concept of Elasticity

- Elasticity measures are convenient tool for looking at impact of relative changes.
- Loosely defined as the percentage change in demand (Q) in response to a 1 percent change in price or service (P).
- Three frequently used (but different) methods for computing “elasticity”:
  - Log arc elasticity
  - Mid-point (or linear) arc elasticity
  - Shrinkage ratio or factor
- Essential to take into account which method is being used to apply correctly for estimation purposes.

36

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## Handbook Usage Concept of Elasticity



37

Source: Adapted from Chapter 1, Appendix A

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## Handbook Usage Concept of Elasticity

Percent Fare Change	Log Arc Elasticity	Linear Arc Elasticity	Shrinkage Ratio
-50%	-0.300	-0.311	-0.46
-30%	-0.300	-0.303	-0.38
-10%	-0.300	-0.300	-0.32
+10%	-0.300	-0.300	-0.28
+30%	-0.300	-0.302	-0.25
+50%	-0.300	-0.304	-0.23
+100%	-0.300	-0.311	-0.19

- When change in price (or service) is small all methods give similar values.
- Large changes result in different values.
- Handbook uses log arc elasticity wherever it was given or possible to calculate.

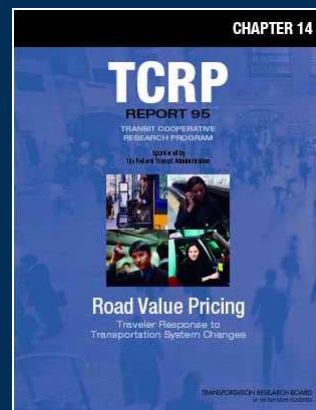
38

Source: Adapted from Chapter 1, Appendix A

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39

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## Project Status Coming Next

- Expected in “late spring”; went to production last week:
  - Ch 2 – HOV Facilities
- Approximate order of publication of remaining works:
  - Ch 17 – Transit-Oriented Development
  - Ch 16 – Pedestrian and Bicycle Facilities
  - Ch 19 – Employer and Institutional TDM Strategies
  - Ch 4 – Busways, BRT, and Express Bus
  - Ch 7 – Light Rail Transit
  - Ch 8 – Commuter Rail
  - Ch 1 – Introduction (with Appendices A, B) and CD-ROM
- Work expected to be substantially complete by end of 2006.

40

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## Project Status Getting the Handbook

- TRB website and bookstore – search for chapters, download PDF versions, or buy printed versions ([www.trb.org](http://www.trb.org)).
- TCRP project website – current status and chapter links: ([www4.trb.org/trb/crp.nsf/All+Projects/TCRP+B-12A,+Phase+II](http://www4.trb.org/trb/crp.nsf/All+Projects/TCRP+B-12A,+Phase+II))

41

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## “Ode to TCRP Report 95”

*Ph.D.s may come, and Ph.D.s may go,  
And many an academic thinks he's really in the know,  
But when it comes to transportation planning, to know the real score,  
Go to TCRP Report 95, you need look no more.*

*Transport theories and models abound to confuse us,  
When we really need clear understanding to soothe us,  
Practical data, examples, and methods that work well,  
We give our thanks to Dick Pratt, this report series is swell !*

*– Darwin G. Stuart, Ph.D.  
TCRP Project B-12A Panel Member*

42

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## Project Status End Notes

### ● Acknowledgements:

- Selected source material for this presentation is from:
  - TCRP Report 95
  - TCRP Research Result Digest 61 (Interim Chapter 1)
  - TRB and TCRP Websites
- Thanks to Richard H. Pratt for providing additional material.

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43

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